Forest ThreatNet

...sharing knowledge and tools needed to anticipate and respond to emerging forest threats

The Eastern Forest Environmental Threat Assessment Center Volume 1 Issue 3 Spring /Summer 2008

From the Director

Humorist Garrison Keillor traditionally begins his signature monologue with, "It's been a quiet week in Lake Wobegon, my home town." Few would say the same about Asheville this spring. The 17-year cicadas returned with a vengeance, filling the air with the whirring sounds of millions of male cicadas doing their best to attract willing mates. The din in many areas was loud enough to disrupt conversation, and a walk outside inevitably led to up-close and personal encounters with the large, winged adults erroneously called locusts in many local vernaculars. Friends and acquaintances had one question for me, "When will these dang cicadas leave?" The mating chorus has subsided, but the tell-tale flagging of dead leaves caused by females laying eggs under the bark of small terminal branches is a visible reminder of their sojourn above ground. Soon the eggs will hatch and larvae will burrow into the soil to begin their amazing 17-year life cycle.

The return of the cicadas is a great opportunity to reflect on the wonders of nature and marvel at the cicadas' unusual and efficient evolutionary strategy. It also reminds us that we are not so removed from the forests and the dynamic forces in play there as we might think. Cicadas generally are not considered serious pests, even though their effect on individual trees, especially young saplings, can be dramatic. Lasting effects of their emergence are few, and they pose no harm to humans or pets. Unfortunately, the same cannot be said of many other insects that survive wherever there are trees, whether in a remote wilderness or our own backyards. We like to think that we have some control over these insects, that our management actions can tip the balance for or against certain species. Other times we just try to endure—and wait for the insects to leave.

For more information about cicadas and links to some of the more interesting Web sites devoted to these and other forest insects, visit our Web site at www.forestthreats.org.

Until next time....

Danny C. Lee

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Detecting Forest Threats through the Hyperspectral Lens

Could spectral "signatures" cast new light?

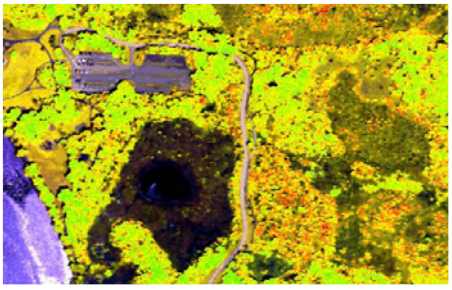
By Stephanie Worley-Firley, EFETAC

When forest health is threatened, early detection is key. Resource managers do not always know the full extent of the threat at hand, however, especially when affected areas are difficult or impossible to access on the ground. A remote sensing technique known as hyperspectral imaging is showing promise as a method to collect data used for mapping forest health decline.

Here's how it works—all plants reflect electromagnetic energy from the sun at multiple wavelengths, including visible and non-visible light. The characteristic reflectances of objects across a range of wavelengths are called spectra. Unique spectral signatures associated with different objects allow them to be identified from the air using sophisticated sensors. Researchers are finding that hyperspectral sensors, which create images based on multiple spectral measurements at specific wavelengths, may be able to differentiate forest species or track changes in forest cover over time.

EFETAC and its sister center, the Western Wildland Environmental Threat Assessment Center (WWETAC), provided support for three recently completed projects that tested use of hyperspectral imaging technology for detecting and mapping forest threats. Two of these studies involved researchers from the Institute for Technology Development (ITD), a non-profit company located at NASA's Stennis Space Center that develops satellite, airborne, field, or laboratory imagery applications for a wide range of research areas.

ITD collected data along roads in the Daniel Boone National Forest in eastern Kentucky, an area plagued by nonnative invasive plants like tree-of-heaven, autumn olive, Chinese silvergrass, bush honeysuckle, and multiflora rose. Researchers found that the spectra of some invasive plants were sufficiently different from surrounding native plants or other invasives to allow them to be readily detected and mapped. Southern Research Station research ecologist James Miller points out seasonal changes and landscape components as factors that influenced the project's success. "Even in these complex forest ecosystems, hyperspectral imagery analysis was capable of identifying particularly troublesome invasive species with an accuracy of greater than 80 to 90 percent," says Miller.



Decline Close-Up: Independence Lake, MI. The predicted decline coverage over Independence Lake, a region of high ash density and prolonged emerald ash borer infestation, highlights large areas of high decline (areas in red have the highest rates of decline, areas in green have the lowest). From: Remote Sensing of Environment, 112, 5: 2665-2676.

In Humboldt County, CA, and Curry County, OR, data from ITD sensors were used to map the occurrence of sudden oak death (SOD), which has devastated populations of oak and tanoak trees in the region. Hyperspectral images were fairly accurate when locating SOD host species, but detecting diseased trees varied by season and canopy characteristics. "Given the right forest type and a narrowed-down forest area to scrutinize closely, hyperspectral imagery could be conceivably useful in detecting infested stands at a slightly earlier stage of disease progression than normal visual methods that only detect mortality," concludes Chris Lee, a project collaborator from Cooperative Extension at the University of California-Davis.

EFETAC also supported a project to test hyperspectral imaging for mapping ash tree locations and detecting emerald ash borer infestations in areas of Michigan and Ohio. The project was led by Northern Research Station (NRS) and University of New Hampshire's Complex Systems Research Center researchers who used hyperspectral images from a commercially available sensor. "When linked to detailed ground measured reference data, very detailed decline, including early decline symptoms, can be accurately mapped using hyperspectral remote sensing," finds Jennifer Pontius, NRS research ecologist. "This enables early identification of infested areas and could be used to improve the efficacy of control and monitoring efforts."

As the technology develops, hyperspectral imaging may become an important piece of a nationwide early warning system for detecting forest threats. Cooperative Extension's Lee says that, "Because quick response is essential for dealing with forest threats, any treatment program is only as strong as its early detection component. Testing the hyperspectral classification technique helps us understand the possibilities and limitations of remote sensing to detect general large-scale declines in forest trees at early stages."

Pontius adds, "Hyperspectral technologies have been well tested in the realm of research. The next step is to bring such techniques to wider applications in the resource management sectors."

CRAFTing Tools for Forest Managers

Scientist Encourages Comprehensive Approach to Forest Management

By Bridget O'Hara, NEMAC and
Karin Lichtenstein, NEMAC

A popular spot for picking blueberries in Western North Carolina is Graveyard Fields on the Blue Ridge Parkway. It is hard to imagine how this place got its name. Rolling hills with small deciduous trees and blueberry bushes have replaced what has become one of the most imperiled forest types in the southeast—the spruce-fir forest. In the early 1900's, a raging fire burned the stumps and fallen logs that gave the 'graveyard' appearance, scorching the soil organic matter and creating a perfect environment for blueberries. This may be good for those who like blueberries, but EFETAC ecologist Steve Norman says such changes present real problems for forest managers. As a vegetation ecologist, he is interested in why forests change and how natural environmental variation and management affect long-term outcomes.

EFETAC ecologist Steve Norman is helping to develop a Comparative Risk Assessment Framework and Tools (CRAFT) that helps managers improve land management decisions.

"For me, you can't say 'forest' without implying change. Forests are all about change–trees establish, grow, and die, species compete, and the environmental backdrop also changes," says Norman. "Climate variability has always affected the system as have disturbances, and in many forests humans have also been important. A forest is in constant flux."

He has been working on a decision process for predicting outcomes to account for uncertainties, called the Comparative Risk Assessment Framework and Tools (CRAFT). Norman has worked with former Pacific Southwest Research Station (PSW) research forester Jeff Borchers, PSW wildlife biologist Sandy Jacobson, EFETAC Director Danny Lee, and UNC Asheville's National Environmental Modeling and Analysis Center project manager Karin Lichtenstein to use probability models called Bayesian Belief Networks (BBNs). He sees BBNs as an effective means to quantify consequences of actions and non-actions across the landscape, portray conditional risk, and create geospatial visualizations of outcomes that will provide a powerful interpretation and communication tool for forest managers.

Building on the National Environmental Policy Act (NEPA) framework for managing public lands, CRAFT approaches forest issues comprehensively. CRAFT allows managers to consider ways an ecosystem will change if left completely alone, or if managed in a certain way at a certain time given the likelihood of disturbance. By providing forest managers with scenarios for possible choices, Norman hopes the tool will improve their ability to account for complexity while making tradeoffs more transparent.

"CRAFT," Norman says, "can be applied to the broadest, regional questions, such as climate change and land use change, or stand-level questions that public or private land owners may have. With CRAFT, forest planning that incorporates the science of uncertainty will become increasingly possible."

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The Eastern Forest Environmental Threat Assessment Center (EFETAC) is an interdisciplinary resource actively developing new technology and tools to anticipate and respond to emerging eastern forest threats. The Center is a joint effort of the Forest Service's Research and Development, National Forest System, and State and Private Forestry and housed within the Southern Research Station.

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Branching Out

NCSU Researcher Examines Forest Genetics and Evolution

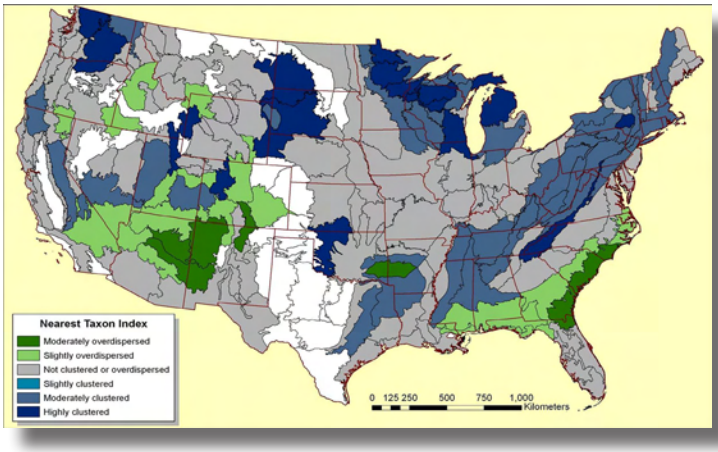
By Stephanie Worley-Firley, EFETAC and Karin Lichtenstein, NEMAC

NCSU researcher Kevin Potter performs forest genetics research in a fir forest.

What causes someone to make a drastic career change from newspaper journalism to forestry research? Curiosity—and a love of writing, of course.

Kevin Potter, a former reporter who covered topics ranging from national politics to homicides and bank robberies, took a job in the news services office at North Carolina State University (NCSU) where he wrote extensively about the school's natural resources research. "As time went on, I began to think that it would actually be really cool to do this work for a living, rather than only writing about it. So in a couple of years, I went from writing news releases about population genetics studies to doing microsatellite molecular marker analyses of Fraser fir and eastern hemlock!" says Potter. Now a research assistant professor in the Department of Forestry and Environmental Resources at NCSU, he is investigating evolutionary relationships among tree species in North America within the context of forest health.

As a cooperator with EFETAC's Forest Health Monitoring (FHM) team, Potter has used information from dozens of recent plant gene sequencing studies to construct an evolutionary "tree of life" that shows how 311 tree species may be related. "Evolutionary diversity is the cumulative evolutionary history of a group of organisms. It may tell you something about a community's resilience in response to threats, such as pests and climate change. Trees in a community that are more clustered on the tree of life are more closely related and may be more susceptible to certain forest threats," says Potter. Maps from Potter's research revealed this clustering among forest tree communities in the Appalachians, Upper Midwest, and Pacific Northwest. According to Potter, these areas may be at greater risk of generalist pests and pathogens because of this clustering. On the other hand, some ecoregions in the Interior West and along the Southeastern Coastal Plain appear to be over-dispersed, meaning that the species tend to be less closely related; therefore, the communities may be less at risk.



Map shows that sections with significant phylogenetic (evolutionary history) overdispersion (green) are confined to the Interior West and the Southeast. Sections with the greatest clustering (blue) are in the Upper Midwest and the Great Plains. Phylogenetically overdispersed communities are expected to be more genetically resilient to change.

Species richness, or the number of tree species present in a plant community, does not always correlate with evolutionary diversity. For example, Potter's examination of Forest Inventory and Analysis tree data shows that evolutionary diversity is higher than species richness in some ecoregions, including in New England and the Pacific Northwest.

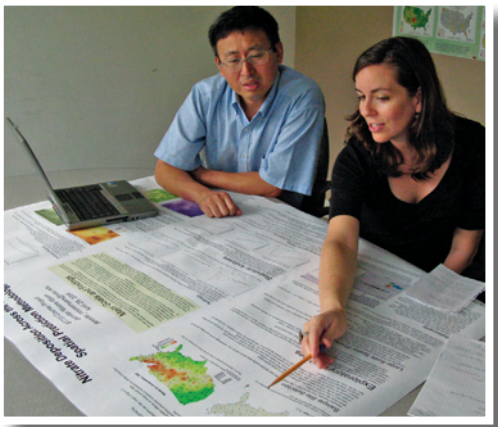
Potter believes this kind of research may change the way natural resource managers pursue conservation efforts. "We may do a better job conserving the biodiversity of an area by targeting the evolutionary diversity of forest tree communities than by focusing on species richness. This is an approach that conservation biologists have been using in Australia and Europe recently, and in some global assessments of mammal biodiversity. I think it has some potential to be useful in the United States as well," says Potter.

With support from fellow NCSU colleagues and EFETAC cooperators Frank Koch and Mark Ambrose, and Kurt Riitters, FHM landscape ecologist, Potter is writing about his findings and thinking about his future work involving forest genetics. "I plan to assess whether invasive plant species are more likely than not to share a common recent evolutionary history (compared to non-native plant species that don't become invasive, for example), and attempt to use the evolutionary relationships among host species to generate maps of pest and pathogen risk," he says. "In general, I think it's important to consider evolutionary biology when thinking about forest threat issues, since evolutionary forces play a central role in shaping processes and patterns in the natural world."

Where Has All the Water Gone?

GIS Specialist Connects Present Water Use to Future Needs

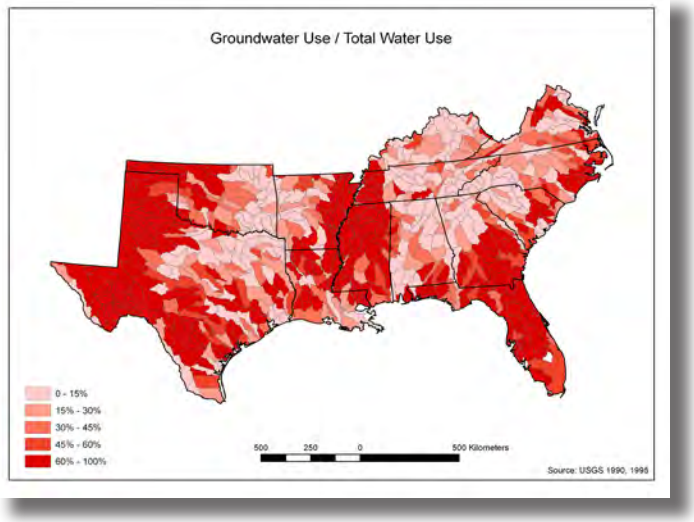
By Bridget O'Hara, NEMAC and
Karin Lichtenstein, NEMAC



SGCP resource information specialist Jennifer Moore Myers and hydrologist Ge Sun discuss a model related to water research.

Climate change. Population growth. Water supply stress. Carbon sequestration. Researchers at EFETAC's Southern Global Change Program (SGCP) in Raleigh, NC, find themselves tackling large amounts of data in order to examine how all of these factors work together. This effort results in better and more efficient methods of managing southern forests, which are expected to face many changes in the next century. Organizing all of these data into an easily understood and analyzed format is the task of SGCP's resource information specialist Jennifer Moore Myers. Drawn to this work by a love for forested landscapes and the enjoyment of being outdoors, she now plays a significant role in SGCP's work. Moore Myers creates relational databases and uses Geographic Information Systems (GIS) to help researchers understand and explain how changes in the environment over time affect the growth of individual tree species and subsequently entire forests. As a GIS specialist, she is able to tie these data together and help researchers see complex patterns of ecosystem response to environmental stress.

Moore Myers, who has a bachelor's degree in environmental geography and a master's in forestry and spatial information science, has always loved plants and learning about their complex environmental interactions. She shares that, "One of the most important environmental changes that can occur is a change in precipitation and water use." Moore Myers has gone to great lengths to find water use data from every possible source in the South for SGCP's Water Supply Stress Index (WaSSI) model. Beyond looking at the average use of water by households, she is collecting data from water resource regions, state water managers, and commercial water users. In fact, some of the largest water users are energy producers, such as electric cooperatives and energy giants like Progress and Duke Energy. Data from these groups help to determine the amount of water that is used throughout the year and how that amount changes with population growth. Changes in available water directly affect plant growth and other changes in forests.



Map shows percentage of total water use comprised of groundwater for 8-digit HUC watersheds in the southern U.S. (Source: U.S. Geological Survey)

With a relational database of water use and water supply, Moore Myers can integrate climate change and population growth projections with the water balance model created by SGCP team leader Steve McNulty and hydrologist Ge Sun. The integration of these models allows SGCP to predict ground water supply expectations for a large region and even develop predictions several years or decades into the future. She then uses the relational database and the modeled data to map water, climate change, and population projections, and is able to indicate how frequently specific areas of the country will be water stressed in the months and years to come.

This research effort by Moore Myers and her SGCP colleagues can help clearly indicate stress on the common water supply and offer forest, municipal, and regional water managers a tool to address environmental change in their region. In this modern age of environmental change, any tool that takes the guess work out of natural resource management is greatly appreciated.

Southern Regional Extension Forestry: Keeping you connected to EFETAC

Bill Hubbard

Forestry education extends well beyond the boundaries of a university campus, so extension foresters are charged to deliver valuable research-based information to natural resource managers, landowners, and citizens. Since 1979, the Southern Regional Extension Forester has served as a liaison between the USDA Forest Service and the forest resource extension units at 13 southern land grant universities.

Bill Hubbard has been the Southern Regional Extension Forester for over a decade. Based at the University of Georgia in Athens, GA, his office is responsible for developing educational and technical services to assist natural resource professionals and improve the efficiency of forestry programs across the South. As technology needs evolve, so does SREF's role in delivering information to stakeholders. EFETAC partnered with Southern Regional Extension Forestry (SREF) when the Center was beginning to take shape in 2005. "We have since assisted EFETAC with conference planning, an online encyclopedia (see sidebar), and, of course, the EFETAC Web site," says Hubbard.

Matt Howell

SREF, with assistance from the University of North Carolina Asheville's National Environmental Modeling and Analysis Center, provided the initial design of EFETAC's online portal, http://www.forestthreats.org. Matt Howell, SREF's Web systems developer, is the main point of contact for EFETAC's expanding Web needs. According to EFETAC Director Danny C. Lee, the partnership with SREF has been significant in promoting the Center's activities. "SREF's technological expertise and creativity have allowed our Center's Web presence to become a user-friendly source for relevant and current knowledge and tools. The online Encyclopedia of Forest Threats is our next step in delivering sound science to a diverse audience." Hubbard adds, "Many forest health issues and threats are facing the eastern U.S., and we are excited to be associated with some of the cutting edge initiatives of the Forest Service."

For more information about the many SREF outreach and education programs, visit http://www.sref.info.

Online Encyclopedia Links Forest Science and Management

SREF at UGA has lent key support for the development of the Forest Encyclopedia Network (FEN) and its latest installment, the Encyclopedia of Forest Environmental Threats. Hubbard serves as a FEN executive editor, and Howell provides the backbone technical programming for the network. The main portion of the recently launched forest threats content is based on case studies and in-depth reviews of topics related to the encyclopedia's broad subject areas: land, air, water, fire, and pests. The encyclopedia's initial content will also be available in print when it is published as a USDA Forest Service General Technical Report later this year.

Access the Encyclopedia at http://www.threats.forestencyclopedia.net.

Scientist Discusses "Riskier" Side of Forest Management

SGCP scientist Johnny Boggs explains river flow patterns in the 17 North Carolina river basins during RiskFest 2008.

EFETAC's Southern Global Change Program biological scientist Johnny Boggs participated in the second annual RiskFest 2008 in Raleigh, NC, in April. The event, themed "Helping Urban and Rural America to Be Future-Ready," is designed, organized, and facilitated by the USDA Risk Management Agency. RiskFest's purpose is to involve a broad range of students, teachers, parents, and private and public professionals in dialogue and strategies to conserve both urban and rural environmental communities.

"RiskFest is an excellent opportunity to expose diverse students to the various risks associated with agriculture, the environment, and energy," says Boggs, whose research focuses on the impacts of nitrogen deposition on nutrient cycling and forest productivity in eastern U.S. forests. "It's important that students recognize the real-world effects of these issues, which includes climate change, and how they can take action and make a difference."

Boggs and other professionals interacted with over 300 6th – 8th grade students at Centennial Campus Middle School. He shared forest management activities to help protect water quality in the North Carolina Piedmont, including the importance of streamside buffer zones, which play a significant role in ecosystem management by reducing sediment and nutrients and providing food, shelter, nesting habitat, and other benefits for land and aquatic animals. Boggs also discussed various threats and risk management factors in North Carolina, including the state's most recent drought.

Boggs Reaches Out to MANRRS

Johnny Boggs is the Southern Research Station's representative to Minorities in Agriculture, Natural Resources, and Related Sciences (MANRRS). Boggs' participation in this year's Denver-based March conference, appropriately themed "Cultivating Minds for Tomorrow's Leadership," helped interest diverse students from colleges and universities across the country in Forest Service career opportunities.

For more information about MANRRS, visit http://www.manrrs.org.

EFETAC in the News...

Landcover Live on Google Earth

You can now view details about landcover across the continental U.S. or even just in your neighborhood! Kurt Riitters, landscape ecologist with EFETAC's Forest Health Monitoring team, has processed data from the 2001 National Landcover Database to create interactive Google Earth maps showing forest spatial patterns, forest density, and mixtures of land use. The maps are visualization tools that can be used to analyze and assess land use change and forest fragmentation. Visit http://forestthreats.org/tools/landcover-maps to learn more and to see the maps.

Josephine Falcone

Western Carolina Student STEPs into EFETAC

Josephine Falcone, a master's biology student at Western Carolina University (WCU), joins EFETAC as a STEP (Student Temporary Employment Program) biological science technician working with ecologist Qinfeng Guo. She is helping to develop and populate Guo's invasive and exotic plants database, a comprehensive catalog of non-native plants in North America used for continent-scale ecological analyses of these key threats to native ecosystems. At WCU, Falcone is studying effects of an insecticide treatment for hemlock woolly adelgid on food availability for insectivorous birds.

EFETAC Scientist Discusses Acid Rain

Steve McNulty, EFETAC's SGCP team leader, presented at the Critical Loads Ad-hoc Committee (CLAD) meeting of the National Atmospheric Deposition Program (NADP) April 28-29 in Pensacola, FL. He updated the group on research he is conducting with Erika Cohen, SGCP resource information specialist, on the effects of critical loads in terrestrial and aquatic habitats. "Critical loads are the estimated levels of pollution above which forest health is at risk. They are just one component of a larger ecosystem stress model, so we are working to determine how interactions among critical loads, climate change, insects, and fire can affect forest health," says McNulty. Visit the NADP Web site at http://nadp.sws.uiuc.edu/ for more information about the program and the CLAD meeting.

Multiple Risks Cause Research Challenges

EFETAC ecologist Bill Hargrove is collaborating with other Forest Service researchers to develop a multi-criteria decision support system (MCDSS) capable of generating a set of National Environmental Threat Assessment Maps (NETAM). "Measuring the interactions among multiple risks, and including both economic and non-economic valuation in risk calculations, remains particularly challenging," says Hargrove, who attended a NETAM workshop at the Remote Sensing Applications Center in Salt Lake City, UT, May 6-8. Sponsored by the Western Wildland Environmental Threat Assessment Center, the workshop brought together researchers and mapping experts working to depict risk from various forest threats at the national scale and provided them an opportunity to compare and contrast the many approaches to mapping threats, hazards, and risks. For more information about the NETAM project or the workshop, contact Ken Brewer at kbrewer@fs.fed.us or 801-975-3754.

Bill Hargrove

Hargrove Wins People's Choice Award

Hargrove was also among the scientists who won the People's Choice Awards gold medal at the 2008 Atmospheric Radiation Measurement (ARM) Science Team Meeting in Norfolk, VA. The award honored Hargrove and scientific partners for their development of a poster titled "A Cluster Analysis Approach to Comparing Atmospheric Radiation Measurement Data and Global Climate Model Results." The People's Choice Awards, new to this year's meeting, were awarded based on votes from all of the ARM scientists attending the meeting. This poster, along with the second and third place winners, can be seen at http://stm.arm.gov/2008/winning_posters_pc.stm

Sino-Eco Names Sun President

SGCP research hydrologist Ge Sun was recently elected president of Sino-Ecologists Association Overseas (Sino-Eco) for its 2008-2010 term. In an unofficial capacity, he assumed presidential responsibilities May 1. Sino-Eco is a non-profit academic organization established in 1988 to encourage the exchange of ideas and knowledge among Chinese ecologists in China and around the world. Additional information can be found at http://forestthreats.org/news-events/news-releases.

Ge Sun

Sign up for an EFETAC RSS!

You can now get the latest news and updates from EFETAC's Web site by subscribing to our RSS feeds. See the available feeds and learn more about RSS at http://forestthreats.org/news-events/rss-feeds.

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