LTER

The Network Newsletter

Message from the Executive Director

Strategic Planning for LTER

Robert B. Waide, Executive Director, LTER Network Office

The LTER Network will spend the next few months developing a strategic plan to help define future goals and activities of the network. The 20 Year Review Committee called for such a plan, saying:

"The LTER program must forge a bold decade of synthesis science that will lead to a better understanding of complex environmental problems and result in knowledge that serves science and society. To realize this ambitious goal, the LTER community, working with NSF, must develop a comprehensive strategic plan for the LTER enterprise."

—Final Report, LTER Twenty-year Review Committee

NSF endorsed the recommendation strongly, and the LTER community is responding. The Executive Committee will take the lead in developing a draft plan, working closely with the Coordinating Committee and the Network Office. The Executive Committee (Dan Childers, Bruce Hayden, John Hobbie, Nancy Grimm, Alan Knapp, Peter McCartney, and Jim Gosz, Chair) met in Washington in late February to decide the timetable and approach to the task of strategic planning. They will meet again before the May Coordinating Committee meeting at Kellogg Biological Station to continue their work. After the Coordinating Committee provides input to the draft, a revised version will be reviewed by the LTER National Advisory Board (Peter Arzberger, Roger Bales, Barbara Bedford, Robert Dickinson, Jim Levitt, John Magnuson, Pam Matson, Elinor Ostrum, Jack Stanford, Margaret Werner-Washburne, Michael Goodchild, and Paul Risser, Chair) this summer. After revision, the strategic plan will be rolled out at the All Scientists Meeting for general comment before taking final form.

NSF has also asked the LTER Network Office (NET) to develop its own strategic plan. This request was based on a series of recommendations made by the Site Review Team that evaluated the Network Office renewal proposal. The goals of the Network Office strategic plan will overlap greatly with the plan being drafted by the Executive Committee for the network as a whole, and the NET plan will be developed in close consultation with the Executive and Coordinating Committees. However, the NET plan will also include sections that address management structure and evaluation of the Network Office, as well as sections focusing on tasks that have been assigned to NET in the new Cooperative Agreement with NSF. These tasks include linking the LTER information management efforts with the global information technology infrastructure and facilitating international LTER activities. One important element of the NET strategic plan will focus on a mechanism for sites to provide input to NET on their needs and to assess NET response to these needs. The goal of this section will be to enhance regular communication between sites and the Network Office. Operationally, this will involve formal requests to sites for evaluation of NET activities as well as visits by NET staff to sites for joint discussions of needs.

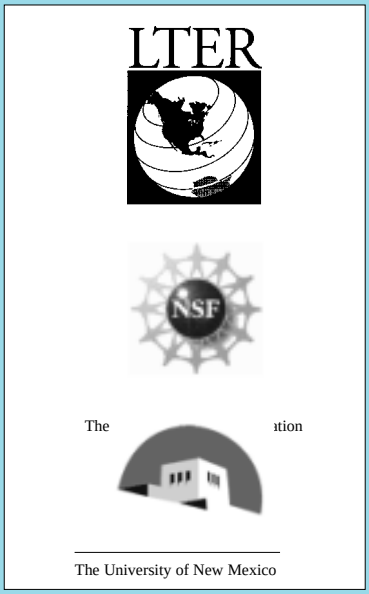
Development of these strategic plans will benefit greatly from the involvement of a wide range of LTER scientists and students. Two groups have already been asked to focus on specific sections of the Network strategic plan. The LTER Education Committee has been working on a strategic plan for education in the LTER Network for over a year. This plan, when completed, will inform development of the education section of the Network strategic plan. The Network

continued bottom of page 2, col. 1

Inside This Issue

The Network News
Vol 16 No 1 Spring 2003

The Network News
is produced each
spring and fall at the
LTER Network Office
through a cooperative agreement
between the
National Science Founation
and the
University of New Mexico



Please contact the
LTER Network Office
with your questions, comments,
ideas
and requests for more copies:
LTER Network Office
University of New Mexico
Department of Biology
Albuquerque NM 87131-1091

Edited, designed and produced by
Patricia Sprott
psprott@lternet.edu
Printed on recycled paper with soy-based inks at Academy Printer

This publication is available in its entirety on the LTER World Wide Web Site:

http://www.lternet.edu

Site News

SGS Symposium

Opening the Doors to Collaboration

◆Nicole Kaplan, SGS LTER

The Shortgrass Steppe (SGS) LTER project, along with the USDA-ARS, the USFS Pawnee National Grassland and the Colorado State University Agricultural Experiment Station sponsored the 6th Shortgrass Steppe Symposium on January 10, 2003, in Fort Collins, Colorado. One of the main goals of this year's symposium was to create opportunities for collaborations between the research community and others interested in or working on issues concerning the conservation or management of the SGS. Keynote talks were given by Greg Gamble and Steve Kettler of The Nature Conservancy of Colorado, "Biodiversity Conservation in the Western High Plains" and Ken Morgan of the Colorado Division of Wildlife, "Species Conservation on Private Lands."

Steve Currey, USDA Forest Service, District Ranger Pawnee National Grassland, and Tammy VerCauteren, Prairie Partners Conservation Biologist with the Rocky Mountain Bird Observatory, Fort Collins, CO, discussing posters at the SGS Symposium.

Each keynote talk was followed by a poster session and a discussion. Since we were specifically seeking areas for future collaborations, the discussions focused on how basic and applied aspects of research fit into conservation efforts, and the relationships between research, land use and management issues facing the SGS. Approximately 90 people attended the symposium, including five high school students from eastern Colorado, who presented several posters of their research. Twenty-six posters were presented covering research studies, conservation, land management, information management, schoolyard LTER, and the GK-12 partnership program. Although it is too early to measure success of the formation of collaborative projects, many email addresses were exchanged and several of the contacts made at the symposium have been continued over coffee and at CSU seminars. We will keep the LTER community updated on how our relationships with conservationists and land managers develop.

Please see the list of poster titles and authors on the *Newsletter* Web site.

Msg from the Director

Continued from Page 1

Information System (NIS) Advisory Group (Barbara Benson, Emory Boose, James Brunt, David Foster, Mark Harmon, Don Henshaw (chair), Tim Kratz, Peter McCartney, Bill Michener, John Vande Castle, Bob Waide, Marilyn Walker) is working to develop a strategy for making the NIS more responsive to the needs of sites and the network as a whole. The results of the group's activities will provide input to both Network and NET planning efforts.

More involvement of LTER scientists will improve our planning efforts. I urge you to comment the planning documents, and to communicate your ideas to the Executive and Coordinating Committees and the Network Office. Presentations and discussions of the strategic plans are scheduled for the All Scientists Meeting, providing an excellent forum to obtain a broad spectrum of

Exploring an Ecosystem Entombed in Ice

Life in extreme environments at McMurdo Dry Valleys LTER

Andrew G. Fountain, MCM-LTER Additional Investigators, Dorota Poransinka, Martyn Tranter, and Christine Forman

Frozen environments comprise 25% of the Earth's surface. Once believed to be devoid of life, closer observations of glacial ice reveals microhabitats—frequently teeming with life. Cryoconite holes, from "cryo" meaning ice and "conite" meaning dust, form on glaciers in the McMurdo Dry Valleys and offer a unique addition to the growing list of extreme habitats where life thrives.

New research on these micro habitats suggests they are more important to the overall function of the polar desert ecosystem than previously thought.

Cryoconite holes develop from sediment that collects in small patches on the glacier surface (Fig. 1-top). As the hole grows, fine sediments, microorganisms and organic matter collect, creating an ideal environment for cold-weather critters.

Open, water-filled cryoconite holes are commonly found on the exposed surfaces of glaciers in temperate alpine regions. These holes frequently contain biota, including microfauna such as tardigrades, rotifers, protozoans, copepods, insect larvae and cyanobacteria. In contrast to these open holes, cryoconite holes on the glaciers of the McMurdo Dry Valleys are covered with an ice lid of up to 30 cm thick (Fig. 1-bottom). This lid isolates the hole from the atmosphere and the surrounding glacier surface. Analysis of the chloride content of the hole melt waters, in comparison to the surrounding ice, suggests that the melt waters are often isolated from the atmosphere for a year or more. As a result, solutes accumulate over time; atmospheric gases such as N2, O2, and CO2 are scavenged from ice bubbles resulting in chemistries within the cryoconite holes that are distinct from the surrounding ice. The photosynthetic and heterotrophic activity of resident organisms modify the initial geochemical characteristics of the cryoconite dust. Algae and cyanobacteria have been identified in cryoconite holes of the McMurdo Dry Valleys, as well as rotifers and tardigrades. Our estimates of bacterial production in the cryoconite sediment rival that of the local lake water.

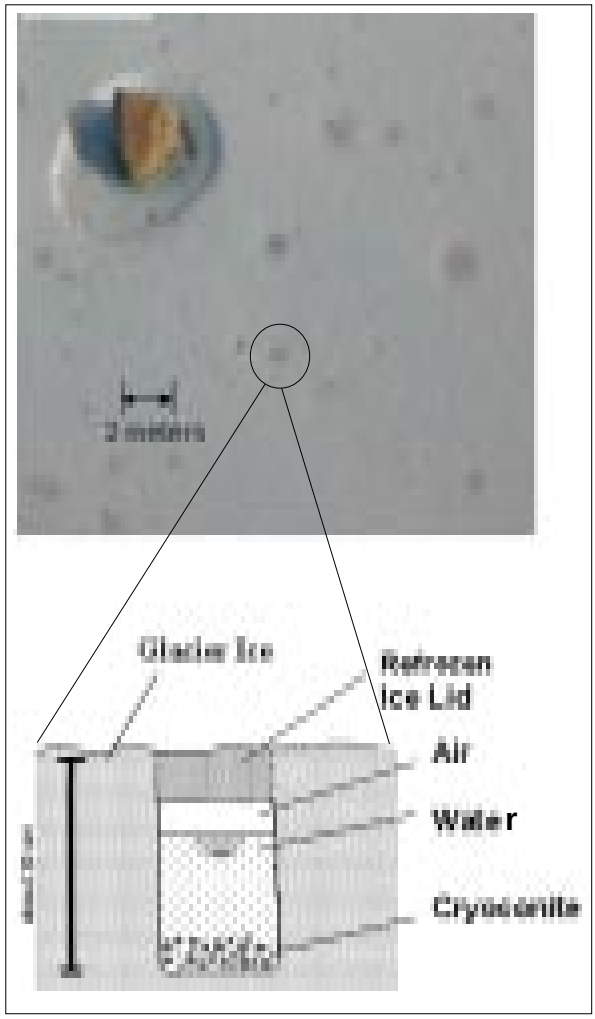


Figure 1. On top is an aerial view of cryoconite holes on Taylor Glacier. Below is a schematic of a vertical cross-section of a cryoconite hole with sediment (cryoconite) at the bottom.

Cryoconite holes cover about 7% of the ice-covered zone of our study glaciers with diameters from 1 cm to meters and averaging about 38 cm. The ice lids average about 14 cm thick over a 14 cm water column. Cryoconite holes are frozen solid for most of the year, except for a few summer months when solar radiation melts the ice around the sediment allowing biological activity to occur within this sealed microcosm. The contents of the holes are flushed during decadal warming events, when melt water abounds on the glacier surface. The flushing events transport the hole contents to the valley streams and eventually to the lakes, thereby providing organic carbon and other nutrients to oligotrophic aquatic ecosystems downstream. Nutrients make their way back up to the cryoconite holes via dust, and various chemical cycles. This feedback loop connects all the major components of the dry valley ecosystem and involves exchanges of unique biogeochemistries between soils, streams, lakes and glaciers.

We have encountered holes that have been isolated by an ice lid from the atmosphere for a decade. For such holes we believe that gases and some nutrients important to the biochemical reactions are scavenged from the melting ice. Other nutrients may be obtained from the dissolution of both inorganic and organic debris in the hole. Photosynthesis, which only occurs during summer, utilizes both new and recycled nutrients and drives the pH, O2-saturation and pCO2 towards values of 11, 160% and 10-7 atms, respectively. This chemistry better resembles that of African soda lakes than glacial melt waters. We speculate that photosynthesis may be limited by this combination of extreme values.

Cryoconite holes contribute to the functioning of the polar desert ecosystem by playing an important role in recycling nutrients, biota, and sediments in a system seemingly lacking linkages between ecosystem components. The formation of the cryoconite holes, partly through biologic

Continued on page 16, center column

MIlestones

Dick Olson Retires

After 35 years of working with environmental data and the producers of those data, Richard "Dick" Olson has announced his retirement from the Oak Ridge National Laboratory's Distributed Active Archive Center (ORNL DAAC). "Although I will miss the interesting and productive interactions with the GPPDI, EMDI, NPP, TCO, GCP, LTER, NCEAS, LTSS, ISLSCP, modeling and other communities," Olson says, "I'm looking forward to different types of adventures."

Olson regards the LTER community and, more specifically, the LTER data managers as a "great group," with special thanks to "all the other data pushers for helping to legitimize data management (and archiving, informatics, etc.), as part of ecosystem science!" Olson says he will retain his current contact information for the immediate future.

The ORNL DAAC will continue to provide access to the various collections of field observations. Please contact Bob Cook, DAAC Scientist (cookrb@ornl.gov, 1-865-574-7329) with questions or suggestions or data needs.

In Memory of Dick Wiegert

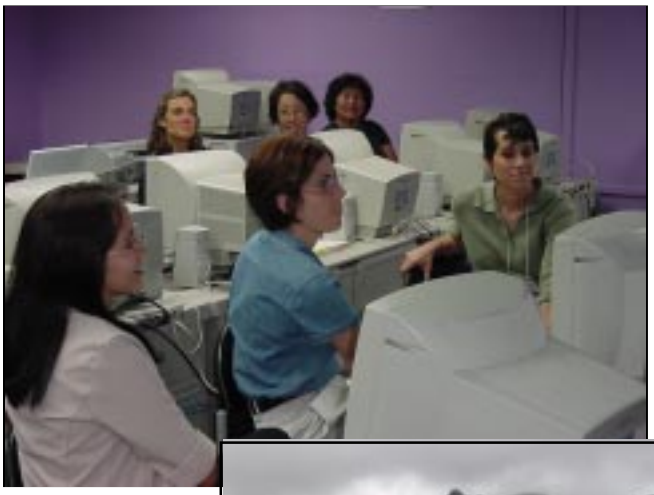
It is with great sadness that we report the death Monday, 4 November 2002, of Richard G. Wiegert, after a long illness. He will be greatly missed by his wife, Liz McGhee, his family and his many friends and colleagues throughout the world.

Those who knew Dick will remember him for his enormous intelligence, his great sense of humor, his love of a good story, his insatiable curiosity about how the world around him worked, and his great love of books and learning. We ask all of you who knew Dick to take a few minutes to remember a special conversation, experience, perhaps even an adventure, that you shared with him, and to join us in celebrating his life rather than mourning his death.

Take a Journey to El Yunque

A New Education Project at LUQ LTER

Researchers at LUQ LTER have teamed up with the Center for Educational Technologies (CET) at Wheeling Jesuit University and the U.S. Forest Service to teach middle-school students about the effects of hurricanes on El Yunque rainforest. The CET has recently been awarded a three-year grant from NSF to develop "Journey to El Yunque" — a four-week, Web-based curriculum unit. The Web site features stunning panoramic views of the rainforest and engaging background reading material. In the culminating activity students manipulate models of population dynamics in the aftermath of Hurricane Hugo. The models are based on the research being conducted at LUQ LTER.



Above: Teachers get hands on experience with the Journey to El Yunque Web-based curriculum. Left: Journeying into the field to experience the tropical forest.

When complete, the Web site will replace the four-week ecology unit students normally study in middle school. Students using "Journey to El Yunque" will learn about food web dynamics and energy flow within an ecosystem. The program will provide a solid foundation for students participating in the Schoolyard LTER program. A prototype of the Web site is available at http://elyunque.cet.edu.

Steven McGee, senior educational researcher at the CET, and Jess Zimmerman, co-PI of LUQ LTER, presented the prototype in January at the third annual Symposium on Long-Term Ecological Research in Puerto Rico, held in conjunction with the LUQ LTER annual meeting. McGee and Zimmerman provided attendees with a demonstration of the program and an explanation of the science underlying the models used in the program.

While in Puerto Rico, the CET hosted four middle-school teachers from the U.S. and two teachers from Puerto Rico who received training on the use of the prototype. The teachers gained hands-on experience with the Web site. In addition, teachers had the opportunity to discuss strategies for integrating the Web site into their classes. The teachers will be testing the prototype of the Web site during the spring semester. After the workshop, McGee led the teachers on a hike through El Yunque so they could obtain first-hand experience with the rainforest.

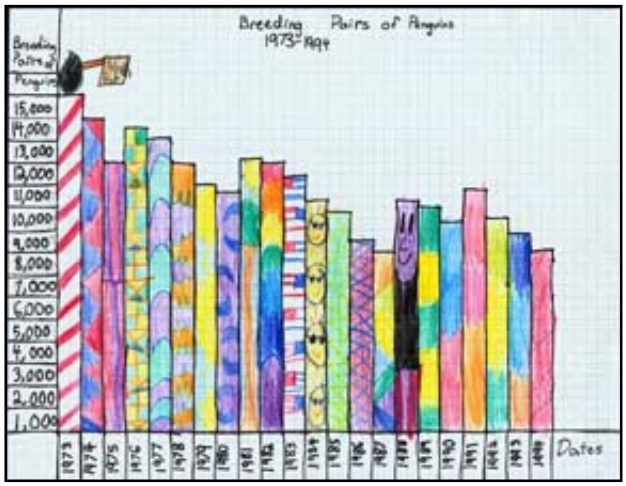
The CET is recruiting middle-school life science teachers who would like to participate in the next phase of Web site testing. Teachers will receive funding to attend a two-day summer workshop at the CET. Please refer interested teachers to Jennifer Kirby (jenn@cet.edu).

On-line Journaling and Data Bridges the Learning Gap to the Antarctic

Cindy Baker, Director of Publications, College of William & Mary

Some lucky 4th and 5th graders in Virginia got to experience the wilds of the Antartic from the comfort of their computer screens. While two College of William & Mary students joined the new Palmer LTER lead PI Hugh Ducklow on an Antarctic Peninsula research cruise this season, school children in Virginia participated via the World Wide Web.

Callie Raulfs and Mary Turnipseed, the first students from W&M to go to Antarctica, recorded journal entries about their impressions of the cruise, while Hugh Ducklow discussed the science.



Pete Barnes' 5th grade class graphs Palmer LTER data.

Cindy Baker, director of publications at the W&M, organized a Web site for the classes (www.wm.edu/antarctica), adding new journal entries and photos from the Antarctic almost daily.

Pete Barnes, 5th grade teacher at Williamsburg/James City County Schools, incorporated the PAL LTER team research into his classes in a number of ways. His reading class wrote short stories based on information they read about Antarctica. His math class graphed the fluctuations in penguin populations culled from data Ducklow sent him and Barnes asked his science students to concoct animals with adaptations that could survive in the Antarctic. The results of these assignments were posted on the Web for the Palmer scientists to review.

"The most quantifiable outcomes of this project would probably come from my math class," Barnes says. "I think my kids definitely benefited from graphing the penguin populations, Antarctic temperatures, and coordinate graphing of Antarctica. We took a test on all types of graphing, and the students did very well, better than last year's group. The kids really took an interest in the fact that we were graphing real data as opposed to something assigned from a textbook. They made good hypotheses about the data and were able to answer higher-level questions about it."

Language arts learning is more difficult to immediately quantify, Barnes said. "I think the kids benefited from reading extensively about Antarctica before writing about it. Once the kids learned that some of their stories would be on a Web site or sent to Prof. Ducklow, I think they took the writing more seriously. Sharing several different types of reading about Antarctica also helped the kids master the pertinent vocabulary and helped their comprehension."

Mary Turnipseed and Callie Raulfs enjoying the Antarctic summer.

Lara Kesslers' 4th grade students in the Charlottesville Public School system used the penguin data to do similar kinds of graphs. Her students diagramed an Antarctic food web and are examining the effects of global warming on the food web. They are also reading about the history of exploration in Antarctica. "My students have started to realize that the true purpose of learning—be it graphing raw data, studying the interdependent parts of an ecosystem, or drawing hypotheses from information—is to solve problems by asking pertinent and well-informed questions," Kessler says.

"The authenticity of the data, the texts we're reading, and the problem of global warming help my students recognize the applicability of the facts they're learning, facts that are all too often divorced from reality. They are asked to act as scientists rather than students--sifting through data, analyzing it and reporting their findings. We are not just discussing the scientific process; we are participating in it!"

For Callie Raulfs, the contact with the public school students added dimension to her time in Antarctica. "The Web site and the chance to correspond with the fifth graders greatly enhanced my overall experience in Antarctica."

The *Richmond Times Dispatch* gave the Web site "two thumbs up" for the journals and the student's participation, and other teachers have approached Barnes and Kessler about joining the project when Ducklow and more WM students return to Palmer Station next research season.

"It was an engaging season with this year's outreach participants adding to the growing diversity of Schoolyard LTER journaling efforts," adds Karen Baker, Palmer LTER information manager and education/outreach cooordinator. "The team used a variety of electronic communications to deliver the excitement of ongoing Antarctic research experiences and data into new classrooms."

Announcing the 4th LTER All Scientists Meeting 18-21 September 2003 Seattle Washington

Launching into Synthesis

Hundreds of scientists from dozens of disciplines will gather in Seattle 18-21 September 2003 for "Launching into Synthesis," the 4th LTER All Scientists Meeting.

This meeting will include a joint session with the annual meeting of the Estuarine Research Federation on 18 September. Following the joint session there will be a joint mixer, and the LTER meeting will continue on Friday, Saturday, and Sunday.

The choice for an LTER/ERF joint session was an easy one says LTER Network Office executive director and meeting coordinator Bob Waide. There are five coastal LTER sites, and they will most all be attending the ERF meeting. Locating the LTER meeting in Seattle and planning a joint session makes it very interesting for everyone, says Dan Childers, PI of the Florida Coastal Everglades LTER site and chair of the joint-session program committee.

The other LTER coastal sites include Santa Barbara (Dan Reed, PI), Georgia Coastal (Tim Hollibaugh and Steve Pennings, PIs), Virginia Coast Reserve (Bruce Hayden, Karen McGlathery, and John Porter, PIs), and Plum Island Ecosystems (Chuck Hopkinson, PI).

The goal of the joint session, titled "Long-term and large-scale patterns in coastal and freshwater aquatic ecosystems," is to bring coastal and estuarine scientists together with scientists from other LTER sites, to address the common theme of large-scale comparisons, Childers says.

This joint session affords the opportunity for convergence and a stronger understanding of ecosystem science, says Tiffany Troxler-Gann, one of two graduate student representatives on the program commitee. The estuarine and coastal systems are the downstream ecosystems of many LTER research sites, Tiffany says, and this meeting will accentuate how LTER work can be more integrated.

Details as they emerge will be available on the website: http://www.lternet.edu/asm

Education Update

◆Sonia Ortega, LTER Network Office

It's shaping up to be an active year for Education in LTER. As you can see, we need full participation from everyone to get the most out of our planned activities.

The Annual Meeting of LTER Education Representatives will take place in conjunction with the All Scientists Meeting in Seattle, Washington. The Network Office will provide funding to education representatives to attend. Information on logistics will be sent to site PIs. Please contact Sonia Ortega (sortega@lternet.edu) with your ideas for workshops, and for the education representatives meeting agenda.

At the top of our agenda will be the Assessment of LTER Education Activities. As NSF decided not to proceed with the formal assessment at this time, we will work on developing ways to assess LTER education activities at our sites. This may include organizing a series of workshops to gather data and to develop tools and assessment instruments.

I recently submitted the LTER Education Strategic Plan to the Executive Committee for review. The plan will be included in the Coordinating Committee meeting agenda (May 6-8, Kellogg Biological Station) for further consideration. The Executive Committee will consider the Strategic Plan for Education in the development of overall Strategic Plan for the Network.

Several LTER education representatives are in the middle of preparing Proposals for consideration to NSF's Education and Human Resources Directorates. Some of these proposals include cross-site participation.

I will be working closely with the Education Committee and with the Education Representatives to coordinate activities and to make this year very productive. Please keep in touch with the LTER education efforts via the website: http://lternet.edu/education/

News from the ILTER Network

◆Alan Schroeder, LTER Network Office

ILTER Annual Meeting in Beijing

On September 5 and 6, Beijing, People's Republic of China will host the 2003 Annual Meeting of International Long Term Ecological Research Network. The meeting is tentatively titled: Long Term Ecological Research: Theories, Technologies and their Applications in Ecosystem Management, and is co-sponsored with the Chinese Academy of Sciences. ILTER Business Meetings and a regional Asian LTER Network meeting will follow on 7 September. Field trips to the Loess Plateau at Yangling in Northern China, the Tibetan Plateau in Qing-Zang, or Subtropical Evergreen Forest in Southern China will commence on 8 September.

All-Scientist Meeting in Seattle

The NET office, in association with the meeting of the Estuarine Research Federation, has begun to organize the 2003 ASM meeting for September 18 - 21 in Seattle, Washington, USA. The ERF's meeting begins on September 14 and will wind up with a joint ERF/LTER session on the afternoon of Thursday, September 18. There will be a joint mixer for the two groups on Thursday evening. Please access information about the ASM on the LTER website: http://www.lternet.edu/asm

Please direct questions regarding International LTER issues to Alan Schroeder in the U.S. LTER Network Offce: aschroeder@lternet.edu

Approaching a Dream

Implementing Ecological Metadata Language at LTER Sites to Facilitate Cross-site Synthesis

• *David Blankman, LTER Network Office*

Ecological Metadata Language (or EML), is a content standard implemented in XML for documenting ecological data. If EML is used at the time the data is recorded, it will "reduce the time required to standardize data —months or years after it has been collected —and will facilitate research at larger scales of time and space" (see "Ecological Metadata Language Increases Research Capability" by John Porter, in *The Network Newsletter* Vol. 15 No.1 Spring 2002).

At a workshop in June 2002, the LTER Information Managers expressed the desire for on-site consultation rather than a group workshop to implement EML. Beginning in December 2002 and continuing over the next several months David Blankman of the LTER Network Office is working directly with the information managers at their sites to implement EML. So far, David has visited Niwot and McMurdo sites in Colorado, the Florida Coastal Everglades, and the Coweeta and Georgia Coastal Ecosystem LTER sites, to onvert their legacy text-based metadata to EML. Meanwhile, a team from Central Arizona-Phoenix LTER site (CAP) will work with those sites that have metadata stored in relational database systems.

The purpose of visits is to assist LTER site information managers in the conversion of legacy metadata to EML and to help the information managers develop systems that will automatically produce EML compliant metadata. As a new LTER site, FCE provides the opportunity to design a system that meets all of the site's internal needs and will be optimized to produce EML.

The conversion of legacy metadata (text-based, i.e., not in a relational database) to EML is a four step process (see Fig. 1).

Visits for the near future include PIE, HFR, HBR, ARC, and BES, as well as Cedar Creek and Luquillo. The CAP team will be assisting the other sites. North Temperate Lakes LTER site is already generating EML dynamically.

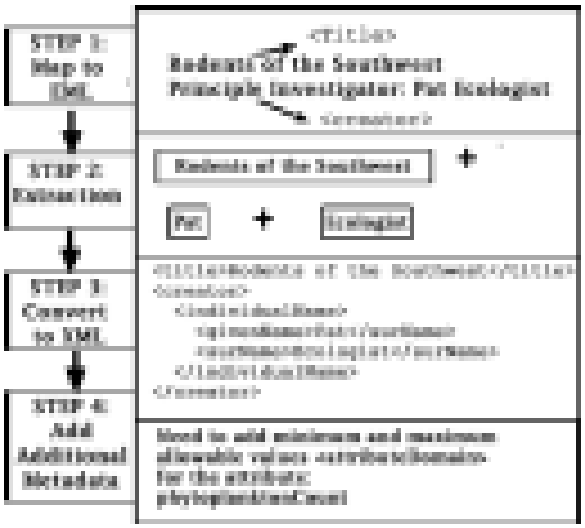


Figure 1. Steps to convert metadata to EML

As part of the move toward standards and to facilitate cross-site synthesis, the Network Office is organizing a workshop to be held this spring. The purpose of this workshop will be to develop a recommendation that might be called LTER EML Core. LTER EML Core will address issues such as:

1. EML is a very flexible and comprehensive standard; the smallest valid EML document would include only a title, and two last names. The largest EML document could contain thousands of separate fields. What should LTER's minimal EML document contain?

2. With EML there are different ways to document the same information. What should the LTER approach be?

3. EML and LTER Researchers: What's in it for me?

The LTER Network is currently in the investment phase of EML. Resources will be needed to convert legacy metadata into EML. Resources will also be needed to continue the development of software to enter, search, and retrieve metadata documents store in EML format.

So, what's the payback? As anyone who has participated in an NCEAS synthesis workshop knows, doing synthetic research in ecology is tedious. Often more time and effort is spent finding and then converting heterogeneous data into a common format, than is spent on the actual synthetic research.

The Present: The software to allow for search and retrieval of relevant data is now available for EML compliant metadata..

The Near Term: Once the vast quantity of legacy LTER metadata is converted to EML and stored in EML aware network catalogs, researchers will be able to do targeted searches for data of interest.

The Future: The true power of EML will emerge in the next decade as intelligent software agents are developed to aid in the integration of ecological data. Through these exercises, we are getting close to Rudolf Nottrott's dream (ca 1993): *I was lying on the beach. I had a research idea. I picked up my smart phone, spoke my research question. The smart phone tapped into my personal data gathering research software agent which searched the web, retrieved the relevant data, sent it to my analytical agent, which then tested the hypothesis. My paper-writing software agent wrote and then submitted a paper to* Science *for review... And then I woke up.*

EML and LTER Researchers: Ask not what EML can do for me, but what you can do for EML. While the EML implementation team can assist the site information managers in the technical aspects of converting legacy metadata to EML, virtually all sites will need to add additional metadata. The site information managers will, in most cases, need to consult with site researchers to help in the generation of the new metadata.

Collaboration Opportunity

National Invasive Species Database

•*Nicole Kaplan, Shortgrass Steppe LTER*

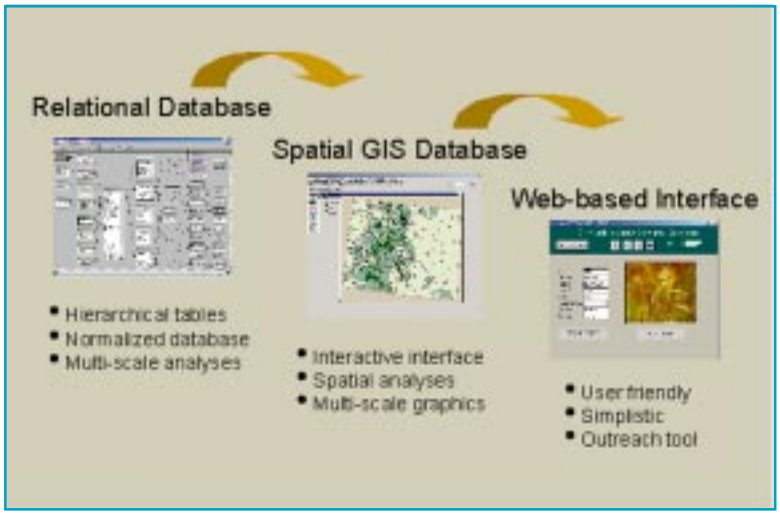
Land managers consider invasive species one of their greatest challenges. The economic cost of invasive non-native plants, animals, and diseases exceeds $138 billion per year, more than the damage caused by other natural disasters, such as flood and fires, combined. Invasive species are poisoning livestock, altering fire regimes, clogging waterways, altering nutrient cycling, and causing the demise of as many as 40 percent of the species listed as "Threatened and Endangered." Nearly all terrestrial and aquatic ecosystems are now affected by invasive species.

The U.S. Geological Survey has partnered with other agencies and research programs, including LTER to establish a "data cooperative" to accelerate the sharing, standardization, completeness, and accessibility of data on the distribution and abundance of non-native plants, animals, and diseases across the U.S. The National Institute of Invasive Species Science is a quickly growing consortium of strong partnerships between government and non-governmental organizations administratively housed in the U.S. Geological Survey's Fort Collins Science Center in Colorado. The Institute represents one of six primary focus areas of the Fort Collins Science Center, with Tom Stohlgren as the Science Program Director.

The Institute has the expertise to develop cost-efficient and information-rich interdisciplinary approaches to inventory and monitoring methods. This approach integrates multi-phase designs, with multi-scale field sampling to provide more consistent, accurate, and complete data at local, regional, and national scales. Information about invasive species found across the U.S. will be distributed through the National Biological Information Infrastructure (NBII).

http://www.nbii.gov/index.html

Tom Stohlgren, other researchers, and information managers at the Institute will focus on information management, research, modeling, technical assistance, and outreach.



The first goal is to synthesize pre-exisitng data sets, including multiple scale information (i.e., 1 m^2 to entire region), on non-native vascular plant species obtained from individuals, organizations, and agencies at all levels in a spatially linked database.

All LTER Network sites will be asked to contribute to the development of this database. For example, state and county officials in Colorado, land mamagement and conservation programs, as well as information managers from the SGS and NWT LTER sites are submitting their existing and legacy data sets on invasive plant species. In this way, collective knowledge created by data synergy can be used to improve the quality of individual data sets collected across the state of Colorado. Data sets for recorded locations for non-native plant species are now available to land managers and the public using online GIS technology. In addition, the synthesized, spatially linked database can be used to create predictive spatial models for hotspots of invasion in the state of Colorado or in a specific land management unit (for example, see: http://www.nrel.colostate.edu/projects/niiss/projects/colorado/colorado.htm).

The Institute's information management system is designed to expand in detail as the program grows. Spatial, hierarchical tables in geodatabases (ArcGIS and MSAccess or Oracle) and new spatial analysis tools, will allow for multi-scale analyses, interactive queries, and multiscale graphics. A web-based interface will allow customers and stakeholders to access and manipulate a variety of databases, GIS themes, and predictive spatial models at local and regional scales without having extensive hardware, software, or access to experts.

The Institute will continue to develop control and restoration techniques for severely affected areas and for the most invasive species. Research is already underway in many wetland, riparian, and aquatic ecosystems where invasive species have become dominant. Monitoring and modeling techniques will help set priorities for control and restoration. On a national scale, invasive plant control techniques published by The Nature Conservancy, individual states, and others will be linked to the NBII. This is an opportunity for the LTER community to cooperate with other agencies and non-governmental organizations, and to contribute their data to the development of a data synthesis project that will help to document, map, predict, and manage the invasion of non-native plants, animals, and diseases across the U.S.

For more information: Thomas J. Stohlgren, USGS National Institute of Invasive Species Science, Phone: 970-491-1980, e-mail: Tom_Stohlgren@USGS.gov

The Biocomplexity Program

Agricultural Landscapes in Transition: A Cross-scale Approach

◆Charles Redman, Ann Kinzig, and Lauren Kuby (CAP LTER)

In 2001, the Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) project, in collaboration with the Baltimore Ecosystems Study (BES) received funding from NSF's "Biocomplexity in the Environment" program to hold a series of workshops to promote the integration of social sciences into long-term ecological research. It was hoped that this incubation grant would spark scientifically exciting interdisciplinary research that would bring together social, biological, and earth scientists to better understand human ecosystems.

One workshop, "Integrating Census, GIS, and Historical Methods into Long-Term Ecological Research," led to six sites receiving a four-year award from the NSF's Biocomplexity program. This project: "Agrarian Landscapes in Transition: A Cross-Scale Approach" or AG TRANS, is an interdisciplinary effort tracing the effects of the introduction, spread, and abandonment of agriculture at LTER sites, with cross-comparisons in Mexico and France. The main LTER sites involved in AG TRANS are: Central Arizona Phoenix LTER, Harvard Forest, Shortgrass Steppe, Coweeta, Konza Prairie, and Kellogg Biological Station. CAP leads this collaboration of ecologists, anthropologists, sociologists, and geographers, a collaboration expected to serve as a model for future integrative projects. Participating scientists include: Charles Redman (PI) and Ann Kinzig (CAP LTER), David Foster (Harvard Forest), Myron Gutmann (Shortgrass Steppe), Ted Gragson (Coweeta), Gerad Middendorf (Konza), Alan Rudy (Kellogg), and Peter Kareiva (The Nature Conservancy). Other participating scientists are listed at http://ces.asu.edu/agtrans/participants.htm.

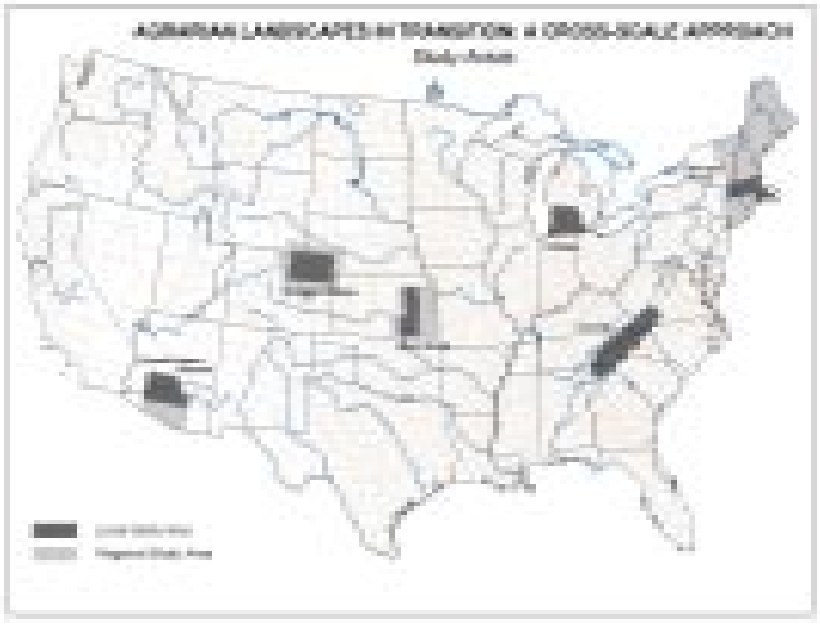
AG TRANS aims to understand what happens when humans impose spatial and temporal signatures on ecological regimes and must then respond to the systems they helped to create, further altering the dynamics of the coupled system and affecting ecological and social resilience or vulnerability. Six LTER sites representing differing biogeographic regions and contrasting agrarian transformations will identify and quantify the ways in which agrarian transformations differ across regions and time and how these variations explain cross-scale patterns.

Expectations are that this multi-scale study will serve as a pilot project for cross-site, interdisciplinary work and lead to a better understanding of the mechanisms that govern ecosystem dynamics. AG TRANS is off to a great start and, we expect it to have a strong positive impact on the entire LTER network. Our overall objective is to better understand the interactions and relationships among and between ecological, social, and geophysical influences on changing agrarian landscapes. To achieve this goal, we will examine these changes and forces at varying temporal, spatial and organizational scales and focus on processes that act on long time scales and legacies in the landscape. The project also promises innovations in the area of integrated data management (across disciplines and sites) and K-12 education, where we will develop curriculum that parallels the research of scientists looking at the agricultural-urban interface. Partnering with The Nature Conservancy will allow us to test applicability of our results to conservation planning.

We have outlined ambitious, yet realistic, objectives for our first year. Our goal for Year 1 is to create baseline sets of spatial, historical, and ecological information about the study areas and a first iteration on a series of models to explain the processes underlying observed transformations. Social, demographic, economic, and political information is being assembled under the direction of Myron Gutmann; regional ecological information is being assembled by a team directed by Peter Kareiva; and extant remote sensing and GIS data is being collected by a CAP team (Will Stefanov and Maik Netzband). Several modeling efforts are being coordinated by Peter Kareiva, Ann Kinzig, Bill Parton, and Marty Anderies. Narrative case studies for each site are also being prepared and will be assembled into a book by David Foster and Charles Redman. In addition, Charlene Saltz and Monica Elser (CAP) are crafting K-12

Continued bottom of next page

AG TRANS http://ces.asu.edu/agtrans



This map shows the LTER participants involved in the interdisciplinary AG TRANS project

LTER Community Outreach

Ecoinformatics Training for Field Stations

◆William Michener and Greg Bonito, LTER Network Office

A National Science Foundation funded Research Coordination Network project is off and running. The project, titled the "Resource Discovery Initiative for Field Stations," aims to develop several critical databases that promote the discovery of personnel, data and information, and infrastructural resources at North American field stations (i.e., Organization of Biological Field Stations-OBFS). In addition, a key component of the project is the annual training of 12 to 24 field station personnel in information management concepts and technologies.

The first of five annual training workshops was successfully held October 20 - November 2, 2002 at the Sevilleta Research Station in central New Mexico. The workshop provided hands-on training in ecological informatics, metadata management, biodiversity data management, web page authoring, bibliographic database management, database management systems (DBMS), quality assurance/quality control, and advanced web page authoring. Trainees received hands-on experience with ACCESS, Dreamweaver, Biota, Endnote, Morpho metadata software, SQL, PERL, and the Specify biodiversity DBMS. Participants used the software to register data sets from their field stations in the OBFS Data Registry, to enter publications and bibliographies from their field stations into a web-accessible "Bibliography of North American Field Station Publications," and to contribute standard field and laboratory methods to a Standard Methods database.

The workshop was attended by thirteen participants, representing biological field stations from Montana to Costa Rica and French Polynesia to Florida. A broad mix of real and virtual instructors served as instructors. The real (i.e., in-person) instructors came from the LTER Network Office (Bill Michener, James Brunt, Troy Maddux, and Marshall White), the Sevilleta LTER (Kristin Vanderbilt), the Central Arizona Phoenix LTER (Peter McCartney), the Virginia Coast Reserve LTER (John Porter), the University of New Mexico (Chris Frazier). Virtual instructors, including Matt Jones from the National Center for Ecological Analysis and Synthesis, Wade Sheldon from the Georgia Coastal Ecosystems LTER, Glenn Garneau from the University of Kansas, and Robert Colwell from the University of Connecticut appeared over Internet-based teleconferences.

PHOTO: (from left) Marsh White (seated, from NET) explains web-page programming to Don Schenck (Flathead Lake Biological Station, Montana), Kristin Vanderbilt (SEV), Neela Akhouri (Lake Erie Center, Ohio), and Eric Sanchez (Organization for Tropical Studies, Costa Rica).

Workshop participants appreciated the diversity of instructors. As one participant exclaimed, "No question went unanswered!" Furthermore, participants uniformly felt that the topics covered during the workshop will be very useful in expanding the informatics capacity at their field stations. "I truly wish that this course had been available three and a half years ago - an excellent course!" remarked one participant. This year (October 27-November 7, 2003) the two-week course will again be held at the Sevilleta and will be broken into two independent modules (one on ecoinformatics technologies, and the second on geographic information systems). In 2004, the course structure remains the same, but the venue moves to La Selva Biological Station in Costa Rica.

AG-TRANS *continued from previous page*

outreach activities with John O'Keefe (Harvard Forest) and Ted Gragson (Coweeta). We expect that the various data-collecting efforts will help provide a context for understanding the processes we are studying and that the initial modeling efforts and case study narratives will help direct the future stages of data collection and analysis.

We believe that AG TRANS will demonstrate the value of these approaches and contribute to their refinement across the LTER network and elsewhere. Another potential contribution is our plan to integrate qualitative approaches with the more frequently applied quantitative approaches of LTER studies. We are planning to host a session at the ASM meeting this September in Seattle. Although it will still be early in the project, we hope to have enough together to stimulate interest across the network and solicit useful input.

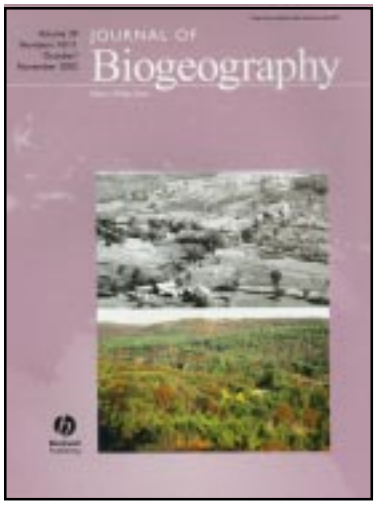
Journal Features Special Section on the LTER Network

The January 2003 issue of the journal *BioScience* features a special section of articles reviewing the insights gained from the U.S. LTER Network, including comprehensive bibliographies. The special section represents the first such production since the early 1990s. Reprints are availalble from the LTER Network Office (office@lternet.edu)

***Bioscience*, Vol 53 No 1**

- Scientific Accomplishments of the Long Term Ecological Research Program: An Introduction (John E. Hobbie) pp 17-21
- The US Long Term Ecological Research Program (John E. Hobbie, Stephen R. Carpenter, Nancy B. Grimm, James R. Gosz, And Timothy R. Seastedt) pp 17-32
- Long-Term Research on Biosphere-Atmosphere Interactions (David Greenland, Bruce P. Hayden, John J. Magnuson, Scott V. Ollinger, Roger A. Pielke Sr., and Raymond C. Smith) pp 33-45
- Disturbance Dynamics and Ecological Response: the Contribution of Long-Term Ecological Research (Monica G. Turner, Scott L. Collins, Ariel E. Lugo, John J. Magnuson, T. Scott Rupp, and Frederick J. Swanson) pp 46-56
- Ecological Variability in Space and Time: Insights Gained from the U.S. LTER Program (Timothy K. Kratz, Linda A. Deegan, Mark E. Harmon, and William K. Lauenroth) pp 57-67
- Using Mechanistic Models to Scale Ecological Processes across Space and Time (Edward B. Rastetter, John D. Aber, Debra C. Peters, Dennis S. Ojima, and Ingrid C. Burke) pp 68-76
- The Importance of Land-Use Legacies to Ecology and Conservation (David Foster, Frederick J. Swanson, John D. Aber, Ingrid Burke, Nicholas Brokaw, David Tilman, and Alan Knapp) pp 77-88
- Long-Term and Large-Scale Perspectives on the Relationship between Biodiversity and Ecosystem Functioning (Amy J. Symstad, F. Stuart Chapin III, Diana H. Wall, Katherine L. Gross, Laura F. Huenneke, Gary G. Mittelbach, Debra C. Peters, and David Tilman) pp 89-98

Special Journal Issue Features Findings from Harvard Forest LTER



This fall the Harvard Forest LTER published a Special Issue of the *Journal of Biogeography* (Volume 29; October/ November 2002) entitled Insights From Historical Geography to Ecology and Conservation: Lessons from the New England Landscape. The volume, edited by David Foster with assistance From Glenn Motzkin and Dave Orwig, contains 20 papers covering diverse topics: paleoecological, dendrochronological and witness tree studies of long-term vegetation dynamics; historical analyses of wildlife and land cover changes; ecosystem consequences of introduced pests and pathogens; controls of land-use history on modern vegetation patterns; and conservation directions for the New England landscape.

The *Journal of Biogeography* can be accessed on the HFR Website: http://harvardforest.fas.harvard.edu/pubs.html

Sevilleta LTER Research Featured on Cover of *Bioscience*

Sevilleta LTER's article "The Ecology and Evolutionary History of an Emergent Disease: Hantavirus Pulmonary Syndrome" is featured on the cover of the November 2002 issue of *BioScience*. The publication represents the work of more than 16 investigators, a network of nine study sites spanning three states, evidence from two El Niños, and a decade of research.

Special Feature

The Value of LTER Site Augmentation

In 1996, National Science Foundation began an experiment that involved augmenting two LTER sites at a funding level double to the Network standard. The sites were selected based on competitive proposals. The successful proposals contained significant commitments to involving social and economic sciences and plans for developing regional-scale research.

Over the past six years, the increased funding has provided these sites, North Temperate Lakes LTER in Wisconsin (NTL) and Coweeta LTER in the southern Appalachian mountains (CWT), the opportunity to focus on complex interactions between humans and ecological processes across a range of scales and to make significant advances in understanding the spatial, temporal, and decision-making components of land use and land-use change, and has helped build regional, national, and international collaborations.

Despite the augmentation "the bridge between natural and social sciences remains exceptionally challenging," NTL PI Steve Carpenter says, the main limitation being the cultural difference between the disciplines. "LTER can be a key bridge for the scientific community as a whole, because LTER can provide ongoing scientific interaction."

For LTER PIs to develop a collaborative style, Carpenter says, takes time— and the right conditions. "I think we are on the road to such collaboration at NTL," he says, "but it's a journey, not a destination." In addition to the augmentation, NTL has had help from IGERT, BioComplexity, Pew, Rockefeller and Packard funds. "We have been lucky, Carpenter admits. "If LTER wants to grow some good natural-social science collaborations, each site needs sustained funding for a few students and some PI time."

The NTL LTER site augmented research in several dimensions, including the addition of a second core site in the urban Madison area, "which provides an important contrast to study lakes in the north that are much less impacted by humans," says Jim Rusak, NTL co-PI. "We have strengthened our remote sensing and landscape ecology components at multiple scales-watersheds to lake districts, to State and the western Great Lakes region." NTL has also been able to forge ongoing collaborations with Canadian sites.

Another dimension involves increasing interdisciplinary integration, including modeling and landscape analysis, "which has strengthened links among climatology, remote sensing, landscape ecology, hydrology, and limnology," Rusak says. "We have also embarked on collaborations with rural sociology and economics."

While augmentation has had its success, research and outreach accomplishments of this nature are not exclusive to augmented sites, says Ted Gragson, CWT LTER PI. "The Harvard Forest LTER site, for example, has some stellar regional-scale research, and Andrews LTER is associated with similarly stellar regional work (although with different funding)," Gragson says. "There are certainly some documents that show the value of, and highlight useful process on regionalization, but they are not specific to [this] augmentation." Gragson points out some emerging models from outside the LTER as well, including the BioComplexity program, and France's Zones Ateliers (see *The LTER Network Newsletter* Vol. 14 No.1 Spring 2001, page 8).

The augmentation project at North

LTER sampling reveals unusual winter lake-ice conditions

North Temperate Lakes LTER field staff drilling a hole through ice on Madison area lakes showing lack of snow cover and open water area in background, February 2003.

Residents of Madison, Wisconsin expect their lakes to have thick hard ice for ice fishing, skating, and ice boating during mid-winter. This year, the ice in some area lakes is not safe. NTL-LTER researchers during their routine sampling noticed that while the top layer of the ice was hard, the majority of the underlying ice was soft and spatially variable in thickness. This was because water temperatures right under the ice were relatively warm, an effect believed to be caused by the combination of a lack of snow cover and ice-free areas that opened up during an earlier warming period. Without the reflective snow, the ice and underlying water was heated by the sun's radiant energy. In addition, open holes on some of the shallower lakes that did not completely freeze over in early winter have allowed the wind to mix the water column bringing the warmer bottom water to the surface. The end result of these relatively warm surface water temperatures has been a premature melting of the ice from underneath even though recent air temperatures have been cold. These unusual lake ice and water temperature conditions prompted LTER researchers to contact government authorities, who in turn notified the public about unsafe ice conditions, especially with warmer weather in the immediate forecast. The unusual ice conditions are also consistent with LTER research findings that winter ice duration on water bodies throughout the world is becoming shorter in response to global warming.

Temperate Lakes LTER site addresses two new types of questions: one type that requires integration of natural and social sciences and another that requires understanding of regional-scale processes. For example: What ecosystem services do the lake districts of rural northern and urban southern Wisconsin provide, and what are their economic values? How do farmer behaviors vary across watersheds, and why? How do ecosystems, agencies, farmers and other lake users, respond to political processes, and how do these responses interact to affect the temporal dynamics of the lakes? What are the effects of prolonged drought on lakes throughout the upper Midwest? How has the timing and duration of ice cover changed in lakes throughout the northern Hemisphere over decadal and century time scales? Can we use satellite imagery to predict regional water quality?

Augmentation has lead to some significant findings at NTL LTER, including: The economically optimal phosphorus input to lakes is less (often far less) than would have been estimated if the work was based on an assumption that the lakes were linear, equilibrium systems with no stochastic factors and no time delays.

By calculating the net economic value of water quality (based on the economics of farming, value of housing near the lake, and the recreational economy derived from boating, fishing and soforth), NTL researchers have shown that the economically optimal phosphorus loading (which maximizes net costs and benefits to society as a whole) is about one-third of the current loading rate to the lake. Furthermore, even economically optimal phosphorus loads may incur a high risk of shifting the lake into an irreversible eutrophic state. The model's improved predictive capability is largely the result of including more realistic (non-linear) relationships between variables and the stochastic influence of climatic variation.

These analyses show that the total economic value generated by the Lake Mendota watershed would increase substantially if less fertilizer were used. Total economic value is the net benefit from all uses of the watershed, including agriculture, lakeshore property values, fishing and other recreation.

Another finding resulting from this effort is that the probability of cyanobacterial bloom on a given day can be reduced from about 65% to 20% by halving the phosphorus inputs. These numbers became effective public outreach tools to launch an aggressive non-point pollution control program.

A phosphorus budget we developed for Madison's Lake Mendota watershed shows that fertilizers, supplements to dairy cattle, and natural inputs are substantially larger than the outputs of crops, meats, diary products and runoff. This excess phosphorus accumulates in soils at the rate of 450 kg per year. The accumulation of phosphorus in watershed soils poses a challenge for lake management, and is a problem of global significance. This work has inspired dialogue in community, including a popular, Web-accessible version of a scientific paper published in *Issues in Ecology* (see http://www.esa.org/sbi/sbi_issues/)

At the regional scale, a workshop provided researchers with common goals of examining landscape-level processes that lead to spatial and temporal patterns of lake characteristics in individual or multiple lake districts. A special issue of *Freshwater Biology* highlighted results from this workshop, which included 10 lake districts from North America, Europe, and Antarctica. At the global scale, records for freeze and thaw dates provide a seasonally integrated view of trends from regions where early temperature measurements are sparse. NTL investigators catalogued these records and developed a shared database for researchers around the world.

Relevant Reading

Carpenter, S.R., D. Ludwig and W.A. Brock. 1999. Management of eutrophication for lakes subject to potentially irreversible change. Ecological Applications 9: 751-771.

Lathrop, R. C., S. R. Carpenter, C. A. Stow, P. A. Soranno and J. C. Panuska (1998). Phosphorus loading reductions needed to control blue-green algal blooms in Lake Mendota. Canadian Journal of Fisheries and Aquatic Sciences 55(5): 1169-78.

Kratz, T. K. and T. M. Frost (2000). The ecological organisation of lake districts: general introduction. Freshwater Biology 43: 297-99.

Grad students Lindsay Stallcup and Marcelo Ardon (University of Georgia) leave for the field carrying mesh bags filled with five different types of leaves to be incubated in streams at La Selva Biological Station in Costa Rica. This project is one of several leaf decomposition experiments taking place at La Selva and the Coweeta and Luquillo LTER sites. Some of these studies involve inter-site comparisons and have been funded by augmentation grants to the Coweeta LTER grant.

Significant findings resulting from augmented studies at Coweeta LTER

Permanent vegetation plots in combination with climate modeling allowed us to relate forest composition and productivity to topography over long time scales. A spatially explicit model of land-use change over

continued on page 16, column 1

Breaking New Ground

International LTER Workshop in Agricultural Ecosystems Leads to Collaboration

◆Andrew Corbin, Kellogg Biological Station LTER— *The author wishes to thank Hen-biau King (Taiwan Ecological Research Network), whose tireless efforts and extraordinary hospitality played a key role in the success of this workshop.*

The first International Workshop on Long Term Ecological Research in Agricultural Ecosystems took place 11 November 2002 at the Taiwan Agricultural Research Institute (TARI) in Wu-feng, Taichung, Taiwan. The five-day event was organized by KBS, TARI, and the Chinese Forestry Association. Workshop sponsors included the Taiwan Council of Agriculture (COA), TARI, NSF and the East Asia - Pacific Regional LTER Network Committee.

The objective of the workshop, which eminated from the LTER All Scientists Meeting in Snowbird, Utah (2000), was to provide insight and advice from KBS researchers and administrators to those in Taiwan, Korea and China who are considering establishing new or enhancing existing agricultural LTER sites. Over seventy researchers and administrators from the U.S., Korea, China, and Taiwan participated in the workshop. Principles and overseas guests spent the rest of the week visiting LTER and other research sites throughout Taiwan.

Above: International participants outside the National Dong Hwa University in Hualien, Taiwan. (left to right) Jiabao Zhang, Zhu Ouyang, Ohseok Kwon, Tim Bergsma, Mike Klug, Andrew Corbin, Yue-joe Hsia, Youngsun Kim, and Hen-biau King. Photo by Youngsun Kim
Left: Mike Klug and Hen-biau King present Su-san Chang with Michigan maple syrup produced at KBS. Photo by Andrew Corbin

The Director-General of TARI, Chien-yih Lin, welcomed participants by recognizing "The unprecedented scale of agricultural expansion and intensification has raised concerns about the state of agroecosystems." Effects of intensification are stressing the integrity of agroecosystems and generating negative impacts on other ecosystems in Taiwan. Lin cited examples such as "soil erosion on downstream fisheries and reservoirs damaging both [these] aquatic ecosystems" and "fertilizer and pesticide residues in water resources, air, and crops [affecting] human health." With his introductory remarks, Chiu-chung Young, from the department of Soil and Environmental Sciences at National Chung Hsing University also acknowledged the concerns brought about by high input agriculture within the ecosystem and advocated the importance of long term ecological research for developing sustainability within modern agriculture. In his greeting, Shan-ney Huang, Director-General of Taiwan's Food and Agriculture Department stated: "This workshop focuses on agricultural ecosystem management at the ecosystem level, which I believe is an advance in agricultural research... [and] serves as a platform to discuss possibilities of establishing new and enhancing existing agricultural LTER sites in countries of our region. I'm looking forward to seeing collaborations among representatives from each site which occur within and following this workshop."

In the keynote address, "LTER in Agronomic Systems: Importance, Infrastructure and Administration" Mike Klug (KBS) considered the typical grant funding process, "...they are really funded in very short time periods and as a result we have lost a lot of information about those broad temporal and spatial scale differences that we see within these systems..."

The talks were separated into three categories: -Session I, General Reviews of Ecolog-ical Research in Agri-culture consisted of Ecol-ogical Research in Agricultural Ecosystems in Korea in which Ohseok Kwon, and Eun-Shik Kim from the National Institute of Agricultural Science and Technology (NIAST) through phase two of the workshop which will include a visit from the East Asia group to KBS in early summer of 2003. focused on the importance of the role of governmental bodies to support ecological research in agroecosystems and the collaboration among participating nations to maximize research productivity. Su-san Chang, Chief, International Organization Division COA, gave an overview of Agricul-

continued next page, column one

International Workshops

continued from previous page

tural Research in Taiwan where she pointed out that safeguarding the ecology and the environment is one of the top three policy objectives of the COA. Jiabao Zhang from the institute of Soil Science in Nan-jiang, Chinese Academy of Science spoke on long term monitoring and study of nutrition in agricultural ecosystems in China.

- Session II, Ecosystem Approaches in Agricultural Research included a Study on Soil Ecology and productivity Improvement of Maize-Rice Cropping in Taiwan by Chiu-chung Young. Nutrient Budgets and Transformations in Subtropical Arable Land was addressed by Hong-chi Lin from the department of Agricultural Chemistry at NTU, and Zhu Ouyang from the Institute of Geography and Resources, Chinese Academy of Sciences presented a study on Long Term Monitoring of Water and Crop Productivity in Agricultural Ecosystems.

- Session III Sustainable Management involved four talks. Project Management, Sampling and Analysis by Andrew Corbin. Chen-fang Lin of the Department of Soil and Environmental Sciences, NCHU spoke on Data Management of Soil Information. Tim Bergsma - KBS LTER deliberated on Designing and Maintaining an Information Management System and Yuong-how Tsai, Chief, Chi-Nan Branch of the Kaohsiung District Agricultural Improvement Station introduced a Long-Term Field Trial for Organic and Conventional Farming Systems.

Consequent discussion contemplated ecosystem landscape approaches such as sustainable management, ecological processes and services and minimizing environmental impacts on a crop by crop basis. The main outcome focused on the need to establish a interdisciplinary team of international collaborators to find common links between cropping systems. Collaborators can benefit from first-hand counsel of researchers and administration administration through phase two of the workshop which will include a visit from the East Asia group to KBS in early summer of 2003.

International Collaboration Reveals Earthworm Invasion in Taiwan

Through international collaboration, LTER investigators have discovered that a species of earthworm that has invaded Puerto Rico is also invading Taiwan. Recent work by Xiaoming Zou of the Luquillo LTER site (P.R.) and Lucy Hou of the Nanhenshan site in Taiwan on the tropical earthworm *P. corethrurus* may influence invasive species policy.

Dr. Zou took his sabbatical leave in the National Cheng Kung University and developed a collaborative research project with Dr. Hou, examining interactions between soil fauna and soil processes. Their work on the invasion of this species in Puerto Rico revealed significant decreases in earthworm diversity, as well as increases in CO^2 efflux from soil to atmosphere. The investigators warned that these ecological consequences may also occur in Taiwan. Their work was reported on in seven national newspapers in Taiwan, sparking the attention of the department of agriculture, who solicited the scientist's advice for controlling the pervasive invader.

One of several newspapers in Taiwan to cover the earthworm invasion story. Note the worms in the photo - center left.

Originating in South America, *P. corethrurus* has invaded almost every part of wet tropical areas of Africa, Asia, Australia, Hawaii, and Central America. The increased need for fishing baits may have brought *P. corethrurus* into Taiwan.

At the Luquillo LTER site in P.R., Zou's research team showed a 20-30% reduction in CO^2 efflux in worm excluded plots, and are currently we are measuring CO^2 in Taiwan in adjacent invaded and non-invaded areas, but have not published the data yet.

Assuming that (1) most of the wet tropics are invaded with this species, and (2) the magnitude of increase in CO^2 efflux is 20%, data from Puerto Rico shows that the invasion of *P. corethrurus* would raise the efflux of CO^2 — as much as equalent to the amount CO^2 release by fossil fuel compustion in the world, at least for short term. The long-term effects are not yet known.

The department of agriculture of Taiwan contacted Hou and Zou, requesting advice to control the spread of the earthworms. The investigators proposed the need for more baseline information on the current status of invasion in Taiwan and research data on its potential effect on soil biodiversity and ecosystem processes. Worm studies in PR demonstrated that forest restoration would reduce the exotic species and enhance the recovery of native earthworms, thus afforestation may be proposed as an effective way to control the spread of *P. corethrurus*.

There are always two sides to any coin. An increase in earthworm density after invasion can accelerate the decomposition of soil organic matter, and thus may increase soil nutrient availability and plant production, balancing the negative effect of increased CO^2 efflux. But the scientists do not have field data on plant production at ecosystem levels.

The Real Value of Augmentation at LTER Sites

continued from page 13

a 40-year period (1950-1990) identifying physical and human factors and determining land-use patterns for representative areas across the region, shows that land-cover changes are more frequent at lower elevations and near roads. The implication is that this development is concentrated in sensitive riparian areas.

The effort has also involved studies of how plant and animal populations respond to biotic and abiotic variation at plot-to-landscape scales, as well as how biota responds to past and present land use patterns across the region. Bird diversity declined with forest patch size, which in turn influenced plant community composition. Some plant groups (e.g., Liliaceae and myrmecochores) with diaspores dispersed by ants were scarce or absent in patches subjected to intensive past land use. Land-use history was more important than patch size in explaining variation in abundance and composition of seed-dispersing ants. Fish density and diversity, in particular, are more affected by upstream than streamside deforestation. The "legacy effect" and the relative importance of upstream process point the way toward large-scale and long-term restoration given the implication that localized efforts may ultimately have little effect.

Small-scale measurements taken in 2000 at three locations in the Little Tennessee and French Broad watersheds were combined with landscape-level modeling to determine the impacts of land-use change on carbon budgets. We found that woody biomass in old growth forest is 2- to 8-fold greater than in early and mid-successional forests.

The discovery of these dramatic effects of land-use patterns and environmental heterogeneity on populations and communities led us to begin a new 30-year study in 2000 of stream regions forecast to differ over time in type and risk of development.

Intersite and Collaborative Activities

Since 1996 Coweeta researchers have led or participated in more than 30 LTER intersite or international research projects. The collaborations include comparison of organic matter budgets in streams within and outside the LTER network and a chironomid biossay technique to assess quality of fine particulate organic matter in streams from five LTER sites. It also involves examining the linkage between biodiversity of litter-inhabiting microarthropods and the decomposition of leaf litter in aquatic and terrestrial ecosystems at Coweeta, Luquillo, and La Selva. Coweeta scientists participated in a cross-site comparative mycorrhizae ecosystem function experiment at Bonanza Creek, Sevilleta, and sites in California, and participated in the 10-year LIDET (Longterm Intersite Decomposition Experiment Team) study designed to test the effects of substrate quality and macroclimate on long-term decomposition and nutrient release dynamics of fine litter at 28 participating sites.

Please review relevant literature on the Coweeta LTER Web site:

http://coweeta.ecology.uga.edu/webdocs/1/publications.html

McMurdo Site News

continued from page 3

activity, may initiate conditions for melt that are critical to the entire polar desert ecosystem in the dry valley. This work has significant ramifications across multiple scales. We are exploring icy extremes that support antarctic life, as well as contributing to the understanding of the global-glaciation theory of our planet. Cryoconite holes provide a modern day analog of a possible refuge for microbial life during Snowball Earth. In addition, our study sets the stage for future searches for life on other ice-bound planets and moons such as Mars and Europa.

Relevant Literature

Gribbon, P. W. 1979. Cryoconite holes on Sermikaysak, West Greenland. Journal of Glaciology, 22, 177-181.

Mueller, D. R., W. F. Vincent, W. H. Pollard and C. H. Fritsen. 2001. Glacial cryoconite ecosystems: a bipolar comparison of algal communities and habitats. Nova Hedwigia, 123, 171-195.

Wharton, R. A., Jr., C. P. McKay, G. M. Simmons, Jr. and B. C. Parker. 1985. Cryoconite holes on glaciers. Bioscience, 35, 499-503.

Publications

Recent Publications from the LTER Community

Andrews

Acker, S. A.; Halpern, C. B.; Harmon, M. E.; Dyrness, C. T. 2002. Trends in bole biomass accumulation, net primary production and tree mortality in Pseudotsuga menziesii forests of contrasting age. Tree Physiology. 22: 213-217.

Bond, Barbara J.; Jones, Julia A.; Moore, Georgianne; Phillips, Nathan; Post, David; McDonnell, Jeffrey J. 2002. The zone of vegetation influence on baseflow revealed by diel patterns of streamflow and vegetation water use in a headwater basin. Hydrological Processes. 16: 1671-1677.

Chen, Hua; Harmon, Mark E.; Sexton, Jay; Fasth, Becky. 2002. Fine-root decomposition and N dynamics in coniferous forests of the Pacific Northwest, USA. Canadian Journal of Forest Research. 32: 320-331.

Cohen, Warren B.; Spies, Thomas A.; Alig, Ralph J.; Oetter, Douglas R.; Maiersperger, Thomas K.; Fiorella, Maria. 2002. Characterizing 23 years (1972-1995) of stand replacement disturbance in western Oregon forests with Landsat imagery. Ecosystems. 5: 122-137.

Gurnell, A. M.; Piégay, H.; Swanson, F. J.; Gregory, S. V. 2002. Large wood and fluvial processes. Freshwater Biology. 47: 601-619.

Harmon, Mark E.; Marks, Barbara. 2002. Effects of silvicultural practices on carbon stores in Douglas-fir - western hemlock forests in the Pacific Northwest, U.S.A.: results from a simulation model. Canadian Journal of Forest Research. 32: 863-877.

Hicks, William T.; Harmon, Mark E. 2002. Diffusion and seasonal dynamics of O2 in woody debris from the Pacific Northwest, USA. Plant and Soil. 243: 67-79.

Hicks, William T.; Harmon, Mark E.; Myrold, David D. 2003. Substrate controls on nitrogen fixation and respiration in woody debris from the Pacific Northwest, USA. Forest Ecology and Management. 176: 25-35.

Janisch, J. E.; Harmon, M. E. 2002. Successional changes in live and dead wood carbon stores: implications for net ecosystem productivity. Tree Physiology. 22: 77-89.

Lach, Denise; List, Peter; Steel, Brent; Shindler, Bruce. 2003. Advocacy and credibility of ecological scientists in resource decisionmaking: a regional study. BioScience. 53(2): 171-179.

Lefsky, Michael A.; Cohen, Warren B.; Parker, Geoffrey G.; Harding, David J. 2002. Lidar remote sensing for ecosystem studies. BioScience. 52(1): 19-30.

Smithwick, Erica A. H.; Harmon, Mark E.; Remillard, Suzanne M.; Acker, Steven A.; Franklin, Jerry F. 2002. Potential upper bounds of carbon stores in forests of the Pacific Northwest. Ecological Applications. 12(5): 1303-1317.

Vanderbilt, K. L.; Lajtha, K.; Swanson, F. 2002. Biogeochemistry of unpolluted forested watersheds in the Oregon Cascades: temporal patterns of precipitation and stream nitrogen fluxes. Biogeochemistry. 62:87-117.

Weisberg, Peter J.; Swanson, Frederick J. 2003. Regional synchroneity in fire regimes of western Oregon and Washington, USA. Forest Ecology and Management. 172: 17-28.

Florida Coastal Ecosystem

Anderson, W.T. and J.W. Fourqurean, 2003. Intra- and interannual variability in seagrass carbon and nitrogen stable isotopes from south Florida, a preliminary study. Organic Geochemistry 34(2): 185-194.

Busch, D.E. and J.C. Trexler (eds.), 2003. Monitoring Ecosystems: Interdisciplinary Approaches for Evaluating Ecoregional Initiatives. Island Press, Washington D.C. 447pp.

Childers, D.L., R.F. Doren, G.B. Noe, M. Rugge, and L.J. Scinto, 2003. Decadal change in vegetation and soil phosphorus patterns across the Everglades landscape. Journal of Environmental Quality 32: 344-362.

Davis, S.E., C. Coronado-Molina, D.L. Childers, and J.W. Day, Jr., 2003. Temporally dependent C, N, and P dynamics associated with the decay of Rhizophora mangle L. leaf litter in oligotrophic mangrove wetlands of the Southern Everglades. Aquatic Botany 75: 199-215.

Trexler, J.C. and D.E. Busch, 2003. Monitoring, assessment, and ecoregional initiatives: a synthesis. In D.E. Busch and J.C. Trexler (eds.) Monitoring Ecosystems: Interdisciplinary Approaches for Evaluating Ecoregional Initiatives. Island Press, Washington, D.C. pp. 405-424.

Trexler, J.C., W. F. Loftus, and J. Chick, 2003. Setting and monitoring restoration goals in the absence of historical data: The case of fishes in the Florida Everglades. In D. Busch and J.C. Trexler (eds.) Monitoring Ecoregional Initiatives: Interdisciplinary Approaches for Determining Status and Trends of Ecosystems. Island Press, Washington, D.C.

FCE-presentations

Childers, D.L. 2003. Relating water flow relates to wetland processes and landscape restoration in the Everglades. Society of Wetland Scientists Conference, New Orleans, LA, June 2003.

Childers, D.L. 2003. Ecological and hydrologic sciences meet socio-economics in the restoration of the Everglades. LTER Network Mini-Symposium, National Science Foundation Headquarters, Arlington, VA, February 2003.

Childers, D.L. 2003. Relating water flow to wetland processes and Everglades restoration, or "getting the water really right" in the river of grass. Invited presentation, IFAS, University of Florida, Homestead, FL, February 2003.

Childers, D.L. 2003. Relating water flow to wetland processes and Everglades restoration in the River of Grass. Invited presentation, Department of Biology, University of Miami, Miami, FL, February 2003.

Evans, S.L., W.T. Anderson, J.W. Fourqurean, R. Jaffe, E.E. Gaiser, L.S. Collins, and C.W. Holmes 2002. Carbon and Nitrogen Stable Isotope Composition of OM From Florida Bay, the Initial Results of a Paleoenvironmental Seagrass Reconstruction. American Geophysical Union 2002 Fall Meeting, San Francisco, CA, December 2002.

Jaffe, R., R.N. Mead, and X. Yunping. 2003. Sedimentary Organic Matter Sources in Florida Bay as Revealed through Molecular Marker Analysis and Compound Specific Stable Isotope Measurements. ASLO, Salt Lake City, UT, February 8-14, 2003.

Maie, N., C. Yang, T. Miyoshi, K. Parish, R. Jaffe. 2003. Chemical characteristics of high molecular weight dissolved organic matter (HMW DOM) in the Florida Coastal Everglades. ASLO, Salt Lake City, UT, February 8-14, 2003.

Mead, R.N., Y. Xu, J.T. Chong, R. Jaffe. 2003. Calibration of an n-Alkane Proxy for Tracing Organic Matter Inputs to Wetland and Estuarine Sediments/Soils. ASLO, Salt Lake City, UT, February 8-14, 2003.

Jornada Basin

Huenneke, L.F., D. Clason, and E. Muldavin. 2001. Spatial heterogeneity in Chihuahuan Desert vegetation: Implications for sampling methods in semi-arid ecosystems. Journal of Arid Environments 47:257-270.

Huenneke, L.F. 2001. Deserts. PP 201-222 in: O.E. Sala, F.S. Chapin and E. Huber-Sannwald, eds. Global Biodiversity in a Changing Environment: Scenarios for the 21st Century. Springer-Verlag, New York.

Rango, A., S. Goslee, J. Herrick, M. Chopping, K. Havstad, L. Huenneke, R. Gibbens, R. Beck, and R. McNeely. 2002. Remote sensing documentation of historic rangeland remediation treatments in southern New Mexico. J. of Arid Environments 50:549-572.

Huenneke, L.F., J. Anderson, M. Remmenga, and W.H. Schlesinger. 2002. Desertification alters patterns of aboveground net primary production in Chihuahuan ecosystems. Global Change Biology 8(3):247-264.

Kellogg Biological Station

Agrarwal, A. A., K. R. Kosola, and D. Parry. 2002. Interactive effects of gypsy moth outbreak and fertilization on hybrid poplar regeneration. Canadian Journal of Forest Research 32: 1491-1496.

Buckley, D. H., and T. M. Schmidt. 2002. Exploring the diversity of soil - a microbial rainforest. Pages 183-208 in J. T. Staley and A. L. Reysenbach, eds. Biodiversity of Microbial Life: Foundation of Earth's Biosphere. Wiley, New York, New York, USA.

Menalled, F., M. Liebman, and K. Renner. 2002. The ecology of weed seed predation in herbaceous crop systems in D. Batish, ed. Handbook of Sustainable Weed Management. The Haworth Press, Binghampton, New York, USA.

Scriber, J. M., K. Keefover, and S. Nelson. 2002. Hot summer temperatures may stop genetic introgression of Papilio canadensis south of the hybrid zone in the North Amercian Great Lakes region. Ecography 25: 184-192.

Scriber, J. M. 2002. The evolution of insect-plant relationships; Chemical constraints, coadaptation and concordance of insect/plant traits. Entomologia Experimentalis et Applicata 104: 217-235.

Scriber, J. M. 2002. Latitudinal and local geographic mosaics in host plant preferences as shaped by thermal units and voltinism. European Journal of Entomology 99: 225-239.

Scriber, J. M., M. Deering, J. Donovan, H. Hereau, G. Ording, and A. Stump. 2002. Species at the edge: Island refuges, interspecific hybridization, and climate-driven range extensions of North American butterflies. Proceedings 10th Insects in Captivity Conference 10: 178-185.

Scriber, J. M., A. Stump, and M. Deering. 2003. Hybrid zone ecology and tiger swallowtail trait clines in North America. Pages 367-391 in C. Boggs, W. Watt, and P. Erlich, eds. Ecology and Evolution Taking Flight: Butterflies as Model Study Systems. University of Chicago Press, Chicago, Illinois, USA.

Tesar, D., and J. M. Scriber. 2002. Growth season constraints in climatic cold pockets: Tolerance of subfreezing temperatures and compensatory growth by tiger swallowtail butterfly larvae. Holarctic Lepidoptera 7: 39-44.

Konza Prairie

Baer, S. G., D. J. Kitchen, J. M. Blair, and C. W. Rice. 2002. Changes in ecosystem structure and function in a chronosequence of grasslands restored through the Conservation Reserve Program. Ecological Applications. 12:1688-1701.

Barrett, J. E., R. L. McCulley, D. R. Lane, I. C. Burke, and W. K. Lauenroth. 2002. Influence of climate variability on plant production and N-mineralization in Central US grasslands. Journal of Vegetation Science. 13:383-394.

Bremer, D. J. and J. M. Ham. 2002. Measurement and modeling of soil CO2 flux in a temperate grassland under mowed and burned regimes. Ecological Applications. 12:1318-1328.

Collins, S. L., S. M. Glenn, and J. M. Briggs. 2002. Effect of local and regional processes on plant species richness in tallgrass prairie. Oikos. 99:571-579.

Damhoureyeh, S. A. and D. C. Hartnett. 2002. Variation in grazing tolerance among three tallgrass prairie plant species. American Journal of Botany. 89:1634-1643.

Danner, B. T. and A. K. Knapp. 2003. Abiotic constraints on the establishment of Quercus seedlings in grasslands. Global Change Biology. 9:266-275.

Dodds, W. K., V. H. Smith, and K. Lohman. 2002. Nitrogen and phosphorus relationships to benthic algal biomass in temperate streams. Canadian Journal of Fisheries and Aquatic Science. 59:865-874.

Fay, P. A., A. K. Knapp, J. M. Blair, J. D. Carlisle, B. T. Danner, and J. K. McCarron. 2003. Rainfall timing, soil moisture dynamics, and plant responses in a mesic tallgrass prairie ecosystem. Pages 147-163 in Weltzin, J. F. and G. R. McPherson, editors. Precipitation Regimes and Terrestrial Ecosystems. A North American Perspective. University of Arizona Press.

Franzluebbers, K., A. J. Franzluebbers, and M. D. Jawson. 2002. Environmental controls on soil and whole-ecosystem respiration from a tallgrass prairie. Soil Science Society of America Journal. 66:254-262.

Fritz, K. M., J. A. Tripe, and C. S. Guy. 2002. Recovery of three fish species to flood and seasonal drying in a tallgrass prairie stream. Transaction of the Kansas Academy of Science. 105:209-218.

Fritz, K. M. and W. K. Dodds. 2002. Macroinvertebrate assemblage structure across a tallgrass prairie stream landscape. Archiv Für Hydrobiologie. 154:70-102.

Goodin, D. G. and G. M. Henebry. 2002. The effect of rescaling on fine spatial resolution NDVI data: a test using multi-resolution aircraft data. International Journal of Remote Sensing. 23:3865-3871.

Grace, J. B., M. D. Smith, S. L. Grace, S. L. Collins, and T. J. Stohlgren. 2001. Interactions between fire and invasive plants in temperate grasslands of North America. Pages 40-65 in Galley, K. and T. Wilson, editors. Fire Conference 2000: The First National Congress On Fire, Ecology, Prevention And Management. Invasive Species Workshop: The Role of Fire In The Control And Spread Of Invasive Species. Tall Timbers Research Station. Tallahassee.

Gustafson, D. J., D. J. Gibson, and D. L. Nickert. 2002. Genetic diversity and competitive abilities of Dalea Purpurea (Fabaceae) from remnant and restored grasslands. International Journal of Plant Science. 163:979-990.

Hartnett, D. C. and G. T. Wilson. 2002. The role of mycorrhizas in plant community structure and dynamics: lessons from grasslands. Plant and Soil. 244:319-331.

Heisler, J. L., J. M. Briggs, and A. K. Knapp. 2002. Long-term patterns of shrub expansion in a C4-dominated grassland: fire frequency and the dynamics of shrub cover and abundance. American Journal of Botany.

Henebry, G. M. 1997. Advantages of principal components analysis for land cover segmentation from SAR image series. Pages 175-178 in Proceedings of 3rd ERS Symposium on Space at the service of our Environment. ESA. Noordwijk, The Netherlands.

Hoch, G., B. L. Brock, and J. M. Briggs. 2002. Applications of advanced technologies in studying and managing grassland landscape integrity. Pages 390-411 in Liu, J. and W. W. Taylor, editors. Integrating landscape ecology into natural resource management. Cambridge University Press. Cambridge, U.K.

Hoch, G. A., J. M. Briggs, and L. C. Johnson. 2002. Assessing the rate, mechanism and consequences of conversion of tallgrass prairie to Juniperus virginiana forest. Ecosystems. 6:578-586.

Huber, R. L. and V. F. Wright. 2002. First Kansas record for Tetraopes texanus (Coleoptera: Cerambycidae). Journal of the Kansas Entomological Society. 75:341.

Kemp, M. J. and W. K. Dodds. 2002. The influence of ammonium, nitrate, and dissolved oxygen concentration on uptake, nitrification, and denitrification rates associated with prairie stream substrata. Limnology and Oceanography. 47:1380-1393.

Knapp, A. K., P. A. Fay, J. M. Blair, S. L. Collins, M. D. Smith, J. D. Carlisle, C. W. Harper, B. T.

Danner, M. S. Lett, and J. K. McCarron. 2002. Rainfall variability, carbon cycling and plant species diversity in a mesic grassland. Science. 298:2202-2205.

Owens, A., M. Tager, and E. Horne. 2002. Phrynosoma cornutum (Texas horned lizard) reproduction. Herpetological Review. 33:308-309.

Parker, T. H. 1999. Responses of Bell's vireos to brood parasitism by the brown-headed cowbird in Kansas. Wilson Bulletin. 111:499-504.

Parody, J. M. and T. H. Parker. 2002. Biogeographic variation in nest placement: a case study with conservation implications. Diversity and Distributions. 8:11-20.

Rundquist, B. C. 2002. The influence of canopy green vegetation fraction on spectral measurements over native tallgrass prairie. Remote Sensing of the Environment. 81:129-135.

Silletti, A. M. and A. K. Knapp. 2002. Long-term responses of the grassland co-dominants Andropogon gerardii and Sorghastrum nutans to changes in climate and management. Plant Ecology. 163:15-22.

Smith, C. C. and J. M. Briggs. 2001. Species, season, and density of buried seeds surviving fox squirrel depredation. Prairie Naturalist. 33:197-208.

Towne, E. G. and K. E. Kemp. 2003. Vegetation dynamics from annually burning tallgrass prairie in different seasons. Journal of Range Management. 56:185-192.

Whiles, M. R. and W. K. Dodds. 2002. Relationships between stream size, suspended particles, and filter-feeding macroinvertebrates in a great plains rainage network. Journal of Environmental Quality. 31:1589-1600.

Wilson, G. W. T., D. C. Hartnett, M. D. Smith, and K. Kobbeman. 2001. Effects of mycorrhizas on growth and demography of tallgrass prairie forbs. American Journal of Botany. 88:1452-1457.

Luquillo

Merriam, J. L., W. H. McDowell, J. L. Tank, W. M. Wolheim, C. L. Crenshaw, and S. L. Johnson. 2002. Characterizing nitrogen dynamics, transport, and retention in a tropical rainforest stream using an in situ 15N addition. Freshwater Biology 47:143-160.

Lugo, A. E., and S. Fu. 2003. Structure and dynamics of mahogany plantations in Puerto Rico. in J. F. Colón and M. Alayón, editors. Big-leaf Mahogany: genetics, ecology, and management. Springer, New York.

Lugo, A. E., and J. Zimmerman. 2002. Ecological life histories. Pages 191-213 in J. Vozzo, editor. Tropical Tree Seed Manual, Agriculture Handbook 721. USDA Forest Service, Washington, DC.

Wang, H. H., and F. N. Scatena. 2003. Regeneration after hurricane disturbance of big-leaf and hybrid Mahogany plantations in Puerto Rico. Pages 237-260 in A. E. Lugo, J. C. F. Colón, and M. Alayon, editors. Big-leaf Mahogany: Genetics, ecology, and management. Ecological Studies 159. Springer-Verlag, New York.

Scatena, F. N., S. J. Doherty, H. T. Odum, and P. Karecha. 2002. An EMERGY evaluation of Puerto Rico and the Luquillo Experimental Forest. General Technical Report GTR-9, USDA Forest Service.

March, J. G., C. M. Pringle, M. J. Townsend, and A. I. Wilson. 2002. Effects of freshwater shrimp assemblages on benthic communities along an altitudinal gradient of a tropical island stream. Freshwater Biology 47:377-390.

Warren, M., and X. M. Zou. 2002. Tree species effects on soil macrofauna in tropical tree plantations of Puerto Rico. Forest Ecology and Management 170:161-171.

Liu, Z. G., and X. M. Zou. 2002. Exotic earthworms accelerate plant litter decomposition in a Puerto Rican pasture and a wet forest. Ecological Applications 12:1406-1417.

Kaye, J., D. Binkley, X. M. Zou, and J. Parrota. 2002. Retention of nitrogen by N-fixing species in tropical tree plantations. Soil Science Society of America Journal 66:612-619.

Pett-Ridge, J., and W. L. Silver. 2002. Effects of substrate and micro-climate change on the survival and growth of the bromeliad Guzmania berteroniana addition experiments? Results from an inter-biome comparison study. J. North American Benthological Society 21:544-560.

Walker, L. R., and R. d. Moral. 2003. Primary succession and ecosystem rehabilitation. Cambridge University Press, Cambridge, UK.

Lodge, D. J., T. J. Baroni, and S. A. Cantrell. 2002. Basidiomycetes of the Greater Antilles project. Pages 45-60 in R. Watling, J. C. Frankland, A. M. Ainsworth, S. Isaac, and C. Robinson, editors. Tropical Mycology. Volume 1 Macromycetes. CABI Publishing Egham, UK.

Fetcher, N., S. Wen, A. Montaña, and F. d. Castro. 2003. Photosynthetic response of hybrid mahogany grown under contrasting light regimes. Pages 117-128 in A. Lugo, J. C. F. Colón, and M. Alayón, editors. Big-leaf mahogany: Genetics, ecology, and management. Ecological Studies Series. Springer Verlag, New York, New York.

Silver, W. L., A. E. Lugo, and D. Farmer. 2002. Soil organic carbon in tropical forests of the U.S. Pages 363-382 in J. Kimble, R. Birdsey, L. Heath, R. Follett, and R. Ratan, editors. The Potential of U.S. Forest Soils to Sequester Carbon and Mitigate the Greenhouse Effect. CRC Press, Boca Ratón.

González, G. 2002. Soil organisms and litter decomposition. in R. S. Ambasht and N. K. Ambasht, editors. Modern Trends in Applied Terrestrial Ecology. Kluwer Academic / Planum Publishers, U.K.

Bloch, C. P., and L. Weiss. 2002. Distribution and abundance of the whipspider Phrynus longipes (Arachnida: Amblypygi) in the Luquillo Experimental Forest, Puerto Rico: response to natural and anthropogenic disturbance. Caribbean Journal of Science 38:260-262.

Lugo, A. E. 2002. Can we manage tropical landscapes? - an answer from the Caribbean perspective. Landscape Ecology 17:601-615.

Cox, S. B., M. R. Willig, and F. N. Scatena. 2002. Variation in nutrient characteristics of surface soils from the Luquillo Experimental Forest of Puerto Rico-A multivariate perspective. Plant and Soil 247:189-198.

Rivera-Ramírez, H. D., G. S. Warner, and F. N. Scatena. 2002. Prediction of master recession curves and baseflow recessions in the Luquillo Mountains of Puerto Rico. Journal of the American Water Resources Association 38:693-704.

Frizano, J., A. H. Johnson, D. R. Vann, and F. N. Scatena. 2002. Soil phosphorus fractionation during forest development on landslides scars in the Luquillo Mountains, Puerto Rico. Biotropica 34:17-26.

Lugo, A. E., F. N. Scatena, W. L. Silver, S. M. Colón, and P. G. Murphy. 2002. Resilience of tropical wet and dry forests in Puerto Rico. Pages 195-225 in L. H. Gunderson and P. Jr., editors. Resilience and behavior of large-scale systems. SCOPE Report 60. Island Press.

Willig, M. R. 2002. Exploring biodiversity in time and space: Profitable directions for mammalogy in the 21st century. Mastozoologia Neotropical 8:107-109.

Andelman, S. J., and M. R. Willig. 2003. Issues of scale in biodiversity. Pages 1-16 in C. E. o. B. a. Conservation, editor. Cambridge University Press, Cambridge, Massachusetts.

González, G. 2002. Soil organisms and litter decomposition. Pages 315-329 in R. S. Ambasht and N. K. Ambasht, editors. Modern Trends in Applied Terrestrial Ecology. Kluwer Academic / Plenum Publishers, UK.

Varner, R. K., M. Keller, J. R. Robertson, J. D. Dias, H. Silva, P. M. Crill, M. McGroddy, and W. L. Silver. 2003. Experimentally induced root mortality increased nitrous oxide emissions from tropical forest soils. Geophysical Research Letters. 30:1141-1145

McMurdo

Vose, James M.; Ryan, Michael G. 2002. Seasonal respiration of foliage, fine roots, and woody tissues in relation to growth, tissue N, and photosynthesis. Global Change Biology. 8: 182-193.

Dodds, Walter K.; López, Amanda J.; Bowden, William B.; Gregory, Stan; Grimm, Nancy B.; Hamilton, Stephen K.; Hershey, Annie E.; Marti, Eugenia; McDowell, William H.; Meyer, Judy L.; Morrall, Donna; Mulholland, Patrick J.; Peterson, Bruce J.; Tank, Jennifer L.; Valett, H. Maurice; Webster, Jackson, R.; Wollheim, Wilfred. 2002. N uptake as a function of concentration in streams. Journal of North American Benthological Society. 21(2): 206-220.

Iliott, Katherine, J.; Boring, Lindsay, R.; Swank, Wayne, T. 2002. Aboveground biomass and nutrient accumulation 20 years after clear-cutting a southern Appalachian watershed. Canadian Journal of Forest Research. 32: 667-683.

Walker, John T.; Geron, Christopher D.; Vose, James M.; Swank, Wayne T. 2002. Nitrogen trace gas emissions from a riparian ecosystem in southern Appalachia. Chemosphere. 49(10): 1389-1398.

Radtke, Philip J.; Burk, Thomas E.; Bolstad, Paul V. 2002. Bayesian melding of a forest ecosystem model with correlated inputs. Forest Science. 48(4): 701-711.

Mitchell, Chris E.; Turner, Monica G.; Pearson, Scott M. 2002. Effects of historical land use and forest patch size on myremecochores and ant communities. Ecological Applications. 12(5): 1364-1377.

Lambers, Janneke Hille Ris; Clark, James S.; Beckage, Brian. 2002. Density-dependent mortality and the latitudinal gradient in species diversity. Nature. 417: 732-735.

Wyckoff, Peter H.; Clark, James S. 2002. The relationship between growth and mortality for seven co-occurring tree species in the southern Appalachian Mountains. Journal of Ecology. 90: 604-615.

Shields, Catherine. 2002. Ozone and Atmospheric Deposition at Coweeta Hydrologic Lab. In: Proceedings Land Use and Biodiversity on the Highlands Plateau. A Carolina Environmental Program Report.2002 December 13; Highlands, NC; Highlands Biological Station: 7-24.

Curtin, Matt. 2002. Water Quality Effects on Fish Communities. In: Proceedings Land Use and Biodiversity on the Highlands Plateau. A Carolina Environmental Program Report.2002 December 13; Highlands, NC; Highlands Biological Station: 7-24.

Grossman, G.D.; Rincon, P.A.; Farr, M.D.; Ratajczak, R.E. Jr. 2002. A new optimal foraging model predicts habitat use by drift-feeding stream minnows. Ecology of Freshwater Fish. 11: 2-10.

Scott, Mark C.; Helfman, Gene S.; McTammany, Mathew E.; Benfield, E. Fred; Bolstad, Paul V. 2002. Multiscale influences on physical and chemical stream conditions across Blue Ridge landscapes. Journal of the American Water Resources Association. 38(5): 1379-1392.

Knoepp, Jennifer D.; Swank, Wayne T. 2002. Using soil temperature and moisture to predict forest soil nitrogen mineralization. Biology & Fertility of Soils. 36: 177-182.

Qualls, R.G.; Haines, B.L.; Swank, W.T.; Tyler, S.W. 2002. Retention of soluble organic nutrients by a forested ecosystem. Biogeochemistry. 61: 135-171.

Fettinger, Jennifer L. 2002. Ruffed grouse nesting ecology and brood habitat in western North Carolina. Knoxville, TN: University of Tennessee. 105 p. M.S. thesis.

North Temperate lakes

Anderson, M. P., R. J. Hunt, J. T. Krohelski and K. Chung (2002). Using high hydraulic conductivity nodes to stimulate seepage lakes. Ground Water 40(2): 117-122.

Bennett, E. and S. Carpenter (2002). P Soup. World Watch: 24-32.

Benson, B. J. and R. J. Olson (2002). Conducting cross-site studies: lessons learned from partnerships between scientists and information managers. Bulletin of the Ecological Society of America: 198-200.

Carpenter, S. R. (2002). Ecological futures: building an ecology of the long now. Ecology 83(3): 2069-2083.

Carpenter, S. R., W. A. Brock and D. Ludwig (2002). Collapse, learning, and renewal. Panarchy : understanding transformations in human and natural systems. L. H. Gunderson and C. S. Holling. Washington, DC, Island Press: 173-93.

Carpenter, S. R. and K. L. Cottingham (2002). Resilience and the Restoration of Lakes. Resilience and the Behavior of Large-Scale Systems. L. H. Gunderson and L. Pritchard, Jr. Washington D.C., Island Press. 60: 51-70.

Dent, C. L., G. S. Cumming and S. R. Carpenter (2002). Multiple states in river and lake ecosystems. Philosophical Transactions of the Royal Society of London B Biological Sciences 357: 632-45.

Donner, S. D., M. T. Coe, J. D. Lenters, T. E. Twine and J. A. Foley (2002). Modeling the impact of hydrological changes on nitrate transport in the Mississippi River Basin from 1955 to 1994. Global Biogeochemical Cycles 16(3): 19 pgs.

Gergel, S. E., M. D. Dixon and M. G. Turner (2002). Consequences of human-altered floods: levees, floods, and floodplain forests along the Wisconsin River. Ecological Applications 12(6): 1755-1770.

Gunderson, L. H., C. S. Holling and G. D. Peterson (2002). Surprises and sustainability: cycles of renewal in the Everglades. Panarchy : understanding transformations in human and natural systems. L. H. Gunderson and C. S. Holling. Washington, DC, Island Press: 315-32.

Hamilton, D. P., C. M. Spillman, K. L. Prescott, T. K. Kratz and J. J. Magnuson (2002). Effects of atmospheric nutrient inputs and climate change on trophic status of Crystal Lake, Wisconsin. Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie 28(Pt. 1): 467-70.

Holling, C. S., S. R. Carpenter, W. A. Brock and L. H. Gunderson (2002). Discoveries for sustainable futures. Panarchy : understanding transformations in human and natural systems. L. H. Gunderson and C. S. Holling. Washington, DC, Island Press: 395-416.

Holling, C. S., L. H. Gunderson and G. D. Peterson (2002). Sustainability and panarchies. Panarchy : understanding transformations in human and natural systems. L. H. Gunderson and C. S. Holling. Washington, DC, Island Press: 63-102.

Hrabik, T. R. and C. J. Watras (2002). Recent declines in mercury concentration in a freshwater fishery: isolating the effects of de-acidification and decreased atmospheric mercury deposition in Little Rock Lake. Science of the Total Environment 297: 229-237.

Kratz, T. K., D. W. Bolgrien, S. Giblin and J. O'Leary (2002). Human Influences on the spatial distribution of coarse woody debris in lakes in northern Wisconsin, USA. Verh. Internat. Verein. Limnol. 28(2): 545-48.

Lathrop, R. C., B. M. Johnson, T. B. Johnson, M. T. Vogelsang, S. R. Carpenter, T. R. Hrabik, J. F. Kitchell, J. J. Magnuson, L. G. Rudstam and R. S. Stewart (2002). Stocking piscivores to improve fishing and water clarity: a synthesis of the Lake Mendota biomanipulation project. Freshwater Biology 47: 2410-2424.

Magnuson, J. J. (2002). A future of adapting to climate change and variability. American Fisheries Society Symposium.

Magnuson, J. J. (2002). Signals from ice cover trends and variability. American Fisheries Society Symposium, American Fisheries Society.

Pace, M. L. and J. J. Cole (2002). Synchronous variation of dissolved organic carbon and color in lakes. Limnology and Oceanography 47(2): 333-42.

Peterson, G. D. (2002). Alternative stable states. Learning Landscape Ecology. S. E. Gergel and M. G. Turner. New York, Springer-Verlag: 166-83.

Peterson, G. D. (2002). Using ecological dynamics to move toward an adaptive architecture. Constructing ecology: nature as the basis for green buildings. C. J. Kibert, J. Sendzimir and G. B. Guy. New York, Spon Press: 127-50.

Peterson, G. D. (2002). Contagious disturbance, ecological memory, and the emergence of landscape pattern. Ecosystems 5(4): 329-38.

Peterson, G. D. (2002). Estimating resilience across landscapes. Conservation Ecology 6(1): 13 (online).

Reed, T. and S. R. Carpenter (2002). Comparisons of P-yield, riparian buffer strips, and land cover in six agricultural watersheds. Ecosystems 5: 568-577.

Rusak, J. A., N. D. Yan, K. M. Somers, K. L. Cottingham, F. Micheli, S. R. Carpenter, T. M. Frost, M. J. Paterson and D. J. McQueen (2002). Temporal, spatial, and taxonomic patterns of crustacean zooplankton variability in unmanipulated north-temperate lakes. Limnology and Oceanography 47: 613-25.

Sarakinos, H. C., M. L. Johnson and M. J. Vander Zanden (2002). A synthesis of tissue-preservation effects on carbon and nitrogen stable isotope signatures. Canadian Journal of Zoology 80: 381-387.

Schnaiberg, J., J. Riera, M. G. Turner and P. R. Voss (2002). Explaining human settlement patterns in a recreational lake district: Vilas County, Wisconsin, USA. Environmental Management 30(1): 24-34.

Smith, D. J., B. J. Benson and D. F. Balsiger (2002). Designing web database applications for ecological research. The Sixth World Multiconference on Systemics, Cybernetics and Informatics. Orlando, Florida, International Institute of Informatics and Systemics. 7: 408-413.

Stedman, R. C. (2002). Toward a social psychology of place: predicting behavior from place-based cognitions, attitude, and identity. Environment and Behavior 34(5): 561-81.

Turner, M. G., T. R. Crow, J. Liu, D. Rabe, C. F. Rabeni, P. A. Soranno, W. W. Taylor, K. A. Vogt and J. A. Wiens (2002). Bridging the gap between landscape ecology and natural resource management. Integrating landscape ecology into natural resource management. J. Liu and W. W. Taylor. Cambridge, UK, Cambridge University Press: 433-60.

Vadeboncoeur, Y., M. J. Vander Zanden and D. M. Lodge (2002). Putting the lake back together: integrating benthic pathways into lake food web models. BioScience 52(1): 44-54.

Vander Zanden, M. J. and Y. Vadeboncoeur (2002). Fishes as integrators of benthic and pelagic food webs in lakes. Ecology 83(8): 2152-2161.

Walker, B., S. R. Carpenter, J. M. Anderies, N. Abel, G. Cumming, M. A. Janssen, L. Lebel, J. Norberg, G. D. Peterson and R. Pritchard (2002). Resilience management in social-ecological systems: a working hypothesis for a participatory approach. Conservation Ecology 6(1): 17 pages.

Watras, C. J., K. A. Morrison and T. K. Kratz (2002). Seasonal enrichment and depletion of Hg and SO4 in Little Rock Lake: relationship to seasonal changes in atmospheric deposition. Canadian Journal of Fisheries and Aquatic Sciences 59: 1660-7.

Westley, F., S. R. Carpenter, W. A. Brock, C. S. Holling and L. H. Gunderson (2002). Why systems of people and nature are not just social and ecological systems. Panarchy : understanding transformations in human and natural systems. L. H. Gunderson and C. S. Holling. Washington, DC, Island Press: 103-19.

Wilson, K. A. (2002). Impacts of the invasive rusty crayfish (Orconectes rusticus) in northern Wisconsin lakes. Ph.D. Zoology, Unversity of Wisconsin-Madison: 194

Yorque, R., B. Walker, C. S. Holling, L. H. Gunderson, C. Folke, S. R. Carpenter and W. A. Brock (2002). Toward an integrative synthesis. Panarchy : understanding transformations in human and natural systems. L. H. Gunderson and C. S. Holling. Washington, DC, Island Press: 419-38.

Peterson, G. D., T. D. Beard, Jr., B. E. Beisner, E. M. Bennett, S. R. Carpenter, G. S. Cumming, C. L. Dent and T. D. Havlicek (2003). Assessing future ecosystem services: a case study of the Northern Highlands Lake District, Wisconsin. Conservation Ecology 7(3): online.

Niwot

Burns, D.A. 2003. Atmospheric nitrogen deposition in the Rocky Mountains of Colorado and southern Wyoming- a review and new analysis of past study results. Atmospheric Environment v. 37 pp. 921-932.

Ebersole, J.J. 2002 . Recovery of alpine vegetation on small, denuded plots, Niwot Ridge, Colorado, U.S.A. Arctic, Antarctic, and Alpine Research. v. 34 no. 4 pp. 389-397.

Greenland, D., Kittel, T.G.F. 2002. Temporal variability of climate at the US Long-Term Ecological Research (LTER) sites. Climate Research v. 19 pp. 213-231.

Hood, R.W., Williams, M.W., Caine, N. 2002. Yields of dissolved organic C, N, and P, from three high-elevation catchments, colorado front range, U.S.A.. Water, Air, and Soil Pollution: Focus v. 2 pp. 165-180.

Kolesar, S.E., McKnight, D.M., Waters, S.B. 2002. Late fall phytoplankton dynamics in three lakes, Rocky Mountain National Park. Hydrobiologia v. 472 pp. 249-263.

Winstral, A, Elder, K., Davis, R.E. 2002. Spatial Snow Modeling of Wind-Redistributed Snow Using Terrain-Based Parameters. Journal of Hydrometeorology v. 3 pp. 524-538.

Williams, M.W.; Losleben, M.V.; Hamann, H.B. 2003. Alpine Areas in the Colorado Front Range as Monitors of Climate Change and Ecosystem Response. The Geographic Review v. 92(2) pp. 180-191.

Palmer

Baker, K.S., G. Bowker, and H. Karasti, Designing an infrastructure for heterogeneity in ecosystem data, collaborators, and organizations, Proceedings of the Second National Conference on Digital Government Research, 20-22 May 2002, Los Angeles, CA, 141-144, 2002a.

Baker, K.S., J. Brunt, and D. Blankman, Organizational informatics: site description directories for research networks, in Proceedings of the 6th World Multi-Conference on Systematics, Cybernetics and Informatics, 14-18 July 2002, Orlando, FL, edited by N. Callaos, J. Porter, and N. Rishe, pp. 355-360, IIIS, Orlando, FL, 2002b.

Brunt, J.W., P. McCartney, K.S. Baker, and S. Stafford, The future of ecoinformatics in Long Term Ecological Research, in Proceedings of the 6th World Multi-Conference on Systematics, Cybernetics and Informatics, 14-18 July 2002, Orlando, FL, edited by N. Callaos, J. Porter, and N. Rishe, pp. 367-372, IIIS, Orlando, FL, 2002.

Cullen, J.J., P.J.S. Franks, D.M. Karl, A. Longhurst, and B.J. Rothschild, Physical influences on marine ecosystem dynamics, in The Sea, edited by A.R. Robinson, and J.J. McCarthy, pp. 297-336, John Wiley & Sons, 2002.

Dierssen, H.M., R.C. Smith, and M. Vernet, Glacial meltwater dynamics in coastal waters West of the Antarctic Peninsula, Proceedings of the National Academy of Science, 99 (4), 1790-1795, 2002.

Frazer, T.K., L.B. Quetin, and R.M. Ross, abundance, sizes and developmental stages of larval krill, Euphausia superba, during winter in ice-covered seas west of the Antarctic Peninsula, Journal of Plankton Research, 24 (10), 1067-1077, 2002.

Frazer, T.K., L.B. Quetin, and R.M. Ross, Energetic demands of larval krill, Euphausia superba, in winter, Journal of Experimental Marine Biology and Ecology, 277, 157-171, 2002.

Gold, A.K., K.S. Baker, J.-Y. LeMeur, and K. Baldridge, Building FLOW: federating libraries on the web, in International Conference on Digital Libraries, Proceeding of the second ACM/IEEE-CS joint conference on digital libraries, 13-17 July, Portland Oregon, pp. 287-288, ACM Press, New York, 2002.

Haberman, K.L., M. Vernet, R.M. Ross, L.B. Quetin, G.A. Nevitt, and W.A. Kozlowski, Grazing by Antarctic krill Euphausia superba on Phaeocystis antarctica: an immunochemical approach, Marine Ecology Progress Series, 241, 139-149, 2002.

Hofmann, E.E., J.M. Klinck, D.P. Costa, K.L. Daly, J.J. Torres, and W.R. Fraser, U.S. Southern Ocean Global Ocean Ecosystems Dynamics Program, Oceanography, 15 (2), 64-65, 2002.

Hollibaugh, J.T., N. Bano, and H.W. Ducklow, Widespread distribution in polar oceans of a 16S rRNA gene sequence with affinity to Nitrosospira-Like ammonia-oxidising bacteria, Applied and environmental Microbiology, 68 (3), 1478-1484, 2002.

Johnson, K.S., and D.M. Karl, Is ocean fertilization credible and creditable?, Science, 296, 467-468, 2002.

Karl, D.M., Hidden in a sea of microbes, Nature, 415, 590-591, 2002.

Karl, D.M., and K. Bjorkman, Dynamics of posphorus, in Biogeochemistry of Marine Dissolved Organic Matter, edited by D. Hansell, and C. Carlson, pp. 249-366, Academic Press, 2002.

Liu, J., X. Yuan, D. Rind, and D.G. Martinson, Mechanistic study of the ENSO and southern high latitudes climate teleconnection, Journal of Geophysical Research, 29 (14), 24/1-24/4, 2002b.

Martinson, D.G., and R.A. Iannuzzi, Spatial/temporal patterns in Weddell Gyre characteristics and their relationship to global climate (in press), Journal of Geophysical Research, 2002.

Smith, D.A., and J.M. Klinck, Water properties on the west Antarctic Peninsula continental shelf: a model study of effects of surface fluxes and sea ice, Deep-Sea Resarch II, 49 (21), 4863-4886, 2002.

Smith, R.C., Global warming: a global warning, in Aquarian Times, pp. 18-20, 2002.

Garibotti, I.A., M. Vernet, W.A. Kozlowski, and M.E. Ferrario, Composition and biomass of phytoplankton assemblages in coastal Antarctic waters: a comparison of chemotaxonomic and microscopic analyses, Marine Ecology Progress Series, 247, 27-42, 2003.

Haberman, K.L., L.B. Quetin, and R.M. Ross, Diet of the Antarctic krill (Euphausia superba Dana) I. Comparisons of grazing on Phaeocystis antarctica (Karsten) and Thalassiosira antarctica (Comber), Journal of Experimental Marine Biology and Ecology, 283 (1-2), 79-95, 2003a.

Haberman, K.L., R.M. Ross, and L.B. Quetin, Diet of the Antarctic krill (Euphausia superba Dana) II. Selective grazing on mixed phytoplankton assemblages, Journal of Experimental Marine Biology and Ecology, 283 (1-2), 97-113, 2003b.

Hader, D.P., H.D. Kumar, R.C. Smith, and R.C. Worrest, Aquatic ecosystems: effects of solar ultraviolet radiation and interactions with other climatic change factors, Photochemical and Photobiological Sciences, 2, 39-50, 2003.

Sevilleta

Parmenter, R. R., T. L. Yates, D. R. Anderson, K. P. Burnham, J. L. Dunnum, A. B. Franklin, M. T. Friggens, B. C. Lubow, M. Miller, G. S. Olson, C. A. Parmenter, J. Pollard, E. Rexstad, T. M. Shenk, T. R. Stanley, and G. C. White. 2003. Small mammal density estimation: A field comparison of grid-based versus web-based density estimators. Ecological Monographs. 73:1-26.

Shortgrasss Steppe

Barrett, J. E., R. L. McCulley, D. R. Lane, I. C. Burke, and W. K. Lauenroth. 2002. Influence of climate variability on plant production and N mineralization in central U.S. grasslands. Journal of Vegetation Science 13:383-394.

Burke, I. C. and W. K. Lauenroth. 2002. Ecosystem ecology at regional scales. Ecology 83: 305-306.

Burke, I. C., W. K. Lauenroth, G. Cunfer, J. E. Barrett, A. R. Mosier, and P. Lowe. 2002. Nitrogen in the central grasslands region of the U.S. BioScience 52(9):813-823.

Kaye, J. P., J. E. Barrett, and I. C. Burke. 2002. Stable nitrogen and carbon pools in grassland soils of variable texture and carbon content. Ecosystems 5:461-471.

Murphy, K. L., I. C. Burke, M. A. Vinton, W. K. Lauenroth, M. R. Aguiar, D. A. Wedin, R. A. Virginia, and P. Lowe. 2002. Regional analysis of litter quality in the central grassland region of North America. Journal of Vegetation Science 13:395-402.

Gill, R. A. and I. C. Burke. 2002. Influence of soil depth on the decomposition of Bouteloua gracilis roots in the shortgrass steppe. Plant and Soil 241(2):233-242.

Gill, R. A., I. C. Burke, W. K. Lauenroth, and D. G. Milchunas. 2002. Longevity and turnover of roots in the shortgrass steppe: influence of diameter and depth. Plant Ecology 159(2):241-251.

Epstein, H. E., R. A. Gill, J. M. Paruelo, G. J. Jia, W. K. Lauenroth, and I. C. Burke. 2002. The relative abundance of three plant functional types in temperate grasslands and shrublands of North and South America: Effects of projected climate change. Journal of Biogeography 29(7):875-888

Foster, D., F. Swanson, J. Aber, I. Burke, N. Brokaw, D. Tilman, and A. Knapp. 2003. The importance of land-use legacies to ecology and conservation. BioScience 53(1): 77-88.

Rebollo, S., D. G. Milchunas, I. Noy-Meir, and P. L. Chapman. 2002. The role of a spiny plant refuge in structuring grazed shortgrass steppe plant communities. Oikos 98:53-64.

Mosier, A. R., J.A. Morgan, J.Y. King, D. LeCain, and D.G. Milchunas. 2002. Soil-atmosphere exchange of CH4, CO2, NOx, and N2O in the Colorado Shortgrass Steppe under Elevated CO2. Plant Soil 240:201-211.

Milchunas, D. G. and I. Noy-Meir. 2002. Grazing refuges, external avoidance of herbivory and plant diversity. Oikos 99:113-130.

Mosier, A.R., J.W. Doran, and J.R. Freney. 2002. Managing soil denitrification. Journal of Soil and Water Conservation. 57: 505-513.

Pielke, R.A. Sr., G. Marland, R.A. Betts, T.N. Chase, J.L. Eastman, J.O. Niles, D. Niyogi, and S. Running. 2002. The influence of land-use change and landscape dynamics on the climate system- relevance to climate change policy beyond the radiative effect of greenhouse gases.Phil. Trans. A, Special Theme Issue . 360 : 1705 - 1719.

Pielke, R.A. Sr., T. Stohlgren, L. Schell, W. Parton, N. Doesken, K. Redmond, J. Money, T. McKee, and T.G.F. Kittel 2002 Problems in evaluating regional and local trends in temperature: an example from eastern Colorado, USAInternational Jornal of Climatology 22: 421-434.

Adegoke, J.O., R.A. Pielke Sr., J. Eastman, R. Mahmood, and K.G. Hubbard, 2003: A regional atmospheric model study of the impact of irrigation on midsummer surface energy budget in the U.S. High Plains. Mon. Wea. Rev., 131, 556-564.

Other Abstracts (in addition to the SGS 2003 Symposium)

Kelly, E.F., R.L. McCulley, S.W. Blecker , O.A. Chadwick, K. Ziegler, L.A. Derry, and I.C. Burke (2002). The Biogeochemistry of Silica in Grasslands Ecosystems of the central Great Plains of North America American Society of Agrononmy Abstracts,

Ziegler, K., Chadwick, O.A., Kelly, E.F. & Brzezinski, M.A. (2002): The ?30Si values of soil weathering profiles: Indicators of Si pathways at the lithosphere/ hydro(bio)sphere I nterface. Geochimica et Cosmochimica Acta, Supplement, 66/15A, pp A881.

Ziegler, K, Chadwick, OA, Kelly, EF, Brzezinski, MA. (2002). d30Si as Tracer for Si Pathways During Basalt Weathering in Arid Environments. In Sixth Meeting of Geochemistry of the Earth Surface, Honolulu HI.

Pielke, R.A. Sr., and T.N. Chase, 2003: A proposed new metric for quantifying the climatic effects of human-caused alterations to the global water cycle. 2003 AMS Annual Meeting, Symposium on Observing and Understanding the Variability of Water in Weather and Climate, 9-13 February, Long Beach, CA.

Hartley, L.M. and J.K. Detling, 2003: Effects of Prairie Dogs on Plant Community and Nutrient Cycling in North American Shortgrass Prairie. Colorado Prairie Dog Technical Conference. 25-27 February, Fort Collins, CO.

Lehmer, E.R. 2003: A Rare Incident of Hibernation in Free-Ranging Black-Tailed Prairie Dogs. Colorado Prairie Dog Technical Conference. 25-27 February, Fort Collins, CO.

Lehmer, E.M. 2003: Ecological and Physiological Indicators of Habitat Suitability for Free-Ranging Back-Tailed and Utah Prairie Dogs. Colorado Prairie Dog Technical Conference. 25-27 February, Fort Collins, CO.

Savage, L. and M. Antolin, 2003: The Effects of Fragmentation and Plague on the Population Genetic Structure of Black-Tailed Prairie Dogs on the SGS-LTER in Northern Colorado. Colorado Prairie Dog Technical Conference. 25-27 February, Fort Collins, CO.

Calendar

Coming events of interest to the LTER Community

Coweeta LTER Annual Science Meeting: June 2002

University of New Mexico
The *Network News*
LTER Network Office
Department of Biology
Albuquerque NM 87131-1091

Non-profit Organization
U.S. POSTAGE
PAID
Albuquerque NM
Permit No. 39