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
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.”

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.

---

SGS Symposium

Nicole Kaplan, SGS LTER

Opening the Doors to Collaboration

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.

---

Site News

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.
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.

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.

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).
Some lucky 4th and 5th graders in Virginia got to experience the wilds of the Antarctic 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.

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.”

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 coordinator. “The team used a variety of electronic communications to deliver the excitement of ongoing Antarctic research experiences and data into new classrooms.”
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 Penning, 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 committee. 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 Directories. 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 Office: aschroeder@lternet.edu
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 L TER 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 convert 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 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.
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-existing data sets, including multiple scale information (i.e., 1 m² 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 management 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/niss/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
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), Gerard 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 educational materials.
Network News

**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 Gameau from the University of Kansas, and Robert Colwell from the University of Connecticut appeared over Internet-based teleconferences.

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.

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).
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 available 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
- 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
- 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

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
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 [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 Temperate Lakes LTER was designed to foster interdisciplinary research and collaboration. The site augmentation experiment involved increasing funding for two LTER sites—North Temperate Lakes (NTL) and Coweeta—doubling their support levels. This enabled researchers to delve into complex interactions between humans and the environment on various scales, thereby advancing our understanding of ecological processes.

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.

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.
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 so forth), 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

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...
International Networking

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 emanated 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.

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, 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 Agro-economic 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 Ecological Research in Agricultural Ecosystems in Korea 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-

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
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 an 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 CO₂ 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.

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 CO₂ efflux in worm excluded plots, and are currently we are measuring CO₂ 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 CO₂ efflux is 20%, data from Puerto Rico shows that the invasion of *P. corethrurus* would raise the efflux of CO₂ — as much as equalent to the amount CO₂ release by fossil fuel combustion 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 CO₂ efflux. But the scientists do not have field data on plant production at ecosystem levels.

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

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


McMurdo Site News

continued from page 3
Publications

Recent Publications from the LTER Community


Coweeta LTER Annual Science Meeting: June 2002