Forest ThreatNet

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

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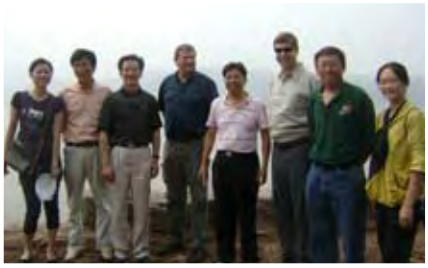
From the Director



Lee and EFETAC research hydrologist Ge Sun (3rd and 2nd from right) toured forest and stream restoration projects near Chongqing with local officials after the IUFRO conference in China.

One of the distinct privileges that I enjoy is the occasional opportunity to describe EFETAC and our work to various audiences. During the past year, for example, I gave quite a few presentations that explored "this is who we are and what we do." Some of those talks also focused on our efforts to understand and combat climate change and its effect on forests—a clear signal of the growing awareness and importance of this issue.

While recently in China at the International Union of Forest Research Organizations (IUFRO) Conference on Landscape Ecology and Forest Management, I had the opportunity to step outside the bounds of my usual responsibilities and examine issues from a broader perspective (see page 6). First, I shared my view of the value of landscape ecology to forest health management. The contribution is substantial in terms of applicable theory and advanced analytical tools arising from the study of landscapes; both are indispensable to understanding and assessing forest threats. A second presentation focused on forest monitoring to support sustainable forest management in the U.S. Forest sustainability is a vital issue throughout the world, and experience gained from the Forest Service's Forest Inventory and Analysis and Forest Health Monitoring programs offers insights applicable to all countries.

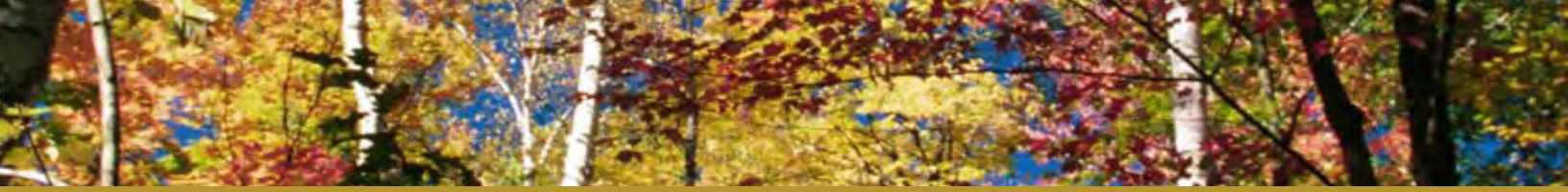
My experience as a presenter leaves me with three major impressions. First, the work that we do is relevant and important. Simply put, people care about forests and are concerned about their long-term health and sustainability. It's easy to justify our efforts when a clear linkage exists to societal goals and concerns. Second, our work covers a broad range of topics connected in ways that leverage their impact. Again, it's easy to find lots of interesting studies within our program, as witnessed by this and previous issues of *Forest ThreatNet*. Less obvious, but no less significant is how these seemingly disparate efforts work together to give an integrated perspective on forests and the threats they face. Finally, the work of our scientists and collaborators is of the highest quality. We deliver state-of-the-art knowledge and tools that rival those produced anywhere in the world.

Small wonder that I remain enthused about coming to work each day and talking about the Eastern Forest Threat Center.

Until next time…

Danny C. Lee

In this Issue



FIRST Offers Broad View of Forest Threats

Advanced technology holds key to early warning system

By Bridget O'Hara, NEMAC

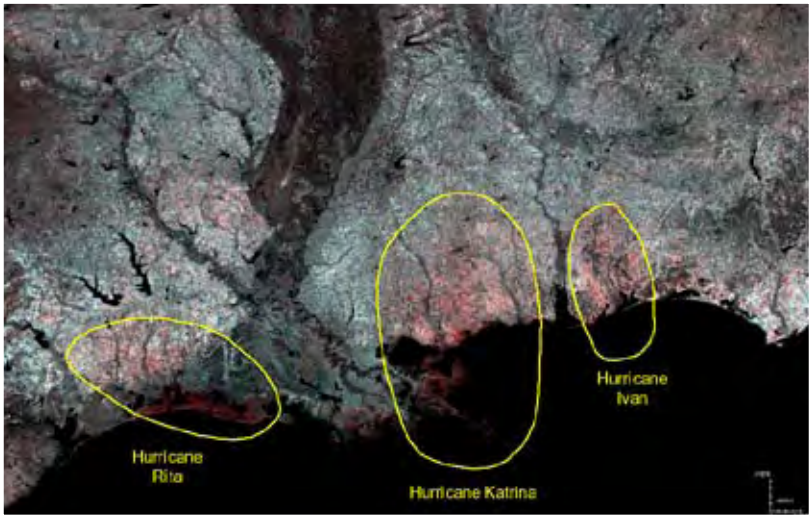
EFETAC research ecologist Bill Hargrove's Forest Incidence Recognition and State Tracking system will help forest managers detect changes on a continental scale.

Deep in a 10,000 acre forest a small insect is chewing holes in canopy leaves. It is nothing a forest manager will give a second thought. That is unless that bug has 10,000 offspring that thrive and completely defoliate a 20-acre hole in the canopy. Research ecologist **William "Bill" Hargrove** has always been interested in these types of interactions that ocurr at the intersection of species. Now, rather than examining holes insects chew in leaves, he is creating a tool that will allow forest managers to spot changes on a continental scale.

Hargrove and his EFETAC colleagues are developing an early warning system that utilizes satellite imagery to detect changes in the landscape. The Forest Incidence Recognition and State Tracking (FIRST) will combine imagery of the entire U.S. from the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor on the terra and aqua satellites with other data on climate, topography, and soils to identify potential forest and wildland threats.

The continental images are comprised of over 32 million cells, each covering approximately 62 acres of U.S. landscape. FIRST will computationally process and classify all imagery and other ecological data, and identify changes that have occurred during the previous 8-day interval. Some changes are normal, expected seasonal, or human-induced. For example, fall and spring will bring many expected changes in leaf color and canopy cover. Hargrove intends to have the alert system automatically overlook these expected changes, concentrating instead on unusual or unexpected changes that may represent locations having potential forest threats.

Hargrove hopes this system will help forest managers identify large scale forest changes faster. Currently, managers check the health of forests through visual surveys. Not intended as a substitute for visual surveys, FIRST will give ground and airborne surveys an added advantage. "FIRST will highlight areas on a map that are possible alerts," he says, "and then forest managers can use overflights, sketchmapping, and people on the ground to confirm and determine the nature and severity of the threat." Hargrove continues, "We hope that FIRST will be of interest not only to forest managers, but also for food and farm production, and even social scientists studying human settlement and living patterns."



The FIRST system will simplify the analysis of impacts from forest threats over large regions. Here, the lasting effects from hurricanes Rita, Katrina, and Ivan can be seen in a single analysis as a reduction in the 20 percent maximum leaf phenology.

Much still needs to be done before FIRST will be available to researchers, managers and the public. Along with NASA's Stennis Space Center colleagues and sister center, the Western Wildland Environmental Threat Assessment Center, EFETAC has developed national data sets on leaf phenology, or seasonal vegetation changes, from the MODIS data as one type of input to FIRST. Historical timing of leaf phenology can provide FIRST with many clues to vegetation status and health. Layers like temperature, precipitation, soils, and topography will also be added as inputs, adding to the types of changes FIRST can detect.

Hargrove emphasizes, "We hope to back-calculate all FIRST products every 8 days to the beginning of the MODIS period, which started in 2000. By providing a standardized analysis rather frequently for many years, the FIRST system should provide a monitoring baseline against which many changes can be measured, making it of interest to lots of potential users."

These types of analyses are computationally intensive, and Hargrove does not expect to go into full production just yet. "The FIRST system is still being designed, developed, and tested, but we hope to have the first large analyses done before the year's end."

Plants Feed Healthy Forests

VEG indicators expand long-term forest health research

By Karin Lichtenstein, NEMAC

Who owns America's forests? How many acres of forest are out there? How healthy are they? Imagine trying to answer these questions….Now think about changes that forests continually face due to disease, insects, fire, and multiple other challenges that exist. Obviously, these questions can become very difficult to answer.

Map shows plot allocations and makes available percentage and relative proportion cover of introduced plant species.

Difficult to answer, but not impossible. Forest Inventory and Analysis (FIA) has tackled these questions since 1928, when researchers began conducting systematic inventories of the nation's forests. Recently, they joined forces with several EFETAC scientists and other partners who are helping to expand these inventories to include forest health indicators—one of which is Vegetation Diversity and Structure (VEG).

This indicator, which was initially implemented by Forest Health Monitoring (FHM) in the 1990's, has undergone many changes and improvements over the years. By adding VEG to the FIA sampling network, it is now possible to estimate the type, amount, and vertical structure of all vascular plants across the entire landscape. Vascular plants include the entire tree and understory plant species in the forest (e.g., trees, ferns, flowering plants). Pacific Northwest Research Station and Anchorage-based research ecologist **Beth Schulz** explains that vascular plants are "a major source of primary production—the conversion of sunlight energy into stored organic matter—and a fundamental determinant of wildlife habitat and wildfire fuel characterization."

Consistent sampling and analysis methods employed by VEG facilitate identification of trends over time and across the many different forest types in the United States. Schulz says the VEG indicator can teach a lot about trends in forest plant species richness and composition, the relative abundance and spatial distribution of those plants (including native and non-native species), as well as the overall physical structure created by plant species.

EFETAC's FHM team leader **Bill Bechtold** adds, "The VEG indicator is unique in that this is the first attempt to sample all vascular plants to be successfully implemented at the national scale." Schulz, Bechtold, and Southern Research Station biometrician **Stan Zarnoch** just completed an important technical report describing in detail sampling and estimation procedures on which the VEG indicator is founded (*Schulz and others, in press*).

The publication is intended as a reference to guide FIA analysts, statisticians, and other researchers in the processing and interpretation of VEG data. Subsequent reports based on VEG data will enable policymakers and land managers to better understand the role vegetation plays in ever-changing forests. As a final point, Schulz notes, "Disturbances in vegetation can have cascading effects through an ecosystem, whether the changes are brought about gradually through natural succession or by sudden destructive forces."

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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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Using 3D to View SPB

New visualization tools aid in southern pine beetle exploration

By Stephanie Worley Firley, EFETAC

Landscape views that provide beauty for human enjoyment, otherwise known as viewsheds, are important—even priceless—for many reasons. However, the tiny southern pine beetle (SPB) can quickly turn a healthy forested viewshed into a disturbing scene of dead and dying trees.

Attacks by SPB, a native pest, are common in the southeastern Piedmont and Coastal Plain. The adult beetles bore into host pines to lay eggs in winding tunnels that girdle and eventually kill the trees. SPB populations can grow rapidly and affect large areas, creating a real concern for land managers as well as tourism and recreation industries and the growing number of people who call the southeast home.

In 1999, before an SPB infestation, mature pure pine stands covered the study area.

Researchers **Bo Song**, **Roy Hedden**, and **Thomas Williams** from Clemson University's Department of Forestry and Natural Resources and Belle W. Baruch Institute of Coastal Ecology and Forest Science know how aesthetically and economically valuable the region's viewsheds are. Beginning in 2006, they partnered with **Kier Klepzig**, Southern Research Station project leader for the Insects, Diseases, and Invasive Plants unit in Pineville, LA, to study the effects on viewsheds when SPB outbreaks occur.

SPB attacked and killed a large number of trees during an outbreak in 2002.

With support from EFETAC, researchers used aerial photos and stand inventory data from various sources to develop models of areas vulnerable to SPB attacks. "Using these data from previous research, we are able to predict the probability of the occurrence of SPB infestation, including where infestations may occur and how much damage could result to forests in the viewsheds," says Song.

But the researchers are not stopping there. They are integrating the knowledge gained from the models into GIS and 3D visualization techniques to create animated simulations of the study area before, during, and following an SPB outbreak. "Now we can fully evaluate SPB impacts on the views and aesthetic qualities of the forested landscapes," says Song.

In 2006, the forest was recovering. Most of the trees attacked in 2002 are gone and have been replaced by regeneration shrubs, herbs, and secondary pine sprouts.

Researchers are also visualizing and analyzing pine host susceptibility under different forest management scenarios. "Our goal is to identify best practices for preventing or minimizing losses from SPB," says Song. "Land managers will benefit when they can actually see how SPB spreads over the forests and how management alternatives to control spots of SPB infestation affect the landscapes. With 3D visualization, we can demonstrate the changes in a forested landscape through time in a virtual environment."

These visualization products will not only prove to be excellent tools for land managers; they will also be effective for communicating forest management strategies to the general public. "There has been very little previous work done looking at the social aspects of invasive insect damage, including the impacts on aesthetics and the multiple uses of forests in the South. This project has provided visually impressive and powerful portrayals of SPB and management tactics to control it," says Klepzig. "One of the most significant aspects of this project is its potential for teaching and outreach. These visualizations will allow a variety of audiences to have a greater understanding of the issues associated with forest management and threats from invasive insects."

See SPB spot growth in 3D vivid animation at [http://www.forestthreats.org.](http://www.forestthreats.org)

Spruce Wither Under Burning Rain

Long-term study reveals acid rain impacts on high elevation forests

By Stephanie Worley Firley, EFETAC

When great numbers of dying spruce trees were observed in New England and the southern Appalachian region during the early 1980s, scientists scrambled to find the cause. Pollution was suspected, but the presence of interacting pollutants in the areas of concern complicated the search for answers. In 1988, **Steve McNulty**, ecologist and team leader of EFETAC's Southern Global Change Program (SGCP), established a research site on southeastern Vermont's Mount Ascutney to test a hypothesis that nitrogen deposition, a major component of acid rain, was to blame for the high rates of spruce decline and mortality.

Nitrogen is an essential element used by plants for growth and survival, but can cause serious problems in excess amounts. When nitrogen compounds in air pollution from automobile exhaust and coal-fired power plants react with moisture in the atmosphere, they form acids that reach the earth's surface in nitrogen rich, acidic precipitation.

Above: *EFETAC biological scientist Johnny Boggs collects data on Mt. Ascutney to assess potential for species regeneration in a red spruce forest impacted by acid rain. The surrounding dead trees are paper birch and red spruce.* **Below:** *Display panels on Mt. Ascutney highlight Boggs' acid rain research.*

In this study, a series of ten research plots across a high elevation red spruce forest on Mt. Ascutney have been fertilized annually with low amounts of nitrogen to simulate long-term nitrogen deposition increases resulting from acid rain. Every four years, researchers have taken measurements and analyzed changes in tree growth, foliage, soils, and the forest floor to determine the ecosystem's response to the elevated nitrogen levels. Two decades after it began, the study continues in the hands of SGCP biological scientist **Johnny Boggs**.

"We now know that acid rain is not killing the red spruce trees directly," says Boggs. "Instead, nutrient imbalances caused by acid rain are changing conditions in this forest ecosystem." He further explains, "Essential nutrients are leached from spruce needles when trees are exposed to acid rain. Specifically, when calcium is lost, needles become more susceptible to freezing injury and death. Soils are affected by acid rain, too. Aluminum concentrations in soils increase, causing displacement of essential nutrients as well as toxicity in tree roots." When healthy growth is altered by acid rain, trees also become more vulnerable to damage from other stressors, like drought, insects, and disease.

Acid rain is not a new phenomenon; the air pollution that causes acid rain has been present in parts of the U.S. since the Industrial Revolution. Unfortunately, the damage is not always immediately visible. "The study on Mt. Ascutney will continue indefinitely to monitor acid rain's effects on forest health and species regeneration through time," says Boggs. Researchers will visit the site to take measurements again in 2010.

"Though impacts of nitrogen deposition have generally only been associated with decline in high elevation spruce-fir forests, high rates of added nitrogen could potentially have negative effects on lower elevation deciduous forests as well. When forests receiving high amounts of acid rain continue to decline, new trees will no longer be able to grow. This could result in major shifts in forest species compositions," says Boggs.

He adds, "We still have a lot to learn, but there are things we can do now to deal with acid rain and its consequences. By reducing our energy consumption and pollution from automobiles, we can increase the chances of keeping our forests healthy for future generations."

The Mount Ascutney Research Project is a collaborative venture. The study site has been provided by the Vermont Department of Forests, Parks and Recreation. Other partners from the University of Vermont, University of New Hampshire, Duke University, and the U.S. Forest Service Northern Research Station have contributed peer-reviewed publications on a variety of topics related to ecosystem responses to nitrogen deposition. Interpretive display panels based on this study were recently installed on Mt. Ascutney. They can be viewed at http://www.forestthreats.org.

EFETAC Director Danny C. Lee (right) and research hydrologist Ge Sun (left) discussed future forest ecosystem services and stream restoration collaborative efforts with Chongqing City forestry officials.

Lee, Sun Present at International Conference

The biannual conference of the International Union of Forest Research Organizations (IUFRO) landscape ecology working group was held September 16-22, 2008, in Chengdu, Sichuan, P.R. China. The U.S. Forest Service co-sponsored the conference, themed *Landscape Ecology and Forest Management: Challenges and Solutions.* EFETAC Director Danny C. Lee delivered a keynote address, "Using landscape ecology to anticipate and respond to emerging forest threats." SGCP research hydrologist Ge Sun participated in a pre-workshop with the U.S.- China Carbon Consortium and organized a hydrology symposium. Lee and Sun also explored collaborative research possibilities on ecosystem services, stream restoration, and forest protection with local officials in Chongqing and the Jinyun Mountain Natural Reserve. Dr. Greg Jennings, North Carolina State University Biological and Agricultural Engineering Department professor, joined them on the visit to Chongqing.

Following the visit to Chongqing, Lee and Sun traveled to Beijing for meetings and presentations at the Chinese Academy of Forestry, Beijing Forestry University, and Beijing Water Authority. Lee also attended the Symposium on Sustainable Forest Management hosted by the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet). He contributed a presentation on behalf of the Forest Service, entitled "Forest monitoring to support sustainable forest management in the United States."

The IUFRO promotes global cooperation in forest-related research and enhances the understanding of the ecological, economic, and social aspects of forests and trees. For more information, visit http://www.iufro.org . APFNet, cosponsored by Australia and the United States, is an open regional organization promoting and improving sustainable forest management and rehabilitation in the Asia-Pacific region. Visit http://en.apfnet.cn/ to learn more.

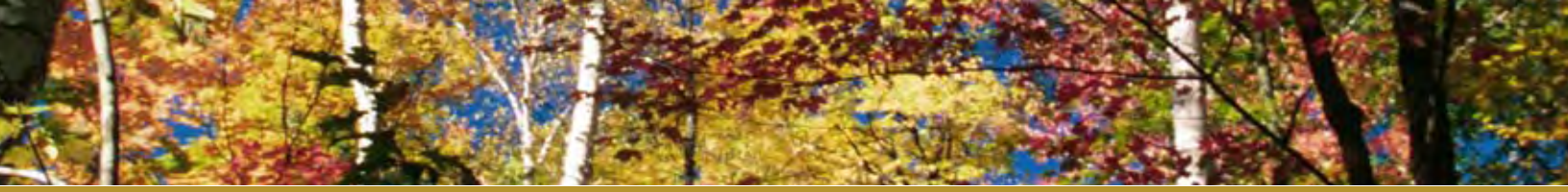
Riitters Contributes to New National Environmental Reports

Kurt Riitters, EFETAC Forest Health Monitoring landscape ecologist, was a key contributor to two recently released assessments outlining current environmental conditions in the U.S. Both reports are based on scientific indicators that provide details about ecosystem characteristics. *The State of the Nation's Ecosystems 2008*, published by the Heinz Center, was compiled by experts from government, business, academia, and nonprofit environmental organizations. As a member of a working group focused on landscape patterns, Riitters developed material for several of the report's indicators including forests, grasslands, agriculture, and urban patterns. The report is one of many projects by the nonprofit, nonpartisan Heinz Center intended to improve the scientific and economic foundations for environmental policy.

Riitters also developed the forest fragmentation indicator for the U.S. Environmental Protection Agency's *Report on the Environment 2008* (EPA 2008 ROE) which explains and analyzes environmental trends in the U.S. The report is an important resource for the American people as well as a guide for the EPA to prioritize its work of improving the environment and, ultimately, human health. *So, how is our environment doing? Access The State of the Nation's Ecosystems 2008 at http://www.heinzctr.org/ecosystems. The EPA 2008 ROE can be found at http://cfpub.epa.gov/eroe.*

Scientists Highlight Invasives, Fire, and Water

EFETAC ecologists Qinfeng Guo and Steve Norman, and research hydrologist Ge Sun attended the 93rd annual meeting of the Ecological Society of America in Milwaukee, WI. Guo presented research findings on the ability of plants to become invasive—emphasizing that effective management strategies should consider the associations between a dominant invasive species and the habitats it has invaded. Norman's research on fire regimes in the wet northern coast redwood forest of California demonstrated that before determining whether fire is an ecological necessity or threat in this unique forest type, land managers must first appreciate fire's highly variable, centuries-long history and pattern of human influence. Sun presented recent forest hydrological research in two special sessions. He discussed how existing forest-water relations may change across hydrological gradients under changing climatic conditions. Sun also summarized SGCP's long-term collaborative research activities with China through the U.S.-China Carbon Consortium and examined how ecohydrological science intertwines with politics and policies. Founded in 1915, the ESA consists of over 10,000 researchers, teachers, and others who use ecological science to address a broad range of environmental issues. *For more information about the ESA, visit http://www.esa.org.*



EFETAC Publications in Review

During the past year, EFETAC scientists have published in a variety of journals and given presentations concerning their research. Please visit http://www.forestthreats.org or http://www.treesearch.fs.fed.us for a comprehensive list through TreeSearch.

Noormets, A., McNulty, S.G., DeForest, J.L., **Sun, G.**, Li, Q., Chen, J. 2008. Drought during canopy development has lasting effect on annual carbon balance in a deciduous temperate forest. New Phytologist 179(3):818-828.

Coulston, J.W., **Koch, F.H., Smith, W.D**., Sapio, F.J. 2008. Invasive forest pest surveillance: survey development and reliability. Canadian Journal of Forest Research 38:2422-2433.

Guo, Q. and A. Symstad. 2008. A two-part measure of degree of invasion for cross-community comparisons. Conservation Biology 22:666-672.

EFETAC in the News...

McNulty Expands Climate Change Discussions

SGCP team leader Steve McNulty is sharing his climate change research through several venues. He kicked off the Forest Service Office of International Programs *Climate Change and Forests* seminar series with the presentation "Likely Impacts of Climate Change on U.S. Forests and Forest Management." McNulty also shared "Climate Change and the Southeast" as part of the Southern Region's climate change learning seminars. He was also invited to consult with regional foresters in Yunnan, China regarding forest restoration under a changing climate. Additionally, McNulty gave the keynote address at the 23rd IUFRO Conference on Air Pollution and Climate Change in Switzerland. Many of the discussions were based on McNulty's draft report, "Vulnerability of the Southeastern U.S. to Climate Change."

Boggs Featured on Forestry Careers Web Site

SGCP biological scientist Johnny Boggs is featured on the Careers in Forestry & Natural Resources Web site. His profile, and that of other individuals from across the country, inspires high school students to consider a career in forestry and natural resources. The site is an outreach component of a National Science Foundation grant. Read more at *http://www.forestrycareers.org*.

Chinese Scientists Tour Southern Research Station

Six scientists from the Chinese Academy of Forestry recently visited the Southern Research Station, touring EFETAC offices in Asheville, the Coweeta Hydrological Laboratory in Franklin, NC, and the Great Smoky Moutains National Park. While touring, they presented an overview of forestry research in China. The group was especially interested in reforestation ecology and effects of forest restoration on water resources. SGCP research hydrologist Ge Sun offered the initial invitation and accompanied the Chinese researchers during their visit.

EFETAC research hydrologist Ge Sun shares dry and wet atmospheric chemical deposition measurements with Chinese Academy of Forestry Vice President Dr. Shirong Liu at Coweeta Hydrologic Lab.

College Students Study Hargrove's Ecoregions

An ecoregion map developed by EFETAC ecologist William Hargrove is used in two higher educational textbooks. McGraw-Hill's sixth edition of *Cartography: Thematic Map Design*, authored by Dent, Torguson, and Hodler features the map as the cover design, and the first edition of *Exploring Geology,* authored by Reynolds, Johnson, Kelly, Morin, and Carter highlights the map in a chapter asking, "How Does Geology Influence Ecology?"

Bechtold Wins Wellness, Photography Awards

FHM team leader Bill Bechtold received a Southern Research Station Director's Award for being the wellness champion for more than a decade. He encourages employees to participate in a wide realm of agency-supported health and physical activities. Bechtold also received two first-place and a third place award in a photography contest sponsored by the SRS Science Delivery Group.

EFETAC FHM team leader Bill Bechtold shows his eye for photography during a recent contest sponsored by the Southern Research Station. He took top honors in the Flora and Scenic categories and 3rd place in the Other category. Bechtold snapped his photos in Western North Carolina and captured (clockwise) a varnish conk, Slick Rock Falls, and hemlock mortality.

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Photo by Steven Katovich, USDA Forest Service, Bugwood.org