



Science for a Sustainable Future

Northern Research Station



United States
Department of Agriculture



Forest
Service

Whether home is a city apartment,
a suburban bungalow, or a rural farmhouse,
our lives depend on the natural resources
around us – clean air, sparkling water,
rich soils, and healthy, diverse landscapes.
Individuals and communities hold the power
to use these precious resources and the
responsibility to protect them for today
and for future generations.

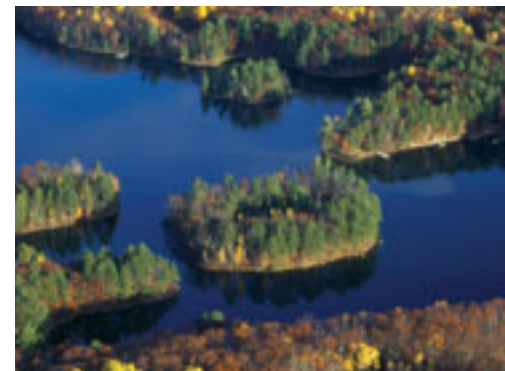
Today's choices shape tomorrow's world.



Today's world faces unprecedented changes. The climate is changing, water shortages and floods loom, and familiar plants and wildlife no longer thrive where they once did. International commerce comes with hitchhiking pest species that invade ecosystems and attack agricultural crops. The expanding environmental footprint of the world's population also raises the question of how the earth will continue to support so many.

The responsibility for ensuring a sustainable future rests with the people making today's natural resource decisions. From the retiree deciding whether to keep grandfather's woodlot in the family, to the county commissioner considering the implications of a new sawmill, to the community activist seeking to preserve the diversity of an oak savanna, each is making choices that will resonate far beyond his or her lifespan.

What the Northern Research Station offers these decisionmakers is information — the knowledge and the tools to help make sound choices for a sustainable future. By answering questions and analyzing "what if" scenarios, science can support efforts to make a difference in the world. Basing today's policies and practices on a clearer understanding of the processes at work in the world promises a better future — one that sustains people, communities, and the land, water, and air on which they depend.



Mission and Vision

The mission of the Northern Research Station is to improve people's lives and help sustain the natural resources in the Northeast and Midwest through leading-edge science and effective information delivery.

Our work focuses on the pressing forest science issues relevant to this 20-state region.

Our research seeks to understand all elements of forests and related landscapes and is organized around the following five themes:

- ▶ Forest Disturbance Processes
- ▶ Urban Natural Resources Stewardship
- ▶ Sustaining Forests
- ▶ Providing Clean Air and Water
- ▶ Natural Resources Inventory, Monitoring, and Assessment

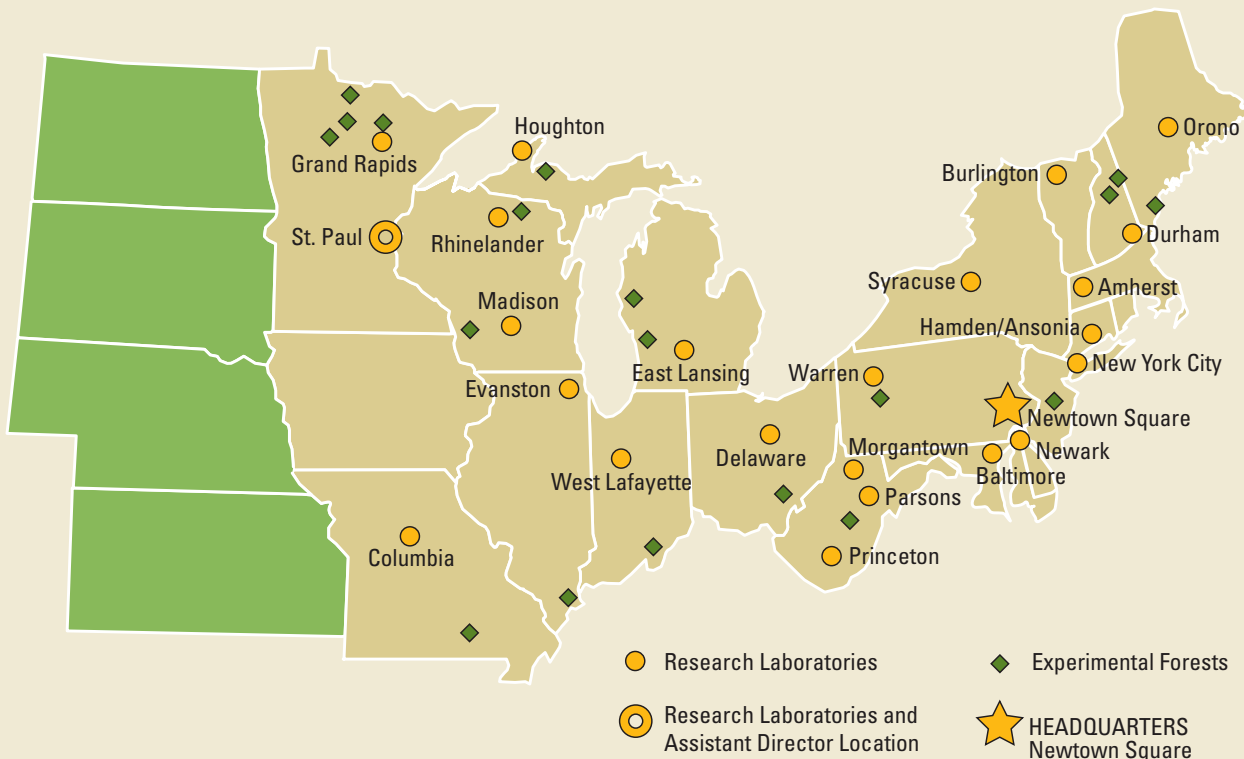
As part of the U.S. Forest Service's Research and Development branch, the people of the Northern Research Station are passionate about our science and sharing it to make a difference. Our commitment to excellence means that we seek to:

- ▶ Serve the people in this region better
- ▶ Link environmental health to community well-being
- ▶ Sustain a diverse cadre of talent that responds rapidly to emerging issues and needs
- ▶ Communicate the knowledge we generate to help develop an informed citizenry
- ▶ Interact effectively with universities, states, and other partners

USDA FOREST SERVICE NORTHERN RESEARCH STATION

VITAL STATISTICS

- ▶ 591 employees, including 135 scientists
- ▶ 24 field locations, including Baltimore, Chicago (Evanston), and New York City
- ▶ 14 research work units
- ▶ 20 experimental forests encompassing a range of climate, soil, and vegetation types
- ▶ Forest inventory and monitoring for 24 states
- ▶ Largest free-air climate change experiment (Aspen FACE) in the world
- ▶ Only Forest Service primary quarantine laboratory in the continental U.S. used for studying invasive species.
- ▶ Only experimental forest principally used for peatland research
- ▶ A below-ground observatory (rhizotron) for studying undisturbed forest soils and below-ground storage of carbon
- ▶ 2 Long-term Ecological Research (LTER) sites, part of the National Science Foundation network for long-term, comparative study of ecosystems
- ▶ Longest running experiments in forest sustainability



RESEARCH WORK UNITS & PROGRAMS	Leader	Locations (leader location in bold)	Principal Science Themes Addressed
Ecological and Economic Sustainability of the Appalachian Forest in an Era of Globalization	Mary Beth Adams 304-478-2000 mbadams@fs.fed.us	Parsons, WV Princeton, WV	<ul style="list-style-type: none"> ▶ Sustaining Forests ▶ Providing Clean Air and Water
Sustaining Forests in a Changing Environment	Susan Stout 814-563-1040 sstout@fs.fed.us	Delaware, OH Irvine, PA	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Sustaining Forests ▶ Providing Clean Air and Water
Ecology and Management of Invasive Species & Forest Ecosystems	Kurt Gottschalk 304-285-1598 kgottschalk@fs.fed.us	Hamden, CT East Lansing, MI Morgantown, WV	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Sustaining Forests
Genetics, Biological Control, and Management of Invasive Species	Jim Slavicek 740-368-0033 jslavicek@fs.fed.us	Hamden, CT Newark, DE Delaware, OH	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes
Forest Inventory and Analysis	Dennis May 651-649-5132 dmay@fs.fed.us	St. Paul, MN Durham, NH Newtown Square, PA Princeton, WV	<ul style="list-style-type: none"> ▶ Natural Resources Inventory, Monitoring, and Assessment
Climate, Fire, and Carbon Cycle Sciences	Richard Birdsey 610-557-4091 rbirdsey@fs.fed.us	East Lansing, MI Houghton, MI Durham, NH New Lisbon, NJ Newtown Square, PA	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Urban Natural Resources Stewardship ▶ Sustaining Forests ▶ Providing Clean Air and Water ▶ Natural Resources Inventory, Monitoring, and Assessment
Center for Research on Ecosystem Change	John Brissette 603-868-7632 jbrissette@fs.fed.us	Amherst, MA Grand Rapids, MN Durham, NH	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Sustaining Forests ▶ Providing Clean Air and Water
Urban Forests, Human Health, and Environmental Quality	Dave Nowak 315-448-3212 dnowak@fs.fed.us	Baltimore, MD Syracuse, NY	<ul style="list-style-type: none"> ▶ Urban Natural Resources Stewardship ▶ Sustaining Forests ▶ Providing Clean Air and Water
People & Their Environments: Social Science Supporting Natural Resource Management & Policy	Lynne Westphal 847-866-9311 lwestphal@fs.fed.us	Chicago, IL St. Paul, MN New York, NY Burlington, VT	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Urban Natural Resources Stewardship ▶ Sustaining Forests ▶ Providing Clean Air and Water
Biological and Environmental Influences on Forest Health and Productivity	Kevin Smith 603-868-7264 ktsmith@fs.fed.us	St. Paul, MN Durham, NH Luquillo, PR Burlington, VT Madison, WI	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Urban Natural Resources Stewardship ▶ Sustaining Forests
Sustainable Management of Central Hardwood Ecosystems & Landscapes	Frank Thompson III 573-875-5341 frthompson@fs.fed.us	Columbia, MO Jefferson City, MO Salem, MO	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Sustaining Forests ▶ Providing Clean Air and Water
Northern Science, Technology, and Applied Results Program (NorthSTAR)	Mark Twery 802-951-6771 mtwery@fs.fed.us	Amherst, MA Shingleton, MI Delaware, OH Irvine, PA Newtown Square, PA Burlington, VT	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Urban Natural Resources Stewardship ▶ Sustaining Forests ▶ Providing Clean Air and Water ▶ Natural Resources Inventory, Monitoring, and Assessment
Institute for Applied Ecosystem Studies: Theory & Application of Scaling Science in Forestry	Neil Nelson 715-362-1153 ndnelson@fs.fed.us	Rhineland, WI	<ul style="list-style-type: none"> ▶ Forest Disturbance Processes ▶ Sustaining Forests ▶ Providing Clean Air and Water
Hardwood Tree Improvement and Regeneration Center	Charles Michler 765-496-6016 cmichler@fs.fed.us	West Lafayette, IN	<ul style="list-style-type: none"> ▶ Sustaining Forests



Our work focuses on the pressing forest science issues relevant to this 20-state region. Science themes are integral to our effectiveness as an innovative and responsive research organization.



Forest Disturbance Processes

Understanding and managing disturbances to maintain healthy forests and protect people

Disturbance and recovery periodically shape forests and are caused by an array of natural forces and human activities. These disturbances shift the balance of resources in an ecosystem to create new winners and losers among the plants and animals that reside there. Disturbances are seen as positive or negative, according to how they affect people's lives. Forest managers must account for forest disturbance processes to maintain healthy, diverse forest ecosystems that are highly resilient and able to absorb the future disturbances that will inevitably occur.

Our research to understand, predict, and manage forest disturbances helps forest managers simultaneously protect people's lives, health, and property; maintain healthy forests; provide products and amenities that improve people's lives; and sustain and enhance forest benefits for future generations. Our research encompasses specific disturbance agents, including the following:

- ▶ Invasive insects, pathogens, and plants
- ▶ Fire
- ▶ Climate and environmental change
- ▶ Land use, fragmentation, and market-driven change
- ▶ Native disturbance factors, particularly severe weather (ice storms, hurricanes, and drought)

It also encompasses the consequences of those disturbances, which include degradation of:

- ▶ Forest health
- ▶ Air, water, and soil quality
- ▶ Fish and wildlife habitat
- ▶ Human health and safety

By explaining the complex interactions of disturbance agents and their consequences, our research helps make forests better able to sustain themselves and the communities that depend on them.

SCIENCE TOPICS

Invasive species

Fire

Climate and environmental change

Land use, fragmentation, and market-driven change

Native disturbance factors

Forest health

▶ For more detail, see

<http://www.nrs.fs.fed.us/disturbance/>





GOALS

- ▶ Assess status of forest health
- ▶ Identify, predict, and mitigate undesirable disturbance
- ▶ Manage beneficial disturbance agents
- ▶ Restore ecosystem health to damaged landscapes
- ▶ Prevent damage to public health and property

PORTRAIT OF THE NORTHERN LANDSCAPE

Forests cover 42 percent (172 million acres) of the region.

This region's forests make up 23 percent of the Nation's total forest land.



Urban Natural Resources Stewardship

Improving the quality of life in urban and urbanizing areas through better natural resources stewardship

More than 80 percent of the U.S. population lives in urban areas. Open space is rapidly being transformed to urban areas, or to the interface between urban and wild areas. In the 1990s, more than 60 percent of new houses were built in this interface. Older cities need to revitalize themselves, rectify past environmental injustice, and improve environmental quality. Improved management of urban natural resources can reduce some of the adverse environmental and health effects caused by urbanization and directly influence the quality of life of people.

We address this complex mix of people, vegetation, and urban services and structures through a research program that encompasses

- ▶ Vegetation effects on ecosystem services (e.g., air and water quality, greenhouse gas sequestration, energy conservation)
- ▶ Wildfire risk
- ▶ Invasive pest impacts
- ▶ Peoples' preferences and desires
- ▶ Management implications

This research takes on increased urgency with increasing numbers of people living in urban areas and urban areas expanding across the globe. Our efforts to involve the public and to develop science, tools, and guidelines that improve natural resources stewardship touch the lives and enhance the well-being of most Americans.

SCIENCE TOPICS

Ecosystem services

Land use and land cover change

Urban natural resources and public health

Neighborhood quality of life

Urban natural resources sustainability and health

Monitoring and assessment of urban forests and trees

Social and environmental justice

Lifestyle behaviors, consumption patterns, and land management

▶ For more detail, see

<http://www.nrs.fs.fed.us/urban/>





GOALS

- ▶ Improve the contribution of urban natural resources to human health and well-being
- ▶ Increase the livability of neighborhoods
- ▶ Reduce the environmental problems associated with urbanization
- ▶ Monitor urban forests, trees, and management regimes
- ▶ Identify and measure ecosystem services in urban areas

PORTRAIT OF THE NORTHERN LANDSCAPE

Forty-one percent (123.3 million people) of the total U.S. population lives here.

Four of the 10 largest metropolitan areas in the United States (New York, Chicago, Philadelphia, and Detroit) lie within the region.

More than 15 percent of the region's population lives at the wildland-urban interface (within or adjacent to forests, grasslands, or wetlands).

Sustaining Forests

Developing knowledge and management tools to maintain and enhance forest productivity and benefits

Forests are central to human health and the health of the environment.

The people and communities of this region have a special relationship with forests, depending on them for benefits as diverse as furniture-grade hardwood lumber, mushrooms, Christmas greens, ginseng, bioenergy, wildlife, recreation, and conservation reserves.

We seek to enhance and sustain the availability of these benefits to all. We work with the stewards of these forests to develop balanced forest management strategies that anticipate changes in the environment and in social and economic conditions. Our research provides the information that people need to achieve their goals and to enjoy healthy, productive forests for many years to come.



SCIENCE TOPICS

Forest products

Genetic, silvicultural, and forest management and utilization tools and recommendations

Wildlife and plant populations

Climate change effects

Bioenergy and other byproducts

Social, psychological, cultural, and economic connections between forests and people

► For more detail, see

http://www.nrs.fs.fed.us/sustaining_forests/



GOALS

- ▶ Foster healthy, productive forests
- ▶ Ensure a sustainable supply of the multiple benefits forests provide
- ▶ Create and deliver information, tools and strategies that support land management, stewardship, and utilization decisions
- ▶ Conduct forest resource monitoring and assessment at regional and local scales
- ▶ Develop approaches to conservation that harness the power of markets and economic growth

PORTRAIT OF THE NORTHERN LANDSCAPE

Diverse forest types occur here, ranging from the spruce bogs of the Great Lakes forests to midwestern oak savannas to the Allegheny Plateau mixed hardwood, to the conifer forests of northern New England.



Providing Clean Air and Water

Developing information and tools to sustain or increase production of clean air and water for a growing population

Northern forests have a vital role in providing clean air and water to the increasing populations of the Northeast and Midwest. For example, urban and community forests help reduce greenhouse gases and city temperatures and improve the local and global environment. Similarly, rainfall that passes through rural and urban forests is cleaner than rainfall that drains from roads or disturbed lands. Using wood as an energy source results in nearly no net increase in atmospheric carbon and produces less greenhouse gas than does burning fossil fuels. Other benefits provided by trees include removal of airborne particulates, control of waste water, and immobilization and removal of toxins. These forest benefits depend on appropriate management and can be disrupted by development, catastrophic fire, climate change, invasive non-native pests, and other disturbances.

Our research program develops appropriate forest management techniques that improve the delivery of clean air and water, thus enhancing the safety and well-being of people and communities. Our researchers provide policymakers and resource managers with accurate information and effective tools to sustain or increase the production of clean air and water. The need for this research is especially urgent given the changing climate, expanding urban areas, and other threats to the environment.

SCIENCE TOPICS

Management actions and their effects on ecosystem processes

Climate change and natural disturbance impacts

Carbon sequestration and soil productivity

Cellulose-based bioenergy

Water quality

Effects of prescribed and natural fire

Mitigation of air and water quality impacts

► For more detail, see

http://www.nrs.fs.fed.us/clean_air_water/





GOALS

- ▶ Understand and project the effects of climate change and variability, air pollution, land management, and natural disturbances on ecosystem processes and air and water quality.
- ▶ Develop efficient and effective methods to estimate and monitor carbon cycling, air pollution, and water quantity and quality for use in forest management and climate change policy development.
- ▶ Develop landscape-scale management practices that promote clean air and water, including carbon sequestration, use of bioenergy, and reduced emissions from natural and prescribed fires.
- ▶ Develop recommendations for urban vegetation management to reduce building energy use, air pollution, and exposure to ultraviolet radiation.

PORTRAIT OF THE NORTHERN LANDSCAPE

The largest group of freshwater lakes in the world, the Great Lakes, forms the northern border of the region.

Chesapeake Bay, the largest estuary in the United States, drains a 64,000-square mile watershed here.

Natural Resources Inventory, Monitoring, and Assessment

Taking the pulse of our Nation's forests to ensure forest health and community well-being

The region's forests are vast and varied, totaling 170 million acres spread across 20 states. Interspersed among these forests are two-fifths of the Nation's inhabitants and some of its largest cities. This confluence of people and trees creates tremendous stresses on forest resources, both in terms of consumptive demands and threats. Significant threats include forest conversion, pollution, invasive pests and plants, fire and other disturbances, and climate change.

We seek to monitor processes to better understand current and potential threats from human use and the environment. The information we develop on forest status and trends is critical to guiding delivery of our science-based knowledge and products necessary to maintain the health and sustainability of natural resources and the well-being of the communities that depend on them. Our well established array of inventory and monitoring activities range from broad-scale inventories and analyses of the region's forests to more tactical inventories of specific land holdings and urban forests to site-specific activities such as long-term monitoring at experimental forests. These inventory and monitoring activities provide the data, analyses, and tools necessary to establish baselines, track change, quantify threats, demonstrate effectiveness, prioritize research efforts, and gauge success relative to natural resources policies and practices.



SCIENCE TOPICS

Inventory

Monitoring

Assessment

Techniques

► For more detail, see http://nrs.fs.fed.us/inventory_monitoring/



GOALS

- ▶ Develop the information and tools necessary to inform forest policies and practices
- ▶ Increase the understanding of forest processes and associated threats to ecosystem health

PORTRAIT OF THE NORTHERN LANDSCAPE

Forests here are on the increase, 1.7 million additional acres of forest land since 1997.

Private landowners hold 74 percent of the forest land in the 20-state region.



NRS Science Strengths



Multidisciplinary cadre of scientists working in both applied and basic research, from the microscopic to the landscape scale

Institutional infrastructure to sustain both large-scale manipulative studies and long-term data collection (and preservation of samples) that require many scientific “generations” to complete

Expertise and experience in working across geographic boundaries

Commitment to providing public and private landowners and other clients with good science on real-world problems, in useful and understandable language and formats

Experimental Forests: Living Laboratories for Long-term Research

The Northern Research Station may be new, but it is built on a rich legacy of long-term research. Many of these long-term studies are based on the Station’s 20 experimental forests, which span the region’s ecological systems and focus research on critical resource issues. These living laboratories allow us to learn how forests change over time and to continue that learning beyond an individual scientist’s career.

Experimental forest and location	Principal Studies
Argonne (WI)	Second-growth hardwood management
Bartlett (NH)	Northern hardwood management; remote sensing technologies
Big Falls (MN)	Black spruce silviculture, wetland ecology
Coulee (WI)	Steep land management
Cutfoot (MN)	Mixed pine silviculture
Dukes (MI)	Northern hardwood silviculture; demonstration area
Fernow (WV)	Mixed hardwood silviculture; watershed research; acid deposition
Hubbard Brook (NH)	Nutrient cycling in northern hardwood forest; soil physics; stream ecosystems
Kane (PA)	Ecology of mixed hardwood forests; deer and regeneration
Kaskaskia (IL)	Uneven-age silviculture of mixed hardwoods; old-growth oak-hickory forests
Lower Peninsula (MI)	Oak and aspen silviculture; red, jack, and white pine plantation management
Marcell (MN)	Peatland hydrology; nutrient cycling; mercury deposition
Massabesic (ME)	White pine management; amphibian and owl ecology; conservation education
Paoli (IN)	Oak regeneration; prescribed burning
Penobscot (ME)	Silviculture of mixed conifers
Pike Bay (MN)	Aspen silviculture; soil productivity; white pine thinning
Silas Little (NJ)	Fire ecology of the New Jersey Pine barrens; climate/fire danger modeling
Sinkin (MO)	Shortleaf pine and oak silviculture
Udell (MI)	Streamflow changes resulting from cutting and reforestation
Vinton Furnace (OH)	Silviculture of upland hardwoods

Other Long-term Study Sites	Principal Studies
Baltimore (MD) Long-Term Ecological Research Site (LTER)	Urban ecology
Harshaw Research Farm (Free Air Carbon Dioxide Experiment) (WI)	Climate change effects on northern forests
Howland Research Forest (ME)	Climate change and the carbon cycle



Partnerships and Science Delivery

Partnerships

Collaboration is at the heart of our research. We rely on partners not only to conduct research studies but also to help define the research topics we pursue and to assist in delivering the final products. By involving others' knowledge, skills, and resources, we improve our effectiveness.

The Northern Research Station works with a wide range of partners, including:

- ▶ Other federal agencies
- ▶ Other research and development programs
- ▶ Universities, teachers, and students
- ▶ Tribal, state, and local governments, agencies, and organizations
- ▶ Professional societies
- ▶ International organizations
- ▶ Non-governmental organizations
- ▶ Landowner associations
- ▶ Industry
- ▶ Communities
- ▶ General public

Delivering Science You Can Use

As the Northern Research Station, we are committed to delivering both the science and the services to help people apply scientific information and technology that improve the health and sustainability of their forests, waters, and communities. Science delivery bridges the gap between creation of scientific information and technology and use of those innovations. With a targeted commitment of expertise and resources, we are developing and delivering products and services geared to customer needs and preferences.

- ▶ We work with partners and stewards of northern forests to ensure that our research is designed to address their most important challenges and to ensure that the tools we develop from our research will meet their needs.
- ▶ We continue a tradition of developing powerful computer-based decision tools and models, training sessions, Web-based management guides and other tools, handbooks, and research publications so that all our partners and the public can access and use the results of our research.
- ▶ We form new partnerships to increase the efficiency and effectiveness of our science delivery.

The Northern Research Station is uniquely positioned to help address the pressing natural resource issues of today and tomorrow. **How can we work with you?**



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NRS-INF-04-08

February 2008



Northern
RESEARCH STATION
USDA Forest Service

“Capitalizing on the strengths of existing science capacity in the Northeast and Midwest to attain a more integrated, cohesive, landscape-scale research program”