LTER Network News
Newsletter of the Long Term Ecological Research Network
Vol. 23 No. 2 Fall 2010

LTER engages Arts and Humanities

L to *r*: A poet, a geologist, an environmental philosopher, an architect, and a forest ecologist take part in a discussion of future scenarios of land change in the Pacific Northwest (AND LTER). Photo: Ben Nieves.

A number of LTER sites and programs continue to cultivate relationships with the arts and humanities on several exciting fronts (see *LTER Network News*, vol. 20, no. 2, Fall 2007).

Over the past year four LTER programs, fueled by supplemental funding from the National Science Foundation (NSF), have engaged the arts and humanities in considering the future scenarios of land use and environmental change. Dubbed LTEArts (or LTEaRts), the media employed by these programs have been highly varied: visual arts featured at North Temperate Lakes (NTL) and Harvard Forest (HFR), performance at Bonanza Creek (BNZ), and humanities at Andrews Forest (AND).

The audiences for these engagements have similarly been diverse: lake associations and gallery patrons for the NTL visual arts in Wisconsin, and the larger Fairbanks

See "LTEArts", p. 3

LTER site acronyms: AND=H.J. Andrews; ARC=Arctic; BES=Baltimore Ecosystem Study; BNZ=Bonanza Creek; CAP=Central Arizona–Phoenix; CCE=California Current Ecosystem; CDR=Cedar Creek; CWT=Coweeta; FCE=Florida Coastal Everglades; GCE=Georgia Coastal Ecosystem; HFR=Harvard Forest; HBR=Hubbard Brook; JRN=Jornada Basin; KBS=Kellogg Biological Station; KNZ=Konza Prairie; LNO=LTER Network Office; LUQ=Luquillo; MCM=McMurdo Dry Valleys; MCR=Moorea Coral Reef; NWT=Niwot Ridge; NTL=North Temperate Lakes; PAL=Palmer Station; PIE=Plum Island Ecosystem; SBC=Santa Barbara Coastal; SEV=Sevilleta; SGS=Shortgrass Steppe; VCR=Virginia Coast Reserve.

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The Network News

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"Network News" going all digital

This issue of *Network News* will be the final edition in print format. The next and all future issues will be published exclusively online, following the recommendations of the LTER Strategic Communication Plan, which is currently being finalized. We will also offer a portable document format (pdf) for those who wish to print out the complete set of stories.

We believe the new format offers significant advantages that will improve communication of LTER activities and achievements. We will, for example 1) save on printing paper (which means fewer trees felled), as well as printing and mailing costs; and 2) be able to carry more stories on a more regular and timely basis. One disadvantage is that we will no longer provide our set of selected and bound stories to distribute to official and casual visitors to our sites, or to provide good, easy reading material to visitors in our waiting rooms. However, if you need such material, you will be able to print the pdf version on demand.

To lessen the trauma of separation, we will email to subscribers a periodic summary with highlights and links to all the stories submitted.

Experienced journalists say that a good story is a timely story; our new electronic format allows you to send in your stories as soon as they are ready to go. We therefore urge you, dear readers, to continue supporting this initiative by sending in your stories.

Moreover, you will also be able to provide direct links to important related online articles to which you want to direct your readers' attention, or attach a pdf for them to download.

A few things will not change however: we will still ask that you send us jargon-free material, no more than 500 words, written in plain English, and well composed high resolution photographs and graphics. We hope these simple guidelines will help us improve the information flow within the Network and communication with the broader community.

By McOwiti O. Thomas, LNO


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Adiós...

LTEArts (continued from p. 1)

community for the BNZ performance in Alaska. The outcomes of these activities are then shared across sites to deepen our understanding of these places and roles of humans in them.

These efforts have two dimensions: 1) outreach, to convey lessons from science to broad audiences, and 2) basic inquiry by practitioners of arts and humanities in the landscapes sampled by LTER science.

An allied project is just getting underway by Freshwaters Illustrated (*www.freshwatersillustrated.org*), a nonprofit organization dedicated to raising public awareness and understanding of aquatic ecosystems through photo, video, and film. The Freshwaters team has received NSF and other funding to produce a documentary media package to communicate the results of LTER research on past, present, and future ecological changes in rivers and watersheds.

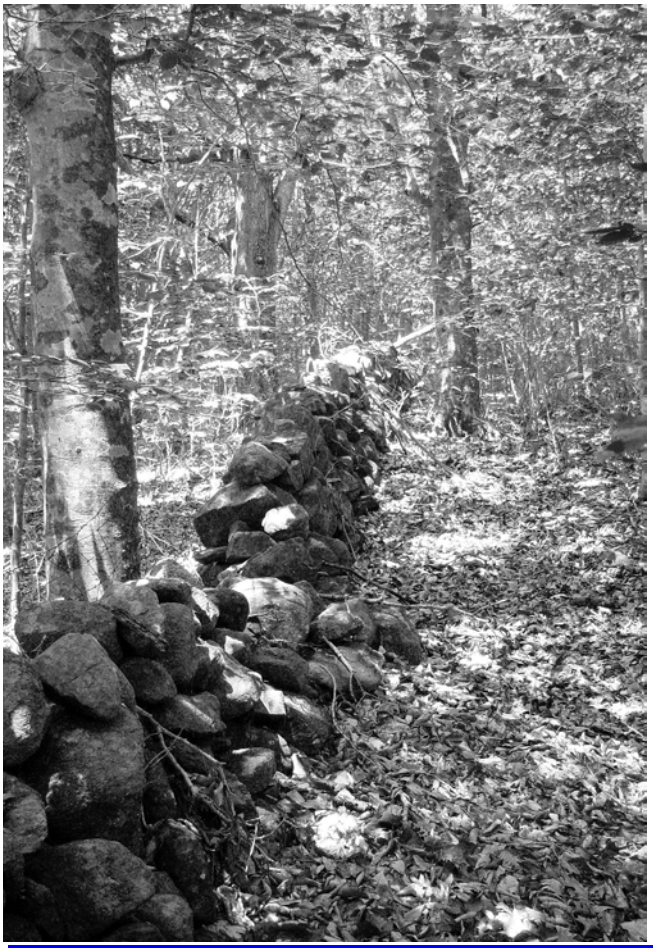
The documentary will explore the effects of climate change and rural development on aquatic organisms and related issues across the LTER network. The products will include a 30-minute film designed for television, several short (3-5 minute) films suitable for web and social media, and curriculum materials targeting academic, conservation, planning/policymaking, and K-12 audiences. The Harvard Forest (HFR), North Temperate Lakes (NTL), Coweeta (CWT), and Andrews Forest (AND) comprise the first set of sites to participate in this initiative; other sites and programs are welcome to take part.

Campfire discussion of future scenarios of land and human change in the Pacific Northwest, Andrews Forest LTER, Spring 2010. Photo: Ben Nieves.

These developments have stimulated interest in encouraging development of similar programs at other LTER sites, and at non-LTER study sites with strong cultural roots, such as the Aldo Leopold Legacy Center near Baraboo, WI. With the development of such sites comes the notion of establishing a network of programs to share information about program development and conduct comparative studies--just as we do in LTER. Thus, work at the interface of science, humanities, and the arts could become a cornerstone of the "broader impacts" of science supported by NSF, capitalizing on the long-term, site-based character of LTER to help advance the Network's communication effort as envisaged in LTER's Strategic Implementation Plan. Stay tuned--you're likely to hear more about these developments in coming months.

For further information on arts and humanities collaborations at a small sampling of LTER sites, please see the respective sites for the North Temperate Lakes (*lter.limnology.wisc.edu/ltearts*), Bonanza Creek (*lter.limnology.wisc.edu/ltearts*), and Andrews Forest (and.*lternet.edu/research/related/writers.cfm?topnav=167*).

By Terry Chapin (BNZ), David Foster (HFR), Tim Kratz (NTL) & Fred Swanson (AND)



Stone walls lacing the New England landscape of Harvard Forest date from 18th and 19th century agriculture. Henry David Thoreau's journals offer a narrative depiction of that time and, thereby, an important contribution to environmental history. Photo: D. Foster.

The shooting of Gail Osherenko's "Our Marine World Heritage" video clips

Gail Osherenko (SBC) recently completed production of a short video for the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Marine World Heritage Program. The title of the video is "Our Marine World Heritage" (you can view it on VIMEO at *www.vimeo.com/16514572*). We asked Gail to share a few tips on what it takes to make such short video clips.

Gail Osherenko behind the camera. Photo: Orah Moore.

So how did this project come about?

I met Dr. Fanny Douvere when I put together an NCEAS (National Center for Ecological Analysis and Synthesis) project on Marine Spatial Planning (MSP) and the Role of Ocean Zoning a few years ago. She was then doing MSP in Belgium, but recently became the director of the Marine World Heritage Program of UNESCO. Dr. Douvere knew that I had started to make videos and asked me at the American Association for the Advancement of Science (AAAS) meeting last spring about making a short video on the Marine Program for their website.

Few people know that there are 43 marine sites among the 900 World Heritage Sites designated. The video illustrates the various criteria for nomination and inscription of ocean places on the World Heritage List, briefly mentions some of the threats to these places, and provides an engaging introduction to the Marine World Heritage Program's website. Video footage and stills come from various sources that we were able to locate.

How expensive is the process?

More expensive than I initially estimated. Generally, one should figure $1,000 per minute of finished video (minimum), but can cost a lot more.

What kind of effort in time and energy does it require?

Considerable. I didn't shoot any of the footage for the video, but it took us several months to obtain high quality footage and still photos from various sources (much of it provided gratis) and to get the appropriate permissions. Learning to make a video, even a short one, is time-consuming. I acquired the skills by hiring and working side-by-side with experts. I've also taken documentary film classes offered for free through Santa Barbara City College.

Any specialized knowledge or equipment? Did you have to hire a professional or rent equipment?

I specialize in docuscience videos and have made two professional films (Arctic Expedition and Dark Side of the Loon) as well as a variety of short pieces for YouTube. I edit using the industry standard, Final Cut Pro, and hire an expert to trouble shoot and provide technical advice on an as-needed basis. The narrator for Our Marine World Heritage is a professional actor from Ventura, Chard Hayward, who is particularly well-known in Australia. We recorded the narration in a professional studio with a professional audio technician.

By McOwiti O. Thomas, LNO

Gail Osherenko filming loons at a pond in Vermont. Photo: Orah Moore.

Moorea and Santa Barbara LTER scientists tour Chinese marine ILTER sites

Workshop participants on recent advances in coral reef research held at the Sanya Tropical Marine Biology Research Laboratory on Hainan Island, China. Photo courtesy of MCR LTER.

This August, six scientists from the Moorea Coral Reef (MCR) and Santa Barbara Coastal (SBC) LTER sites were hosted for two weeks by their colleagues in the People's Republic of China to discuss potential areas for cooperation with marine ILTER sites in the Chinese Ecosystem Research Network (CERN).

Despite their rich history of interaction, marine sites in LTER and CERN have yet to forge linkages. However, a visit to SBC in October 2009 by scientists and officials from the Chinese Academy of Sciences (CAS), National Science Foundation of China (NSFC) and the US National Science Foundation (NSF) highlighted the potential opportunities for cooperation between the US and Chinese long term research networks, especially on the effects of global climate change on marine ecosystems.

Funding by NSF's Office of International Science and Engineering and generous logistical support from the Chinese hosts enabled Russ Schmitt, Dan Reed, Sally Holbrook, Bob Carpenter, Ruth Gates, and Pete Edmunds to hold a series of planning meetings throughout China. The meetings culminated in a workshop with CAS scientists and graduate students at the Sanya Tropical Marine Biology Research Station on Hainan Island. The main goals of the trip were to assess opportunities for cooperation for the marine LTER community in general, and to explore how to expand the vibrant program of exchange and research collaboration between MCR and the Kenting Coral Reef site in Taiwan to include CERN's Sanya Coral Reef site. CERN consists of 55 sites, of which four focus on coastal marine ecosystems.

Field trip to Jiaozhou Bay, Qingdao aboard the RV Chuangxin. Photo courtesy of MCR LTER.

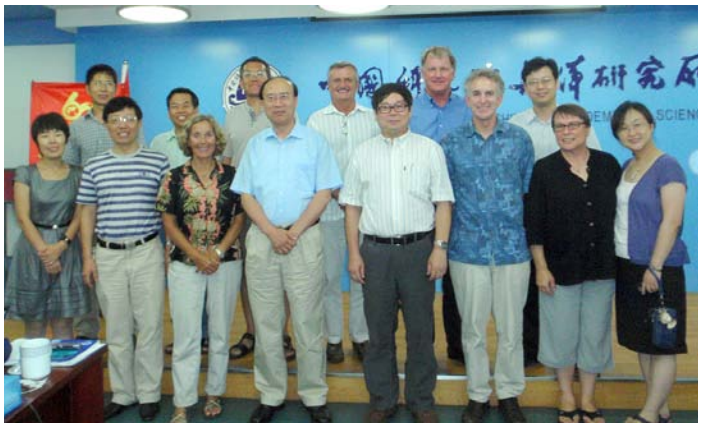
The US delegation first met with officials at CAS headquarters in Beijing to gain deeper insight into potential areas of cooperation, and the most effective ways to build them. The LTER scientists then visited the CAS Institute of Oceanology at Qingdao (which boasts 500 Ph.D. researchers), where they learned about the research themes and findings of the Jiaozhou Bay CERN program; toured the Institute's impressive facilities; participated in a formal planning meeting; and made a field trip with scientists and graduate students aboard a small oceanographic vessel to the Jiaozhou Bay site. The LTER delegation then traveled to the Sanya Tropical Marine Biology Laboratory where they met with scientists and students working on the Sanya Coral Reef site, toured the lab and field site, and participated in a two-day science workshop that highlighted research themes and projects of mutual interest between the two networks. After

See "CERN", p. 6

CERN (continued from p. 5)

the workshop, the delegation traveled to Guangzhou to meet with scientists at the CAS South China Sea Institute of Oceanology (which has 400 Ph.D. researchers), which administers the Sanya lab.

The LTER team found great interest at all levels within CERN in developing research collaborations and student exchanges with marine sites in the LTER Network. Their Chinese counterparts expressed interest in participating in more focused workshops with LTER marine scientists to identify specific research themes and potential collaborative projects--an objective that is now being pursued.



Participants in the planning meeting with scientists at the CAS Institute of Oceanology at Qingdao. Photo courtesy of MCR LTER.

With respect to student exchanges, NSF's existing East Asia and Pacific Summer Institute (EASPI) program could be used to fund LTER graduate students to work with CAS researchers and their CERN sites.

By Sally Holbrook
& Russ Schmitt, MCR

News Brief

SGS LTER's Jack Morgan awarded for work on climate science

A Shortgrass Steppe LTER senior research scientist and former Co-PI, Dr. Jack Morgan, was this year recognized with a CO-LABS Governor's Award for High-Impact Research in the category of Climate Science.

Over the past twenty years, Dr. Morgan led a team from the Rangeland Resources and Soil Plant Nutrient Research Units, USDA-Agricultural Research Service, to understand how semi-arid grasslands are responding to rising concentrations of carbon dioxide in Earth's atmosphere.

The group has determined that increasing carbon dioxide is altering the water relations and plant species composition in rangelands of Colorado and Wyoming, with implications for forage production and quality, carbon sequestration and drought response in rangelands around the world. These findings have contributed valuable knowledge to climate change analyses conducted by the US Global Change Program, the International Geosphere-Biosphere Programme, and the Intergovernmental Panel on Climate Change, and are being incorporated into adaptive management strategies for rangelands.

(Submitted by Sallie Sprague, SGS)

Comings and Goings

Jeremiah Wright

Jeremiah Wright joined the LTER Network Office in September 2010 as a Network Information Systems Analyst and Programmer.

Jeremiah was born and raised in Tucumcari, New Mexico and graduated from the University of New Mexico in 2004 with a B.S. in chemistry. From 2003-2008, Jeremiah studied computational systems biology in the Biology Department at UNM (2003-2006) and the Biochemistry Department at the University of Zurich (2006-2008). During that time, he developed software and algorithms to analyze and model large biochemical interaction networks, such as genome-scale transcription regulation and metabolism, to better understand the influence of organisms on their environment, and vice versa.

From 2008-2009, Jeremiah studied industrial microbiology at TU Delft during which he automated and performed laboratory experiments to evolutionarily engineer baker's yeast (Saccharomyces cerevisiae). This research is closely related to the challenge of producing bioethanol from inedible plant material, such as crop waste.

Jeremiah is also currently in the final stages of a doctoral program at the University of Zurich.

In September 2010, **Nancy Grimm** began a 2 year Program Officer rotation in the Division of Enviromental Biology at NSF. In her absence, Dan Childers will be the Lead PI of CAP as it transitions into its third phase of research (CAP3) later in the year.

LTER management team at NSF sees changes, makes changes

The NSF LTER management team includes Nancy Huntly (left), Matt Kane (top right), and Tom Baerwald (bottom right). Not pictured are Roberta Marinelli, Dave Garrison, Deborah Winslow, Stephen Langdon, Peter McCartney, Liz Blood, and Myra McAuliffe. Photos courtesy of NSF.

This year saw a number of changes in the LTER management team in the Division of Environmental Biology (BIO/DEB) at the National Science Foundation (NSF). As of October, when Todd Crowl left NSF to return to his position at Utah State University, I became Program Officer for the LTER Program, along with Matt Kane, who also worked with the program last year.

This year's full management team for LTER at NSF also includes program officers from the Office of Polar Programs (Roberta Marinelli, who manages the Palmer Station (PAL) and McMurdo (MCM) projects), GEO/Ocean Sciences (Dave Garrison, who manages the Moorea Coral Reef (MCR), Plum Island Ecosystem (PIE), Georgia Coastal Ecosystem (GCE), Santa Barbara Coastal (SBC), and North Temperate Lakes (NTL) projects, Social Behavioral and Economic Sciences (Tom Baerwald, who co-manages the Central Arizona-Phoenix (CAP) and Baltimore Ecosystem Study (BES) awards, and Deborah Winslow and Stephen Langdon from the Cultural Anthropology program), BIO/Division of Biological Infrastructure (Peter McCartney and Liz Blood), and Office of International Science and Engineering (Myra McAuliffe). We all thank Todd for his recent service to the LTER program and Henry Gholz, who has transitioned to other responsibilities at NSF this year, for his exemplary long-term leadership and service to the program.

Supplements to LTER awards will be handled somewhat differently beginning this year. We expect to send instructions in January that describe categories that will be considered for supplementary support in the coming year and the process and format for applying for a supplement.

Researchers should note that there is a new Grant Proposal Guide (NSF 11-1) that includes some important changes that you should be aware of for future proposal submissions, such as the new requirement for a Data Management Plan.

Also, there have been a few other changes in NSF policy since the last LTER renewals. Currently, NSF must have evidence of Institutional Animal Care and Use Committee (IACUC) approval for any project that includes use of vertebrates before an award can be made to support that project.

Similarly, NSF must have evidence of Institutional Review Board (IRB) approval or exemption for a project involving human subjects before an award can be made to support a project.

Additionally, a proposal that requests funding to support a postdoctoral researcher must include, as a supplementary document, a description of the mentoring activities that will be provided for such an individual.

We have begun to organize the site reviews that will occur during 2011, with the North Temperate Lakes (NTL), H.J. Andrews (AND), Coweeta (CWT), Konza (KNZ), and Palmer (PAL) up for mid-term project review.

I look forward to meeting more of the LTER scientists and learning about what you see as the challenges and opportunities for the LTER Network and its contributions to scientific understanding based on excellent long-term, site-based research and long-term time-series data. Please feel free to contact me by email or phone, or to drop by if you are in the area of NSF.

By Nancy Huntly, Program Director for LTER and Evolutionary Processes, Division of Environmental Biology, NSF

ARC, NWT study: Climate change may create tipping points for populations, not just species

Researchers measure survival and reproduction of thousands of arctic and alpine plants over six years

As Earth's climate warms, species are expected to shift their geographical ranges away from the equator or to higher elevations. While scientists have documented such shifts for many plants and animals, the ranges of others seem stable. When species respond in different ways to the same amount of warming, it becomes more difficult for ecologists to predict future biological effects of climate change--and to plan for these effects.

In a study published recently in the journal *Nature*, University of Wyoming ecologist Daniel Doak and Duke University ecologist William Morris report on a long-term study of arctic and alpine plants. The results show why some species may be slow to shift their geographic ranges in the face of climate change, and why we might expect to see sudden shifts as warming continues. "This study illustrates the critical need for long-term research to address our most pressing ecological challenges," says Saran Twombly, program director in the National Science Foundation (NSF)'s Division of Environmental Biology, which funded the research. "Without the temporal and spatial scales employed here, we have little hope of understanding the complex ways in which organisms will respond to climate change."

The plant species targeted by Morris and Doak range from populations in the high mountains of Colorado and New Mexico to species growing along the arctic coastline in far northern Alaska. These regions include habitats that have undergone substantial climate change, leading to the expectation, says Doak, that—especially at the southern edge of their range—populations of the plants should be collapsing.

However, after studying the growth and survival of tens of thousands of individual plants over six years, the researchers show a more complex pattern of responses. At the southern edge of their ranges, the plants indeed show negative effects of warmer conditions, with lower survival. "But in most years," says Doak, "these effects are balanced by plants in the south growing more rapidly, so that populations there are no less stable than those in the north." The opposing trends mean that under current conditions, even across the huge range of conditions Morris and Doak studied, populations of these plants are doing equally well across 30 degrees of latitude--one-third the distance from the equator to the north pole.

However, the researchers' results don't indicate that these plants, or other species, will be unaffected by warming conditions. By looking at the performance of individual plants in particularly hot and cold years, they found that the compensatory effects across moderately cold to moderately warm years (lower survival balanced by more rapid growth) will not hold up with increased warming. Instead, in the warmest years at all study sites, both survival and growth of the plants fell. "Up to a point," says Doak, "we may see little effect of warming for many organisms. But past a climatic tipping point, the balance of opposing effects of warming will likely cease, leading to subsequent rapid declines in populations."

While this tipping point will be different for each species, responses of natural populations to gradual shifts in climate will not necessarily in turn be gradual. "We shouldn't interpret a lack of ecological response to past warming to mean that little or no effects are likely in the future," says Doak. The researchers' work also points to a methodology with which to better understand and predict how climate effects on one species will combine to create overall population-wide effects. "A key part of this approach is the need for long-term studies so we can observe and use the rare years with extreme climates to anticipate what the average future climate will bring," Doak says.

Reprinted from a NSF news release, www.nsf.gov.

Above: A single moss campion plant shows the influence of climate change on entire populations (Photo: Tracy Feldman). ***Left***: Bill Morris and Alex Rose measure plants in an alpine cirque above Kennecott, Alaska (Photo: Daniel Doak).

Light on Leaves

Lasers reveal forest structure in HD

Not long ago if you wanted to measure the height of a tree, you had to do trigonometry on the ground — or gear up for a climb. But these days you have a more sophisticated option: beaming lasers from the sky.

A revolutionary airborne technology called LiDAR ("light detection and ranging") is making it possible to measure and map entire forests in a sliver of the time—and for a fraction of the cost—of earlier methods. By bombarding forests with hundreds of thousands of light pulses from laser equipment mounted on airplanes, scientists in the LTER program at Oregon State University are getting never-before-seen 3-D images of dense old-growth stands such as McDonald Forest in Oregon's Willamette Valley and H.J. Andrews Experimental Forest in the McKenzie River Basin. And they're doing it for the bargain-basement price of $2 an acre (not counting computer processing, which will add at least another dollar per acre to the cost). In contrast, the cost of putting two technicians on the forest floor with notebooks and measuring tapes is about $30 an hour. At a pace of about one hour per tree, mapping a forest the size of the Andrews on foot, with its 15,000 rugged acres in the Cascades foothills, would take years, if it could be done at all. With LiDAR you can start after breakfast and have the raw data in hand before lunch.

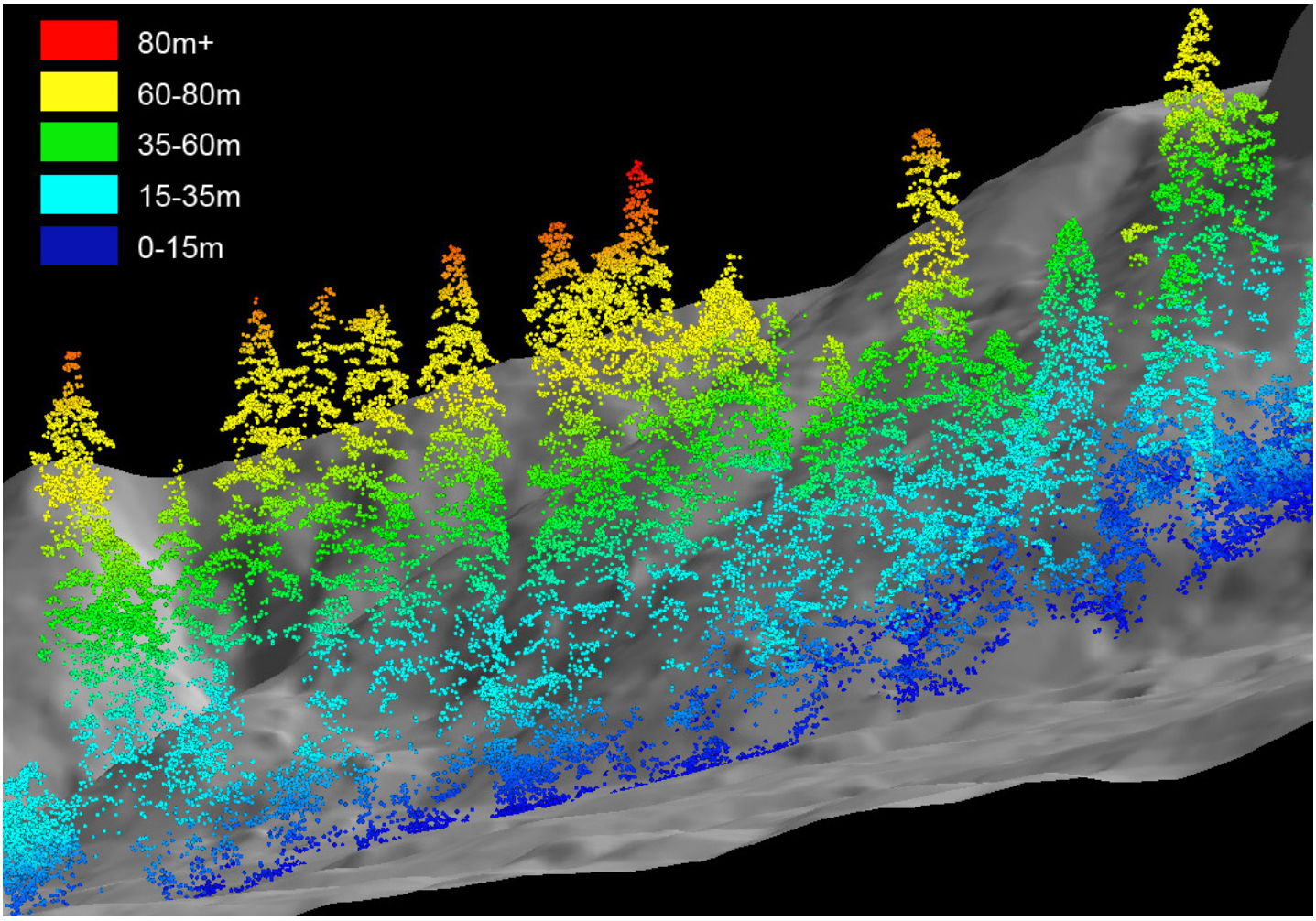
In fields as diverse as geology, oceanography and forest ecology, LiDAR is in fierce demand. "LiDAR is everywhere," says Tom Spies, a research ecologist at the USDA Forest Service, Pacific Northwest Research Station, who has a courtesy appointment at OSU. "It's the hot new technology, the hot stuff."

BOUND FOR THE CROWN

Boots on the ground, however, still have a role. That's why researchers have been out in the field manually double-checking the height of the Andrews' tallest 10 or 12 trees the old-fashioned way: with a tape measure.

One cool autumn afternoon, Spies and Mark Schulze, director of the Andrews Forest, one of the original LTER network sites, stand at the foot of an ancient Douglas fir as they strap on the harnesses

See "LiDAR", p. 10



LiDAR image shows a canopy height profile across a narrow transect through a 500-year-old-growth Douglas fir forest. Each dot represents a "hit" and return of a laser pulse. The colors indicate height in meters above the ground. This structural variability creates a wide range of habitats for different wildlife and plant species. (Image courtesy of Tom Spies and Keith Olsen, OSU College of Forestry)

LiDAR (continued from p. 9)

and snap on the carabiners they will use to leverage their body weight. With gloves and helmets secured, the College of Forestry researchers clip their ascenders onto two of the colorful nylon ropes rigged in advance by professional climbers Rob Miron and Jason Seppa of the Pacific Tree Climbing Institute. Craning their necks, they can barely see where the orange and red lines disappear into the deep-green canopy. Crowning at 280 feet, the tree towers are as tall as a 25-story building.

The scientists are soon dwarfed as they hoist themselves skyward, dangling beside pitch-stippled bark as gray and craggy as a weathered mountainside. This silent colossus was a seedling about the time Shakespeare was writing his plays.

Spies and Schulze are "ground truthing" the LiDAR readings — that is, they're comparing the laser readings against manual measurements in order to verify the LiDAR's accuracy. "We use a 300-foot tape measure," says Schulze. "We stake one end to the ground at the base of the tree and attach the other to our climbing harness and take it up in a straight line along the trunk. Eventually, we reach a point above which we're not comfortable climbing, and use a telescoping height pole to measure the remaining distance to the tip of the crown."

So far, accuracy has been within a whisker. "LiDAR can measure heights to the nearest centimeter," reports Spies.

SEEING STRUCTURE

LiDAR's beauty, aside from being fast and cheap, is its 3-D capability. It can characterize a forest's structure at every layer: from streambed to treetop, from open clearing to tangled undergrowth, from massive coniferous branches to twiggy deciduous boughs. Sitting at their computers, scientists can rotate the colorful LiDAR images to view the forest from an infinite number of angles.

This remote sensing tool is similar to the radar that air traffic controllers and meteorologists use to monitor jets and hurricanes, except one uses electromagnetic waves while the other uses pulses of light. Radar (originally dubbed RADAR, for "radio detection and ranging") works by bouncing radio waves off a target to gauge its distance and position. LiDAR does the same thing with lasers, targeting anything from woodlands to coastlines to rainclouds.

LiDAR gives Matt Betts, OSU forest ecologist, a new view of complex habitat. By climbing into the canopy, he can compare data to direct observation. (Photo: David Stauth, OSU)

For the H.J. Andrews Forest project, 10 laser points per square meter are beamed to Earth from a sensor mounted beneath a small twin-engine plane owned and operated by Watershed Sciences, a Corvallis-based firm. After hitting an object — a fallen log, a rocky outcropping, a thick mesh of branches, a logging road — light from each pulse scatters backward to the sensor. This bounce-back is called an "echo." The period of time each beam takes to return to the sensor indicates the object's elevation. So if the beam comes back fast, that means it bounced against something tall. If it comes back later, it bounced against something lower in the forest layers, maybe even bare earth where foliage is thin. The digital images that emerge provide a comprehensive picture of forest structure unlike anything possible pre-LiDAR.

"Forest structure is key to its ecology," says Spies. "Knowing the details of forest structure not only allows us to better predict and manage habitat for wildlife but also to understand microclimates, measure carbon and biomass, manage wildfires and design restoration efforts."

OSU ecologist and wildlife biologist Matt Betts explains that "vertical structure" — how vegetation is layered throughout the forest — determines habitat selection and even survival for forest species.

"Many experts increasingly believe vertical structure is the primary driver of biodiversity," asserts Betts, an assistant professor of forest ecosystems and society. "Researchers can often predict with considerable accuracy the diversity of birds, mammals, even insects and butterflies that will live in areas, based on what you can tell of the vertical structure of the forest."

TRANSFORMATIONAL TECHNOLOGY

Forest ecologists like Spies and Betts comprise only one LiDAR user group. The current and future uses for this new tool are as vast as Oregon's storied woods. Already, other OSU geoscientists have used LiDAR to study post-tsunami landscapes in Samoa and detect hidden earthquake faults in Puget Sound. NASA is using it to estimate global carbon stocks and detect atmospheric changes across the planet. The National Oceanic and Atmospheric Administration is tracking topographic changes along coastlines. The list is long and varied.

Spies goes so far as to liken LiDAR to such transformational technologies as the telescope and the microscope. "Anytime there's a new tool in science and research, it opens up a whole new avenue of investigation, one that you couldn't necessarily anticipate," he notes. "You end up discovering that it can give you answers to questions you never thought you could ask before."

By Lee Sherman, OSU

*Read more about this story in "*LiDAR Use Expands into Monitoring Biodiversity, Ecosystem Health,*" OSU news release, September 14, 2010*

Stirred, not shaken: Whole-lake mixing studies microbes and invasive fish at NTL

Lake mixing is a natural phenomenon; in most Wisconsin lakes, it happens every spring and fall. During summer, distinct layers form, with a cool bottom layer (the hypolimnion) isolated from warmer surface waters. This pattern of mixing and stratification has been going on in Wisconsin lakes since the retreat of the glaciers. But in other parts of the world, mixing follows a different schedule. For example, NTL researchers Trina McMahon, Tim Kratz, and graduate students Stuart Jones and Ashley Shade, documented erratic mixing of Yuan Yang Lake in Taiwan caused by typhoons through their involvement in the NTL Microbial Observatory (MO) and the Global Lakes Ecological Observatory (GLEON). The unexpected mixing events reshuffled microbial communities, but recovery was rapid.

These dramatic events gave McMahon an idea: what would happen if a typhoon hit Wisconsin? Thus was hatched a plan that involved collaboration between engineering and limnology, and between NTL, MO, and GLEON research.

McMahon and Shade honed their question to ask how microbial communities would respond to the novel disturbance of summertime lake mixing. They enlisted the services of another NTL graduate student, Jordan Read, to figure out how to mix a lake--and to do so without stirring up sediments or bubbling in air that might overly disrupt the microbes. The solution: the Gradual Entrainment Lake Inverter, or GELI (like the donut). An aluminum ring was fitted with a PVC hose so that air could be added or removed, and a geomembrane was stretched across the ring like a trampoline. Adding air causes the GELI to rise; removing it causes it to sink. Rising pulls cold water from the hypolimnion up while falling pushes warm surface waters down to mix the lake.

Two GELIs were deployed in North Sparkling Bog, along with a GLEON buoy, to monitor lake dynamics, in 2008. After 5 days of floating and sinking, the GELIs converted the stratified lake into a thermally uniform system. Mixing produced a number of changes, some expected and others unexpected. The microbial communities were drastically altered, but recovered to pre-mixing conditions within 20 days. The lake re-stratified quickly, but unlike the microbes, was not quite the same for the rest of the summer. Both during and after the mixing, the hypolimnion reached temperatures that were likely never been experienced by the lake. The normally cool, 10° water reached levels as high as 20° during and after the peak mixing period. And this led to another idea, this time posed by Jake Vander Zanden: could mixing be used to warm up a lake to get rid of an invasive fish that needs cold water?

So now, the GELIs are being moved up the road, and in 2011, will be put to work in Crystal Lake in hopes of eliminating rainbow smelt, a non-native fish that preys upon and outcompetes several native species. Mixing the lake should temporarily eliminate the cold or deepwater refuge that rainbow smelt alone occupy, and will allow Vander Zanden and colleagues to determine if ecosystem changes caused by smelt invasion are reversible. Crystal Lake is one of 11 NTL core study lakes, so 30 years of long term data provide the storyline of pre-smelt conditions and how the lake changed in response to smelt invasion in the 1980s.

By Emily H. Stanley, NTL

Two GELIs connected by air pumps on North Sparkling Bog. An automated buoy designed by Global Lakes Ecological Observatory Network (GLEON) researchers monitored temperature, dissolved oxygen, and water chemistry throughout the mixing experiment. Photo: Ashley Shade.

BES holds Annual Meeting and Community Open House & Greening Celebration

The 12th Baltimore Ecosystem Study (BES) Annual Meeting was held October 27–28 in the University Center Ballroom at the University of Maryland in Baltimore. More than 110 people attended, including BES researchers, educators, community members, students, and media representatives.

The meeting began with an overview by Steward Pickett, the Project Director, who spoke about the recent National Science Foundation (NSF) approval for another 6-year cycle of BES research. Dr. Pickett briefly outlined the ongoing research that will continue, as well as new aspects of the study. He stressed the importance of working with a new sustainability paradigm, and a guiding question that focuses on understanding urban sustainability and resilience. The new phase of the NSF grant, which runs to 2016, will emphasize improved linkage between social and biophysical research, new theoretical models, and the use of scenarios of future change in the region.

The meeting lasted one and a half days, during which BES researchers, including scientists and graduate students, presented the results of their work. The thirty presentations covered topics such as urban birds and mosquitos, urban streams, environmental justice, toxic contaminants in the environment, soil studies, tree planting, urban development, community gardens, nitrogen along the urban to rural gradient, temperature studies, and teaching about climate, among others.

Among the keynote speakers were two guests from other LTER sites: Dan Childers of the Central Phoenix-Arizona (CAP) LTER, and Laura Ogden of the Florida Coastal Everglades (FCE) LTER. Both spoke about potential ways that BES, CAP, and FCE might collaborate on cross-site research involving the urban aspects of each LTER.

A formal poster session held on the afternoon of the first day of the talks was a great opportunity to show ongoing research and results with engaging graphics and charts of findings. On that day authors of the 16 informative posters were available to discuss their posters with attendees, though the posters were set up and made available for viewing during the entire meeting.

Above: Alimatou Seck and Steward Pickett at the BES Annual Meeting poster session. ***Left***: Bill Stack, on the left, from the Baltimore Center for Watershed Protection stands with Dr. Steward Pickett after being awarded the 2010 Baltimore Ecosystem Study Director's Award. Photos: Jonathan M. Walsh.

A Community Open House and Greening Celebration followed the Annual Meeting that evening at the Cylburn Arboretum Vollmer Visitor Center in the city. The joint gathering organized by BES and Parks & People highlighted community involvement in various greening activities, such as community gardens, in Baltimore.

In addition to awards by Parks & People to community gardeners, the informal venue was a good opportunity to disseminate non-technical project information and to share BES results with regional decision makers, community members, teachers, students at all grade levels, and the media. In addition to wonderful food and drink, participants enjoyed music by members of the Dunbar High School band.

By Holly J. Beyar
Project Facilitator, BES

Diandre Williams, Greg Jackson, Andy Miller and Evan Schiesser present a stream biodiversity study. Photo: Jonathan Walsh.

BES hosts Congressional staffers and agency personnel on ESA field trip

The Public Policy Office of the Ecological Society of America (ESA) organized a field trip to Baltimore for congressional staff members, mission agency leaders, and professional scientific organizations headquartered in Washington, DC. BES researchers, educators, and community and governmental partners assembled at three sites in Baltimore to introduce the visitors to activities and outcomes of the LTER project.

Michael McGuire, GIS Manager at the University of Maryland, Baltimore County (UMBC) talks to guests about the Visualization lab. Photo courtesy of BES LTER.

During a visit to the stream sampling site near the mouth of the Gwynns Falls stream in Carroll Park, the visitors learned about the overall structure of the project, which uses the watershed concept as a major conceptual framework and empirical integrator. BES researchers described the concept and research strategy of LTER, as well as important research findings and their relevance to local governmental decision making.

During lunch at the US Geological Survey building on the campus of the University of Maryland, Baltimore County, the visitors were further introduced to important partners from USGS and senior administrators of the University, which hosts the BES LTER program. While on campus, the group toured the wet and dry labs and the Geographical Information Systems and visualization facilities at UMBC's Center for Urban Environmental Research and Education.

The group's final stop was Franklin Square Elementary School in the Harlem Park neighborhood of west Baltimore, where the visitors learned about community engagement and after-school education activities facilitated by the Parks & People Foundation. The researchers demonstrated how they monitor small catchment areas and measure interventions aimed at stormwater management across the watershed . They also highlighted the interactions among formal and non-formal education, community revitalization, best practices for stormwater management, and municipal policy.

The visitors left Baltimore with a sense of the novel science and the practical outcomes of LTER research in an urban setting. BES acknowledges the expertise and thanks the ESA Public Policy Office for initiating and facilitating this important opportunity to engage an important audience for the products of research and science education.

By Holly J. Beyar, BES

BES at annual meeting of Maryland Water Monitoring Council

Several members of the BES LTER made presentations at the 16th Annual Meeting of the Maryland Water Monitoring Council on November 18, 2010, in North Linthicum, MD. The meeting's theme was Environmental Justice: Healthy Waters, Healthy Communities. Participants included seasoned professionals, policy makers, government agency personnel, consultants, academics, students, and citizens.

Steward Pickett, BES lead Principal Investigator (PI), gave one of two plenary talks, introducing the research, education, and engagement activities of BES to the more than 300 people at the meeting. BES's new theme, "From Sanitary City to Sustainable City," was particularly relevant to the meeting's theme, and Pickett's talk highlighted the conceptual and empirical advances that BES is making in research on environmental inequity and social-biophysical sources of environmental hazards.

Pickett's presentation complemented that of the other plenary speaker, Ms Vernice Miller-Travis, Vice Chair of the Maryland State Commission on Environmental Justice and Sustainable Communities. Ms. Miller-Travis was one of the contributors to the United Church of Christ's 1986 report that helped establish the environmental justice movement and scholarship.

BES co-PIs, Ken Belt, Morgan Grove, and Sujay Kaushal, also presented their research relating to the themes of water, watersheds, and environmental justice.

By Holly J. Beyar, BES

Harvard Forest commissions new field wireless network

The Harvard Forest Field Wireless Network (HFFW) became operational earlier this year with funding from the National Science Foundation (NSF), the Department of Energy (DOE), and Harvard University. Inspired by an NSF-sponsored workshop at Sevilleta in 2002 (see *Network News*, Fall 2002, p.10), and after years of planning and testing, the HFFW provides high speed network access to major research sites across Harvard Forest's 375-ha Prospect Hill Tract.

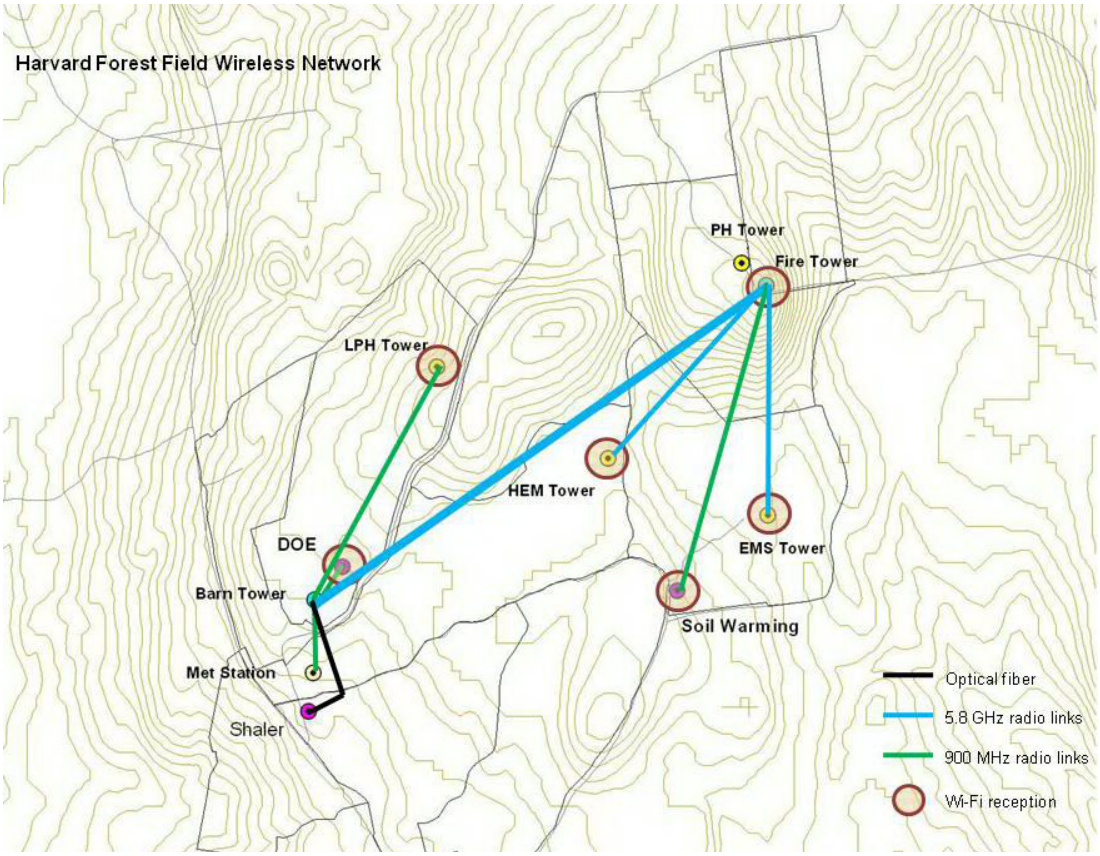
The new 40m relay tower at the Barn site. Photo: Emery R. Boose

The use of wireless networks in the field has many potential advantages for research and education. Scientists can monitor and control their equipment remotely and detect problems almost immediately. From their desktops, researchers can access real-time data for environmental modeling and forecasting. Students, too, can watch events unfold in real time.

In designing the HFFW we faced both challenges and advantages compared with other LTER sites that have implemented field wireless networks (*Network News*, Fall 2007, p. 1). Challenges included hills (which block wireless signals) and dense forest (which saps signal strength), the need for high network bandwidth (to accommodate a large number of users and data intensive experiments), and a desire to implement the HFFW as a part of the Harvard University network. Advantages included the existence of a fire tower and three eddy flux towers for relaying signals above the canopy, access to line power at the major experiments, and generous support from the University and its network engineers for the project.

Final design for the HFFW was achieved through partnership among Harvard Forest, Harvard Network Operations, and Silvian Technology Services. The physical layout takes advantage of existing towers (plus a new 40m relay tower) for line-of-sight transmissions between towers above the canopy as well as transmissions down through the canopy to surrounding experimental sites on the ground. Radios in two unlicensed frequency bands are used: 5.8 GHz for tower to tower (faster) and 900 MHz for tower to ground transmission (better canopy penetration).

See "Wireless", p. 15



Map showing tower to tower (blue) and tower to ground (green) radio links. Wi-Fi reception is shown in red.

Wireless (continued from p. 14)

Joining the Harvard University network required radios with VLAN support, which makes it possible to have separate virtual networks (e.g., data, voice, network management) over the same physical network. In the end we selected a carrier-grade line of radios (Alvarion BreezeAccess VL) because of their robust design and advanced features. At each major research site, radios are connected via Ethernet to a Cisco network switch and Wi-Fi access point. Since all this equipment requires line power, we decided to limit the HFFW itself to sites with power, though sensor networks and other extensions of the HFFW might be powered in other ways.

As part of the Harvard network, the HFFW takes advantage of core network functions for registration, management, and security. Remote access is enabled through a VPN (virtual private network). All major nodes (radios, switches, and access points) are continuously monitored and email alerts are sent whenever a node goes down. In its present form the HFFW includes three eddy flux towers, two global warming experiments, and a met station, but the network design is scalable to accommodate significant expansion in the future.

The HFFW is jointly administered by Harvard Forest and Harvard Network Operations. For more details, please see *harvardforest.fas.harvard.edu/research/hffw.html.*

By Emery R. Boose, HFR

KBS creates "BEST" Schoolyard network

KBS scientist Melissa Kjelvik and Delton-Kellogg High School teacher Connie High. Photo:Tom Getty.

Graduate students at the Kellogg Biological Station (KBS) Long Term Ecological Research (LTER) site are working with K-12 science teachers and students to plant the seeds for the "BEST" (BioEnergy Sustainability) Schoolyard Research Network. The network involves about 300 research plots in 22 schools in 11 districts located in five counties in southwest Michigan. The research plots are designed to mimic long-term, collaborative research at KBS and the Great Lakes Bioenergy Research Center (GLBRC). Project faculty, staff, graduate students, and teachers are collaborating on experimental design, research protocols, and curriculum development. These collaborative efforts are creating authentic research experiences for our K-12 partner teachers and students, who are carrying out actual field research.

The project is supported by a GK-12 (Graduate STEM Fellows in K-12 Education) grant from the National Science Foundation's (NSF) Division of Graduate Education. GK-12 programs are designed to impart to graduate students in the sciences the skills necessary to pursue a professional career in science. Through interactions with teachers in K-12 schools, graduate students are expected to improve communication and teaching skills while enriching science instruction in K-12 schools. Working in partnership with the GLBRC and the NSF's Math and Science Partnership for Culturally Relevant Ecology, the GK-12 project thus supports KBS's own K-12 initiative.

For more information on the "BEST" Project, please contact program director Tom Getty (getty@msu.edu) or program manager Robin Tinghitella (*hibbsr@msu.edu*).

By Sara Parr Syswerda
K-12 Partnership Coordinator, KBS

LTER cross-site team studies land fragmentation

A team of researchers recently completed a cross-site research initiative that examined land fragmentation across the cities and metropolitan areas associated with five Long Term Ecological Research (LTER) sites: Central Arizona-Phoenix (Phoenix, Arizona), Sevilleta (Albuquerque, New Mexico), Jornada Basin (Las Cruces, New Mexico), Short Grass Steppe (Fort Collins, Colorado), and Konza Prairie (Manhattan, Kansas).

Land fragmentation refers to discontinuous, low-density development at the urban fringes typical of suburbanization, exurbanization, sprawl, and leap-frog development. Such fragmentation has negative consequences for socio-ecological systems because it disconnects wildlife habitats, destroys migration corridors, increases costs of providing public services, and increases transportation distances (e.g. from home to work or other service locations).

Funded through a 2008 Social Science LTER Supplement, the study involved a host of faculty, post-doctoral, staff, and student researchers at the five sites: Central Arizona-Phoenix (Abigail York, Christopher Boone, Milan Shrestha, and Sainan Zhang); Jornada (Barbara Nolen, John Wright and Rhonda Skaggs); Konza Prairie (John Harrington and Tom Prebyl); Sevilleta (Amaris Swann and Mike Agar); and Short Grass Steppe (Michael Antolin).

The research team focused on understanding both the patterns and the drivers of land fragmentation. Using a revised classification of the National Land Cover Data for all five sites, they examined land fragmentation trends from 1992 to 2001. They found that residential development had increased land fragmentation on the fringes or peripheries at all research sites. Their analyses revealed three general fragmentation patterns:

- Riparian: fragmentation along rivers (Las Cruces and Albuquerque)
- Polycentric: suburbanization and exurbanization in disaggregated cities (Manhattan and Fort Collins)
- Monocentric: rapid urban growth in a concentric ring pattern (Phoenix)

By gathering local expert opinions and reviewing existing literature on the subject, the team identified five relevant drivers of land fragmentation across the five sites: availability of water, population dynamics, transportation, topography, and institutions. A rich analysis of these drivers for each city using historical data revealed the importance of legacies of land use decision making. For example, rail corridors continue to influence observed patterns of urban growth in many of the cities.

Additional results from this research will be published in an upcoming issue of *Urban Ecosystems*, and detailed analyses from specific sites are in preparation. The land fragmentation research also feeds into the work of an Urban Long Term Research Area Exploratory (ULTRA-Ex) grant that focuses on open space and ecosystem services in the Albuquerque, Las Cruces, and Phoenix areas. Many of the researchers listed above have reconvened to undertake the ULTRA-Ex research.

By Marcia Nation, CAP

Evidence of land fragmentation in Phoenix. Photo: Milan Shrestha.

Kimberly La Pierre replaces Chelse Prather as graduate student co-Chair

At the end of 2010, Chelse Prather will step down as co-Chair of the LTER Graduate Student Committee (GSC) to be replaced by Kimberly La Pierre.

During her time as co-chair, Chelse worked with former student co-chair Amber Hardison to organize the most recent ASM graduate student symposium and an LTER graduate student-sponsored oral session at the 2010 Ecological Society of America (ESA) meeting. Mirroring her successful stint in LTER student leadership, Chelse successfully defended her dissertation at the University of Notre Dame in October, and is currently pursuing a postdoc opportunity at Florida State University, where she mentors graduate students in interdisciplinary studies involving biology, history, and philosophy. Chelse says she greatly enjoyed working with the LTER graduate students and hopes to continue her involvement with the LTER program while continuing the research that she began during her PhD program. The GSC thanks Chelse for her service to the LTER graduate student community.

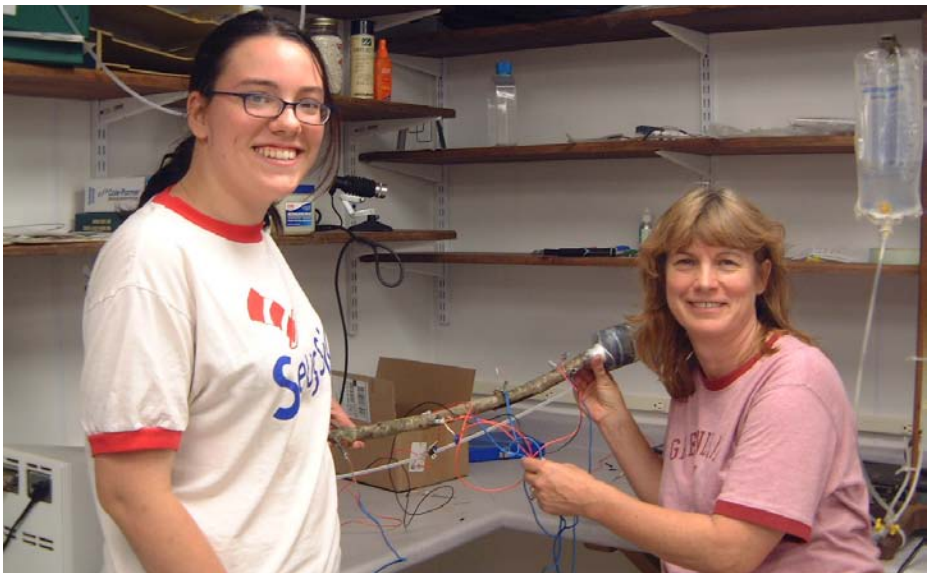
Meanwhile, Kim, a Yale University graduate student who is well acquainted with cross-site work, will continue her dissertation work across three sites, which include the Konza Prairie (KNZ) and Shortgrass Steppe (SGS) LTER sites. Kim is studying the interactions between top-down and bottom-up effects on grassland plant communities across a broad precipitation gradient. Reflecting on her work at KNZ and SGS and her interactions with other graduate students at ASM, which led to an ongoing working group, Kim says she's impressed by how much LTER research is driven by graduate students. She believes that students can improve both their own research and the whole LTER network if they make good use of the "long-term" and the "network" aspects of the LTER Network. Like her immediate predecessor, she says she is excited to work with other graduate students to increase cross-site collaboration and to help grad students get the most out of the network.

The GSC is currently working to improve the grad student website, and wishes to thank all the grad students who sent in pictures and other material. The Committee will shortly be sending out an email with details of the new changes and improvements to the grad students list serve. Meanwhile, students who are still keen to send in pictures to be used on the website are asked to send them by email to Sally Koerner (skoerne@unm.edu).

Kim La Pierre (KNZ), new Graduate Student Committee co-Chair. Photo courtesy of Kim La Pierre.

By Sally Koerner (KNZ) & Chelse Prather (LUQ), GSC co-chairs, & Kimberly La Pierre, incoming GSC co-Chair

Harvard Forest offers Research Experience for Undergraduates



Harvard Forest REU student, Jennifer Levye, with her mentor, Missy Holbrook, measuring water flow in a tree limb. Photo: Larisa Proulx.

Like so many Harvard undergraduates, when Jennifer L. Levye '11 arrived at Harvard almost four years ago, she was initially set on being pre-med. But her longtime interest in the environment lingered, and after discovering the Harvard Forest Research Experience for Undergraduates (REU) program later that year, she became interested in gaining research experience through the ecology program.

Through independent research, which results in a final presentation, the 20 to 35 students in the Harvard Forest program gain skills and scientific knowledge and are supported by a network of mentors and their fellow students, resulting in what many say is a life-changing experience.

"I started out pre-med. After Harvard Forest, I realized I liked trees more than I liked studying people," Levye says.

See "REU", p. 18

REU (continued from p. 17)

FOREST ROOTS

In 1998, Harvard Forest became part of the Long Term Ecological Research Network, a group of 26 research sites that share data and receives its funding from the National Science Foundation.

"Being a part of the network gives us funding, infrastructure, and community. We also get to have projects that run for multiple decades," says Clarisse M. Hart, outreach and development manager for education and research programs at Harvard Forest.

Although students have been involved with the Forest since its foundation, David R. Foster, Harvard Forest's director, started the REU program in 1985. Since then, student researchers have become a cornerstone of the Forest.

CLOSE MENTORING, CLOSE COMMUNITY

Levye was unsure of which project to apply for, so she went to Professor Noel "Missy" Holbrook, who was leading a project, to ask for advice. Ultimately, Holbrook became Levye's mentor for the summer and for the rest of her college career.

Even students outside of Harvard connect with mentors early on. Relena Ribbons, who attended the program in 2008, is a 2010 graduate of Wellesley College. Her project involved studying the effects of insect infestation on hemlock forests in Connecticut.

"After I decided to apply I was already in contact with my advisor, [David A. Orwig]. Making that contact was important," Ribbons says.

The REU program includes other events outside of research such as weekly seminars, field trips, and workshops.

"I was kind of expecting to go into the program and be spending a lot of time by myself working on my project, but I had a lot of time to interact with the other students," Ribbons says.

"It's like a summer camp for almost-grown-ups," says David Diaz '06, who first participated in the program in 2003.

ACADEMIC AWAKENINGS

Diaz, at the time a history concentrator, was looking for a summer opportunity close to Boston. He contacted Aaron M. Ellison, a senior research fellow in ecology at Harvard Forest, and learned about a project that involved identifying and counting ants.

Jennifer Levye at work in the woodshop. Photo: Larisa Proulx.

Diaz says, "I'd always been good at science and math, but I never really considered it a career or a study option."

Diaz's experience motivated him to create a special concentration of environmental history. Now he works as a forest carbon associate at Ecosystem Marketplace, an environmental non-profit in Washington, D.C.

Ribbons is pursuing a Master of Science in forest resources at the University of Massachusetts Amherst. "Harvard Forest was a good academic awakening, and after that I was a super-charged battery, ready to go," Ribbons says. "After the REU program, I knew I was going to grad school."

Alumni say the REU program was one of their best college experiences. Alumni also say that they have continued to benefit from the connections they made during the program.

"It's not that often coming into your profession that you have a lot of connections," Diaz says. "It's very nice to have a network."

This article was condensed by Clarisse Hart, Outreach & Development Manager for Education & Research Programs, Harvard Forest LTER, from an original article of the same title written by KERRY M. FLYNN in The Harvard Crimson (www.thecrimson.com/article/2010/12/6/students-forest-harvard-program).

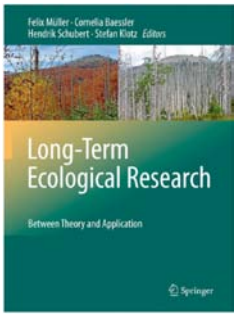
Useful new publications

CAP LTER featured in new book

CAP LTER has been featured as an urban sustainability research program in a recent National Research Council publication, *Pathways to Urban Sustainability: Research and Development*. The book is the result of a workshop on the status of urban sustainability research and development programs in the United States that sought to understand how current research and planning is contributing to the development of sustainable urban systems which provide healthy, safe, and affordable environments for Americans living in cities.

Visit *books.nap.edu/catalog.php?record_id=12969* to download an online copy of the book.

Long-Term Ecological Research: Between Theory and Application



Edited by F. Muller, C. Baesler, H. Schubert, and S. Klotz, this book focuses on studies dealing with the investigation of complex, long-term ecological processes with regard to global change, the development of early warning systems, and the acquisition of a scientific basis for strategic conservation management and the sustainable use of ecosystems.

Theoretical ecological questions of long-term processes, as well as an international dimension of long-term monitoring, observations and research are brought together. The outcome is an overview on different aspects of long-term ecological research, including "Twenty-eight years of the US-LTER Program: Experience, results, and research questions," written by Jim Gosz, Bob Waide, and John Magnuson.

This book will be of interest not only to ecologists, conservation biologists, biodiversity scientists and environmentalists, but also to administrators of protected areas and natural resource managers.

The USA-NPN

A National Observation and Information Management Network for Phenology

If you headed outside this fall you might have seen maple leaves turning to their late season colors, osprey migrating south and bucks locking antlers. These recurring plant and animal life stages are called "phenology", and information on the timing of these seasonal events is important to recreation, agriculture, natural resource management, health, and conservation. Phenology can help answer questions such as why organisms occur in a particular place, what affects the growth and development of particular species, and how a changing climate might impact these species.

The USA National Phenology Network (USA-NPN; *www.usanpn.org*) was created as a collaborative network of government agencies, nongovernmental organizations, citizen science and education programs, as well as individual researchers and citizen scientists, to make long-term phenology data sets accessible to scientists and resource managers. With this goal in mind, the USA-NPN National Coordinating Office (NCO) has developed standardized monitoring protocols and an Information Management System (IMS) to facilitate collaboration and participatory data collection and digitization. The IMS includes components for data storage, such as the National Phenology Database, as well as a website built using the open-source Drupal content management platform for information-sharing and data visualization, and a Java application for collection of contemporary observational data. The system was reviewed in July 2010 by experts in the field, among them Inigo San Gil, a USA-NPN board member and the liaison between the Long Term Ecological Research (LTER) Network and the National Biological Information Infrastructure (NBII).

To help people across the nation track phenology with observations of plants and animals in their own backyards, the USA-NPN NCO has developed a plant and animal phenology observation program called Nature's Notebook. Since going live in March 2009, the program has registered 2,300 observers and submitted over 40,000 observations on 300 plant and 60 animal species to the National Phenology Database. However, some of our most committed observers are participating through partner organizations, such as the University of California-Santa Barbara's Phenology Stewardship Program, the Arbor Day Foundation, and the Great Sunflower Project.

LTER is closely involved with the USA-NPN, whose NCO and several LTER sites, including Jornada Basin and Hubbard Brook, are currently working to develop and implement methodologies and tools to cross-walk historical data with newly-developed, standardized protocols for monitoring phenology. In fact, researchers at Cedar Creek LTER in Minnesota are currently the top contributors to Nature's Notebook, with over 3,000 observations submitted. Additionally, during the 2009 LTER All Scientists Meeting at Estes Park, CO, interested scientists convened a working group on phenology and held a workshop to assess the level of interest and acquire LTER site level input. Visit *www.usanpn.org/lter* to view the working group report.

Participants in a Phenology and Climate Change workshop, organized by the Ventura Fish and Wildlife Office and the University of California Santa Barbara, learn plant anatomy in preparation for phenology monitoring. Photo: A. Rosemartin.

National Park Service staff make phenology observations as part of the Northeast Temperate Network's phenology pilot project. Photo: A. Miller-Rushing.

The upcoming year is likely to see stepped up observer recruitment efforts, the addition of intensity and abundance measures to our protocols, a prototype smartphone application, and web services for data input and output.

If you would like to participate as a partner organization, we invite you to explore the partners' area of our website (*www.usanpn.org/participate/new-partners*) or contact us for more information at *partners@usanpn.org*. If, instead, you prefer to participate as an individual, becoming an observer is easy: visit *www.usanpn.org/how-observe* to learn about the plants and animals that you can observe and how to observe, and then sign up and start reporting!

By Alyssa Rosemartin, Erin Posthumus & Theresa Crimmins, USA-NPN NCO

Konza soil research provides insight into future global warming predictions

Soil that was once thought to be the least vulnerable to decomposition is actually the most sensitive to increasing temperatures, making it more likely to release carbon into the atmosphere as the climate warms, according to researchers at Konza Prairie (KNZ) LTER and a colleague.

KNZ researchers Joseph Craine, a research assistant professor of biology at Kansas State University (KSU), and Kendra McLauchlan, a KSU assistant professor of geography, together with Noah Fierer, Shortgrass Steppe LTER researcher and assistant professor of ecology at the University of Colorado at Boulder, are the authors of "Widespread Coupling between the Rate and Temperature Sensitivity of Organic Matter Decay," published recently in the journal *Nature Geoscience*. Their data will be used to develop a model for more accurately predicting future global warming.

With more than $450,000 in grants from the National Science Foundation, the three researchers analyzed microbial decomposition of soil organic matter from 28 different sets of soils collected from sites across North America—stretching from Alaska to Puerto Rico. The samples were incubated for a year, periodically altering the temperatures to measure changes in the rate of soil microbe respiration.

"We found that as we warmed different soils, those soils that were the hardest for microbes to degrade showed the greatest response to the increase in temperature," Craine said. "We were the first to demonstrate that chemical laws discovered more than 120 years ago predict how warming affects microbial decomposition of soil carbon."

Based on their research and the results from other studies that incubated a range of organic materials like simple sugars, leaves, roots and other soils, the group discovered a general relationship that clearly shows that carbon molecules in the soil with the most chemical resistance to microbial enzymes are most sensitive to temperature increases.

"The future of the Earth's temperature depends on the ability of soils to retain carbon as the world warms," Craine said. "Globally, soils contain about twice as much carbon as found in the atmosphere and three times as much found in vegetation. That means even a small percent increase in carbon released from the soil could have a major impact on the atmosphere and future warming."

Sensitive soils: increasing temperatures are likely to release more carbon from soils into the atmosphere. Photo courtesy of Kansas State University.

The process of removing carbon from the atmosphere and storing it in the soil is a natural part of the carbon cycle, although soil carbon varies greatly in quality, Craine said. A small portion of the carbon stored in the soil can be returned to the atmosphere through decomposition, when soil microbes digest organic matter and release carbon dioxide as a byproduct.

"Soil carbon quality is best explained by how easy it is for organic matter in the soil to decompose," McLauchlan said. "Chemically speaking, things with a lower carbon quality are harder for microbes to eat, and they're just more complicated structurally."

Evidence from the study contradicted the group's original hypothesis by finding that complicated carbon molecules are more sensitive to increasing temperatures in varied soil samples.

"The results were surprising, in a sense, because we think that the more complicated a carbon molecule is, the more difficult it should be to break down," McLauchlan said. "It should be protected; basically it should be inaccessible and be very stable in the soil; however, what's protecting it is thermodynamics. When you add heat, that makes those reactions go, and the soil becomes vulnerable."

The group will be developing an equation that can be used in models to simulate data about future emissions of carbon dioxide from the soil in response to warming, Craine said. The data could ultimately become the basis for politicians to enact legislation to prepare for and to mitigate future warming.

"The work does not, in and of itself, tell us how much more carbon dioxide will enter the atmosphere as the Earth warms, but it does provide a key equation that can be incorporated into computer models," Craine said. "It's possible that we have been vastly underestimating how much additional carbon dioxide will enter the atmosphere."

This story was sourced from a press release by Stephanie Jacques, KSU.

Tiger teams spur NIS stakeholders, developers toward shared vision

May 2010 marked the launch of tiger team Aragorn, a group of LTER volunteers who will help developers at the LTER Network Office (LNO) conceptualize, design, and test the Network Information System (NIS).

Tiger Team members hold frequent meetings by video-conference. Screen capture by Mark Servilla.

Each tiger team — nine in all are planned, hence the team codenames' correspondence to the characters from Tolkien's Lord of the Rings novels — oversees a major subsystem of the NIS. The purview of team Aragorn is the Metadata Management suite of NIS software components. Two other teams have come up in recent months to work on the NIS subsystems dedicated to Workflow Management (codename Boromir) and Data Management (codename Frodo), with the remaining six teams scheduled to begin their work at various points over the next year or so.

The term tiger team is borrowed from the defense industry, where specialized teams are assembled to test the security of critical systems. As applied to the NIS the definition, it is more general and refers to "a team set up solely in response to a specific situation or problem while recognizing but not resolving larger-scale and longer-term issues" (source Wikipedia).

The tiger team model was proposed, largely as an outcome of an extensive review of the operational plan of the LNO conducted earlier this year, as a way for key NIS stakeholders (LTER scientists, students, and information managers) to promote community dialog and provide rapid, iterative feedback to the NIS software development effort. Each tiger team typically consists of two to five members from the LTER community who volunteer several hours per month over a span of four to eight months, contributing their scientific, technical, and non-technical expertise. NIS developers based at the Network Office also participate regularly in tiger team meetings and related activities.

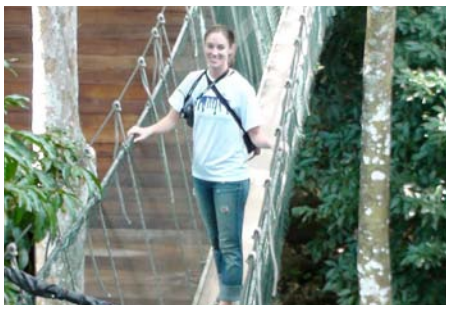
Kristin Vanderbilt, Information Manager at Sevilleta LTER, who volunteered for the Aragorn team (Metadata Management) in part to learn about its underlying web services technology, noted: "It's been valuable to get explanations from the experts." But her own input has proven useful to the team on a number of occasions, particularly with regard to questions about design choices and how they affect end users. "That's the part of NIS development that most concerns me — what the information manager user experience will be like," she said, adding, "I hope scientists are volunteering for the tiger teams to ensure that their needs will be met."

By Duane Costa
NIS Lead Developer, LNO

Synthesizing large datasets

LTER information managers and graduate students collaborate on an international research project

Two graduate students and four information managers from the US Long Term Ecological Research (LTER) Network joined researchers from Malaysia, Taiwan, Vietnam, and Thailand in the "Second Analytical Workshop on Dynamic Plot Database Application and Tool Design" that took place July 18-23, 2010 in Kuala Lumpur, Malaysia. The workshop brought together scientists and information managers from the Center for Tropical Forest Science (CTFS), East Asia Pacific-ILTER and the US LTER to collaboratively analyze long-term datasets collected by CTFS while monitoring forest plots in Taiwan, Malaysia, Singapore, Panama, Japan, Puerto Rico and the US.



Jennifer Holm, a graduate student at the University of Virginia, explores the upper reaches of the forest on the canopy bridge located on the Forestry Research Institute of Malaysia (FRIM) campus. Photo: John Porter.

The workshop had two major goals: 1) to "field-test" advanced informatics tools and approaches built around the Ecological Metadata Language (EML), the "R" statistical language, and the Kepler Scientific Workflow system; and 2) to attempt comparative ecological analyses of data from multiple international plots to identify broad patterns. Two analyses were initiated at the workshop: Jennifer Holm, a graduate student at the University of Virginia, led a working group that examined how forest biodiversity differs between

See "Datasets", p. 22

Datasets (continued from p. 21)

Above, *l* to *r*: Jennifer Holm (Univ. of Virginia), Dr. Shamsudin Ibrahim (FRIM Forestry Division Director), Don Henshaw (AND), Omar Ali Abdul Rahim, Abdul Rahman bin Kassim (Workshop organizer), and Matthew Vadeboncoeur (Univ. of New Hampshire). ***Left***: Jennifer, *r*, in discussion with, l to r, Dr. Rahman bin Kassim, Dr. Ibrahim, and Vietnamese researcher, Dr. Luu Hong Truong. Photos: John Porter.

plots, while University of New Hampshire graduate student Matt Vadeboncoeur's working group explored how spatial structure varies across sites.

The workshop also provided hands-on training on how to use the three informatics tools to Malaysian scientists engaged in the Malaysian Ecological Research Network (MyERNET). This initiative by the Forestry Research Institute of Malaysia is using metadata-based approaches pioneered by the Partnership for Biodiversity Informatics (which includes the US LTER) to increase data archiving and reuse. Meei-ru Jeng of the Taiwan Ecological Research Network (TERN) led a session that included presentations by information managers from the US, Taiwan, and Malaysia.

In addition to the formal workshop sessions, participants had the rare opportunity to tour the Pasoh Forest—which is the oldest mapped large forest plot (50 ha) in Asia and hosts a very large and sophisticated forest flux tower and canopy walkway system—during a two-day field trip. They also had a custom tour of the new National Botanical Garden and a traditional Malaysian dinner at a historical museum.

The CTFS forest plot datasets are large and complex; for instance, over 400,000 individual trees from 817 species have been monitored at a large forest plot in Pasoh, Malaysia. Synthesizing of the multiple forest plot datasets, which differed in the detail of taxonomic data, designation of the status of stems (live, dead, main, secondary), and structure of the data files, proved quite a challenge. However, the workshop participants took advantage of EML and the Kepler Workflow System to make data processing steps more efficient. EML metadata were used to automatically write R statistical programs for reading the data, which were then customized to resolve dataset-specific idiosyncrasies. Once a workflow was generated in Kepler, it was reused, often with only a few modifications, on other datasets. Although the R statistical language and Kepler learning curves were steep, workflow reuse ultimately accelerated the data processing steps.

The workflows have turned out to be an effective mechanism for collaboration between workshop members, who are currently completing analyses from their home institutions across Asia and the US. For instance, workflows created in Virginia can be revised in Taiwan and run in Malaysia. Working groups are also developing additional data resources on the climate and ecology of the forest plot locations to facilitate the comparisons, and expect to submit a manuscript describing the results of their analyses by early 2011.

Funding for participation in the workshop for Matt Vadeboncoeur (HBR), Jennifer Holm (VCR), and information managers Kristin Vanderbilt (SEV), John Porter (VCR), Don Henshaw (AND), and Eda Melendez-Colom (LUQ) was provided by the National Science Foundation through an International Supplement to the Sevilleta LTER. The Forestry Research Institute of Malaysia (FRIM) generously covered all participants' local costs in Malaysia. Before the workshop, Chau-Chin Lin and the TERN information management team hosted Matt and Jennifer in Taiwan and provided them with additional training in ecoinformatics tools.

By Kristin Vanderbilt (SEV)
& John Porter (VCR)

Don't forget to read DataBits, the Information Managers' newsletter, online at www.lternet.edu.

ILTER holds annual meeting in Israel

Participants at the ILTER Coordinating Committee meeting in Israel, September 2, 2010. Photo: Eun-Shik Kim.

The 2010 International LTER (ILTER) Coordinating Committee meeting took place from August 30 to September 3 at the Jacob Blaustein Institute for Desert Research in Sede Boqer, Israel. The meeting included a science workshop the first two days, featuring presentations on topics ranging from the ecosystem services delivered by 11 sites in the UK to European Biodiversity Observation Network's (EBONE) research at Israel LTER sites.

The ILTER science agenda currently focuses on ecosystem services, and several countries are participating in a collaborative research project on this topic led by Patrick Bourgeron (NWT), chair of the ILTER Science Committee. Other ILTER projects include:

♦ Organize citizen panels via a web-based discussion forum to study socio-ecological interactions and assess how citizen attitudes towards environmental issues vary between ILTER countries (led by Finland);

♦ Monitor the ILTER Network and analyze the results to investigate how effectively the network is functioning (led by Spain and Mexico);

♦ Link in situ biodiversity data with net primary productivity (NPP) data from satellites to test hypotheses of the Group on Earth Observations Biodiversity Observation Network (GEO BON) program (led by UK);

♦ Study the flows of ecosystem services up and down mountains in the North American region (led by USA); and

♦ Further develop the ILTER site database, *www.ILTERnet.edu/sites* (led by Mexico).

Notable highlights from the ILTER business meeting, which was held following the science meeting, were:

♦ Portugal's status as a member of the ILTER network was confirmed;

♦ Sweden presented a new proposal for LTER-Sweden, which would have 11 LTER and one Long Term Socio-ecological Research (LTSER) site, and was also accepted as a formal member;

♦ ILTER Information Management Committee chair Kristin Vanderbilt (SEV) reported on the implementation of an ILTER metadata catalog based on Ecological Metadata Language (EML) and regional Metacat databases to store the metadata.

♦ The ILTER Public Policy Committee reported that it has developed a new ILTER logo and website (*www.ILTERnet.edu*), and will be developing a new communications strategy and implementation plan in the coming year.

ILTER reported strong links with other programs, which include the Global Earth Observations System of Systems (GEOSS); the United Nations Educational, Scientific and Cultural Organization (UNESCO) International Hydrological Program (IHP); the International Human Dimensions Program on Global Environmental Change (IHDP) Global Land Project; and the United Nations Environment Program (UNEP) Climate Change Adaptation Network.

US LTER International Committee changes

The US LTER International Committee, the LTER body charged with liaising with ILTER, had some membership turnover this year. The 10-person committee now comprises co-chairs Patrick Bourgeron (NWT) and Kristin Vanderbilt (SEV), Chris Madden (FCE), William McDowell (LUQ), Charles Redman (CAP), Rinku Roy Chowdhury (FCE), Sieglinde Snapp (KBS), Jim Tang (HFR), Tiffany Troxler (FCE), and Robert Waide (LUQ/LNO), with Kate Lajtha (AND) and David Hartnett (KNZ) continuing to share their international experience as ex-officio members.

By Kristin Vanderbilt, SEV

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Calendar

Coming Events of Interest to the LTER Community

JANUARY 2010

January 12-13: Central Arizona-Phoenix annual All Scientists Meeting, Arizona State University, Phoenix. Contact Marcia Nation (Marcia.Nation@asu.edu) for more details.

FEBRUARY 2010

February 17-21: American Association for the Advancement of Science (AAAS) Annual Meeting, Washington, DC. Visit http://www.aaas.org/meetings/2011/ for more information.

MARCH 2010

March 1-3: LTER Executive Board meeting at the National Science Foundation (NSF), Arlington, VA. Contact George Garcia (ggarcia7@unm.edu) for more information.

March 2: NSF-LTER Mini-Symposium, NSF, Arlington, VA. Contact George Garcia (ggarcia7@unm.edu) for more information.

March 2-3: LTER National Advisory Board meeting, NSF, Arlington, VA. Contact George Garcia (ggarcia7@unm.edu) for more information.

MAY 2010

May 17: LTER Executive Board meeting at Georgia Coastal Ecosystem (GCE) LTER, Jekyll Island, GA. Contact George Garcia (ggarcia7@unm.edu) for more information.

May 18-19: LTER Science Council meeting. GCE LTER, Jekyll Island, GA. Contact George Garcia (ggarcia7@unm.edu) for more information.

May 20: LTER Principal Investigators meeting. GCE LTER, Jekyll Island, GA. Contact George Garcia (ggarcia7@unm.edu) for more information.