

**Environment and Natural Resources Trust Fund  
2011-2012 Request for Proposals (RFP)**

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**LCCMR ID: 135-F1+2+5**

**Project Title:** Climate Change and Resilience in Boreal Forests

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**Category:** F1+2+5. Climate Change and Air Quality

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**Total Project Budget:** \$ \$215,414

**Proposed Project Time Period for the Funding Requested:** 3 yrs, July 2011 - June 2014

**Other Non-State Funds:** \$ 0

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**Summary:**

Locate areas where boreal tree species may persist in a warmer climate, assess whether temperate species can replace boreal species and whether invasive species may interfere with climate change adaptation

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**Name:** Lee Frelich

**Sponsoring Organization:** U of MN

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Saint Paul MN 55108

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**Email:** frel001@umn.edu

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

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**Location**

**Region:** NE

**Ecological Section:** Northern Superior Uplands (212L)

**County Name:** Cook, Lake, St. Louis

**City / Township:** \_\_\_\_\_

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

# 2011-2012 MAIN PROPOSAL

## PROJECT TITLE: Climate change and resilience in boreal forests

### I. PROJECT STATEMENT

Boreal forests of spruce, fir, paper birch, aspen and jack pine cover more than 2 million acres of land on the Border Lakes Ecological Subsection of northern Minnesota. These forests are near the southern edge of their geographic range. With a warmer climate boreal tree species will be under increased stress from heat, drought, fires, storms, and insect pests. Therefore, the health and productivity of these forests may be jeopardized by a warmer climate. To plan for these changes, we need to know whether the forest is poised to respond in a resilient fashion as the boreal tree species decline:

1. Will temperate forest species now at the northern edge of their range in the Border Lakes, such as red maple, sugar maple, American basswood, bur oak, pin oak, red oak, and white pine expand to take the place of declining boreal species such as spruce and fir?
2. Are sufficient seed source populations already present for these temperate species to fill in the niche vacated by boreal tree species, and are those temperate populations already expanding?
3. Will invasive plant species (e.g. buckthorn) be able to jump in and take advantage of the warming climate and changing forest situation, possibly displacing native species?
4. Will boreal species like spruce, fir and jack pine be able to persist under a future warmer climate in areas with locally cooler climates (thermal refuges) such as bogs and north-facing hillsides?

With this project we will obtain the information necessary to answer these questions and provide the scientific basis for climate change adaptation plans for a variety of scenarios (from low to high magnitudes of change) that may occur over the next century. These goals will be accomplished by surveying the forest to assess the abundance of colonies of temperate species at the northern edge of their range, the potential for these colonies to expand, and whether invasive species are present that may interfere with forest adaptation to climate change. We will also measure temperature in areas with varied physiographic settings (e.g. bogs, and north and south facing hillsides), for 2 years to assess whether cool microclimates exist that may allow persistence of boreal tree species on some parts of the landscape. This information will be used to prepare adaptation and management options for commercial and BWCAW wilderness forests. Finally, via presentations and workshops in the Border Lakes Ecological Subsection, we will inform forest managers regarding future scenarios for forest health and resilience, and options for adaptation to climate change. The audience will include staff of the Superior National Forest, Minnesota DNR, County and Tribal forestry divisions.

### II. DESCRIPTION OF PROJECT ACTIVITIES

#### **Activity 1: Survey abundance of temperate species (e.g. maple and oak) and invasive species within Border Lakes boreal forests. Budget: \$96,654**

A graduate student and undergraduate student assistant will survey large tracts of forest to assess the number and geographical distribution of outlying colonies of temperate tree species and invasive plant species (e.g. buckthorn), as well as evidence regarding current or future potential expansion of their populations within the southern margin of the boreal forest. This data will allow us to assess whether temperate tree species are poised to expand as the climate warms, and whether invasive species may interfere with forest adaptation to climate change.

#### **Measureable Outcomes**

- |   |               |
|---|---------------|
| 1. Map showing distribution of temperate tree species | December 2013 |
| 2. Map showing distribution of invasive plant species | December 2013 |

**Activity 2: Locate cold-temperature refuges for boreal tree species. Budget: \$91,955**

The graduate student and assistant will place 100 HOBOs (small devices originally developed for NASA space programs, that record temperature on an hourly basis and store the data for up to a year for later download to a computer) in the field to measure the effect of topographical features, such as south and north facing slopes, bogs and lakeshores on local climate. This data will be collected for two years. Analyses of this data will allow us to predict whether refuges with cool temperatures will allow persistence of boreal species for a variety of future climate change scenarios.

**Measureable Outcome**

- 1. Map of locations where boreal species are most likely to persist October 2013**

**Activity 3: Outreach and education on forest adaptation options. Budget: \$26,805**

Develop and present two workshops, one each for managers of commercial forests and managers of the Boundary Waters Canoe Area Wilderness. Develop a public lecture to be presented at 10 or more locations throughout the state. The workshop for forest managers will be geared towards Forest Service, State, County and Tribal forest managers and will be offered through the University of Minnesota Sustainable Forests Education Cooperative at Cloquet Forestry Center. The workshop for wilderness managers will be offered at a location convenient for Superior National Forest staff (probably their Duluth headquarters). The public presentation will be aimed at small landowners and wilderness users and presented at venues throughout the state (e.g. Vermilion Community College in Ely).

**Measureable Outcomes**

- 1. Adaptation guidelines for forest managers July 2013**
- 2. Presentations and workshops January-June 2014**

**III. PROJECT STRATEGY**

**A. Project Team/Partners.** Lee Frelich is the project manager, partially supported by project funds, and will be the advisor/supervisor to the graduate and undergraduate students, and will participate directly in the field work and data analyses. Peter Reich will collaborate and provide expertise on forest ecology, tree population dynamics and landscape ecology, co-advise a graduate student and help with data analyses. Reich will not receive support from this grant and will contribute \$20,000 of in-kind services. A graduate student to be determined will be supported by project funds and take on this project as part of his/her Ph.D. research. An undergraduate student will be hired with project funds as a field assistant during the summers of 2012 and 2013 and as a lab assistant at the University of MN during the academic years 2011-2012 and 2012-2013.

**B. Timeline Requirements.** The proposed project would last 36 months, from July 1, 2011- June 30 2014. Field data on the forest and microclimate will be collected by a graduate student and undergraduate assistants during the summers of 2012 and 2013. Site selection and pilot work for the 2012-2013 field work will be done from July-October 2011. Data analyses will occur as data comes in throughout the project, and will be synthesized during summer and fall of 2013. Outreach and education will take place during the latter half of 2013 and first half of 2014.

**C. Long-Term Strategy and future funding needs.** This project will capitalize on results from a previous workshop on Climate Change Adaptation and Biodiversity Conservation in Minnesota (Co-Organized by Frelich, June 2008), by using the Border Lakes forests as the first area to undergo detailed analyses for climate change adaptation using principles gathered from the scientists at the 2008 meeting. Also, the results with public education and policy will be carried forward after the termination of this project by Greater Quetico-Superior Climate Change Adaptation Plan Alliance, a coalition of environmental groups that has held preliminary organizational meetings and is pursuing their own funding. This project will also serve as a pilot for future climate change adaptation plans for other ecoregions of the state, and as a national model for this type of planning.

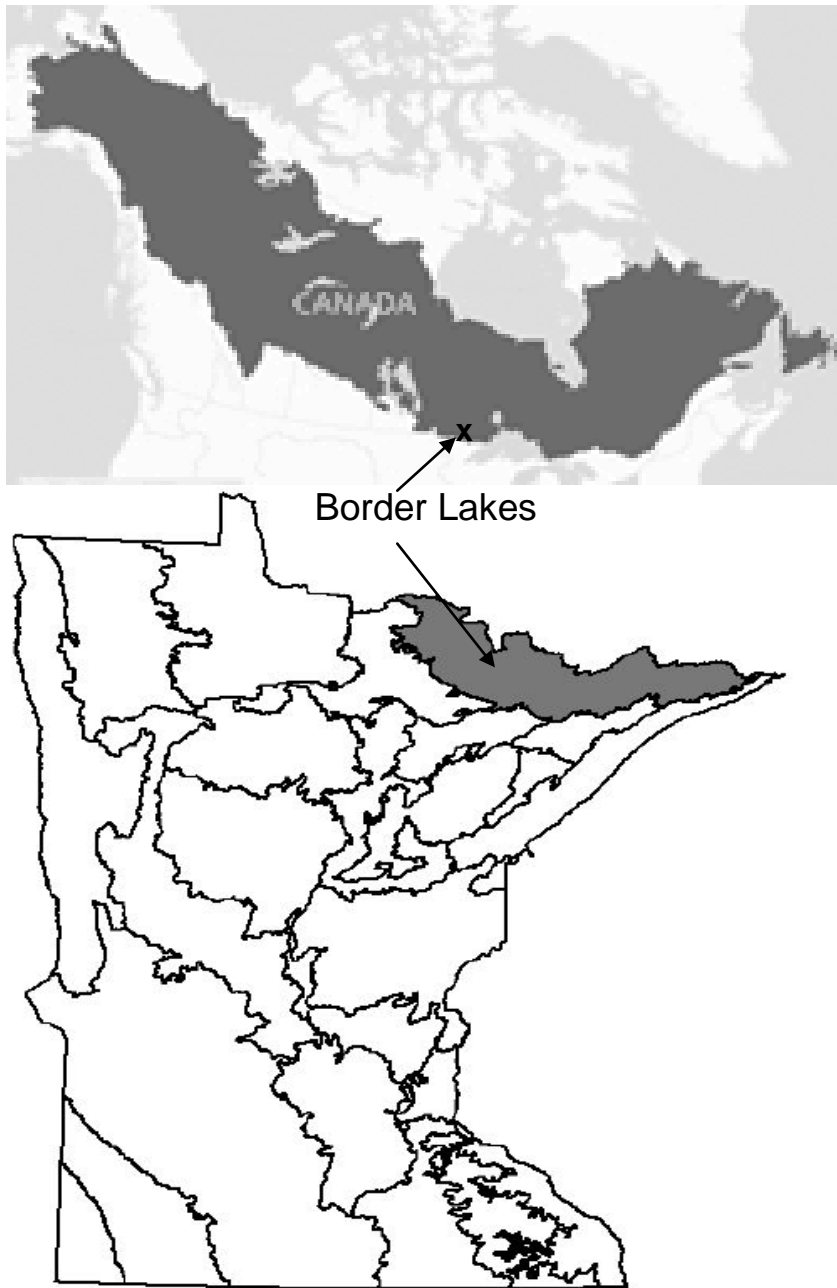
## 2011-2012 Detailed Project Budget

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

<u>BUDGET ITEM</u> (See list of Eligible & Non-Eligible Costs, p. 13)	<u>AMOUNT</u>
<b>Personnel:</b> Frelich, project manager, advise graduate students, supervise undergraduate students, analyze data, write papers and co-write papers with graduate student, present workshops on climate adaptation (0.3 FTE for 3.0 years, 75% for salary and 25% for benefits, on soft money).	\$ 67,256
<b>Personnel:</b> Graduate student, collect and analyze field data, write papers (0.5 FTE for 3.0 years, 54% for salary and 46% for benefits; benefits include tuition).	\$ 108,805
<b>Personnel:</b> Undergraduate assistant, help collect field data during summer, assist with analysis in the lab during academic year (0.4 FTE for 2.5 years, 97% for salary and 3% for benefits).	\$ 20,653
<b>Equipment/Tools/Supplies:</b> 100 HOBO units to record temperatures on an hourly basis at remote field sites, approximately \$42 each, and a GPS unit for navigation in remote areas.	\$ 4,700
<b>Travel:</b> Summer field work for graduate student and undergraduate assistant, including lodging (camp grounds and university field station facilities will be used as much as possible to reduce costs), car rental and mileage for 4 months (2 months for each of 2 summers). Also included is mileage for visits while field work is in progress by project manager Frelich, mileage for travel by Frelich and Reich to present workshops. All travel will be in state.	\$ 12,000
<b>Additional Budget Items:</b> Materials for workshops and public education, including duplication and dissemination of results.	\$ 2,000
<b>TOTAL ENVIRONMENT &amp; NATURAL RESOURCES TRUST FUND \$ REQUEST</b>	<b>\$ 215,414</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>	NA	
<b>Other State \$ Being Applied to Project During Project Period:</b>	NA	
<b>In-kind Services During Project Period:</b>	NA	
<b>Remaining \$ from Current ENRTF Appropriation (if applicable):</b>	NA	
<b>Funding History:</b>	NA	



Map. The Border Lakes Subsection (Lower map, shaded, map credit: MN DNR) lies at the southern margin of the North American boreal forest dominated by spruce, fir and jack pine (Upper map, dark gray, map credit: Global Forest Watch Canada). The Border Lakes is also close to the northern range limit for temperate forest species sugar maple, red maple, American basswood, red oak, bur oak, and white pine, which may replace the boreal species with a warmer climate.

## **Curriculum Project Manager Qualifications and Organization Description**

### **Project Manager: Lee E. Frelich**

Director, The University of Minnesota Center for Hardwood Ecology and Research Associate.  
Department of Forest Resources, University of Minnesota, St. Paul, MN 55108.

### **Professional Appointments and Preparation**

Director, The University of Minnesota Center for Hardwood Ecology, 1997 to date.  
Research Associate, Department of Forest Resources, 1992 to date.  
Post-doc with Margaret Davis, University of Minnesota, 1988-1991.  
Ph.D., Forestry, University of Wisconsin-Madison, 1986.  
B.S., Botany and Bacteriology, University of Wisconsin-Madison, 1980.

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

Invited speaker at >100 symposia, seminars, and workshops, e.g. presentation to joint meeting of Minnesota House and Senate, University of Michigan, Iowa State, University of Calgary, European Congress of Conservation Biology. Institute for Scientific Information, lists Frelich among the top 1% of all scientists in the world in the Ecology and Environment Category, 2006 to date. Co-author, Minnesota Generic Environmental Impact Statement on Timber Harvesting and Forest Management (document that led to establishment of the Forest Resource Council and guides forest policy in the state from 1990-2040). More than 200 appearances in the media, including the *New York Times*, *National Geographic*, *Newsweek*, *Star Tribune*, MN Public Radio.

### **Areas of Expertise**

Forest ecology, ecology of fires and windstorms in forests, invasive species, climate change and effects of climate change on forests.

### **Project Management Experience**

Principal investigator on several National Science Foundation, Minnesota Department of Natural Resources, and USDA Forest Service projects. Principal investigator of the invasive earthworm project at the University of Minnesota.

### **Peer-reviewed publications**

Eighty-five publications, including articles, books, book chapters, and environmental impact statements. Fifty-eight publications in the peer-reviewed literature, and 10 in preparation.

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

Eighteen years of research experience in forests of the Border Lakes subsection, primary expertise on global warming, co-organizer of the highly successful workshop on Climate Change Adaptation and Biodiversity Conservation in Minnesota (MN Landscape Arboretum, June 2008). Have given numerous workshops and presentations for Forest Service, MN DNR, county, and tribal forest managers from 1995-2010.

### **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. The Department of Forest Resources is the leading research and educational institution on forest related issues in Minnesota. For over 100 years the department has played a key role in discovering and fostering sustainable forest resource management activities in Minnesota.