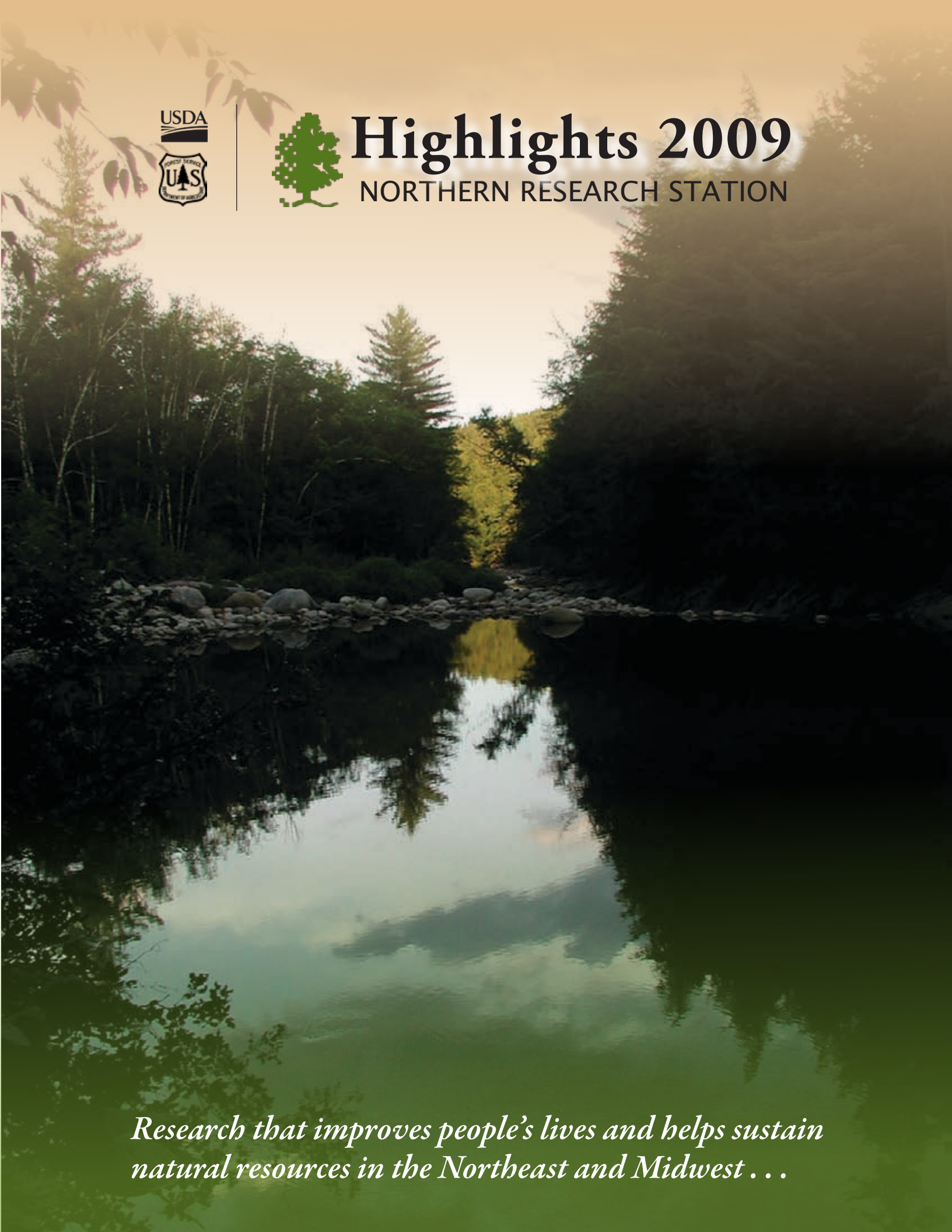


Highlights 2009

NORTHERN RESEARCH STATION

Research that improves people's lives and helps sustain natural resources in the Northeast and Midwest . . .

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

OUR VISION: HEALTHY FORESTS, HEALTHY PEOPLE, HEALTHY COMMUNITIES

The Northern Research Station serves the most densely populated and most heavily forested portion of the United States. We envision a region where trees and natural resources support a high quality of life; where resilient habitat supports thriving wildlife, fish, and plant communities; where clean water abounds and where people work together to sustain, and where necessary, restore the health of forests, from urban centers to deep wilderness. We further envision forests that provide a wide array of benefits and renewable products from hardwood for furniture to bark for native basketry, to bioenergy to heat homes and schools, to a sunset viewed from a mountain top. The Northern Research Station is dedicated, organized, and staffed to provide the high quality scientific information that people need in a form they can use.

FROM THE STATION DIRECTOR

This summer, a powerful concept emerged from dialogue among the Northern Research Station, its sister Forest Service units in the East, and top Forest Service leadership. Landscape-Scale Conservation—the notion that we can better serve people where they live through a cohesive, comprehensive approach to land management, protection, and wise use—excited a broader vision of how the Forest Service can better fulfill its mission in challenging times.

Specifically, this emerging framework refers to the ability to conceive, plan, finance, and manage projects with significant natural conservation value while incorporating the cultural and economic activities of people situated in those landscapes. It offers a comprehensive look at multiple problems and opportunities, as opposed to a piecemeal approach, coordinating goals and actions for the good of the whole.

The Northern Research Station's role in landscape-scale conservation is a familiar one—to produce and synthesize high quality scientific information as the basis for informed decision-making and to deliver that science through multiple communication platforms. In these pages, you will find highlights of our 2009 efforts in fulfilling that role. These key accomplishments represent a broad array of research in forest disturbance processes, sustaining forests, urban natural resources stewardship, providing clear air and water, and natural resource inventory and monitoring.

I look forward to continuing to work with you as we find new ways for the Northern Research Station to deliver the science that meets the needs of rural and urban communities and help sustain the landscapes of the Northeast and Midwest.

Michael T. Rains

Overview

NORTHERN RESEARCH STATION

KEY POINTS

As part of the USDA Forest Service Research and Development mission area, the Northern Research Station provides leading-edge science and technology applications and effective information delivery.

- Our work extends across 20 states of the Northeast and Midwest.
- Our 24 field locations include Baltimore, Chicago, and New York City.
- We operate a network of 23 experimental forests that produce unique insights into long-term trends in natural resource conditions.
- We conduct forest inventory and monitoring for 24 states.
- We work with a wide range of clients and partners to conduct research and deliver results.

Our work helps advance the stewardship of landscapes along a rural to urban gradient to ensure the long-term health and productivity of the region's natural resources.

SCIENCE THEMES

The Northern Research Station's five science themes are the driving force of its science portfolio. The program direction for each theme is achieved through the coordinated actions of 14 research work units. Our science themes are:

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

Our program focus of environmental literacy integrates NRS research into regional efforts to improve environmental literacy, which helps people make responsible choices about the environment through lifelong, place-based, inquiry-based learning.

BIOMASS UTILIZATION

"If only there was a use for small-diameter woody material…" is a lament heard throughout the forested United States. People view biomass utilization through a multi-faceted lens: as a step in the quest for energy independence; as a tool for economic revitalization; as a way of reducing wildfire risks; or as a means of improving ecosystem health. What is standing in the way to achieving any of these worthy goals through biomass utilization? NRS scientists Pamela Jakes and Sarah McCaffrey assisted partners who examined 10 Federal biomass projects throughout the country with these questions in mind. They found that transportation cost is one of the major barriers to biomass utilization, along with the perceived low value of biomass, lack of value-added product options, and environmental concerns. In communities where the projects were located, people overwhelmingly supported the development of small-scale technology to increase biomass utilization. Small-scale projects for energy generation and for production of animal bedding, flooring, and related goods were seen as more viable than large-scale projects because of the size and types of local markets, required capital investment, available workforce, and increased social acceptance for small-scale use. Of particular interest is the development of local industries that produce value-added products and keep the economic benefits in the local community.

Pamela Jakes, U.S. Forest Service

Value-added products such as flooring utilize small-diameter material to produce jobs important to community sustainability.

PARTNERS
Dennis Becker, University of Minnesota; Kathleen Halvorsen, Michigan Technological University; Cassandra Moseley, University of Oregon

RESTORING THE AMERICAN CHESTNUT

Paula Murakami, U.S. Forest Service

Pollination of one of the few remaining American chestnuts in Vermont, an attempt to capture genes from locally adapted, cold-tolerant native trees.

The American chestnut was a key forest tree species in eastern North America and new research may help return this species to forests. A fungal blight that spread across eastern North America about 100 years ago killed almost all American chestnut trees and eliminated them as a dominant forest species. The fungus that caused the blight was first brought into the U.S. from Asia and it still persists in sprouts from living stumps and root systems of otherwise-dead native chestnuts. The American Chestnut Foundation® (TACF) is leading a partnership with the Northern Research Station and other institutions to selectively breed blight-resistant chestnut. Recent testing by NRS scientist Paul Schaberg and researchers at the University of Vermont has focused on the survivability of the TACF hybrid/backcross stock in the northerly portion of the original range of American chestnut. One study showed that American chestnut seedlings were less tolerant of cold and were more prone to freezing injury and dieback of terminal shoots. In another study, the nuts of American chestnut were also found to be prone to injury if not protected from subfreezing temperatures. New studies are investigating ways in which the cold tolerance of nuts and shoots can be bolstered through genetic selection and management practices.

PARTNERS
The American Chestnut Foundation; The University of Vermont

PREVENTING THE SPREAD OF INVASIVE INSECTS

Wood products—especially wood packaging materials and firewood—have been identified as important pathways for the movement and introduction of invasive insects, particularly bark beetles and wood borers. Two recent invasive insects, Asian longhorned beetle (ALB) and emerald ash borer (EAB), were probably introduced and transported this way. NRS researchers Therese Poland and Melody Keena explored innovative treatments for killing the insects while inside of various wood products. One treatment, proposed as a potential replacement for fumigation or heat treatment, is using vacuum to desiccate the insect larvae. The other treatment, proposed to prevent escape of invasive species from firewood (which is often moved without any treatment), is double-bagging with large plastic bags such as garbage bags, until the insects have emerged and died inside the bags. The use of vacuum treatments to kill ALB and EAB larvae and bagging firewood with plastic bags to prevent escape and spread of EAB were effective.

Therese Poland, U.S. Forest Service

Ash firewood enclosed in a double plastic bag to prevent live EAB from being transported; all adult beetles that emerged from the firewood died inside the plastic bags.

PARTNERS

Zhangjing Chen and Marshall White, Virginia Tech University; Deepa Pureswaran, Canadian Food Inspection Agency; Andrea Diss-Torrance, Wisconsin Department of Natural Resources

PRESERVATION OF LINGERING ASH TREES

Reports following the outbreak of the emerald ash borer (EAB) indicated that there was no resistance to this insect in the Detroit area, where ash was a popular street tree. As the beetle spread away from urban areas into more genetically diverse native stands and woodlots, NRS researchers Jennifer Koch, Kathleen Knight, and Therese Poland, along with a partner, established plots to monitor the impact of EAB in these areas. More than 3,000 ash trees in infested forests in Michigan and Ohio have been monitored yearly using a canopy health index. Almost all of the ash trees are dead, however these inventories have identified a small number of trees that have persisted. Data collected in 2009 showed that about 1.0% of the ash trees have remained alive and that 0.1% retained a healthy crown appearance. Even if these trees ultimately succumb to EAB, the traits that helped them survive longer may be helpful in breeding ash trees that could resist EAB. Forest Service researchers and collaborators are working quickly to preserve these "lingering ash" so tests can be performed to determine what mechanisms that allow them to survive.

Jennifer Koch, U.S. Forest Service

Grafting a bud from "lingering ash" onto rootstock.

PARTNERS

Dan Herms, Ohio State University, OARDC

PLANNING WILDLIFE CONSERVATION IN LARGE LANDSCAPES

Wildlife conservation and management practices have traditionally used site-level approaches, but now, larger-spatial-scale efforts are needed. NRS scientists have been at the forefront of developing these larger-scale models. Spatially explicit information on habitat requirements, land use, and vegetation composition and structure now make it possible to model habitat dynamics of larger landscapes. The book *Models for Planning Wildlife Conservation in Large Landscapes*, published in 2009 and edited and compiled by NRS scientist Frank R. Thompson, III, and a colleague, Joshua Millspaugh, consolidates conceptual basis and practical approaches to modeling and conserving wildlife in large landscapes. The book is divided into three sections. The first includes chapters that address critical concepts to consider in large-scale conservation activities. The second includes chapters reviewing available modeling approaches. The last component includes chapters integrating theory and methods as a series of case studies from diverse ecosystems and for multiple wildlife species. The book is available from Academic Press.

PARTNERS

Seventy authors from universities, state and federal agencies, industrial landowners, private consulting firms, and nongovernmental organizations contributed to the 24 chapters in this book.

URBAN NATURAL RESOURCES STEWARDSHIP

RESTORATIVE COMMONS

The Northern Research Station published the proceedings of a conference titled *Restorative Commons: Creating Health and Well-being through Urban Landscapes*. Participants at the 2007 conference shared lessons learned from the fields of urban natural resource management and design with other practitioners, policymakers, and the general public. They explored the relationships of urban landscape to human health and well-being and documented some of the most compelling practices and principles currently utilized to create restorative commons (that is, public shared space) either as small-scale experiments or as larger efforts to "institutionalize innovation."

The conference proceedings were published in conjunction with the nonprofit organization Meristem, which was also a partner in the conference. Along with the preface by Dr. Oliver Sacks (noted neurologist and author), the book includes 18 articles by researchers in the fields of medical history, evolutionary psychology, and urban planning as well as essays on practitioners' experiential knowledge. As urban areas are increasing in population and area, ways to make urban life more livable and healthy are increasingly more important. *Restorative Commons* is an important part of spreading the word about what is common to us all and is being used in classrooms and by nongovernmental organizations and research labs across the country. The book, edited by NRS researcher Lindsay Campbell and Anne Wiesen of Meristem, is available from NRS (nrs.fs.fed.us/pubs).

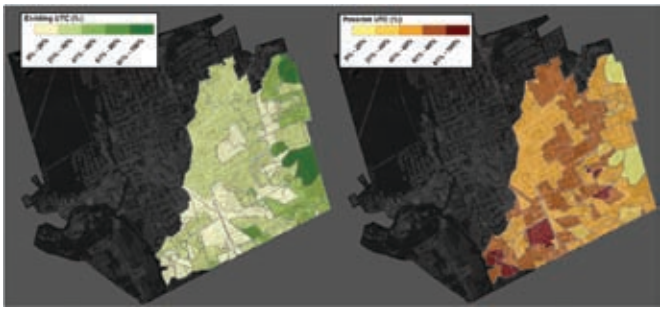
Glenis Holder, Greenthumb, used with permission

Young girl in Clinton Community Garden, Hell's Kitchen, NYC.

PARTNERS
Meristem, New York, NY

URBAN TREE CANOPY: THE DEVELOPMENT OF PRIORITIZATION TOOLS

Scientists from the Northern Research Station, the University of Vermont (UVM) Spatial Analysis Laboratory, and other partners have developed tools for the high resolution assessment of urban landcover. These tools have been applied to a range of cities, including Burlington, VT; Boston, MA; New York City; and Baltimore and Cumberland, MD. Based upon these assessments, these cities have established urban tree canopy (UTC) goals and allocated resources to meet these goals. The next phase in the UTC effort is to develop tools that enable cities to prioritize where to plant new trees and maintain existing cover. Because priorities may vary with diverse social and environmental goals, UTC prioritization tools must be able to incorporate, standardize, and apply social and biophysical spatial data at a variety of scales.



This image depicts the percent existing (left) and possible urban tree canopy (UTC) for catchments in the Moon Brook watershed in Rutland, VT.

In the final phase of a class at UVM, students developed UTC prioritization tools and continued a joint independent study with New York City Parks & Recreation Department to finish the development and documentation of the UTC prioritization tools and applications for NYC. Over the next year, the UTC prioritization tools will be applied to other cities where initial UTC assessments have been completed, including cities in Vermont, Massachusetts, Connecticut, Rhode Island, New York, Maryland, and Washington, D.C.

NRS scientists Morgan Grove, Jarlath O'Neil-Dunne, Erika Svendsen, and Lindsay Campbell are involved in this research.

PARTNERS
Austin Troy, Dexter Locke, Kelly Ann Goonan, Michele Romolini, University of Vermont; Jacqueline Lu, Jessie Braden, and Fiona Watt, Department of Parks & Recreation, New York City

PROTECTING HABITAT FOR GRASSLAND BIRDS ALSO IMPROVES LIFE FOR PEOPLE

More than 80 percent of the U.S. population lives in urban areas, and these areas are experiencing rapid growth and large-scale development of open space. Many residents are concerned about the loss of open spaces and the amenities they provide, and many local organizations, including local governments, have policies and funds to acquire land or conservation easements within or on the fringe of metropolitan areas. NRS scientists developed a tool to help these organizations prioritize large contiguous areas for conservation and restoration and to understand the financial implications of their choices.

NRS scientists Robert Haight and Stephanie Snuder analyzed land acquisition and restoration strategies in Kane County, IL, on the outskirts of Chicago. In Kane County, planners are concerned about the needs of grassland birds, which are among the most visible and popular elements of the grassland fauna and are also vulnerable to habitat loss and fragmentation. Results pointed out the desirable areas of grassland habitat that could be protected for minimum cost and the financial implications of increasing the goals for habitat protection.

Torre Hovick, Iowa State University, used with permission

A focus of conservation planners is protecting and restoring habitat for species such as the bobolink.

PARTNERS
University of Washington, University of Illinois, Kane County (IL) Forest Preserve District

LISTENING TO NEGLECTED VOICES

Natural resource managers need to understand the cultures and concerns of ethnic minority communities to serve them effectively. The Hmong people from Southeast Asia came to the U.S. as refugees after the Vietnam War. They originated from mountainous areas and have continued their cultural involvement in hunting and fishing in their new country. NRS researcher David Bengston conducted focus groups with Hmong Americans in Minnesota and Wisconsin to explore their perspectives on public lands and find ways to defuse the tensions and problems between the Hmong and other residents. Participants had suggestions for improvement and shared insights regarding the needs of new refugees. Suggestions include 1) provide cultural training for land managers about the Hmong and other minority groups; 2) hire more ethnic and minority land management employees; 3) offer more training classes for Hmong on hunting safety and rule changes; 4) offer separate classes for women because of the different ways in which Hmong women use public lands; and 5) improve and add signs to explain the rules on public lands.

Tou Thai Lee, University of Minnesota, used with permission

Hmong angler and his catch.

PARTNERS
Michele Schermann, MaiKia Moua, and Tou Thai Lee, University of Minnesota

TREE BIOLOGY EDUCATION FOR LANDSCAPE PROFESSIONALS

Kenneth Dudzik, U.S. Forest Service

A continuing series of presentations by Kevin Smith link tree biology to tree performance and the functioning of healthy rural, urban, and community forests.

PARTNERS
International Society of Arboriculture, Ecological Landscaping Association, and American Nurseryman, and others

Urban and community forests need arborists and other landscape professionals who understand the relationship of tree biology and the environment. Although landscape professionals and the public have many prescriptive guides for tree planting, fertilization, and other management needs, choosing among the various available options can be difficult without an understanding of the "why" behind the "how." As part of an environmental education series to help meet such needs, NRS scientist Kevin T. Smith prepared four new publications and delivered supporting workshops to national, regional, and state groups. These products provide the biological links between "how-to" guides and successful urban and community landscapes.

TRAINING MANAGERS TO USE NATURAL MODELS FOR ECOLOGICAL SILVICULTURE

The Northern Research Station is a founding member of the Conservation Forestry Network (CFN), which aims to improve forest management across North America. The CFN works by bringing together experts, land managers, stakeholders, and decision-makers in workshops that focus on the application of ecological principles to forest management.

Alexander Evans, Forest Guild, used with permission

Dr. Brian Palik (right) discusses ecological silviculture in Wisconsin with Menominee Tribal Foresters.

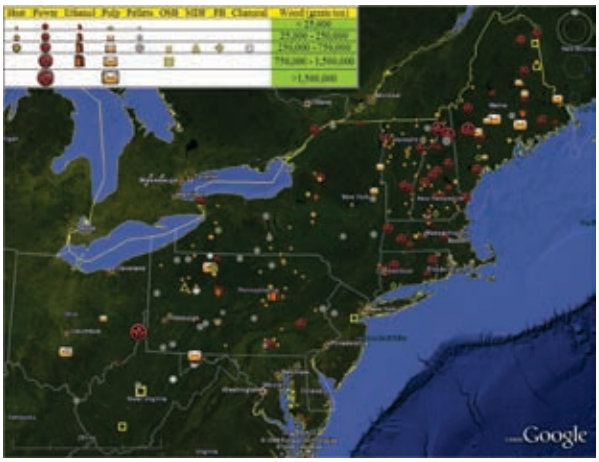
NRS scientists in 2009 organized and conducted workshops in Wisconsin, West Virginia, and Maryland, and organized a symposium on ecological silviculture at the Society of American Foresters annual convention in Nevada. Together, these activities reached more than 300 forestry professionals, working for several dozen organizations, from most forested states. These training sessions provide forest managers and policy makers with information on the science of natural disturbance and stand dynamics and how these natural processes create structurally complex, diverse, and healthy forests. Importantly, the trainings provide practical guidelines for integrating this ecological information into silvicultural prescriptions aimed at restoring and sustaining ecologically healthy forests, while maintaining the productive capacity of our forest resources.

PARTNERS

The Forest Guild: Conservation Forestry Network; Society of American Forests (SAF), Ecology and Range Working Group; West Virginia University; Maryland and Delaware SAF; University of Wisconsin-Stevens Point; University of Wisconsin-Madison; Wisconsin Department of Natural Resources; Chequamegon-Nicolet National Forest; University of Washington; Jones Ecological Research Center

WOOD-BASED ENERGY SYSTEMS AND POTENTIAL EFFECTS ON ROUNDWOOD DEMAND AND SUPPLY

Planning for energy utilization requires information on the availability and future utilization trends of woody biomass from forests. NRS scientist Jan Wiedenbeck and a partner at Pennsylvania State University identified 342 facilities in the northeastern United States that use pulpwood or "energy wood." Eighty-four percent of these facilities are in business to produce an energy-related product; 16% use it to fuel their internal operations. These 342 facilities potentially consume 46.9 million tons of wood per year.



Map by Li Ma, Pennsylvania State University, used with permission

Map of facilities in northeastern U.S using woody biomass for energy production.

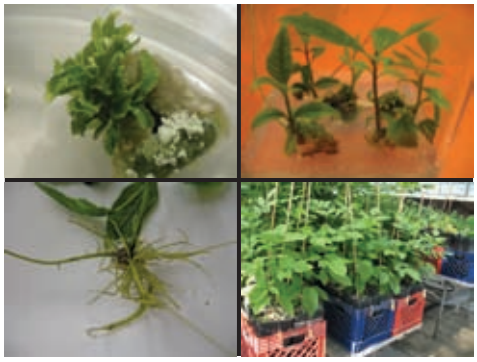
Because of the location of these facilities and the forests, this assessment suggests that future woody biomass demand data collection be focused on five key states: Maine, New Hampshire, Vermont, New York, and Pennsylvania. Small-scale bioenergy projects pose no threat of significantly reducing the supply of woody biomass in the Northeast due to the ongoing decline in pulp and paper production together with the apparent decline in other traditional woody-biomass-using industries. Assuming the normal evolution of events occurs in the region, woody biomass consumption will increase by about 25 percent over the next decade. The future direction of electricity production from wood and co-firing of wood in coal power plants, especially in Pennsylvania, West Virginia, and Ohio, will have the greatest impact on the woody biomass resource.

PARTNERS

Dr. Chuck Ray, Pennsylvania State University

DEVELOPING EMERALD ASH BORER-RESISTANT ASH

Ash timber is valued for applications requiring strong, hard wood. In the urban landscape, ash trees are important street trees, as they sequester pollutants, conserve energy by provide shade, and shelter urban fauna. The emerald ash borer (EAB), an exotic beetle from Asia, is attacking and killing all ash trees in North America. First identified in Michigan in 2002, the EAB has since been detected in Ontario, Ohio, Indiana, and at least nine other states. There are no known resistance genes in native species of ash nor any means of complete eradication at this time. The EAB has cost municipalities, property owners, nursery operators, and forest products industries tens of millions of dollars, and the ecological costs are enormous.



Paula Pijut, U.S. Forest Service

Plant regeneration from green ash hypocotyls.

A team of scientists at the NRS' Hardwood Tree Improvement and Regeneration Center and others in East Lansing, MI, are using gene insertion techniques to develop ash with resistance to the EAB. *Bacillus thuringiensis* (Bt) is toxic to caterpillars and has widespread use in controlling forest pests in the U.S. and Canada. The team has developed plant tissue culture and genetic methods to insert a Bt toxin gene into green, white, and black ash tissues to impart resistance to the EAB. This is a major step toward developing ash trees that could resist the EAB.

FAMILY FOREST LANDOWNERS AND STEWARDSHIP ACTIVITIES

Family-owned forest lands provide goods and services that benefit both owners and society, including recreation, timber, wildlife habitat, and clean water. To encourage landowners to undertake stewardship practices to protect and sustain their forest resources, government agencies use a variety of approaches, including incentives, tax relief, technical assistance, and educational programs. However, the effectiveness of these methods has not been well examined. NRS researcher Stephanie Snyder and partners examined the usefulness of paying family forest owners to commit to forest stewardship.

They found that landowner interest in enrolling in the Minnesota's Sustainable Forest Incentives Act (SFIA) program was significantly influenced by the payment amount, the acres of forest land owned, the landowner's intention to obtain a forest management plan, opposition to the program's covenant requirement, and familiarity with the program. However, at the current incentive rate offered ($5/acre), few family forest landowners were interested. Increased compensation would probably increase the rate of enrollment, but agencies should consider if these higher incentive levels are feasible or warranted, or if family forest landowners could be enticed to undertake stewardship activities through other types of approaches.

PARTNERS

Dr. Michael Kilgore, Dr. Steven Taff, and Joseph Schertz, University of Minnesota

DELIVERING BEST SCIENCE FOR SUSTAINING MIXED OAK FORESTS

Northern Research Station scientists achieved two milestones in science delivery, working with state forest management agencies in Pennsylvania and Ohio. Since 2000, NRS scientists have worked with the Pennsylvania Bureau of Forestry to organize science-based knowledge about oak ecology and management into guidelines for inventory, analysis and sustaining mixed-oak forests in the region. At the same time, these agencies have also identifed research gaps and begun studies to close them. Topics include competitive ability of seedlings of different species and sizes, and how these relationships are changed by prescribed fire, forest harvesting, and other silvicultural activities.

U.S. Forest Service.

SILVAH training session in Ohio.

The guidelines have been organized into the SILVAH decision-support system and have been offered in training sessions in Pennsylvania, West Virginia, and Indiana. The SILVAH framework is continuously updated as research results accumulate. In 2008, this systematic approach was published. In 2009, the Oak-SILVAH approach was presented for the first time in a training session in Ohio. The response was so positive that the Ohio Department of Natural Resources wants to incorporate Oak-SILVAH training for its foresters.

PARTNERS

Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry; Ohio Department of Natural Resources

PROVIDING CLEAN AIR and WATER

INFLUENCE OF FIRE ON MERCURY DEPOSITION

A large forest blowdown event in 1999 in Minnesota's Boundary Waters Canoe Wilderness Area damaged 370,000 acres and raised concerns about the fuel load of downed trees. Prescribed burning is one method to reduce fuel loads, but many are concerned about the effect of fire on mercury availability in aquatic systems. Because little research has studied the effects of fire on mercury cycling, this blowdown area presented an ideal opportunity.

Emma Witt, University of Minnesota, used with permission

Collecting a precipitation sample located under a deciduous canopy in Boundary Waters Canoe Wilderness Area of the Superior National Forest.

As part of a larger study of the effects of fire on the watershed cycling of mercury, NRS scientist Randy Kolka and colleagues assessed the influence of fire on the deposition of mercury. In nonfire conditions, they found that forest canopy type and density were the primary influences on total deposition of mercury (THg) and methyl mercury (MeHg, which is the bioaccumulative form of Hg). Precipitation falling through conifer canopies tended to have higher concentrations of both THg and MeHg when compared to deciduous canopies or forest openings. Similarly, conifer canopies had four times higher concentrations of THg and 10 times higher concentrations of MeHg after fires than before. Higher concentrations were also found under deciduous canopies and in forest openings post-fire.

These data show that conifer canopies are very important contributors of mercury inputs to watersheds and that fires mobilize considerable stored mercury that is deposited locally. Thus, using fire as tool to lessen fuel loads is problematic from a mercury deposition perspective, particularly if this increased local deposition finds its way into the food chain.

PARTNERS
Superior National Forest; University of Minnesota; U.S. Geological Survey

IMPROVING WATER QUALITY IN THE CORN BELT

In the last 200 years, upwards of 80 percent of the land in the U.S. Corn Belt agro-ecosystem has been converted from natural perennial vegetation (trees, shrubs, and forbs) to intensive row-crop agriculture. While this provides many important benefits, the practices used also cause significant ecological problems, including significant effects on water quality at both the local and larger scale. Despite research showing how re-integration of perennial vegetation at strategic landscape positions can reduce the decline in water quality, the land area devoted to row-crop production in the Corn Belt continues to increase.

Tim McCabe, courtesy of USDA NRCS

Farm pond in Benton County, Iowa.

NRS researcher Lynne Westphal and others sought to improve understanding of how Corn Belt stakeholders make conservation decisions. They found that the adoption of conservation practices is based not only on profitability but also on the interplay between contextual factors at three distinct levels of the system: 1) compatibility with farm priorities, profitability, practices, and technologies; 2) community-level reinforcement through local social networks, norms, and support structures; and 3) consistent, straightforward, flexible, and well targeted incentives and regulations. Potential solutions include engaging in collaborative learning at the community level that would result in locally relevant changes with significant regional impacts, which could lead to more adoption of perennial cover in the Corn Belt.

PARTNERS
Ryan Atwell, then Ph.D. Candidate, Iowa State University, now AAAS Fellow with FS Research; Lisa Schulte Moore, Iowa State University

CLIMATE CHANGE EFFECTS ON EPHEMERAL FOREST POOLS

Robert Brooks, U.S. Forest Service

This ephemeral forest pool located on the Quabbin Reservation is part of the study of pool hydrology and macroinvertebrate fauna.

PARTNERS
Massachusetts Department of Environmental Conservation

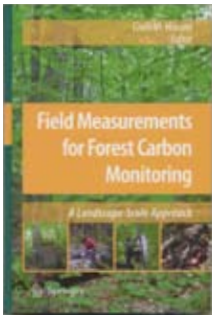
Northern Research Station researcher Robert Brooks has been studying ephemeral (vernal) forest pools on the Quabbin Reservoir watershed in central Massachusetts. The long-term study has revealed numerous aspects of the structure and function of these critical and sensitive habitats.

Vernal pools are the preferred breeding habitat for mole salamanders and wood frogs; support a rich, diverse, and abundant macroinvertebrate community; and contribute to overall forest biodiversity. The hydrology of ephemeral pools is determined principally by weather patterns and is likely to be particularly sensitive to changes in climate. Built on the foundation of this long-term study, a review paper on the potential impacts of projected climate change on ephemeral waters was published in 2009 in the journal *Climatic Change*.

FOREST CARBON MONITORING

The role of forests in the global carbon cycle is becoming increasingly important, partly because forests can provide lower-cost greenhouse gas mitigation options and a variety of co-benefits. Characterizing and monitoring forest carbon stocks and fluxes is a key research need to help scientists and managers understand how to sustain and enhance the carbon storage capacity of our nation's forests. NRS scientists led an effort to capture, in a single handbook, a landscape-scale monitoring program for all major forest carbon pools and fluxes.

In collaboration with the North American Carbon Program and scientists from U.S. and Canadian institutions, NRS scientists designed a landscape-scale forest carbon monitoring program. Because forest carbon studies involve scientists in many different fields, it is unlikely that any single researcher would have experience in all of the types of measurements needed to conduct forest carbon research at scales larger than a forest stand. NRS scientist Coeli Hoover is the editor of the comprehensive handbook on the methods and measurements used in forest carbon inventory and monitoring. The book, *Field Measurements for Forest Carbon Monitoring: A Landscape-Scale Approach* was published by Springer.



PARTNERS
North American Carbon Program

REVISITING LONG-TERM SILVICULTURE EXPERIMENTS

Forest managers seek strategies to develop forests that are capable of sustaining forest productivity, habitat quality, and other ecosystem services under changing and variable climatic conditions. Also, because rising levels of atmospheric carbon dioxide are a major driver of climate change, forest managers are being asked to mitigate climate change by maximizing carbon storage and sequestration in forest ecosystems. Meeting these objectives is a challenge for forest managers. NRS scientist John Bradford is addressing this challenge by re-evaluating long-term silvicultural experiments. Originally designed to identify methods for maximizing timber growth and yield, decades-long NRS datasets and measurement plots are being examined to determine forest management strategies that can be used to adapt to climate change. So far, analyses suggest that there is a tradeoff between forests managed for high growth rates and forests managed for maximum carbon storage. Also, these studies suggest that lower stocking levels can lead to high-complexity forests, which may be capable of greater adaptation. NRS researchers compiled and analyzed data from five long-term studies and began to focus on contemporary climate change questions.

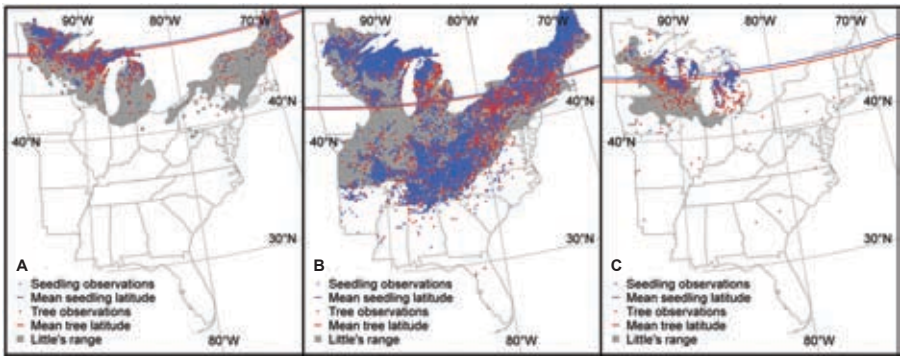
Shawn Fraver, U.S. Forest Service

Collecting increment cores from trees to quantify annual growth patterns.

PARTNERS
University of Minnesota; Chippewa National Forest; Superior National Forest; U.S. Forest Service, Region 9

TREE SPECIES DISTRIBUTIONS ARE RESPONDING TO CLIMATE CHANGE

Changes in tree species distributions are a potential impact of climate change on forest ecosystems. Although NRS scientists have already examined this possibility with computer modeling, real-world examination of this possibility has been limited due to a lack of consistent annual forest inventories across the United States. However, the Forest Inventory and Analysis (FIA) Program of the U.S. Forest Service, has now provided such inventories, and NRS scientists are now actually testing climate change hypotheses.



Symbol identification: blue dots=seedling observations, red dots=tree observations, blue line=mean seedling latitude, red line=mean tree latitude, shaded grey=Little's historic tree range. Tree species identification: A) Tamarack, B) silver maple, C) northern pin oak.

NRS scientists Christopher Woodall, Charles Perry, James Westfall, and their partners compared the current geographic distributions of tree seedlings to biomass for species in the eastern U.S. using the FIA inventory. If, indeed, northern latitude forests are most affected by warming temperatures, then one would expect tree seedlings to be farther north than their counterpart mature trees.

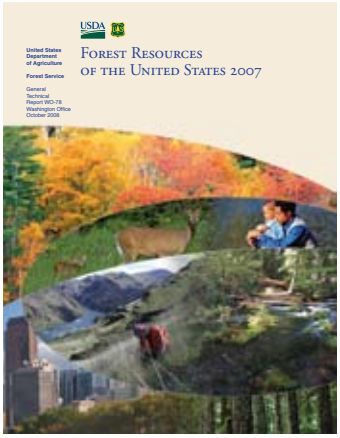
The study found that compared to mean latitude of tree biomass, mean latitude of seedlings was significantly farther north (> 20 km) for many northern study species. Density of seedlings relative to tree biomass of northern tree species was nearly 10 times higher in northern latitudes compared to southern. It is hypothesized that as northern (for example, paper birch) and southern tree species populations together migrate northward due to greater regeneration success at higher latitudes, generalized species (for example, red maple) may fill their vacated niches in southern locations. The results of this study suggest that the process of northward tree migration in the eastern United States is currently under way for numerous species at rates approaching 100 km/century.

PARTNERS

C.M. Oswalt, U.S. Forest Service, Southern Research Station;
A.O. Finley, Michigan State University, Department of Forestry

UPDATING INFORMATION ON FOREST RESOURCES

Northern Research Station (NRS) Forest Inventory and Analysis researchers, Patrick Miles, Charles Perry, Scott Pugh, and Ron Piva, in cooperation with FIA staff from the Southern, Northern, Rocky Mountain, Pacific Northwest Stations, and Washington Office, updated U.S. forest resource statistics from the 2002 Resources Planning Act (RPA) Assessment to provide information on the nation's forests for 2007. The resource tables they prepared provide estimates of forest area, volume, mortality, growth, removals, and timber products output presented in various ways, such as by ownership, region, or state.



Current resource data and trends are analyzed and placed within the context of changes since 1953. Additional analyses look at the resource from an ecological, health, and productivity perspective. A mini-atlas of map plates includes national displays of forest type, ownership, biomass, fragmentation, and other key spatial elements. An interactive RPA Data Wiz CD is also included to provide user access to the resource data.

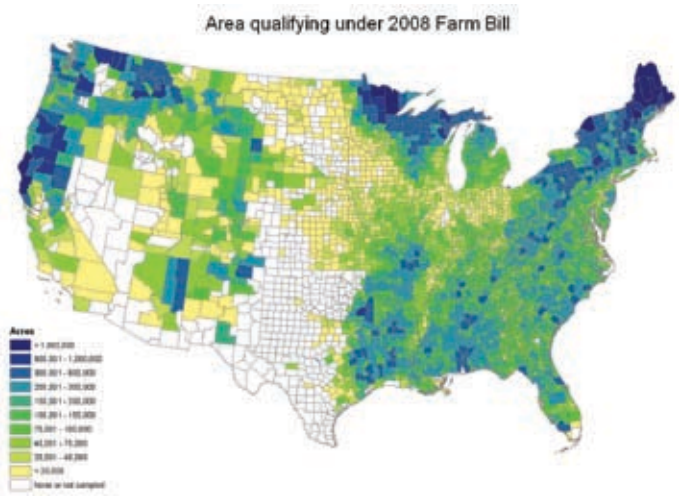
PARTNERS

W. Brad Smith, U.S. Forest Service, Washington Office

DATA INFORMS ENERGY POLICY DEBATES

Northern Research Station Forest Inventory and Analysis (FIA) scientists provided the Forest Service Washington Office's Legislative Affairs staff with a series of data summaries and maps. This information helped the Legislative Affairs staff demonstrate to lawmakers the important contribution that National Forest System (NFS) and Bureau of Land Management (BLM) lands could make to the renewable energy portfolios of the United States.

The initial response quantified and visually depicted the forested acres open to biomass for energy production in each state under the 2007 Energy Bill and 2008 Farm Bill. The Farm Bill definition was limited to nonfederal lands and the Energy Bill definition further limited production to plantations. These initial products clearly demonstrated the lack of opportunity in the West due to the exclusion of federal lands. The next response quantified the lost opportunities on National Forest System, BLM, and other Federal lands. Then finally, as part of a broader effort, NRS FIA researchers provided information on stand age, status, growth, and harvests to help inform legislative compromise language that would include NFS and BLM lands that were not late-successional/mature. The NRS information was a classic example of timely use of findings to help inform sound forest policy. NRS scientists Barry Wilson, Patrick Miles, John Vissage, and Mark Hansen participated in this effort.



Area of land by county qualifying under alternative biomass for energy bills, based on latest FIA data. Map by Barry Wilson, U.S. Forest Service.

PARTNERS
FIA units of the Southern, Rocky Mountain, Pacific Northwest, and Pacific Southwest Research Stations; the FIA Washington Office staff

GREAT PLAINS INITIATIVE—PREPARING FOR EMERALD ASH BORER

Approximate locations of the Great Plains Initiative Nonforest Tree Inventory plots; data from 1,200 plots were collected during the summer of 2008, and several hundred more during the summer of 2009.

PARTNERS
States of Nebraska, North Dakota, Kansas, and South Dakota

The Forest Inventory and Analysis (FIA) National Inventory and Monitoring Applications Center (NIMAC), in partnership with cooperators from state forestry agencies in North Dakota, South Dakota, Nebraska, and Kansas, processed data from a nonforest tree inventory aimed at assessing the potential impact of the emerald ash borer (EAB) and other factors on the states' tree resources.

Tree and site data were collected from about 1,200 nonforest plots during the summer of 2008. During the summer of 2009, several hundred additional plots were established with a focus on urban areas and windbreaks. Initial results from 2008 data indicate that the proportion of ash trees in nonforest areas is more than double that in forested areas and that the total number of ash trees is much larger as well. Relationships between species composition, site factors, and ownership are being assessed so that managers can better understand how to confront EAB and tree management issues in nonforested areas. Some of the study results were published in *South Dakota's Forest Resources, 2007*. Andrew Lister was the lead researcher for this initiative.

RESEARCH COLLABORATION YIELDS BIG RESULTS

Northern Research Station scientists Joanne Rebbeck and Kathleen Knight worked with 7th and 8th grade science students at Dempsey Middle School in Ohio to collect data on the emerald ash borer infestation at their school forest. The emerald ash borer (EAB), an introduced forest pest, kills ash trees by feeding on the vascular tissue just under the bark. Students surveyed the forest, made hypotheses about infestation patterns, dissected ash trees in the classroom, and collected data on the EAB larvae and other insects inside the trees. In a finding that put these students at the cutting edge of science, they found a dead EAB larva beside a cocoon in an EAB feeding gallery. When these cocoons were incubated, tiny, delicate parasitoid wasps emerged. These parasitoid wasps lay eggs on EAB larvae, and the wasp larvae eat the EAB larvae, then form a cocoon, pupate, and exit the tree as adults. The parasitoids the students found were identified as species of native North American wasps, including one, *Leluthia astigma*, which had not previously been recorded as parasitizing EAB. Although the parasitization rate was low (2% of EAB were parasitized), the *Leluthia* were reared in a biocontrol facility to learn about their biology and potential as a biocontrol for EAB. The students were recognized at the Ohio Department of Agriculture's EAB Awareness Week event.

PARTNERS
Deborah Bogard, Dempsey Middle School, Delaware (OH) City Schools; David Cappaert, Michigan State University; Robert Kula, Agricultural Research Service; Kamal Gandhi, University of Georgia


Joanne Rebbeck, U.S. Forest Service
Students examine an ash log and mark woodpecker feeding holes with blue paint.


Joanne Rebbeck, U.S. Forest Service
A student uses a drawknife to peel an ash log, exposing EAB galleries.

THE INVESTI-GATOR, A NEW SCIENCE EDUCATION PUBLICATION FOR UPPER ELEMENTARY STUDENTS

The Northern Research Station co-published the first edition of the *Investi-gator*, a new science education journal for upper elementary students. The *Investi-gator* is aimed at fifth-graders and is the newest member of the *Natural Inquirer* publications family—developed by the Forest Service Research & Development Science Quality Services Staff in partnership with the Cradle of Forestry Interpretive Center—and provides an avenue to spread new knowledge developed by Forest Service scientists to new audiences. This issue uses research from the NRS as a foundation for teaching about scientific inquiry. The *Investi-gator's* first edition addresses why leaves change color, effects of ozone on tree growth, and other topics. Order free copies of the Investi-gator at www.scienceinvestigator.org. NRS' Environmental Literacy Coordinator Barbara McGuinness was co-editor of this publication.

PARTNERS
U.S. Forest Service R&D Science Quality Services Staff; Cradle of Forestry Interpretive Center; Project Learning Tree

UPDATING THE CARBONPLUS CALCULATOR

The CarbonPlus Calculator has been developed by the Northern Research Station (NRS) and its partners to help people estimate their carbon dioxide emissions (what is sometimes called the carbon footprint); provide tips on how to reduce that carbon footprint; and learn about the many benefits trees provide in addition to absorbing carbon.

Each participating city or location can customize the calculations to improve the accuracy of estimates compared to national averages. Designed originally for the general public, the new 2009 version of the calculator adds features specifically for businesses and government agencies to identify ways to reduce their emissions. People can also generate a "pledge certificate" to remind themselves of ways to reduce emissions, and some partner cities are using the increased awareness created by the calculator to encourage support of local tree-planting and greening programs in their cities.

PARTNERS
Cities of Philadelphia, Boston, New York, Baltimore; State of Vermont; The Davey Tree Institute; University of Massachusetts

Mark Twery, U.S. Forest Service

Trees in cities improve quality of life and help reduce net carbon emissions.

i-TREE LEARNING LAB, A LESSON PLAN FOR HIGH SCHOOL STUDENTS

The Northern Research Station partnered in 2009 with the U.S. Forest Service's Conservation Education staff (Washington, D.C.) to create i-Tree Learning Lab, a high-school level lesson plan that helps students understand the benefits of urban forests. After inventorying trees on their school grounds or in their neighborhoods and recording tree species and diameter, students return to the classroom to enter their data into www.treebenefits.com, an online calculator that helps students understand each tree's storm-water, property value, energy, and carbon dioxide benefits.

The lesson plan has been presented to educators at the National Science Teacher's Association (NSTA) 2009 National Conference Workshop, an NSTA Learning Center webinar, and the D.C. Green Summer Jobs Program. With project partner Project Learning Tree, i-Tree Learning Lab is also being incorporated into the national GreenSchools! Program. i-Tree Learning Lab is correlated to the following topics of the National Education Standards of Science: Inquiry, Life Sciences, Earth and Space Science, History and Nature of Science, and Mathematics. Additional modules are planned.

PARTNERS
U.S. Forest Service Conservation Education Staff;
i-Tree Project partners include: The Davey Tree Expert Company, Arbor Day Foundation, International Society of Arboriculture, and Society of Municipal Arborists

NRS RESEARCH WORK UNITS

RWU No.	Research Work Unit	RWU Leader
NRS-01	Ecological and Economic Sustainability of the Appalachian Forest in an Era of Globalization	Mary Beth Adams
NRS-02	Sustaining Forests in a Changing Environment	Susan Stout
NRS-03	Ecology and Management of Invasive Species and Forest Ecosystems	Kurt Gottschalk
NRS-04	Genetics, Biological Control, and Management of Invasive Species	Jim Slavicek
NRS-05	Forest Inventory and Analysis	Dennis May
NRS-06	Climate, Fire, and Carbon Cycle Sciences	Rich Birdsey
NRS-07	Center for Research on Ecosystem Change	John Brissette
NRS-08	Urban Forests, Human Health, and Environmental Quality	Dave Nowak
NRS-09	People and Their Environments: Social Science Supporting Natural Resource Management and Policy	Lynne Westphal
NRS-10	Biological and Environmental Influences on Forest Health and Productivity	Kevin Smith
NRS-11	Sustainable Management of Central Hardwood Ecosystems and Landscapes	Dan Dey
NRS-12	Northern Science, Technology, and Applied Results Program (NorthSTAR)	Mark Twery
NRS-13	Institute for Applied Ecosystem Studies: Theory and Application of Scaling Science in Forestry	Eric Gustafson
NRS-14	Hardwood Tree Improvement and Regeneration Center	Charles Michler

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