LTER
# Network News
Newsletter of the Long Term Ecological Research Network
Vol. 18 No. 1 Spring 2005

# 2005 LTER Mini-Symposium a Big Success

Washington's scientific community was all ears recently as the national Long Term Ecological Research (LTER) network held its 5th Annual LTER Mini-symposium at the National Science Foundation (NSF) in Arlington, VA, on March 3, 2005. The purpose of the annual mini-symposium is to showcase to Washington the relevance and broader impacts of the scientific research undertaken by the LTER network.

The symposium has earned a reputation in D.C. as a "must attend" event for people from federal agencies, non-governmental organizations, professional societies, private organizations, and others who are interested in learning what LTER scientists and educators are doing and planning.

Each year the LTER coordinating committee announces the following year's theme in the fall and solicits nominations for topics and speakers from within the Network. This year's theme was "*Long-Term Marine Research and the Grand Challenges in Ecology*." This theme provided opportunities for scientists and educators from the LTER's two newest sites, California Current Ecosystem (CCE) and Moorea Coral Reef (MCR) in French Polynesia, as well as scientists from other marine sites, to present their work to a diverse public audience of scientists, policy makers, educators, members of the media, and the general public (see Table 1, p. 2).

The event was hosted by NSF's Division of Environmental Biology (DEB) and Division of Ocean Sciences (OCE) and attracted over 120 people from across the nation's capital and beyond. Participants included representatives from the National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), National Academies of Science (NAS), Smithsonian Environmental Research Center (SERC), Capitol Hill (Knauss Fellows), American Institute of Biological Sciences (AIBS), Ecological Society of America (ESA), U.S. Global Change Research Program (USGCRP), Joint Oceanographic Institutions Ocean-Research Interactive Observatory Networks (JOI-ORION), American Association for the Advancement of Science

See "Symposium," p.2

## NSF Director Praises LTER

NSF Director, Dr. Arden Bement, recently spoke to a large audience of scientists and policymakers at the National Council for Science and the Environment's 5th National Conference on Science, Policy and the Environment, in Washington, D.C. Bement featured the LTER network prominently as he addressed the theme of the conference, "Forecasting Environmental Changes." He presented research activities of several LTER sites, spoke about LTER reflections from several Principal Investigators, and highlighted the children's book from Niwot Ridge (*"My Water Comes From the Mountains"*) when talking about environmental education and public outreach. His speech also covered other NSF-funded research, cross-agency initiatives, earth observation systems, cyberinfrastructure, environmental education, and future foci for U.S. science.

*See excerpts of Bement's speech on page 10.*

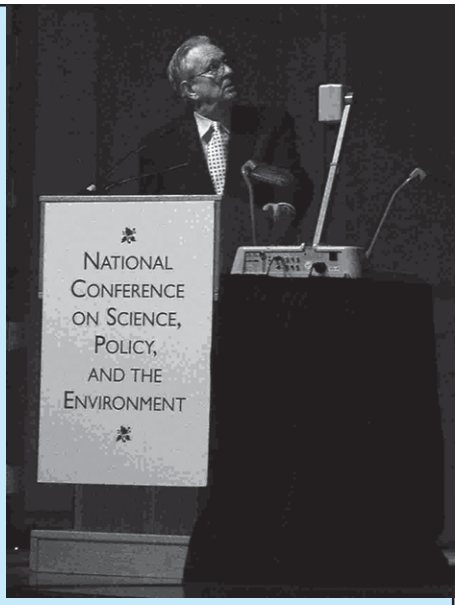


Photo: Michelle Kelleher

NSF Director, Dr. Arden Bement, addressing the National Council for Science and the Environment's 5th National Conference on Science, Policy and the Environment "Forecasting Environmental Changes" in Washington, D.C.

## In This Issue

The Network News

Vol 18 No 1 Spring 2005

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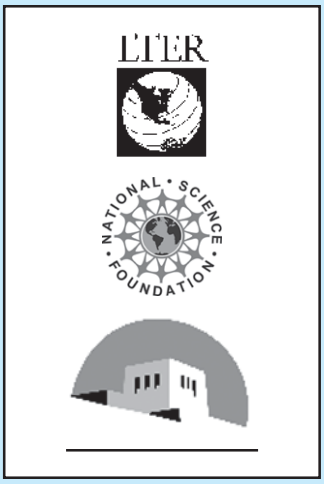


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**www.lternet.edu**

# Editorial

Anyone familiar with the national Long Term Ecological Research (LTER) Network must have noticed the fast pace of current activity within the network, and this issue of *The Network News* certainly reflects that pace. Probably the most important of all these activities is the ongoing planning grant process, which has reached a crucial stage with the formation of various working groups and the development of crucial research questions to help meet the identified ecological Grand Challenges. This issue of the newsletter includes an update on the planning process; a fare of site, education, and informatics news; an interesting scientific report; and tid-bits from various LTER projects.

This issue also continues our new trend of carrying in print only short, simplified versions of stories, and publishing the full versions online to cater for readers who need more details. The online version is updated as often as we receive new stories.

As always, we urge you to keep your contributions coming—it's never too early to submit an item. Further, whenever you're thinking of contributing a story, please think about photos and illustrations to accompany it. Thanks to Hollywood, television, and a world gone multimedia-crazy with computer games, most of us now find "gray" text boring and need lots of visual stimulation to keep reading.

To all those who contributed to this issue we say thank you and keep it up.

*McOwiti O. Thomas*
*Editor, LNO*

**Table 1: List of Mini-Symposium presenters, topics, and brief descriptions of their presentations.**

| Grand Challenge | Presenter(s) | Topic | Abstract/Description |
|---|---|---|---|
| Altered Biodiversity | Sally Holbrook (SBC/MCR) & Dan Reed (SBC) | Change in Habitat-forming Species on Temperate and Tropical Reefs: Consequences to Biodiversity and Community Structure | This topic used data from the Santa Barbara Coastal Ecosystem (SBC) and MCR LTER sites to explore patterns of resistance of biodiversity and community structure of reef fishes to variation in abundance of giant kelp and corals, the major structure-forming organisms on temperate and tropical reefs. It also discussed the similarities and differences in likely responses of fish assemblages in these ecosystems to different types of disturbances (including climate variation). |
| Coupled Human/Natural Systems | Wilfred Wollheim (Grad student/Plum Island Ecosystem (PIE) LTER | Hydrological and Biogeochemical Impacts of Land Use Change in a Suburbanizing Watershed | This topic is an overview of the hydrological and biogeochemical changes in the suburbanizing watersheds of the Plum Island Estuary. These watersheds are close to Boston MA and are experiencing widespread residential development. Major changes include increased urban runoff, increased nitrogen (N) loading, and large exports of water and N via net interbasin transfers of drinking water. |
| Educating the Public | Ali Whitmer (SBC/MCR) | A Role for LTER in Marine Science Education | |
| Climate Change | Mark D. Ohman (CCE) | Nonlinear Ecosystem Responses to Climate Forcing in the California Current System | Over 55 years of research in the California Current System has uncovered multiple, interacting time scales of climate forcing, including a secular warming trend, the Pacific Decadal Oscillation (PDO), and El Niño. The nonlinear responses of pelagic ecosystems to these climate drivers create particular challenges to forecasting future trajectories of marine ecosystems. |
| | Sharon Stammerjohn (Graduate student/Palmer) | Regional Rapid Warming and Changes in the Physical Environment: The Palmer LTER Study Region West of the Antarctic Peninsula | The Antarctic Peninsula (AP) region is warming faster (in winter) than any other region on earth. This presentation will show how the physical environment of the western AP region has changed, and how the ice-dominated marine ecosystem has been impacted. |
| Altered Biogeochemical Cycles | Karen McGlathery (Virginia Coast Reserve) | LTER Contributions to Understanding the Coastal Eutrophication Problem | |

## Symposium (continued from p.1)

(AAAS), National Ecological Observatory Network (NEON), and Nature. Several LTER Principal Investigators, scientists, and educators, as well program officers, senior management, and staff from NSF also attended.

The topics were organized around the broader "Grand Challenge" themes of Altered Biodiversity, Coupled Human/Natural Systems, Educating the Public, Climate Change, and Altered Biogeochemical Cycles.

To add your (or someone else's) name to the invitation announcement list, please email name, organization, and email address to Henry Gholz at *hgholz@nsf.gov*.

*Michelle Kelleher*
*Science Assistant, BIO/DEB, NSF*

*You can access and download the Powerpoint presentations online at http://lternet-183.lternet.edu/doc_archive/presentations/*

# LTER Planning Grant Activities Gain Steam

In our last issue (*The Network News Vol. 17 No. 2 Fall 2004*), Scott Collins described the award of a 2-year National Science Foundation grant to enable network-wide planning activities. This activity has since taken off and the following article gives a brief update of these efforts.

The LTER Network received a planning grant in 2004 to develop a Strategic Planning Process that builds upon recent LTER Coordinating Committee and All Scientist Meeting planning activities. The objective of the planning activity is to produce multi-site, highly collaborative and integrated research initiatives. These research initiatives will include synthesis components and, where appropriate, will be coupled with novel training opportunities in graduate and undergraduate education. Some research will involve non-LTER sites, including various networks, organizations, societies, cross-site and single-site studies, multidisciplinary, and interdisciplinary studies. This process will foster synthetic, large-scale research to address the Grand Challenges in ecology (see *http://www.lternet.edu/grandchallenges/*).

The first step in the planning process was the formation of a "Meeting of 100" LTER and non-LTER scientists, which took place in Florida in November 2004. This group of scientists was chosen by the Science Task Force (STF) following nominations from the LTER community and other sources including the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUASHI), Collaborative Large-Scale Engineering Analysis Network for Environmental Research (CLEANER), Organization of Biological Field Stations (OBFS), National Ecological Observatory Network (NEON), and other relevant networks.

The STF consists of five LTER scientists with various backgrounds and areas of expertise—namely, Barbara Benson, Daniel Childers, Scott Collins, James Gosz, and Allison Whitmer. STF used the recommendations from the Meeting of 100 as input for the next phase of the planning process, which focused on the Grand Challenge research questions and established four Network Science Working Groups (NSWGs). The NSWGs will generate specific research projects and their implementation plans, specific research designs, and assess the technologies and resources needed to meet these Grand Challenges. Figure 1 shows how the whole framework is conceptualized.

The NSWGs include four conceptual domains:

1. Biotic Structure (chair: Jim Rusak)
2. Altered Biogeochemistry (chair: Indy Burke)
3. Altered Climate Change (chair: Mark Williams)
4. Human-Natural Systems (chair: Ted Gragson).

Two other groups—Education, Outreach, and Training (chair: John Moore) and Governance (chair: Ann Zimmerman)—were formed to help develop the conceptual domains to accomplish the overall goals of the planning process.

All the conceptual groups met in January and February 2005 to generate cross-cutting and novel questions for purposes of the planning grant. The results of their efforts were assessed at the recent STF/Advisory Committee joint meeting in late March 2005. An All Hands Meeting that includes STF and NSWG chairs, among others, is planned for June 2005. The All Hands Meeting will pull together the conceptual domains and narrow the focus for scientific ideas generated by the planning process. Future meetings will continue to narrow the focus and further develop the science under the planning grant theme.

*Caleb Hickman*
*Science Assistant, LTER Planning Grant, LNO*

*For more information on the progress of the LTER planning activities see the working Wiki website at: http://intranet.lternet.edu/planning/index.php/Main_Page*

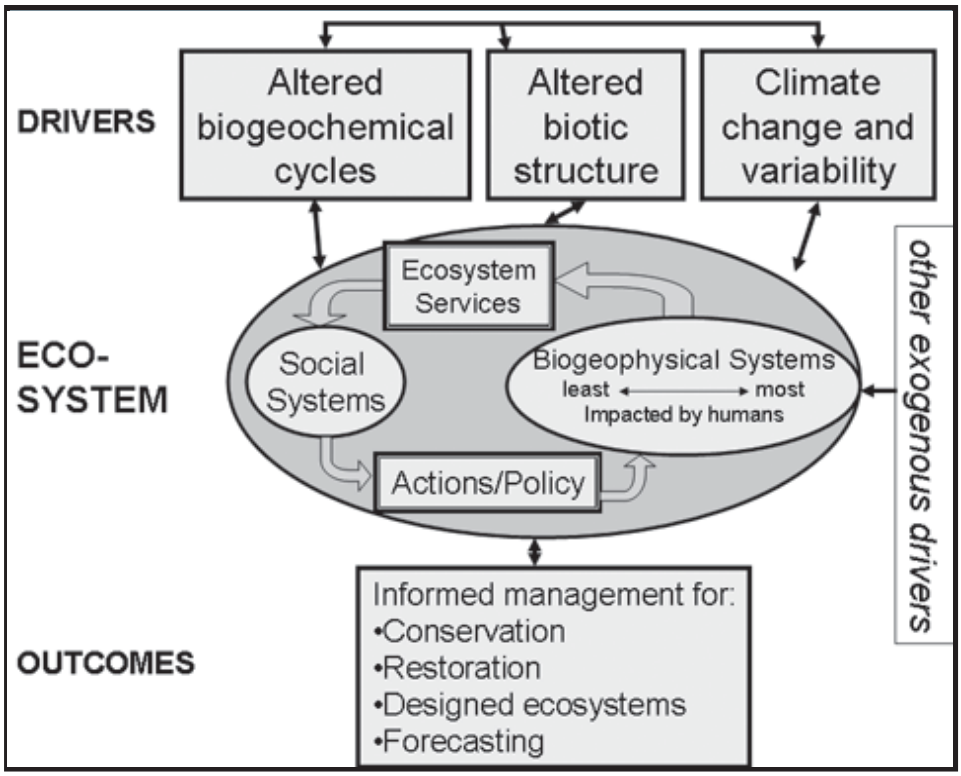



Figure 1. Planning grant conceptual framework

## Long Term Ecological
# Reflections

Photo: Al Levno

Forest of tranquility: the beauty of nature at Andrews Forest is an inspiration to writers and artists.

### *New project complements Long Term Ecological Research at Andrews LTER*

At the H.J. Andrews Experimental Forest in the Oregon Cascades, LTER scientists are enjoying a new collaboration with creative writers. The LTER group is partnering with *The Spring Creek Project for Ideas, Nature, and the Written Word* to provide week-long residencies at the Andrews Forest for essayists, poets, and other writers. This new program is encouraging Long-Term Ecological *Reflections*—supporting writers and humanists in their efforts to explore human/nature relationships as they evolve over many lifetimes.

The Spring Creek Project, an independently funded program in the Department of Philosophy at Oregon State University, is dedicated to bringing together the wisdom of the environmental sciences, the clarity of philosophical analysis, and the creative expressive power of the written word. Spring Creek's director, Philosophy professor Kathleen Dean Moore, says, "In every way we can think of, we encourage people to cross disciplinary boundaries to think more creatively about how to live sustainably, respectfully, and joyously in ecosystems threatened by cascading changes."

The writer-in-residence program began in April 2004 with writer and lepidopterist Robert Michael Pyle. Pyle's week of writing, roaming the forest, and talking with Andrews' field staff resulted in a collection of journal entries, poems in progress, and an essay published in Pyle's *Orion* magazine column (Winter 2004). His essay, "The Long View," was inspired by his visit to Mark Harmon's 200-year log decomposition study site at the Forest. "The long view requires faith in the future," Pyle wrote, "even if you won't be there to see it for yourself."

Photo: Al Levno

Even dead trees have a "life cycle" at Andrews Forest, where millions of other life forms depend on them for survival.

The second writer-in-residence, Robin Kimmerer, is a botany professor at SUNY-Syracuse. *Gathering Moss*, her book of reflections on the natural world viewed from her perspectives as bryologist, ecologist, parent, and Native American, has just won the 2005 Burroughs Medal for Natural History writing. She focused her Andrews Forest visit on water, which was abundant during her October stay.

Results of these reflection activities will be much like the results of science field studies—published pieces, records of observations left for later use by the originator and by the public, and oral communications, including readings and lectures by the writers. The written reflections of the writers-in-residence will be posted to the *Forest Log* on the H.J. Andrews website (*http://www.fsl.orst.edu/lterhome.html/*).

*Fred Swanson*
*Andrews LTER/USDA Forest Service*
*Pacific Northwest Research Station*
*(with material from Charles Goodrich and Kathleen Dean Moore, Spring Creek Project, Dept. of Philosophy, Oregon State University).*

# SGS Hosts 7th Symposium

The 7th Shortgrass Steppe (SGS) LTER Symposium was held January 14, 2005, with contributions from the USDA Forest Service (USFS), Pawnee National Grassland, and Rocky Mountain Bird Observatory. Over 150 people attended, representing twenty-five agencies, universities, and non-governmental organizations, ranging from local high school students and farm and livestock producers to U.S. legislators. Participants focused on management, research, and conservation. Presenters from Colorado State University (CSU) and the USDA's Agricultural Research Service (ARS) Rangeland Resources Research Unit, explored issues of grazing, drought, weeds and invasive species, faunal diversity, and prairie dogs. Twenty-three posters were presented on research studies, conservation, land management, information management, education, and outreach.

Justin Derner (ARS) presented a rich history of land use and research, focusing on cattle grazing management practices employed by the Crow Valley Livestock Cooperative. This Cooperative is the oldest grazing association in the U.S. and works closely with researchers and land managers. Justin identified suburban development as having potentially the greatest impact on the culture, lifestyle, habitat, and biodiversity of the SGS. He stressed the importance of considering social sciences in planning SGS research, management, and conservation activities, as well as the need for all stakeholders to work together on important issues.

Photo: Sallie Sprague

Drs. Dana Blumenthal (left) and Jack Morgan (right) providing musical entertainment during lunch at the recent SGS Symposium. Dana is a new collaborator and Jack is a Co-PI of the SGS LTER program; both scientists are affiliated with the USDA Agricultural Research Service.

Nolan Doesken (CSU) discussed the current statewide drought, issues of climate change, and the uncertainty that exists in forecasting weather. He described the climate of the SGS and summarized average annual precipitation, monthly temperatures, and the relationship between precipitation and evaporation. Noting that a small number of isolated events contribute greatly to annual precipitation in the area, creating a need for more rain gauges across the landscape, Nolan distributed rain gauges to students from Future Farmers of America to install in Grover, Colorado for the Community Collaborative Rain, Hail and Snow Network (*http://ks.cocorahs.org/*).

Dana Blumenthal (ARS) discussed the challenges in applying generalizations to the invasion of a landscape by exotic species. After explaining theories of invasion and preliminary results of studies conducted in the SGS and mixed grass prairie, Dana led a group

See "SGS Symposium," p.19

## "Home on The SGS"

*Entertainment during lunch at the 7th Annual SGS Symposium was provided by some of our own staff, PIs, and collaborators, who sang our own SGS lyrics to the tune of good old "Home on the Range":*

**Verse1 (*Caroline Yonker & Bob Flynn*)**

Oh, give me a home where the bovine do roam,
Where the pronghorn and prairie dogs play
Where the air is so pure, save the scent of manure
With treasures not found on eBay.

**Chorus (*all*)**

Home, home on the range (the experimental range)
Where hard working friends also play
Publications are found and good people abound
And cattle gain weight everyday.

**Verse2 (*Caroline Yonker*)**

Oh give me a creek, like the waters so meek
In the Owl, the Cow, the Horsetail
'Cause the rain is so fickle, they're 'oft just a trickle
The floodplain so sandy and pale.

**Verse3 (*Caroline Yonker*)**

Oh, I love the hills, rock outcrops and fills,
Their colors so subtle and brown.
And I love the buttes, the soil 'neath my boots
A beauty of local renown.

**Verse4 (*Nicole Kaplan*)**

Oh, give me a steppe we can study in depth
Where we count and clip grass all the day
Where habitat is key, for you and for me
But all stays below ground 'til May.

**Verse5 (*Nicole Kaplan & Bob Flynn*)**

Oh! A research site, where the sun's always bright
That tans your skin oh so well
And when the sun goes down, we count rabbits all around
Then retire to the Pawnee Motel.

**Verse6 (*Judy Hendryx*)**

At home in the lab, it's not really so bad
As the samples we carefully weigh
Where the students do toil over the prairie soil
And the seeds we do count many days.

**Verse7 (*Judy Hendryx*)**

Oh, the plants we do grind, into powder so fine
Into vials we place them with care
Then we analyze them on the old C-H-N
And burn them off into thin air!

**Verse8 (*Bob Flynn*)**

This landscape I assess, with my personal GPS
My research this data doth foster
I get perfect stats, and fine-looking maps
All for my PowerPoint poster.

## North Temperate Lakes'

# Study Ties Lakefront Property Values to Water Clarity

By merging economic valuation techniques used by social scientists and limnological data obtained via satellite, NTL-LTER has recently demonstrated important economic and ecological links among property valuation, shoreline zoning regulations, and water quality. In light of the rapid development of the lakes of northern Wisconsin, counties have created lake classifications and shoreline restrictions to reduce ecological impacts.

Vilas County, with the Wisconsin Department of Natural Resources' help, was one of the first to institute a comprehensive lake classification scheme in which lakes are rated according to their sensitivity to and current level of development. Sensitive lakes (typically the smallest, see Fig. 1) with low levels of current development (Fig. 2) have the greatest restrictions. Economically, the most significant restriction associated with lake classification is the minimum frontage requirement. Current state law sets the minimum frontage requirement at 100 feet. The lake classification scheme requires additional frontage of 50, 100, or 200 feet depending on the class.

Both economic theory and common sense lead to the conclusion that a good portion of the economic gains and losses associated with the lake classification scheme will be capitalized in the values of shoreline property. Yet it is not clear whether the effect on property values will be positive or negative. One can anticipate a negative *development effect* arising because restricting an owner's opportunity to do with his land as he pleases reduces the market value of the land. On the other hand, to the extent that *all other* property on a lake is similarly restricted, positive benefits of natural amenities are generated, such as more scenic views and higher water clarity, and one would expect this *amenity effect* to be capitalized in the land value.

To disentangle the negative *development effect* and the positive *amenity effect*, we used a hedonic price equation and market sales data for 1172 lakefront properties sold before and after the classification took effect. Based on these data, percent change can be predicted for representative undeveloped parcels of lakefront property, relative to state minimum shoreline regulations. The overall effect of the lake classification on property value is positive, though the effect can also be negative on some smaller lakes with stricter regulations. Lake classification not only provides some ecosystem protection for the Vilas county lakes, but generally also raises the value of the lakes.

Another factor included in the valuation was lake water clarity, as measured by Secchi depth derived from the Satellite Lake Observatory Initiative (*www.lakesat.org*). Preliminary results indicate that water clarity also has a positive effect on lakeshore property values. At mean water clarity levels in Vilas lakes (3.25 meters), a 30 cm increase in Secchi depth raises the value of undeveloped lakeshore property by about 3.6 percent. This study is one of the first to demonstrate an economic link between property valuation, shoreline zoning, and water quality for any lake district and lays the groundwork for additional investigations on the interactions and feedbacks inherent in socio-economics and ecological systems.

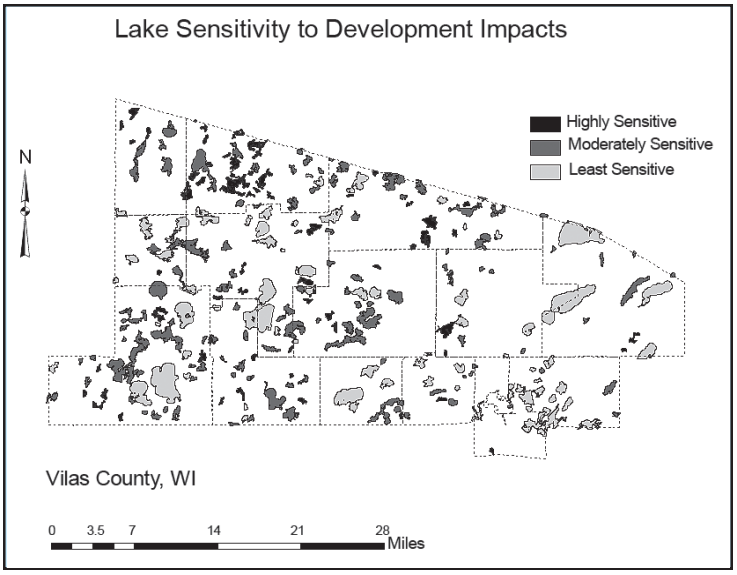



Fig.1: Vilas County, WI, shoreline development classification scheme.

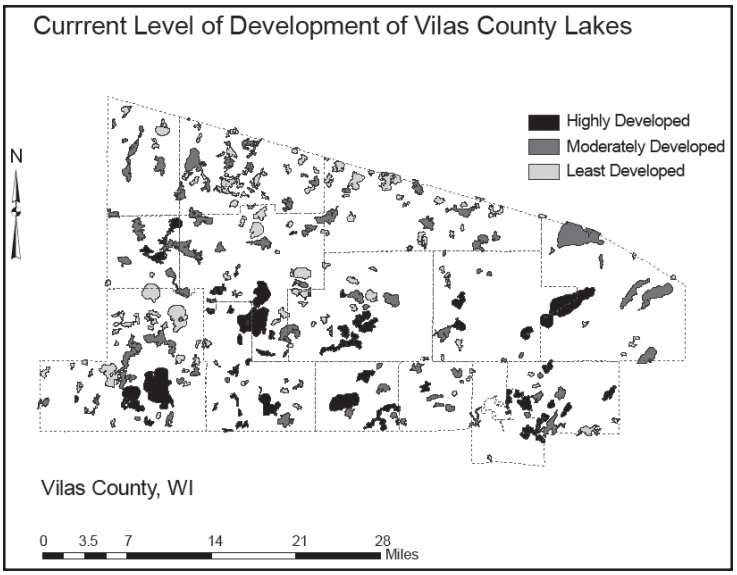


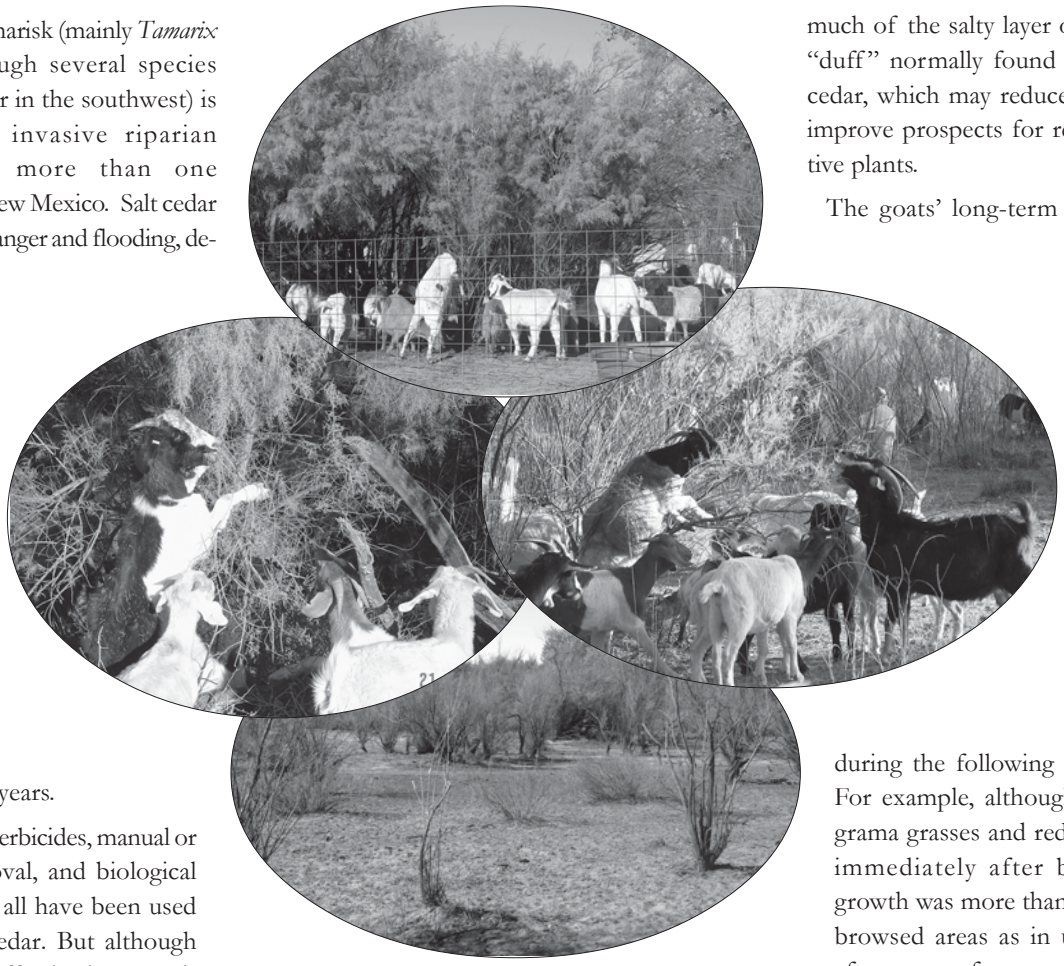

Fig. 2: Current development levels for Vilas County, WI.

*For more information please contact Bill Provencher and Michael Papenfus, NTL.*

# Browsing the Bosque

## Jornada scientists use goats to control salt cedar in New Mexico

Scientists at the Jornada LTER recently turned to an age-old, but almost forgotten solution to the salt cedar problem in New Mexico: goats. In a study to determine the effectiveness of goat browsing for controlling salt cedar, the scientists used 400-650 goats to browse more than 20 experimental plots for 1-2 days each during fall 2003 and 2004.



Salt cedar or tamarisk (mainly *Tamarix ramosissima,* though several species and hybrids occur in the southwest) is an introduced invasive riparian tree infesting more than one million acres in New Mexico. Salt cedar can increase fire danger and flooding, decrease water quantity and quality, increase soil salinity, replace native species, degrade wildlife habitat, and limit human use of riparian areas. Damage from salt cedar is projected to cost $2.9 billion in this area over the next 10 years.

Fire, flooding, herbicides, manual or mechanical removal, and biological control methods all have been used to control salt cedar. But although goats have been effective in controlling weeds and reducing woody biomass that fuel fires in the western USA, they have never been tried on salt cedar.

The study plots were located in salt cedar stands near San Acacia and San Marcial along New Mexico's Rio Grande river valley. Western Weed Eaters, professional goat herders with extensive commercial experience in using goats for weed control and land restoration, provided and managed the goats for the study.

The goats browsed the salt cedar aggressively and gained weight during the study. They damaged nearly all the salt cedar plants in the browsed areas and removed significant amounts of biomass. In mixed vegetation, small salt cedar plants were browsed down to the ground and the width of larger plants decreased by about 34 percent. However, salt cedar resprouts strongly and it may take up to five years of browsing to exhaust root reserves and kill salt cedar plants. Most plants killed in the first two years of browsing were damaged by goats breaking branches and stripping bark. In areas where salt cedar was removed mechanically and allowed to regrow for four years, goats were particularly effective, reducing the density of resprouts by more than 50 percent.

Goat browsing was less effective in dense stands of large salt cedar with stems more than 6 cm in diameter. However, the goats also browsed the dense wall of vegetation that grew at the edges of salt cedar areas, improving access and reducing the time and cost of salt cedar removal by mechanical or manual methods. The goats also ate much of the salty layer of shed leaves or "duff" normally found under dense salt cedar, which may reduce soil salinity and improve prospects for restoration of native plants.

The goats' long-term impact on plant species composition is not clear since they ate both undesirable weeds and desirable species. Their browsing had different effects on individual plant species, although most of the vegetation recovered during the following growing season. For example, although goats browsed grama grasses and reduced grass cover immediately after browsing, grass growth was more than twice as great in browsed areas as in unbrowsed areas after a year of regrowth.

However, after two years of browsing the goats removed nearly all of the biotic soil crust, and it is not clear how quickly the crust will recover once the browsing ends or if the bare soil will be covered with grasses and other small plants. Still, careful management of the timing and intensity of goat browsing can reduce damage to desirable species such as cottonwoods. The use of goats for salt cedar control must be adjusted to each place and time. Clearly, success depends upon the knowledge and judgment of the goat herder.

*Sandy Tartowski*
*Jornada Experimental Range LTER*

# A Successful Year for LTER Graduate Students in 2004

The LTER Network Graduate Student Committee (GSC) is emerging as a strong voice for graduate student involvement in Network activities and the development of new graduate student opportunities. The accomplishments of 2004 highlight the successes of members of the GSC in fostering these goals.

The First LTER Graduate Student Collaborative Research Symposium will be held at the H. J. Andrews Experimental Forest Station in Blue River, OR, April 13–17, 2005. Symposium preparations are progressing apace with the assistance of Symposium Committee members Harmony Dalgleish, Stephanie Oakes, Chelsea Crenshaw, Tiffany Troxler Gann, and Robert Daoust; H. J. Andrews Experimental Forest; Oregon State University; Florida Coastal Everglades; and Florida International University.

The Symposium is designed to foster interactions among LTER and ILTER graduate students to stimulate their engagement in comparative and collaborative ecological research. It will serve to strengthen the role of the LTER Network in providing experiences and training to encourage present and future graduate student participation in the broader LTER and ILTER communities, emphasizing new focuses on collaboration and synthetic work.

Structured over four days, the Symposium will include a short plenary address, synoptic talks focused on graduate student-led research at each of the 26 LTER sites and participating ILTER sites, individual research talks, student-led collaborative research workshops, and training sessions given by LTER and non-LTER scientists. Support from LTER sites has been excellent, with each site sponsoring the attendance of at least one of their students – a truly collaborative effort which will greatly facilitate the success of the Symposium. We also have great support from our ILTER network partners: we will have students attending from South Africa, China, Brazil, Mexico, Mongolia, Austria, Switzerland, France, and the Czech Republic.

Photo: Tiffany Troxler Gann

Working group members Harmony Dalgleish, Rachel Michaels, and Nancy Grimm at Florida International University writing the Graduate Student Collaborative Research Symposium proposal, February 2004.

LTER and ILTER graduate students submitted over 70 abstracts of oral presentations, posters, and student-led workshops. Staff members of H. J. Andrews and OSU are organizing several field trips and hikes to interesting scientific research sites.

Whendee Silver, who is affiliated with the Luquillo Experimental Forest, will be the main plenary speaker. Scott Collins (SEV) will speak about the new "culture of synthesis" in LTER. Five training sessions are planned, including: "Communicating Science to Non-Scientists" by Ashley Simons at Sea-Web; and "Initiating, Undertaking, and Managing Collaborative and Multidisciplinary Research Projects" by Darrel Jenerette, who has published in BioScience on the subject of LTER interdisciplinary science.

The idea for a Graduate Student Collaborative Research Symposium evolved from discussions at the LTER Student Session during the 2003 Ecological Society of America (ESA) annual meeting and from a workshop entitled "Facilitating graduate student opportunities for collaborative research" during the 2003 LTER Annual Scientists Meeting (ASM).

After the ASM the symposium organizing committee asked for and received funds from the LTER Network Office to organize a working group to write a proposal for the Symposium. The working group, comprised of graduate students Robert Daoust (PIE), Tiffany Troxler Gann (FCE), Harmony Dalgleish (KNZ), Stephanie Oakes (PAL), Rachel Michaels (VCR), Evan Kane (BNZ), and Tamara Heartsill Scalley (LUQ), was held at Florida International University in Miami, FL in February 2004. The proposal writing process was greatly enhanced by the attendance of LTER Executive Committee member Nancy Grimm (CAP). In May 2004, the GSC was informed that its proposal for a graduate student symposium was being funded as a supplement to Florida Coastal Everglades (FCE) LTER.

Please visit our Symposium website at *http://student.lternet.edu/symposium/* for more details.

See "Grad. Students," p.9

Grad. Students (cont. from p.8)

## Other highlights:

In February 2004, GSC co-chairs Robert Daoust and Tiffany Troxler Gann visited LNO in Albuquerque to work with web designers Marshall White and Jeanine McGann to develop a new and improved Graduate Student website. One of the website's most important new features is the Graduate Student Representative page, where photos and contact information for site representatives can now be found.

In July 2004, Robert Daoust rotated out of his position as GSC co-chair. We welcomed our newly elected co-chair, Chelsea Crenshaw (SEV).

During the ESA annual meeting in Portland, OR, the GSC held the annual LTER Graduate Student Evening Session—a panel discussion designed to facilitate interaction between LTER graduate students from various sites and LTER scientists and NSF personnel. LTER personnel in attendance included Scott Collins, Bob Waide, Don Henshaw, McOwiti Thomas, and Nancy Grimm; NSF had Henry Gholz and Sonia Ortega (then still with LNO).

Chelsea Crenshaw, newly elected LTER Network Graduate Committee Co-Chair

In November 2004, graduate students Stephanie Oakes, Chelsea Crenshaw, Tiffany Troxler Gann, and Sarah Emery participated in the "Meeting of 100" convened to, among other things, develop research questions addressing the Grand Challenges of Ecology as part of the LTER Planning Grant activities. The working groups that emerged from this meeting recognized and incorporated the participation of graduate students in the planning grant activities. We thank the Planning Grant committee for encouraging graduate student perspectives and input in the future of LTER science.

Upcoming activities of the LTER Graduate Student Committee include a "Lunch Chat" co-hosted by the ESA Student Section during the 2005 ESA annual meeting scheduled for Montreal, Canada, in August. Graduate students are encouraged to register for this lunch event, which is scheduled for Monday, August 8. The Lunch Chat is popular event borrowed from the annual LTER ASM and a great opportunity to interact with some of Ecology's leading scientists. The GSC will also co-host a session of the ESA Student Section that evening.

We look forward to the opportunity to meet LTER and ILTER graduate students enthusiastic to develop new relationships to facilitate collaborative research in LTER during the First LTER Graduate Student Collaborative Research Symposium. We hope to see the Symposium instituted by the LTER community and become one more reason to pursue graduate student research with the LTER Program.

*Tiffany Troxler Gann*
*Co-Chair, LTER Network Graduate Student Committee (FCE/FIU)*

# Making Links, Building Bridges…

## *NTL hosts science party*

*Science and the Northwoods* was the theme of a very successful regional "block party" sponsored by the North Temperate Lakes LTER September 16-17, 2004. Over 130 attendees representing more than 25 universities; NGOs; local, state, tribal and federal agencies; K-12 educational institutions; and media outlets met to share ideas about a wide variety of environmental research in the Northern Highland Lake District.

The meeting provided an opportunity for this extremely diverse set of researchers, educators, and interested members of the public to meet, find out about each other's environmental programs, and make connections. Its primary purpose was to build networks among the wide variety of scientists interested in the northern lakes region. The resultant linkages, much like the roots put down by the white pine outside the main conference center, turned out to be numerous and multifaceted. The topics ranged widely, from paleoecological investigations of forests and lakes, through the impact of invasive species on aquatic and terrestrial ecosystems, to development scenarios, demographics, and land use changes that were likely to shape the regional landscape for years to come.

The meeting gave the participants, most of whom were surprised to learn about research programs that they had not encountered before, a sense of the breadth of ongoing environmental research in the region.

The format of the meeting contributed greatly to its success. Talks were greatly restricted in length—five minutes of presentation followed by two minutes of questions—and participants were urged to show pictures and conceptual diagrams of their research or management initiatives instead of data or statistics. Although many feared initially that the format would be overwhelming, the five-minute "infomercials" proved to be very popular and the rapid turnover ensured that the audience was not fatigued. This format also ensured that the meeting could be held in plenary throughout its two-day agenda and allowed ample breaks for conversation among participants, who now had a common experience to build upon and stimulate discussion. Participants left the meeting excited about the diversity of research in the region and the interdisciplinary opportunities for future collaborations.

*Jim Rusak, NTL*

## Comings & Goings

Inigo San Gil

**Inigo San Gil** joined the LNO in January as *Senior Application Support Analyst* to provide assistance on EML standard data compliance for the LTER Network. Inigo will work to create crosswalks between NBII Biological Data Profile (BPD) and EML standards as well as provide support to the different LTER sites to achieve their EML-related goals. He has been visiting and will continue to visit the LTER network sites in the coming months to assist with metadata management.

Inigo was born in San Sebastian, Spain and has quite a diverse professional background. He worked as a database developer while finishing his B.S. degree in Physics in Zaragoza, Spain. He then moved to the U.S. to pursue a Ph.D in Mechanical Engineering at Yale University. While working on his thesis dissertation (focusing on turbulence, fractals, and scaling laws), Inigo joined IBM Thomas Watson Research Center at Yorktown Heights, NY and later Los Alamos National Lab, where in addition to falling in love with the land of enchantment (New Mexico), he performed numerical simulations and data analysis on a number of supercomputing facilities. After completing his Ph.D, he joined the Yale Core Facility for Bioinformatics where he developed web-enabled databases and data analysis tools for genomic research. Inigo moved last year to New Mexico following his family and in joining the LTER will fulfill a lifelong dream to contribute to ecological research.

**Michelle Murillo**, formerly the Network Manager at LNO, has returned to a position at Los Alamos National Laboratories in January. Michelle, who also was previously involved with the Andrews and Sevilleta LTER sites, was instrumental in securing the LNO databases as part of the integration of network databases project. She also put a tremendous amount of work into the development of the Request Tracker (RT) ticket system, which has helped to streamline the request for assistance process at LNO.

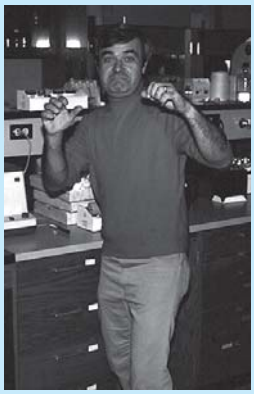


Photo: Mike Kaufman

Klug circa 1985 – before joining LTER

After 33 years at KBS, **Mike Klug** has retired. Klug joined the faculty in the Department of Microbiology and Public Health at Michigan State University and KBS in 1971. Klug was co-founder of both the LTER program at KBS, where he was Director from 1996-2003, and the Center for Microbial Ecology at MSU.

While teaching the Microbial Ecology course at MSU for over 30 years, Klug also contributed to the development and teaching of a Biogeochemistry course at KBS. He was also involved in K-12 programs and led teacher enhancement programs funded by the Kellogg Foundation and the National Science Foundation.

Klug and his wife Carol recently moved to an 80-acre wooded and grassy landscape in rural Southwest Michigan, but he plans to continue his involvement with KBS in some capacity in the future. Responding to questions about his new-found "freedom," Klug, who has three married children and a grandchild quipped: "Soon I'll be tapping my trees, getting my beehives ready, ordering apple trees, and putting a hoop-house together…" You know – the fun kind of work!

We wish Mike the best.

*Andrew Corbin and Alice Gillespie*
*Kellogg Biological Station LTER*

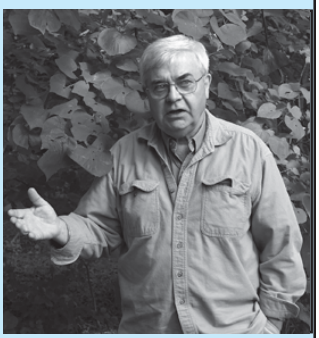


Photo: Zueng Sang Chen

Klug post-retirement, 2005

### Bement reflects upon the "long view" of LTER science

Arden Bement, Director of the National Science Foundation, acknowledged H. J. Andrews LTER's Long-Term Ecological Reflection project (see story on page 4) during a speech entitled "From New Sight to Foresight: The Long View on the Environment" presented to National Council for Science and the Environment on February 4, 2005. **Excerpts:**

"I have titled my talk today "From New Sight to Foresight: The Long View on the Environment." This sums up our evolving vision of environmental research and engineering at the National Science Foundation.

Foresight means the "perception of the significance and nature of events before they have occurred." Another definition is "care in providing for the future; prudence." Both definitions inform the National Science Foundation's role in environmental research and education.

At NSF we embrace three aspects of environment: the natural, social and constructed environments. Insights into all three comprise our ability to perceive, and to provide for, our future.

I've also mentioned "new sight"—by which I mean the expanded vision bestowed by vast observational networks and breakthroughs in sensors. Development of these tools is part and parcel of our ability to foresee.

Then there is the "long view." Some of you will be familiar with NSF's Long-Term Ecological Research Program (or LTER), now celebrating its 25th anniversary. But how many have heard of the "Long-Term Ecological Reflection" Program? A participant in this Oregon State University venture, essayist Robert Michael Pyle, contemplated beauty and decomposition at an LTER site deep in a forest of the Pacific Northwest.

Musing over the unhurried pace of decay and regeneration in the forest, he observed that "Most of us take the short-term view, most of the time." The long view, he noted, "requires faith in the future—even if you won't be there to see it for yourself." In NSF's approach to the environment, we are constantly stretching that view, across disciplines, across time and across space.

For almost two decades, NSF has supported major, cross-disciplinary efforts on the environment, ranging from global change—initially focused on physical science—to biocomplexity in the environment, grounded in biological science but involving all disciplines."

*Read the full speech at: http://www.nsf.gov/news/speeches/bement/05/alb050204_ncse.jsp*

# The Duplin River Study: Exchange Processes Between Intertidal Areas and Tidal Creeks

The Georgia Coastal Ecosystem LTER program is studying the biogeochemical processes that change constituent concentrations in water as it flows over the marsh during flood tide and as it returns to the creek during ebb. This exchange of water occurs in a complex marine environment consisting of three coastal plain estuaries and numerous tidal channels, surrounded by some of the largest intertidal areas—i.e., alternately flooded and dried twice a day by tides—in the US (Figure 1). To understand the marsh-creek exchanges, the periodic wetting and drying of large intertidal areas must be simulated. Models to compute material exchange require detailed information about the topography of the area and the amount of water stored in the intertidal areas and released into the tidal channels and estuaries. Intertidal topography is complex and these areas are difficult to access, so remote sensing techniques were used to obtain the relevant information. Moreover, the models must carefully balance between retaining the complexity of the flow regime and simplifying the problem enough to solve it without sacrificing the accuracy of the exchange process computations. This article will describe briefly the approach we have taken to arrive at this balance.

Initially, we used a set of images to define the large intertidal areas surrounding the main channel of the Duplin River. We then incorporated this information into a model of the Duplin River system. Our model uses a scheme that defines intertidal storage modules to represent the contribution of each tidal watershed to the Duplin River. (*For a more detailed account of this process, read the web edition of this article* at http://www.lternet.edu.)

## Processing of aerial images

We obtained the intertidal topography of the area by taking a series of seven infrared (IR) aerial images of the Duplin River at 1-hour intervals from low water (LW) to high water (HW). We used the IR false color image prints (scale 1:24,000) obtained along the flight line to classify ground units such as water, spartina marsh, sand, and mud across three spectral bands (green, ë = 0.55 nm; red, ë = 0.65 nm; and near infrared, ë = 0.75–1.00 nm). We set all classes corresponding to flooded areas to 0 (zero), and all other areas to 1. The resulting image was a mask that, when multiplied by any one of the original components, defined all of the flooded area at 1-hour intervals from LW to HW.

See "Duplin River Study," p.12

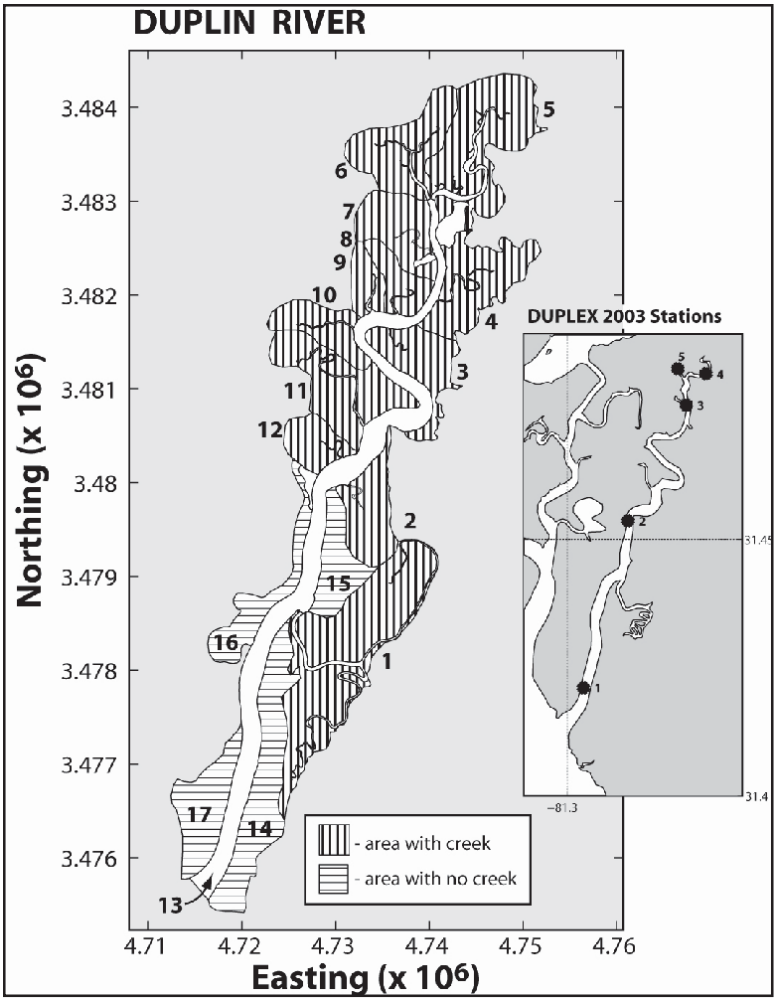



**Figure 1:** The definition of 17 polygons using aerial remote sensing techniques. Easting and northing dimensions are in meters based on the UTM grid of 1983. Inset shows the distribution of monitoring buoy, from which data were acquired to validate the hydrodynamic model. See web edition of this article at http://www.lternet.edu.

Duplin River Study (cont. from p.11)

## Storage tanks for simulating intertidal areas

We used a storage-tank scheme based on the aerial images to define the Duplin's 12 main tributary tidal creeks and their intertidal drainage areas. We then used the *GCE Mapping Toolbox*, written by Wade Sheldon (*http://gce-lter.marsci.uga.edu/lter/research/tools/it_development.htm*) to measure the areas of each polygon. For each polygon we assumed that no water crosses the drainage boundaries. While some cross-boundary transport may occur at extreme high tides, the volume involved is quite small compared to that which drains the intertidal area through the creek.

We defined 17 polygons, 12 of which have tributary tidal creeks and corresponding catchment basins (polygons 1–12). The four without a creek (polygons 14, 15, 16, and 17) are assumed to transmit mass into and out of their areas uniformly as a line source or sink. Polygon 13 is the main Duplin River at LW, which ends 10 km (six miles) upriver where the channel splits and defines the initial mesh of the hydrodynamical model described later.

We used the HW and LW rectified images to compute changes in the water surface area in each polygon. By establishing the mean depth of each secondary creek draining into the Duplin River, we determined the volume of water flowing into and out of each polygon during one cycle of the tide. The scheme is a compromise between wetting and drying sub-models that deal with complex intertidal topography that require large computer time, and over-simplified models that omit the intertidal areas altogether. The primary advantages are:

- The scheme overcomes limitations of acquiring detailed data on spatial changes of the elevation of intertidal areas
- The storage tanks perform the same function as peripheral tidal creeks by removing momentum from the creek during flood and releasing the mass back into the river during ebb
- The storage vessels can simulate biogeochemical processes, enabling the quantification of the volume of water exchanged between the marshes and creeks.

## Linking to the hydrodynamic model

We are currently designing modeling experiments to understand how the Duplin River interacts with the intertidal areas. Our goals are to identify the main tidal creeks affecting the dynamics of the Duplin River and to quantify how salt is transported and diffused in the area. We are using the TELEMAC model, a hydrodynamic model based on finite element techniques developed by the Laboratoire National d'Hydraulique (EDF–Paris, France). The unstructured grids found in finite-element models makes TELEMAC ideal for incorporating the complex boundary and topography of the Duplin River.

We obtained the boundary, initial conditions, and data for validating the model from a study conducted in the Duplin River in August 2003. We used data from moorings to estimate the amplitude and phase of the tidal wave, the energy of the transport (tidal and non-tidal), the net amount of salt transported through the river, and the harmonic constituents of the tidal currents as a function of water depth, thus providing validation points for our model. We used measurements carried out in Doboy Sound, into which the Duplin empties, to define the boundary condition at the river mouth, and those from stations 1, 2, 3, 4, and 5 to validate the model. We also used a simplified version of the current model mesh without the polygons. We are currently integrating the intertidal storage scheme into the mesh to help synthesize the considerable amount of physical oceanographic data in the Duplin River and to provide quantitative estimates of marsh-creek exchange processes.

## Conclusions

We are planning several studies to aid in the quantification of material exchanges between marshes and tidal creeks. These studies include the calculation of diffusion and dispersion coefficients for use in studies of fluxes of carbon and other material, and calculations of fluxes into and out of the storage tanks to quantify marsh-creek exchange processes. By quantifying fluxes into and out of each polygon, we hope to define regions of the intertidal area that are more efficiently connected to the Duplin River. This would offer an indication of the potential for planktonic organisms to access different parts of the marsh surface, an important issue for larvae that settle onto the marsh surface as part of their life cycle.

The techniques described here could be used in other LTER marine sites, such as Virginia Coastal Reserve and Plum Island Sound, which also need accurate knowledge of exchange processes between intertidal areas and tidal creeks.

## Acknowledgments

We gratefully acknowledge support from the National Science Foundation (OCE 99-82133), which funded the aerial mission to gather the infrared images. Thanks also to Steven Pennings, Tim Hollibaugh, and Daniela Di Iorio for their valuable comments on an earlier draft of this article.

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# INFORMATICS BITS AND BYTES

## NISAC committee working hard to facilitate LTER synthesis

In the last issue I highlighted progress on software, databases, and technical support projects at the LTER Network Office (*The Network News Vol. 17 No. 2 Fall 2004*). This quarter I update you on some important developments from the Network Information System Advisory Committee (NISAC) and the progress of the Informatics Training and Software Usability Testing Lab at LNO.

NISAC was appointed in Spring 2003. The group is made up of LTER principal investigators Tim Kratz (NTL), Mark Harmon (AND), Robin Ross (PAL), Deb Peters (JRN), and Stuart Gage (KBS); information managers Don Henshaw (chair, AND), Barbara Benson (NTL), Emery Boose (HFR), and Peter McCartney (CAP); and LNO representatives Bob Waide, Bill Michener, John Vande Castle, James Brunt, and Mark Servilla.

The Committee met four times in the last year and had numerous conference calls. In addition to setting ongoing NIS priorities at the Network Office, the group is developing a Network Information System (NIS) module selection process and a strategic plan for the Network Information System, revising the LTER Network Data Policies, and helping to refine information management review criteria.

### NIS module selection process

NIS modules are specifically targeted information content for the NIS. To make decisions and prioritize the selection of new content, NISAC developed a process (since approved by the LTER Coordinating Committee (CC)) that names potential data types and outlines the process and documentation necessary to propose a new module. Adding content to the NIS helps document the progress of synthesis activities, and modules become Network resources that increase efficiency of future synthesis.

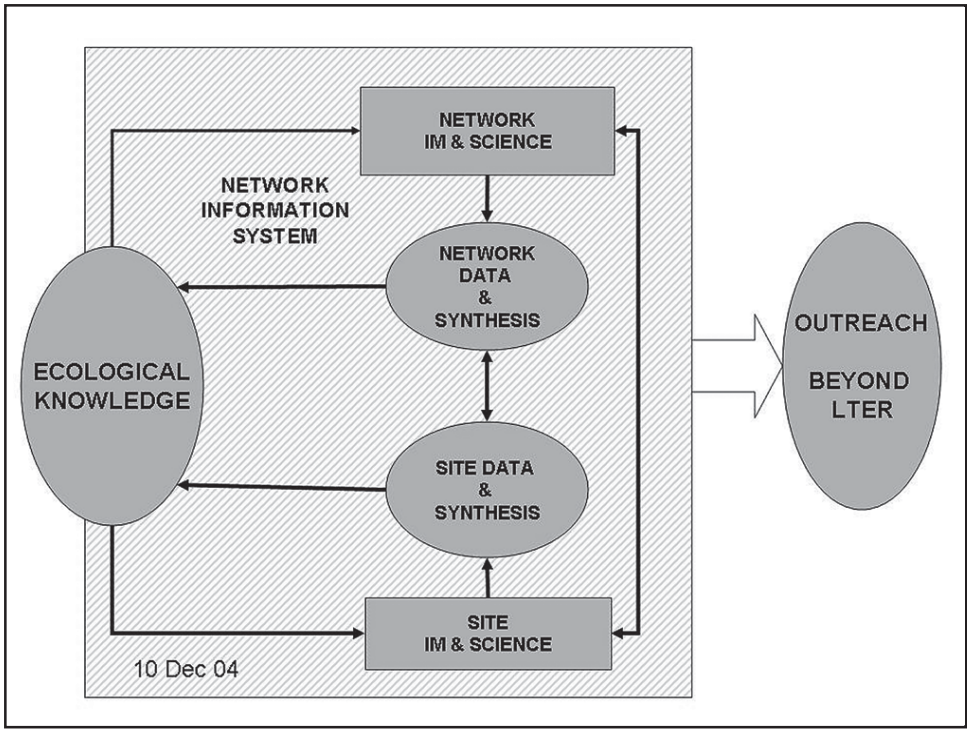



Figure 1. Mark Harmon and Stuart Gage produced this conceptual drawing of NIS function for the strategic plan.

### Network Information System Strategic Plan

NISAC is in the final phase of strategic planning that defines the mission and goals of the NIS effort and elaborates the strategies and actions necessary to make progress over the next four years. The draft plan defines NIS as an infrastructure for confederation and research collaboration depending on site data repositories, and comprising information technologies and information products resulting from research activities across LTER and its partners. NIS enhances information flows among data, synthesis, and knowledge about ecological systems (Figure 1). NIS will be implemented through the use of shared standards, software tools, training, and support, to integrate and provide compatibility across LTER sites, institutions, and researchers. The NIS strategic plan seeks to balance the development of short-term priority products with the development of long-term generic solutions and an improved network-wide infrastructure. While NIS serves primarily the LTER scientific community and collaborators, it is also a "portal" to LTER data products for the broader scientific community, natural resource managers, policymakers, and the general public.

### LTER Network Data Policy Revision

A NISAC working group was charged with analyzing the current LTER site policies for the release, access, and use of LTER data. As a result, the group recommended: 1) expanding the current LTER Data Access Policy to cover the release of data and metadata, 2) standardizing Network requirements for accessing LTER data, and 3) drawing up data use agreements specifying terms of acceptable use of LTER data.

Consequently, revised LTER data release and general data use policies have been drafted and are in review. The adoption of these revised policies by the LTER Network is motivated by the needs:

❖ to ensure that the data release, data access, and data use language is consistent and clear across the network

See "Informatics," p.14

Informatics (cont. from p.13)

- ❖ to standardize the approach to data access requirements for automated data distribution
- ❖ to standardize the requirements for data provision and use
- ❖ to ensure that the LTER Network data policies are consistent and interoperable with those of other NSF-funded programs.

Re-evaluation of the policy serves to assure data providers that their data sets will be used appropriately and promotes a culture within the ecological community of making data available to the general scientific community in a timely fashion.

## Information Management Review Criteria

NISAC is working with the Information Management committee to develop criteria for reviewing LTER site information management systems. The aim is to provide appropriate and unambiguous criteria to site information managers, management teams, and reviewers on the kind of data and information management standards the LTER Network expects of its sites. The effort is spearheaded by Emery Boose, and the document it has prepared is in its final phases of review and should be available for use after the Spring CC meeting.

The Committee will meet again in June with the Network Science Working Groups, which are charged with assessing current LTER information capabilities and IT infrastructure, and will work with the Science Task Force to define infrastructure models to support and facilitate the goals of synthetic research.

Drafts of all the documents mentioned above can be viewed on the LTER committees working area of the intranet (*http://committees.lternet.edu*).

*James Brunt*
*Associate Director for Information Management*
*LTER Network Office*

Photo: McOwiti O. Thomas

LNO personnel in the new Informatics Training and Software Usability Testing lab

*For more informatics news, read* **Databits** *online at http://www.lternet.edu/*

# Informatics Training Lab Opens at LNO

The LTER Network Office (LNO) is in the process of completing the installation of a laboratory for informatics training and usability testing. LNO associate directors Bill Michener and James Brunt designed the lab to be more functional than traditional computer classrooms. The lab boasts comfortable, clustered seating and large, dual, LCD color monitors. Designed to be more functional than traditional computer classrooms, the laboratory eliminates visual barriers and rows and aisles that impede personalized instruction. Although the audiovisual system has not been completed, the lab has been used for five intensive training sessions since computers were installed in October 2004 (Table 1, p. 15). The lab is funded through the NSF's SEEK grant and the University of New Mexico and is operated by LNO and SEEK personnel.

The first official training at the Informatics Training and Software Usability Testing Laboratory was held in October 2004. The new, state-of-the-art facility is equipped with 21 top of the line Dell PC's with dual 19-inch flat panel displays. The lab is organized in four pods, each with five systems surrounding the instructor station at the center of the lab. Each system runs on Microsoft Windows XP Professional and is equipped with the appropriate productivity office software tools, database management tools, anti-virus scanner, adware/spyware blocker, firewall, and other utility software. Training-specific software can be added on request. The instructor station is further equipped with dual high resolution LCD projectors. The systems are all connected via wired Gigabit network, and high-speed wireless connectivity is provided for user mobile devices. The lab is also equipped with screen recording and capture software to help collect usability information. Work is underway to provide instructor console-managed facilities for video teleconferencing, DVD and VHS playback, LCD projection, and instructor-to-trainee station cloning for guided training and demonstration techniques.

Five training courses have been held since the lab opened. These trainings are geared toward introducing the general concepts of ecoinformatics to information and data managers at field stations, and academic faculty in ecology and biology. Over the past year and a half LNO, in conjunction with National Center for Ecological Analysis and Synthesis, has conducted nine on-site trainings. The following are brief descriptions of some of the trainings offered:

## OBFS Resource Discovery Initiative for Field Stations

A two-week workshop to help field station and data managers acquire the skills and tools of ecoinformatics for data acquisition and archiving, and to apply these skills to managing ecological data at field and marine stations across the country. Participants learn how to design dynamic websites, employ advanced wireless networking technologies, use Morpho to create Ecological Metadata Language (EML), and get ESRI (Environmental Systems Research Institute) certification in ArcGIS. More than 50 data and field station managers have received this training over the past two years.

## KNB Data Management Tools

A three-day intensive workshop to give ecologists, biologists, and data managers hands-on experience using some of the ecoinformatics tools created under the Knowledge Network for Biocomplexity Project (*http://knb.ecoinformatics.org*) and to apply these skills to managing ecological data at field and research stations across the country. Participants get hands-on experience with Morpho metadata software, KNB data registry page, Ecological Metadata Language (EML), and Metacat. More than 50 ecologists, biologists, and data managers have received this training over the past year.

## The Early Career Faculty and Postdoctoral

A one-week workshop to help early career faculty and postdoctoral associates incorporate ecoinformatics concepts and tools in their research and teaching. Participants receive hands-on experience using emerging technologies from the SEEK project (*http://seek.ecoinformatics.org/*)—such as Kepler system for scientific workflows, EcoGrid, as well as other database and metadata management software and wireless technologies. About 30 early career faculty in biology, ecology, and related fields have received this training thus far.

Laura Downey, Senior Usability Engineer on the SEEK project at LNO, is using these trainings to conduct a variety of usability activities to help gauge users' needs and to improve our software tools. To date, Laura has gathered usability data on Kepler, Morpho, and the KNB data registry pages.

*Samantha Romanello*
*SEEK Project, LNO*

**Table 1 - Recent Training in LNO Information Technology Training and Usability Lab**

| Training | Group |
|---|---|
| Informatics training for biological field station personnel | Resource Discovery Initiative for Field Stations (RDIFS) |
| Biodiversity and Ecological Analysis and Modeling (BEAM) | Science Environment for Ecological Knowledge (SEEK) |
| Early Career Faculty and Postdoctoral Training | Science Environment for Ecological Knowledge (SEEK) |
| Data Management Tools Workshop for LTER information managers | Knowledge Network for Biocomplexity (KNB) |
| Data Discovery in the Biological Sciences | Resource Discovery Initiative for Field Stations (RDIFS) |

## Cyberinfrastructure for Grassland Biodiversity Studies

The LTER Network has long recognized the importance of developing a broad-scale understanding of biodiversity processes and how altered biodiversity affects ecosystem response. The need to synthesize an ever-increasing body of biodiversity and productivity data is essential toward that end. Past synthetic studies of species diversity and productivity relationships (Waide *et al.* 1999; Gross *et al.* 2000; Scheiner *et al.* 2000; Knapp & Smith 2001; Knapp *et al.* 2004) have largely been accomplished by manually integrating many data sets—a lengthy and tedious process at best. Given the network-wide emphasis on synthetic, cross-site studies and the voluminous data anticipated from the National Ecological Observatory Network (NEON) project, the need for automated methods of integrating heterogeneous data for use in sophisticated analyses is paramount.

SEEK (*http://seek.ecoinformatics.org*) is a large, NSF-funded Information Technology Research (ITR) project designed to provide solutions for data integration (Michener *et al.* accepted). The SEEK cyberinfrastructure is currently being prototyped and tested with biodiversity and productivity data from six LTER grassland sites (ARC, GCE, JRN, KBS, NWT, and SGS) through a collaborative working group. The group includes ecologists and information managers associated with the participating sites, geospatial scientists, ecoinformatics specialists, computer scientists, and software developers from the LTER Network Office, National Center for Ecological Analysis and Synthesis, and University of California, Davis. The goal of the prototype project is to design generic tools for automated or semi-automated data integration based on the specific characteristics of these data sets. The robustness of the tools will be tested on data from additional sites. The integrated datasets will then be input into the Kepler Workflow System (*www.kepler-project.org*), which provides automated analysis and modeling.

The SEEK project builds on prior research on ecological metadata standards

See "Cyberinfrastructure," p.16

## Cyberinfrastructure (cont. from p.15)

(*http://knb.ecoinformatics.org*). This prototype project requires level 5 metadata (the most detailed level) and will demonstrate the effectiveness of metadata-driven approaches to data discovery, integration, and analysis in ecology. A second prototype project is developing computer-intensive approaches, using broad-scale species distribution analysis with ecological niche modeling (Peterson & Vieglais, 2001). Both prototypes will benefit from cutting-edge IT approaches in ontologies and semantic mediation that formally capture the knowledge of a discipline for logical reasoning by the system.

Such approaches (data-intensive, computer-intensive, and discipline-intensive) are being researched across many scientific communities in ongoing projects and represent an emerging scientific cyberinfrastructure framework. The SEEK project, which makes use of all of these new approaches, is the forerunner of cyberinfrastructure design for the NEON (*http://www.neoninc.org/documents/it_communications_meet1_report.pdf*) project, which will implement the design for synthetic research across all scientific questions of interest.

### References


Gross, K. L., M. R. Willig, L. Gough, R. Inouye and S. B. Cox (2000). Patterns of species density and productivity at different spatial scales in herbaceous plant communities. *Oikos,* 89, 417-427.

Knapp, A. K. and M. D. Smith (2001). Variation among biomes in temporal dynamics of aboveground primary production. *Science,* 291, 481-484.

Knapp, A. K., M. D. Smith, S. L. Collins, N. Zambatis, M. Peel, S. Emery, J. Wojdak, M. C. Horner-Devine, H. Biggs, J. Kruger and S. J. Andelman (2004). Generality in ecology: testing North American grassland rules in South African savannas. *Frontiers in Ecology and the Environment,* 2, 483-491.

Michener, W. K., J. H. Beach, M. B. Jones, B. Ludaescher, D. Pennington, R. S. Pereira, A. Rajasekar and M. Schildhauer (accepted). A knowledge environment for the biodiversity and ecological sciences. *Journal of Intelligent Information Systems.*

Peterson, A. T. and D. A. Vieglais (2001). Predicting species invasions using ecological niche modeling: new approaches from bioinformatics attack a pressing problem. *BioScience,* 51, 363-371.

Scheiner, S. M., S. B. Cox, M. Willig, G. G. Mittelbach, C. Osenberg and M. Kaspari (2000). Species richness, species-area curves and Simpson's paradox. *Evolutionary Ecology Research,* 2, 791-802.

Waide, R. B., M. R. Willig, C. F. Steiner, G. Mittelbach, L. Gough, S. I. Dodson, G. P. Juday and R. Parmenter (1999). The relationship between productivity and species richness. *Annual Review of Ecology and Systematics,* 30, 257-300.


*Deana D. Pennington*
*SEEK Project, LNO*

## Making Technology Work for Scientists

Technology has become ubiquitous in our personal and professional lives, from the internet and web applications, to parallel processing and grid technologies. The ability to communicate and share results has increased by orders of magnitude with the advent of email, the World Wide Web, instant messaging, and other technologies. But the success of all of these new technologies hinges on humans' ability to use the technology to accomplish desired tasks—whether that involves modeling climate change across the globe due to global warming, or entering weekly time charges on the company intranet.

When I was interviewing for the usability engineer position on the Science Environment for Ecological Knowledge (SEEK) project, I was very excited about the opportunity to make technology work for scientists. One of the major goals of the SEEK project and the LNO is to help scientists take advantage of current technology to support their research in new and different ways. And we understand that if technology is frustrating or doesn't help you do what you need to do, you won't use it.

The field of making technology work for people is called "usability," and it is my passion. I'm interested in making sure you can use technology efficiently and effectively to accomplish your tasks and that you have a satisfying experience while doing so. My major goal is to make the technology work for you instead of you having to work to use it.

Many people think usability involves only the user interface of a product. While that is a primary focus, usability is really about the entire product. An application can have a wonderful user interface but lack the necessary features to help you get your work done. Conversely, an application can be full of powerful and useful features, but it won't help you much if the interface isn't designed to let you fully exploit the system internals.

There are many ways to ensure usability. First, usability practitioners apply good design principles developed through years of human factors research. But the primary component is making sure that users of the technology are involved in the requirements, design, and evaluation process. To that end, we might ask you to participate in different activities such as answering questionnaires, becoming involved in focus groups or directed discussions, and performing exercises using prototypes or finished applications so we can determine any usability issues and resolve them.

We want to understand your needs so that we can produce the best tools for you. We may, for example, ask if we can observe you in your working environment for a day to understand the tasks you do daily, the problems you encounter, and the technology you currently use. The more we know about you and your work, the better we can improve existing tools and design new ones that let you fully exploit the power of technology while supporting your research needs and enabling you to conduct new and better science.

We have already put these activities into practice in developing a SEEK product, the Kepler Workflow System. We conducted surveys, basic usability testing, and focus groups at two recent Kepler workshops—during a working group meeting in December 2004 and during an Ecoinformatics training workshop in January 2005. We identified several usability issues, made recommendations for improvements, and collected suggestions for features to be included in future. The cooperation of workshop participants (the users) was essential in all these activities, so the next time someone from LNO asks you to participate in usability activities, you can do so with the knowledge that not only are we working hard to make technology work for scientists, but you are doing your important part in making technology work for yourself and other scientists.

*Laura L. Downey*
*SEEK Project, LNO*

# Strategies for Building Scientific Cyberinfrastructure

## Continuing an ethnographic approach begun in 2002...

In 2004 the National Science Foundation's cross-cutting Human and Social Dynamics theme awarded Geoffrey Bowker and Karen Baker a three - year grant to study the dynamics of building scientific *cyberinfrastructure*—the connective elements needed to hold together communities of scientists working in multiple locations who want to share data and knowledge (see the Atkins Report, 2003, *http://www.communitytechnology.org/nsf_ci_report/*).

Work on the grant project, entitled *"Interoperability Strategies for Scientific Cyberinfrastructure: A Comparative Study,"* began in September 2004 with the arrival at University of California, San Diego, of Florence Millerand, a postgraduate researcher trained in Human-Computer Interface studies, and David Ribes, a graduate student in sociology working with distributed communities that incorporate technical infrastructure. The project's goal is to understand how to simultaneously mobilize community, organizational, and technical resources in support of data integration—that is, enabling the movement of data and ensuring it can be used across and within different disciplines.

A lot is at stake in the development of these new cyberinfrastructures. Often viewed as mere "technical" development efforts, we take an approach to cyberinfrastructures as being as much about the sociotechnical, the interplay of the conceptual and organizational with technical, as about the technology itself. Cyberinfrastructure has human dimensions: they include changing ways in which organizations recognize and support scientific work and how the ramifications of science are tended and individual careers are viewed.

The Comparative Study builds on work begun in 2002 with an earlier NSF grant, *"Designing an Infrastructure for Heterogeneity of Ecosystem Data, Collaborators, and Organization"* (see Network News Vol. 14 No. 2, Fall 2001), which opened up dialogue on 'data ecology'; supported postdoctoral researcher Helena Karasti; and initiated a cross-domain dialogue between LTER ecologists, information managers, and science studies researchers (Baker & Bowker, 2001).

Building from the salient features of infrastructure and collaboration, we are studying community characteristics in general and coordination mechanisms in particular. We are using a qualitative research approach, building from grounded theory using ethnographic and theoretical sampling approaches (Strauss, 1987).

Our initial work focuses on three projects with technical infrastructures:

- GEON, a distributed geosciences project based at the San Diego Supercomputer Center that is using ontologies as a shared community approach (Keller, 2003);
- Ocean Informatics, an oceanographic team at Scripps Institution of Oceanography that is developing a conceptual framework as a community building strategy to initiate dialogue on informatics as a design environment (Baker et al., 2005);
- The LTER community, a distributed network that is working to establish very long term baselines of ecological data (Hobbie et al., 2003).

Human dimension efforts within the LTER network recognize humans, in their individual capacities and as community members, as participants in designing their environment as well as in perceiving it (Kinzig et al., 2001; Redman 1999; Redman et al., 2004; LTER white paper).

LTER sites can draw from potentially synergistic fields within social science, ranging from political and economic ecology to history and anthropology, as well as sociology and sociotechnical informatics. For instance, local LTER sites focus on built communities (e.g., urban or education communities); on anthropological studies, (e.g., historical land use); or on data ecologies (e.g., information systems). We are working today within a context of multiple perspectives transitioning to include realistic approaches to science. For our work with data, technology, and communities we draw specifically upon science studies, information science, sociotechnical, and organizational informatics (e.g. Zimmerman, 2003; Bowker, 2001).

The realization that data, databases, and information systems are not socially or culturally neutral, changes our approach to designing scientific infrastructures. With a need for coordinated databases, we focus on strategies that enable interoperability.

### References


Baker KS, and GC Bowker, 2001. Designing an Infrastructure for Heterogeneity of Ecosystem Data, Collaborators, and Organizations. *The Network Newsletter Vol. 14 No. 2 Fall 2001.*

Bowker, GC, 2001. Biodiversity, Datadiversity. *Social Studies of Science*, 30(5), 643-684.

Hobbie, JE, SR Carpenter, NB Grimm, JR Gosz, and TR Seastedt, 2003. The US Long Term Ecological Research Program. *BioScience* 53(2), 21-32.

Keller, RB, 2003. GEON (GEOscience Network)-A First Step In Creating Cyberinfrastructure for The Geosciences. *Electronic Seismologist*, July/ August 2003.

Kinzig, AP, S Carpenter, M Dove, G Heal, S Levin, J Lubchenco, SH Schneider, and D Starrett, 2000. Nature and society: an imperative for integrated environmental research Excecutive Summary of a workshop sponsored by NSF, *Developing a Research Agenda for Linking Biogeophysical and Socioeconomic Systems,* Tempe, AZ, 5-8 June, http://lsweb.la.asu.edu/akinzig/report.htm

Redman, CL, JM Grove, and LH Kuby, 2004. Integrating Social Science into the Long-Term Ecological Research (LTER) Network: Social Dimensions of Ecological Change and Ecological Dimensions of Social Change. *Ecosystems* 7, 161-171.

Redman, CL, 1999. Human Dimensions of Ecosystem Studies. *Ecosystems* 2, 296-298.

Strauss A, 1987. Qualitative Analysis for Social Scientists. Cambridge University Press, Cambridge.

Zimmerman A, 2003 *Data Sharing and Secondary Use of Scientific Data: Experiences of Ecologists* PhD Thesis. The University of Michigan, Ann Arbor, pp 272.



*Karen S. Baker (UCSD, PAL/CCE LTER)*
*Geoffery C. Bowker (Santa Clara University)*
*Florence Millerand (UCSD)*
*David Ribes (UCSD)*


*For more information and a fuller list of references, see the online version at www.lternet.edu.*

## Taiwanese Researchers Get Tips from Kellogg LTER

Phase II of the International Workshop on Long Term Ecological Research in Agricultural Ecosystems took place last October at the Kellogg Biological Station (KBS) LTER. The six-day event was organized by KBS and the Taiwan Ecological Research Network (TERN). The workshop's objective was to familiarize TERN guests with the operations of KBS, its investigators, and administrators, as they prepared to establish a new agricultural LTER in Taiwan. Six TERN scientists spent nearly a week touring KBS, meeting with the LTER executive committee, and visiting southwest Michigan regional research and commercial agricultural sites. They ended the week by participating in the KBS LTER All Investigator Meeting at Michigan State University.

Chau Chin Lin, information manager for the Taiwan Forestry Research Institute and a future TERN executive committee member observed: "What was attempted at KBS was to understand how effective data management facilitates research and delivers services for use by ecologists. I was very impressed to find out that there is a sound philosophy for research data management at the KBS site." Chin Lin also noted that although IT techniques had changed tremendously in the past 20 years, the data management philosophy and legacy at KBS maintains a continuous and complete track of the data. He was particularly impressed with how KBS has used EML (ecological metadata language) successfully to modernize its data management while benefiting scientists to expand data sharing to all other LTER sites in the US.

Photo: Zueng Sang Chen

Workshop organizers (L-R) Mike Klug, Shan Ney Huang, and Andrew Corbin on the KBS Main Site.

The TERN visitors found KBS LTER's other operations very much to their liking. According to Shan Ney Huang, Director of Agricultural Experiment Stations in Taiwan, the main site experimental design and management was admirable. He found KBS's project foci—plant competition, Carbon and Nitrogen allocation, herbivory, pathogenesis and gene transfer, nutrient availability and soil organic matter dynamics, and the modeling of system-wide outputs—to be well discussed and organized, helping to facilitate research goals focused on the impact of agricultural activities on environmental sustainability. "Those findings can be adapted for us to set up the research in subtropical Taiwan with our intensive cropping systems," he noted.

Chi Ling Chen from the Taiwan Agricultural Research Institute added: "We are trying to assemble the agricultural LTER site in Taiwan in order to understand the mechanisms of the ecological system for agriculture in the subtropics." She said the agricultural LTER site would probably be located at the Taiwan Agricultural Research Institute. "The information we learned from our visit will be very useful for assembling the agriculture LTER site in Taiwan," she said.

For Zueng Sang Chen, Head of the Department of Agricultural Chemistry, National Taiwan University, "the most successful thing for me is the design of the project under different cropping systems. KBS has a good operations and management system to handle all monitoring and data management and to share all the metadata to the related PIs and other public researchers." Chen said KBS's efforts to provide education and extension activities for nearby schools and the community increases the center's influence and adds value to the station.

KBS and TERN researchers hope to continue their collaborative relationship throughout the establishment of the new site by addressing critical needs and facilitating an enduring international partnership.

*Andrew Corbin*
*Kellogg Biological Station LTER*

Photo: Andrew Corbin

Taiwan delegation along the Lake Michigan shore. (L-R) Zueng Sang Chen, Mike Klug, Chi Ling Chen, Shan Ney Huang, Chiu Chung Young, Chau Chin Lin, and Bing Huei Chen.

*For information on Phase I of the International Workshop, see* The Network Newsletter Vol. 16 No. 1 Spring 2003.

## JAPANESE SCIENTISTS HOST SUCCESSFUL U.S.-JAPAN WORKSHOP

A joint workshop on Biogeochemistry and Hydrology of Forested Watersheds associated with ILTER was held by U.S. and Japanese scientists March 14-18, 2005 in Hokkaido, Japan. The workshop had three aims: 1) facilitate the exchange of current research results, emphasizing long-term data collection, among U.S. and Japanese scientists; 2) stimulate further collaborative research between the two groups; and 3) facilitate further development of the Japanese ILTER Network.

The workshop was funded by the Japanese Society for the Promotion of Science (JSPS). U.S. scientists were funded by a National Science Foundation supplement to the Hubbard Brook LTER. Workshop participants (22 Japanese and eight U.S.) first gathered at the Uryu Experimental Forest (Hokkaido University) in northern Hokkaido—a region characterized by extensive snow (over two meters) and very cold temperatures (-41 °C) in winter.

Hideaki Shibata (Hokkaido University) opened the workshop with an overview of on-going research in the cool-temperate watersheds of Hokkaido, followed by a poster session during which Japanese and U.S. scientists shared research results on a wide variety of hydrological and biogeochemical topics. The next day participants took a field excursion to Uryu Experimental Forest. After an overview of the research site by the Director, Toshiya Yoshida, the group used skis, snowshoes, and snow caterpillars to reach the potential ILTER experimental sites.

Photo courtesy of Hideaki Shibata

U.S.-Japan Workshop participants at Uryu Experimental Forest, Hokkaido Japan.

Among U.S. presenters, Sheila Christopher discussed her current research, which is sponsored by a JSPS Postdoctoral Fellowship. Afterwards, Rick Hooper (Consortium of Universities for the Advancement of Hydrologic Science, Inc.) presented a case study of successful large-scale collaborative hydrologic research among U.S. universities, and a round-table discussion led by Nobu Ohte (Kyoto University) and Steve Hamburg (Brown University) focused on the similarities and differences between U.S. and Japanese watersheds.

The next day the group traveled south by bus and aircraft to Seto City and toured Aichi Experimental Forest (University of Tokyo) on Honshu, Japan's main island. Hirofumi Shibano, Director of the experimental forest, led a field excursion to Shirasaka watershed, another potential Japanese ILTER site with a long history of hydrological monitoring. Later, Charley Driscoll (Syracuse University) gave an overview of the Hubbard Brook LTER site, emphasizing the importance of long-term research. Myron Mitchell (SUNY Environmental Science and Forestry) and Hideaki Shibata then led the group in a very productive discussion on major issues related to hydrological and biogeochemical research in Japan. The issues were divided into five categories: 1) spatial scaling, 2) riparian zones, 3) climate change and global warming, 4) disturbance and land use, and 5) nutrient limitation.

Workshop organizers and participants are compiling these ideas into a report that will be used to develop future proposals to cover research not only in Japan, but throughout East Asia. These ideas will be discussed further at the next meeting of the East Asia and Pacific regional ILTER scheduled for March 2006 in Japan.

*Sheila F. Christopher, JSPS Postdoctoral fellow, Field Science Center for the Northern Biosphere, Hokkaido University, Japan*

## SGS Symposium (cont. from p.5)

discussion on environmental changes in the SGS that may create favorable conditions and provide resources for invasive species. In turn, SGS-LTER researchers discussed their resource enrichment studies, explaining that currently grazed pastures in the SGS have not been invaded significantly by exotic species.

CSU's Mike Antolin presented research on interactions between prairie dogs, the plague, and the diversity of fauna in prairie dog towns. He explained the introduction of plague in Black-tailed prairie dog populations has affected the structure of dog towns, and that extinctions caused by plague and conditions for re-colonization may be tied to temperature, moisture, physical interactions with infected wildlife, and the persistence of plague in the environment.

To wind up, Alan Knapp (CSU) gave a synthesis of all the ideas presented during the day. He reviewed the challenges facing SGS researchers, managers, and producers; gave a history of LTER research at local, regional, and international scales; and discussed the need for forecasting services for ecosystems. He observed that while LTER research is being applied to conservation and management planning, it is challenged still by the need for ecosystem predictions. LTER research addresses patterns of invasion, responses of ecosystems to variations in weather patterns, and potential influences of climate change, which are current global questions for managers, policy makers, and scientists. But while we may not be very successful at making accurate predictions, he said, we do know enough from our research under different ecosystem conditions to build scenarios and understand the potential consequences of certain actions. In the long term, he concluded, increases in human population and the ensuing impact on the natural world will present new challenges to our understanding of ecosystems and necessitate incorporating human dimensions into research, management, and conservation activities.

*Nicole Kaplan, Sallie Sprague, Caroline Yonker and Judy Hendryx, SGS LTER*

*More information can be found at http://sgs.cnr.colostate.edu/News/sgs_symposium_05/sgs_sym_05-home.htm*

# Publications

## ...of special interest

### CAP LTER Publication

**"Approaches to the study of urban ecosystems: The case of Central Arizona—Phoenix"** by *Nancy B. Grimm* and *Charles L. Redman*. In **Urban Ecosystems** (Published by Springer Science+Business Media B.V., formerly Kluwer Academic Publishers B.V.); Volume 7, Number 3, September 2004; Pages 199 – 213; ISSN: 1083-8155 (Paper) 1573-1642 (Online).


***Abstract***

CAP LTER focuses on an arid-land ecosystem profoundly influenced, even defined, by the presence and activities of humans and is one of only two LTER sites that specifically studies the ecology of an urban system. In this large-scale project, biological, physical, and social scientists are working together to study the structure and function of the urban ecosystem, to assess the effects of urban development on surrounding agricultural and desert lands, and to study the relationship and feedbacks between human decisions and ecological processes. Our interdisciplinary investigations into the relationship between land-use decisions and ecological consequences in the rapidly growing urban environment of Phoenix are of broad relevance for the study of social ecological systems and cites in particular. Refinements in our conceptual model of social ecological systems focuses our attention on recognizing the scales and periodicities of ecological and human phenomena, understanding the means and impacts of human control of variability in space and time, and finally an evaluation of the resilience of various aspects of socio-ecological systems especially their vulnerabilities and their potential for adaptive learning.


### Arctic Synthesis Book now Online

The synthesis book of the International Biological Program (IBP) Tundra Biome, **"An Arctic Ecosystem: The Coastal Tundra at Barrow, Alaska,"** is now available online. The book, published in 1980, is an integrated discussion of a tundra ecosystem rather than a collection of independent papers. Although divided into chapters on abiotic settings, primary production processes, soil and decomposition processes, and herbivory, the complex lines of interaction and influence among the divisions run throughout the book. Within each of these subdivisions, the reader will find a common theme: the limitation of rates of biological processes by low temperature, the related conditions of short growing season, and the presence of permafrost. The book is put online jointly by the Marine Biological Laboratory of the Woods Hole Oceanographic Institution (MBLWHOI) Library and the Arctic LTER project. The book joins another online book, *"Limnology of Tundra Ponds, Barrow, Alaska"* (1980), which is the synthesis volume for the aquatic projects in the Tundra Biome IBP.

*For more information:*

- An Arctic Ecosystem: The Coastal Tundra at Barrow, Alaska: *http://www.mblwhoilibrary.org/databases/brown/index.html*
- Limnology of Tundra Ponds, Barrow, Alaska: *http://www.mblwhoilibrary.org/databases/bobbie/index.html*

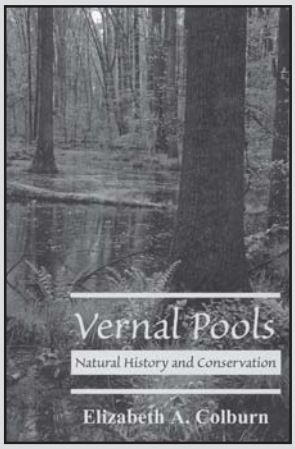
### Recently added to the Sevilleta Publications Database

*Duran, K. L., Lowrey, T. K., Parmenter, R. R., Lewis, P. O.* 2005. Genetic diversity in Chihuahuan Desert populations of creosotebush (Zygophyllaceae: Larrea tridentata). American Journal of Botany 94:722-729 [SEV Pub. No. 306]

## Harvard Forest Releases Three New Books

### Vernal Pools: Natural History and Conservation

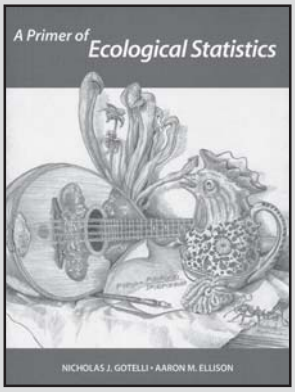
*Aquatic ecologist, Betsy Colburn has drawn on her twenty-five years of in depth, wide-ranging studies of Vernal Pools in compiling this valuable reference book entitled* ***Vernal Pools: Natural History and Conservation*** *(McDonald and Woodward Publishing Company; $25 from HF).*




This book is recommended for scientist and layperson alike as it provides a comprehensive background on the natural history, ecology, and conservation of these biologically diverse and dynamic seasonal ponds. Written in an accessible style, the following audiences will find this book to be an especially important reference: landowners, naturalists, teachers, researchers, conservationists, resource managers, planners, and policy makers. Researchers may especially appreciate the extensive technical information including scientific citations and a list of suggestions for future research on each topic contained in this volume. Readers will find a wealth of information not previously available in one source.

### A Primer of Ecological Statistics

*Senior Research Fellow at Harvard Forest, Aaron Ellison, along with University of Vermont Biology professor, Nicholas Gotelli, has developed a very different kind of ecological reference book:* ***A Primer of Ecological Statistics*** *(Sinauer Associates; $35 from HF).*




*A Primer of Ecological Statistics* explains fundamental material in probability theory and experimental design for ecologists and environmental scientists. The book is designed to serve as either a stand-alone or supplementary text for upper division undergraduate or graduate courses in ecological and environmental statistics, ecology, environmental science, environmental studies, or experimental design. The Primer also could be used for short-courses or workshops for conservation biologists and environmental managers. The book emphasizes a general introduction to probability theory and provides a detailed discussion of specific designs and analyses that are typically encountered in ecology and environmental science. Topics include probability, statistical distributions, hypothesis testing, probability

*Continued p. 21*

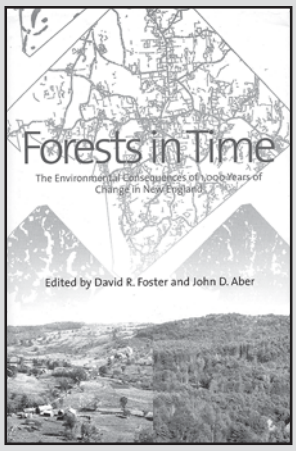
*Ecological Statistics (from p. 20).*

values, Bayesian analysis, experimental and sampling design, data archiving, regression, analysis of variance, categorical data, and multivariate analysis. A comprehensive glossary, a mathematical appendix on matrix algebra, and extensively annotated tables and figures are included.

## Forests In Time

(Second Printing for the Harvard Forest LTER Synthesis Volume)

*Harvard Forest director, David Foster, and University of New Hampshire professor, John Aber, (PIs at Harvard Forest and Hubbard Brook LTER sites) have combined history and science in ecological studies and environmental management in the form of* ***Forests In Time: The Environmental Consequences of 1000 Years of Change in New England*** *(Yale University Press; $25 from HF).*




This book represents the synthesis volume for the Harvard Forest LTER program and has contributions from more than fifty authors. The authors apply an interdisciplinary approach to one of the most remarkably transformed landscapes in North America: the New England countryside. Written in accessible prose and profusely illustrated with photographs, maps, and graphs, the book relates the history of changes in New England and then explores the results of integrated ecosystem studies and experiments in

# List of Recent Publications from the LTER Community

## Andrews


Ashkenas, Linda R.; Johnson, Sherri L.; Gregory, Stan V.; Tank, Jennifer L.; Wollheim, Wilfred M. 2004. A stable isotope tracer study of nitrogen uptake and transformation in an old-growth forest stream. Ecology. 85(6): 1725-1739.

Forman, R. T. T., and others. 2003. Road ecology. Island Press. 481 p.

Garman, Steven L. 2004. Design and evaluation of a forest landscape change model for western Oregon. Ecological Modelling. 175: 319-337.

Harcombe, P. A.; Greene, S. E.; Kramer, M. G.; Acker, S. A.; Spies, T. A.; Valentine, T. 2004. The influence of fire and windthrow dynamics on a coastal spruce-hemlock forest in Oregon, USA, based on aerial photographs spanning 40 years. Forest Ecology and Management. 194: 71-82.

Harmon, Mark E.; Bible, Ken; Ryan, Michael G.; Shaw, David C.; Chen, H.; Klopatek, Jeffrey; Li, Xia. 2004. Production, respiration, and overall carbon balance in an old-growth *Pseudotsuga-Tsuga* forest ecosystem. Ecosystems. 7: 498-512.

Holub, Scott M.; Lajtha, Kate. 2004. The fate and retention of organic and inorganic 15N-nitrogen in an old-growth forest soil in western Oregon. Ecosystems. 7: 368-380.

Homann, P. S.; Remillard, S. M.; Harmon, M. E.; Bormann, B. T. 2004. Carbon storage in coarse and fine fractions of Pacific Northwest old-growth forest soils. Soil Science Society of America Journal. 68: 2023-2030.

Johnson, Sherri L. 2004. Factors influencing stream temperatures in small streams: substrate effects and a shading experiment. Canadian Journal of Fisheries and Aquatic Sciences. 61: 913-923.

Johnston, Carol A.; Groffman, Peter; Breshears, David D.; Cardon, Zoe G.; Currie, William; Emanuel, William; Gaudinski, Julia; Jackson, Robert B.; Lajtha, Kate; Nadelhoffer, Knute; Nelson, David Jr.; Post, W. Mac; Retallack, Greg; Wielopski, Lucian. 2004. Carbon cycling in soil. Front Ecol. Environ. 2(10): 522-528.

Jones, Julia A.; Post, David A. 2004. Seasonal and successional streamflow response to forest cutting and regrowth in the northwest and eastern United States. Water Resources Research. 40: W05203, doi: 10.1029/2003WR002952.

Lindh, Briana; Muir, Patricia S. 2004. Understory vegetation in young Douglas-fir forests: Does thinning help restore old-growth composition? Forest Ecology and Management. 192: 285-296.

Lookingbill, Todd R.; Goldenberg, Neal E.; Williams, Brian H. 2004. Understory species as soil moisture indicators in Oregon's western Cascades old-growth forests. Northwest Science. 78(3): 214-224.

Moore, Georgianne W.; Bond, Barbara J.; Jones, Julia A.; Phillips, Nathan; Meinzer, Frederick C. 2004. Structural and compositional controls on transpiration in 40- and 450-year-old riparian forests in western Oregon, USA. Tree Physiology. 24: 481-491.

Pyle, Robert Michael. 2004. The long haul. Orion. September/October: 70-71.

Pypker, T. G.; Bond, B. J.; Unsworth, M. H. 2004. The role of epiphytes in the interception and evaporation of rainfall in old-growth Douglas-fir forests in the Pacific Northwest. In: The 26th conference on Agricultural and Forest Meteorology ; Vancouver, BC, Canada. Boston, MA: American Meteorological Society.

Unsworth, Michael H.; Bond, B. J.; Mix, A. C.; Pypker, T. G.; Mahrt, L. 2004. Nocturnal air drainage in forest canopies: A new way of studying physiological responses to the weather? In: The 26th conference on Agricultural and Forest Meteorology ; Vancouver, BC, Canada. Boston, MA: American Meteorological Society.

Weisberg, Peter J. 2004. Importance of non-stand-replacing fire for development of forest structure in the Pacific Northwest, USA. Forest Science. 50(2): 245-258.


## Florida Coastal Everglades


Borum, J., O. Pedersen, T. M. Greve, T. A. Frankovich, J. C. Zieman, J. W. Fourqurean and C. J. Madden. 2005. The potential role of plant oxygen and sulphide dynamics in die-off events of the tropical seagrass, Thalassia testudinum. Journal of Ecology 93(1): 148-158.

Daoust, R.J. and D.L.Childers, 2004. Ecological effects of low-level phosphorus additions on two plant communities in a neotropical freshwater wetland ecosystem. Oecologia 141:672-686.

Davis, S.E., J.E. Cable, D.L. Childers, C. Coronado-Molina, J.W. Day, C.D. Hittle, C.J. Madden, D. Rudnick, E. Reyes, F. Sklar, 2004. Importance of Episodic Storm Events in Controlling Ecosystem Structure and Function in a Gulf Coast Estuary. Journal of Coastal Research 20(4):1198-1208.

Ewe, S.M.L. and Sternberg L. da S.L. 2005. Growth and gas exchange patterns of the invasive exotic Schinus terebinthifolius contrasted with native species under controlled saline conditions. Trees. 19(2):119-128.

Mead, R.N., Y. Xu, J. Chong and R. Jaffé, 2005. Sedimentary organic matter source assessment in a subtropical wetland and estuarine environment using the molecular distribution and carbon isotopic composition of n-alkanes. Organic Geochemistry 36: 363-370.

Krauss, W.K, Doyle, Twilley, R. R., Smith T. J, Whelan K. R.T., Sullivan, J K. 2005. Woody Debris in the Mangrove Forests of South Florida. Biotropica 37(1): 9–15.

Maie, N., C.Y. Yang, T. Miyoshi, K. Parish, and R. Jaffé. 2005. Chemical characteristics of dissolved organic matter in an oligotrophic subtropical wetland/estuarine ecosystem. Limnology and Oceanography 50(1): 23-35.

Scully N.M., N. Maie, S. Dailey, J.N. Boyer, R.D. Jones and R. Jaffé, 2004. Photochemical and microbial transformation of plant derived dissolved organic matter in the Florida Everglades. Limnology & Oceanography 49(5): 1667-1678.

Stevenson, C. and D.L. Childers, 2004. Patterns of fish decomposition in an oligotrophic freshwater Evergaldes marsh. Wetlands 24(3): 529-537.


## Georgia Coastal Ecosystem

***Journal Articles***


Cai, W.-J. and Dai, M., 2004. A Comment on "Enhanced open ocean storage of CO2 from shelf sea pumping". Science, 306: 1477c.

Cai, W.-J. et al., 2004. The biogeochemistry of inorganic carbon and nutrients in the Pearl River estuary and the adjacent Northern South China Sea. Continental Shelf Research, 24: 1301-1319.

Goranson, C.E., Ho, C.-K. and Pennings, S.C., 2004. Environmental gradients and herbivore feeding preferences in coastal salt marshes. 140: 591-600.

Magalhães, C.M., Joye, S.B., Moreira, R.M., Wiebe, W.J. and Bordalo, A.A., 2005. Salinity and inorganic nitrogen effects on nitrification and denitrification rates in intertidal sediments and rocky biofilms: Douro River estuary, Portuga. Water Research, in press.

Pennings, S.C. and Silliman, B.R., 2005. Linking biogeography and community ecology: latitudinal variation in plant-herbivore

interaction strength. Ecology, in press.
Richards, C.L., Hamrick, J.L., Donovan, L.L. and Mauricio, R., 2004. Unexpectedly high clonal diversity of two salt marsh perennials across a severe environmental gradient. Ecology Letters, 2004(7): 1155-1162.
Richards, C.L., Pennings, S.C. and Donovan, L.A., 2004. Community-wide patterns of phenotypic variation in salt marsh plants. Plant Ecology, in press.
Salgado, C.S. and Pennings, S.C., 2005. Latitudinal variation in palatability of salt-marsh plants: are differences constitutive? Ecology, in press.
Snyder, M., Taillefert, M. and Ruppel, C.D., 2004. Redox zonation at the saline-influenced boundaries of a permeable surficial aquifer: effects of physical forcing on the biogeochemical cycling of iron and manganese. 296: 164-178.
Wang, Z. and Cai, W.-J., 2004. Carbon dioxide degassing and inorganic carbon export from a marsh dominated estuary (the Duplin River): A marsh CO2 pump. Limnology & Oceanography, 49(2): 341-352.
Zimmer, M., Pennings, S.C., Buck, T.L. and Carefoot, T.H., 2004. Salt Marsh Litter and Detritivores: A Closer Look at Redundancy. Estuaries, 27(5): 753–769.

***Book Sections***

Blanton, J.O., Andrade, F. and Adelaide Ferreira, M., 2005. The Relationship of Hydrodynamics and Morphology in Tidal-Creek and Salt-Marsh Systems in South Carolina and Georgia. In: G.S. Kleppel, M.R. DeVoe and M.V. Rawson (Editors), Implications of changing land use patterns to coastal ecosystems. Springer-Verlag, New York, NY.
Craft, C.B., 2005. Natural and constructed wetlands. In: M.G. Anderson (Editor), Encyclopedia of Hydrological Sciences. John Wiley and Sons, New York.
Kohlmeyer, J., Volkmann-Kohlmeyer, B. and Newell, S.Y., 2004. Marine and estuarine mycelial Eumycota and Oomycota. In: G.M. Mueller, G.F. Bills and M.S. Foster (Editors), Biodiversity of Fungi. Inventory and Monitoring Methods. Elsevier Academic Press, Amsterdam, pp. 533-545.
Newell, S.Y., Lyons, J.I. and Moran, M.A., 2005. A saltmarsh decomposition system and its ascomycetous laccase genes. In: G. Gadd, P. Dyer and S. Watkinson (Editors), Fungi in the Environment. Cambridge University Press, Cambridge, UK.
Pennings, S.C. and Borneman, E.H., 2005. Indirect effects of interactions among species on coral reefs, Life and death of coral reefs. Chapman & Hall, London.
Pomeroy, L.R. and Cai, W.-J., 2005. Oxygen, carbon dioxide, and estuarine condition. In: G.S. Kleppel, M.R. DeVoe and M.V. Rawson (Editors). Springer-Verlag, New York.

***Theses***

Albers, G., 2004. Applications of Island Biogeography: Plant Diversity and Soil Characteristics Among Back-Barrier Islands Near Sapelo Island, Georgia. M.S. Thesis, University of Georgia, Athens, Georgia.
McFarlin, C.R., 2004. Impact of Fertilization on a Salt Marsh Food Web in Georgia. M.S. Thesis, University of Georgia, Athens, Georgia, 127pp. pp.
Ogburn, M., 2004. Investigations of salt marsh die-back in coastal Georgia. M.S. Thesis, University of Georgia, Athens, Georgia.
Richards, C.L., 2004. Evolution in closely adjacent salt marsh environments. Ph.D. Dissertation, University of Georgia, Athens, GA, 141pp. pp.
Salgado, C., 2004. Latitudinal variation in palatability of salt marsh plants: Constitutive or induced? M.S. Thesis, University of Houston, Houston, TX.
Thoresen, M., 2004. Temporal and spatial variation in seston available to oysters and the contribution of benthic diatoms to their diet in the Duplin River, Georgia. M.S. Thesis, University of Georgia, Athens, Georgia.
White, S.N., 2004. Spartina species zonation along an estuarine gradient in Georgia: Exploring mechanisms controlling distribution. M.S. Thesis, University of Georgia, Athens, Georgia.

## Kellogg Biological Station

Holdaway-Dopp, H.A. 2003. Changes in microbial community responses to gradients of carbon, nitrogen, and wetting cycles in concentric layers of soil macro-aggregates. MS Theses, Michigan State University, East Lansing, Michigan, USA.
Morris, S. J., and G. P. Robertson. 2005. Linking function between scales of resolution. Pages 13-26 in J. Dighton, P. V. Oudemans, and J. F. White, eds. The Fungal Community, 3rd Ed. Marcel Dekker, New York, New York, USA.
Kosola, K. R., D. M. Durall, G. P. Robertson, D. I. Dickmann, D. Parry, C. A. Russell, and E. A. Paul. 2004. Resilience of mycorrhizal fungi on defoliated and fertilized hybrid poplars. Canadian Journal of Botany 82: 671-680.
Robertson, G. P., and S. M. Swinton. 2005. Reconciling agricultural productivity and environmental integrity: A grand challenge for agriculture. Frontiers in Ecology and the Environment 3: 38-46.
Russell, C. A., K. R. Kosola, E. A. Paul, and G. P. Robertson. 2004. Nitrogen cycling in poplar stands defoliated by insects. Biogeochemistry 68: 365-381.

## Luquillo

Angulo-Sandoval, P., H. Fernandez-Marin, J. K. Zimmerman, and T. M. Aide. 2004. Changes in patterns of understory leaf phenology and herbivory following hurricane damage. Biotropica 36:60-67.
Bloch, C. P. 2004. Long-term responses of snail populations and communities to disturbance in the Luquillo Experimental Forest, Puerto Rico. Ph. D. Dissertation. Texas Tech University, Lubbock, Texas.
Brokaw, N., S. Fraver, J. S. Grear, J. Thompson, J. K. Zimmerman, R. B. Waide, E. M. E. III, S. P. Hubbell, R. Condit, and R. B. Foster. 2004. Disturbance and canopy structure in two tropical forests. in E. Losos and J. E. G. Leigh, editors. Tropical Forest Diversity and Dynamism: Results from a Long-Term Tropical Forest Network. The University of Chicago Press.
Cantrell, S. A. 2004. Sampling methods to study discomycetes diversity in a subtropical rain forest. Caribbean Journal of Science 40:8-16.
Cantrell, S. A., T. Iturriaga, and D. H. Pfister. 2004. An updated checklist of the discomycetes for the Dominican Republic and the Caribbean Region. Caribbean Journal of Science 40:139-144.
Chambers, J. Q., and W. L. Silver. 2004. Some ecophysiological and biogeochemical responses of tropical forests to atmospheric change. Philosophical Transactions of the Royal Society 359:463-476.
Covich, A.P., K.C. Ewel, R.O. Hall, P.G. Giller, D. M. Merritt, and W. Goedkoop. 2004. Ecosystem services provided by freshwater benthos. Chapter 3, pp.45-72, IN: D. H. Wall (ed.) Sustaining Biodiversity and Ecosystem Services in Soils and Sediments. Island Press, Washington, D.C.
Covich, A.P., M.C. Austen, F. Barlocher, E. Chauvet, B.J. Cardinale, C.L. Biles, P. Inchausti, O. Dangles, M. Solan, M.O. Gessner, B. Statzner and B. Moss. 2004. The role of biodiversity in the functioning of freshwater and marine benthic ecosystems. BioScience 54: 767-775.
Dodds, W. K., E. Martí, J. L. Tank, J. Pontius, S. K. Hamilton, N. B. Grimm, W. B. Bowden, W. H. McDowell, B. J. Peterson, H. M. Valett, J. R. Webster, and S. Gregory. 2004. Carbon and nitrogen stoichiometry and nitrogen cycling rates in streams. Oecologia 140:458-467.
Erickson, H. E., and G. Ayala. 2004. Hurricane-induced nitrous oxide fluxes from a wet tropical forest. Global Change Biology 10:1155-1162.
Fernández-Marín, H., J. K. Zimmerman, and W. T. Wcislo. 2004. Ecological traits and evolutionary sequence of nest establishment in fungus-growing ants (Hymenoptera, Formicidae, Attini). Biological Journal of the Linnean Society 81:39-48.
Finical, L., J. Sharpe, and X. M. Zou. 2004. Understorey fern responses to post-hurricane fertilization and debris removal in a Puerto Rican rain forest. Journal of Tropical Ecology 20:173-181.
Fonte, S. J., and T. D. Schowalter. 2004. Decomposition of Greenfall vs. Senescent Foliage in a tropical Forest ecosystem in Puerto Rico. Biotropica 36:474-482.
Grau, H. R., T. M. Aide, J. K. Zimmerman, and J. R. Thomlinson. 2004. Trends and scenarios of the carbon budget in post-agriculture Puerto Rico (1936-2060). Global Change Biology 10:1163-1179.
Halleck, L. F., J. M. Sharpe, and X. Zou. 2004. Understorey fern responses to post-hurricane fertilization and debris removal in a Puerto Rican rain forest. Journal of Tropical Ecology 20:173-181.
Lugo, A. E., W. L. Silver, and S. M. Colón. 2004. Biomass and nutrient dynamics of restored tropical forests. Water, Air and Soil Pollution 4:731-746.
McGroddy, M., W. L. Silver, and J. R. Cosme de Oliviera. 2004. The effect of phosphorus availability on decomposition dynamics in a seasonal lowland Amazonian forest. Ecosystems 7:172-179.
Ortiz-Zayas, J. R., and F. N. Scatena. 2004. Integrated water resources management in the Luquillo Mountains, Puerto Rico: An Evolving process. Journal of Water Resources Development. (HELP) 20:387-398.
Pascarella, J. B., T. M. Aide, and J. K. Zimmerman. 2004. Short-term response of secondary forests to hurricane disturbance in Puerto Rico, USA. Forest Ecology and Management 199:379-393.
Pringle, C. M. 2004. The need for a more predictive understanding of hydrologic connectivity. Aquatic Conservation 13:467-471.
Pringle, C. M. 2004. What is hydrologic connectivity and why is it ecologically important? Hydrological Processes 17:2685-2689.
Richardson, B. A. 2004. Tank Bromeliads: Faunal Ecology. Pages 195- 198 in M. D. Lowman and H. B. Rinker, editors. Forest Canopies - 2nd Edition. Elsevier Academic Press, Burlington MA.
Ruan, H. H., X. M. Zou, F. N. Scatena, and J. K. Zimmerman. 2004. Asynchronous fluctuation of soil microbial biomass and plant litterfall in a tropical wet forest. Plant and Soil 260:147-154.
Sánchez, Y., and X. M. Zou. 2004. Plant influences on native and exotic earthworms during secondary succession in old tropical pastures. 48:215-226.
Schellekens, J., F. N. Scatena, L. A. Bruijnzeel, A. I. J. M. v. Dijk, M. M. A. Groen, and R. J. P. v. Hoogezand. 2004. Stormflow generation in a small rain-forest catchment in the Luquillo Experimental Forest, Puerto Rico. Hydrological Processes 18:505-530.
Silver, W. L., A. W. Thompson, M. E. McGroddy, R. K. Varner, J. R. Robertson, J. D. Dias, H. Silva, P. Crill, and M. Keller.

2005. Fine roots dynamics and trace gas fluxes in two lowland tropical forest soils. Global Change Biology 11:290-360.

Silver, W. L., L. Kueppers, A. E. Lugo, R. Ostertag, and V. Matzek. 2004. Carbon sequestration and plant community dynamics with reforestation of tropical pasture. Ecological Applications 14:1115-1127.

Thompson, J., N. Brokaw, J. K. Zimmerman, R. B. Waide, E. M. E. III, and D. A. Schaefer. 2004. Luquillo Forest Dynamics Plot. Pages 540-550 in E. Losos and J. E. G. Leigh, editors. Tropical Forest Diversity and Dynamism: Findings from a Large Scale Plot Network. University of Chicago Press, Chicago, USA.

Uriarte, M., C. D. Canham, J. Thompson, and J. K. Zimmerman. 2004. A maximum-likelihood, spatially explicit analysis of tree growth and survival in a tropical forest. Ecological Monographs 74:591-614.

Uriarte, M., L. W. Rivera, J. K. Zimmerman, T. M. Aide, A. G. Power, and A. S. Flecker. 2004. Effects of land use history on hurricane damage and recovery in a neotropical forest. Plant Ecology 174:49-58.

Wang, H., and C. A. S. Hall. 2004. Modeling the effects of hurricane Hugo on spatial and temporal variation in primary productivity and soil carbon and nitrogen in the Luquillo Experimental Forest, Puerto Rico. Plant and Soil 263:69-84.

## North Temperate Lakes

Bade, D.L., S.R. Carpenter, J.J. Cole, P.C. Hanson, and R.H. Hesslein. 2004. Controls of d13C-DIC in lakes: Geochemistry, lake metabolism, and morphometry. Limnology and Oceanography 49:1160-1172

Cabot, P.E., S.K. Bowen, and P. Nowak. 2004. Manure management in urbanizing settings. Journal of Soil and Water Conservation 59:235-243

Cardille, J., M.T. Coe, J.A. Vano. 2004. Impacts of Climate Variation and Catchment Area on Water Balance and Lake Hydrologic Type in Groundwater-Dominated Systems: A Generic Lake Model. Earth Interactions 8:1-24

Carpenter, S. R. and W. A. Brock. 2004. Spatial complexity, resilience and policy diversity: fishing on lake-rich landscapes. Ecology and Society 9:8

Folke, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson and C.S. Holling. 2004. Regime shifts, resilience and biodiversity in ecosystem management. Annual Review of Ecology Evolution and Systematics 35:557-581

Graham, J.M., A.D. Kent, A. C. Lauster, A.C. Yannarell, L.E. Graham, E.W. Triplett. 2004. Seasonal dynamics of phytoplankton and planktonic protozoan communities in a northern temperate humic lake: diversity in a dinoflagellate dominated system. Microbial Ecology 48:528-540

Haight,R.G., D.T. Cleland, R. B. Hammer, V. C. Radeloff and T.S. Rupp. 2004. Assessing fire risk in the wildand urban interface a landscape ecosystem approach. Journal of Forestry 102:41-48

Hammer, Roger B., Volker C. Radeloff, Susan I. Stewart, Richelle Winkler and Paul R. Voss. 2004. Characterizing spatial and temporal residential density patterns across the Midwest, 1940-1990. Landscape and Urban Planning 69:183-199

Hanson, P. C., A. Pollard, D. L. Bade, K. Predick, S.R. Carpenter, and J. Foley. 2004. A model of carbon evasion and sedimentation in temperate lakes. Global Change Biology 10:1285-1298

Johnson, P.T.J., D.R. Sutherland, J.M. Kinsella, K.B. Lunde. 2004. Review of the trematode genus Ribeiroia (Psilostomidae): Ecology, life history and pathogenesis with special emphasis on the amphibian malformation problem. Advances in Parasitology 57:191-253

Kent, A.D., Jones, S.E., Yannarell, A.C., Graham, J.M., Lauster, G.H., Kratz, T.K. and Triplett, E.W. 2004. Annual patterns in bacterioplankton community variability in a humic lake. Microbial Ecology 48:550-560

Kim, E., L. Wilcox, L. Graham, J. Graham. 2005. Genetically Distinct Populations of the Dinoflagellate Peridinium limbatum in Neighboring Northern Wisconsin Lakes. Microbial Ecology 48:521-527

Nowak, P. and P.E. Cabot. 2004. The human dimension of measuring the effectiveness of resource management programs. Journal of Soil and Water Conservation 59:128A-134A

Richmond, H.E., T. R. Hrabik and A. F.Mensinger. 2004. Foraging mechanisms of age-0 yellow perch (Perca flavescens). Journal of Fisheries Biology 65:195-205

Vander Zanden M.J., J.D. Olden, et al. 2004. Predicting occurences and impacts of smallmouth bass introductions in north temperate lakes. Ecological Applications 14:132-148

Walker, B., C. S. Holling, S. R. Carpenter, and A. Kinzig. 2004. Resilience, adaptability and transformability in social-ecological systems. Ecology and Society 9:5

Wilson, K.A., J.J. Magnuson, D.M. Lodge, A.M. Hill, T.K. Kratz, W.L. Perry, and T.V. Willis. 2004. A long-term rusty crayfish (Orconectes rusticus) invasion: dispersal patterns and community change in a north temperate lake. Canadian Journal of Fisheries and Aquatic Sciences 61:2255-2266

Yannarell, A.C. and E.W. Triplett. 2005. Geographic and environmental sources of variation in lake bacterial community composition. Applied & Environmental Microbiology 71:227-239

Yannarell, A.C., and E.W. Triplett. 2004. Within- and between-lake variability in the composition of bacterioplankton communities: investigations using multiple spatial scales. Applied and Environmental Microbiology 70:214-223

Yannarell, A.C., A.D. Kent, G.L. Lauster, T.K. Kratz, and E.W. Triplett. 2004. Temporal patterns in bacterial communities in three temperate lakes of different trophic status. Microbial Ecology 46:391-405

Yeates, P.S. and J. Imberger. 2004. Pseudo two-dimensional simulations of internal and boundary fluxes in stratified lakes and reservoirs. International Journal of River Basin Management 1:1-23

Yuan, H.L. and C.H. Wu. 2004. A two-dimensional vertical non-hydrostatic sigma model with an implicit method for free-surface flows. International Journal for Numerical Methods in Fluids 8:811-835

Yuan, H.L. and C.H. Wu. 2004. An implicit three-dimensional fully non-hydrostatic model for free-surface flows. International Journal for Numerical Methods in Fluids 7:709-733

### *Books / Book Chapters*

Rasmussen, J.B. and M.J. Vander Zanden. 2004. The variation of lake food webs across the landscape and its effect on contaminant dynamics. In Food Webs at the Lanscape Level. University of Chicago Press.

Vander Zanden M.J., K.A. Wilson et al. 2004. Species introductions and their impacts in North American shield lakes. In Boreal Shield Watersheds: Lake Trout Ecosystems in a Changing Environment. J.M. Gunn, R.A. Ryder and R.J. Steedman, CRC Press, p. 185-188.

Vander Zanden, M.J. and D.M. Sanzone. 2004. Food web subsidies at the land-water ecotone. In Food Webs at the Landscape Level. G.A. Polis, M.E. Power and G.R. Huxel, University of Chicago Press, p. 185-188.

## Shortgrass Steppe

### *Journal Articles:*

Lauenroth, W. K., H. E. Epstein, J. M. Paruelo, I. C. Burke, M.R. Aguiar, and O. E. Sala. 2004. Potential effects of climate change on the temperate zones of North and South America. Revista Chilena de Historia Natural 77 (3):439-453.

Loik, M.E., D.D. Breshears, W.K. Lauenroth, and J.Belnap. 2004. "A multi-scale perspective of water pulses in dryland ecosystems: climatology and ecohydrology of the western USA." Oecologia 141: 269 – 281.

Lowell, J.L., D.M. Wagner, B. Atshabar, M. Antolin, A.J. Vogler, P. Keim, M.C. Chu, and K.L. Gage. 2005. "Identifying sources of human exposure to plague." Journal of Clinical Microbiology 43:650-656.

Pepper, D.A., S.J. DelGrosso, R.E. McMurtrie, and W.J. Parton. 2005. "Simulated carbon sink response of shortgrass steppe, tallgrass prairie and forest ecosystems to rising [$CO_2$], temperature and nitrogen input." Global Biogeochemical Cycles 19(1): GB1004, doi:10.1029/2004GB002226.

Rebollo, S., D.G. Milchunas, and I. Noy-Meir. 2005. "Refuge effects of a cactus in grazed shortgrass steppe under different productivity, grazing intensity and cactus clump structure." Journal of Vegetation Science 16:85-92.

Roberts, L.M., R.L. McCulley, I.C. Burke, and W.K. Lauenroth. 2004. "Indications of deep soil water usage by limber pine (Pinus flexilis) and skunkbush sumac (Rhus aromatica) in northeastern Colorado: An oxygen isotope study." American Midland Naturalist 152: 178 – 182.

### *Book Chapters:*

Baron, J.S., S.J. Del Grosso, D.S. Ojima, D.M. Theobald, and W.J. Parton. 2004. "Nitrogen emissions along the Colorado Front Range: Response to population growth, land and water use change, and agriculture." In: DeFries, R. and Asner, G. (Eds), Ecosystem Interactions with Land Use Change, American Geophysical Union, Washington D.C., p. 117-128.

Kelly E.F., and C.M. Yonker. 2004. "Soil Forming Factors/Time." In: D. Hillel, (Ed.). The Encyclopedia Soils in the Environment., Elsevier Ltd., Oxford, U.K. V1:536-539.

Morgan, J.A. 2005. "Rising atmospheric $CO_2$ and global climate change: management implications for grazing lands.". In: S.G. Reynolds and J. Frame (Eds), Grasslands: Developments Opportunities Perspectives. FAO and Science Pub. Inc., p. 245-272

Pendall, E., J.Y. King, A.R. Mosier, J.A. Morgan, and D.G. Milchunas. 2005. "Stable isotope constraints on net ecosystem production under elevated CO2." In: L.B. Flanagan, J.R. Ehleringer, and D.E. Pataki. (Eds) Stable Isotopes and Biosphere-atmosphere Interactions: processes and biological controls. Elsevier, San Diego, p. 182-198.

# Calendar

*Coming Events of Interest to the LTER Community*

## APRIL 2005

**April 21**: LTER Planning Grant Governance Group Meeting, Ann Arbor, Michigan.

**April 27-29**: LTER Synthesis Workshop, Wyndham Hotel, Burlington, Vermont.

## MAY 2005

**May 1-6**: SMS-KR-Taxon Groups Developers Meeting, Estes Park, Colorado.

**May 4-7**: LTER Fertilization Synthesis Group Meeting, Irvine, California.

**May 24-25**: Site Review, North Temperate Lakes, Wisconsin (*Contact*: Steve Carpenter, PI).

## JUNE 2005

**June 2-3**: Site Review, Konza Prairie, Kansas (*Contact*: John Blair, PI).

**June 24-26**: Kepler Meeting, Santa Barbara, California.

**June 28-29**: Site Review, Coweeta Hydrologic Lab (southern Appalachian forest), North Carolina (*Contact*: Ted Gragson, PI).

**June 13-17**: LTER Planning Grant, Annual All Hands Meeting, Hotel Santa Fe, Santa Fe, New Mexico.

## JULY 2005

**July 14-15**: Site Review, Short Grass Steppe, Colorado—review in Ft. Collins (*Contact*: Eugene Kelly, PI).

**July 20-22**: 2nd International workshop on Data Integration in the Life Sciences, San Diego Supercomputer Center, California.

**July 19-20**: Site Review, Andrews Forest, Eugene, Oregon (*Contact*: Mark Harmon, PI).

**July 27-29**: 17th International Scientific and Statistical Database Management Conference, University of California-Santa Barbara, California.

## AUGUST 2005

**August 4-7**: Annual Information Managers Meeting, Montréal, Canada.

**August 7-12**: 90th Annual Meeting of the Ecological Society of America and IX International Congress of Ecology (NTECOL), Palais des congrès de Montréal, Montréal, Canada.

## SEPTEMBER 2005

**September 20-22**: Executive/Coordinating Committee Bi-annual Meeting, Virginia Coastal Reserve LTER, Virginia.

**September 21-25**: OBFS Annual Meeting, Coweeta Hydrologic Laboratory and Highlands Biological Station, North Carolina.

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