



Network News

Newsletter of the Long Term Ecological Research Network

Vol. 21 No. 2 Fall 2008

Braiding perspectives on the Tanana

Bonanza Creek's artist-scientist field trip brings "Reflections" to life



Aerial view of the braided Tanana River (photo by Roger Ruess)

Seven scientists and seven artists spent a day together in late August 2008 exploring the Tanana River floodplain ecosystem at the Bonanza Creek LTER near Fairbanks, AK. Among the artists were a poet, two landscape painters, a photographer, textile artist, singer-songwriter/educator, and a dancer-choreographer.

They were accompanied by LTER plant, microbial, and ecosystem ecologists, and an Alaska Native graduate student who was studying Fairbanks surface water quality. The eclectic group's goal was to weave together observations on their connections to the local ecosystem and the impacts of climate change upon it.

[See "Tanana", p. 3](#)

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

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The Network News

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www.lternet.edu

NSF grants LTER-CSU partnership \$12.5 million for environmental literacy

The National Science Foundation's (NSF) has awarded researchers from four Long Term Ecological Research (LTER) sites, 11 universities, and K-12 school districts from across the nation a \$12.5 million grant to enhance environmental science literacy. The grant by NSF's Mathematics and Science Partnership program aims to create a dynamic teacher development program targeted at middle school and high school teachers in the science, technology, engineering and mathematics (STEM) disciplines.

Colorado State University (CSU) is the lead institution in the program, which will create a framework where environmental science literacy drives learning of core science and mathematics concepts. John Moore, a co-principal investigator at the Shortgrass Steppe (SGS) LTER site and director of CSU's Natural Resource Ecology Laboratory, will oversee the program.

The LTER Network Office, based in the Biology Department at the University of New Mexico, will work to create a clearing house of opportunity for research for students and teachers based on activities at the 26 LTER sites and try to match teachers and students with appropriate research and education programs.

The collaborative program will connect the research prowess of the environmental sciences and education of partner universities and sites within the 26-member LTER network, which is also funded by NSF, with K-12 science and math teachers in partner schools and districts. The focus will be on human-ecosystem interactions to develop culturally relevant ecology from both a scientific and educational perspective.

"Dr. Moore and his colleagues have done a great service by translating the education goals of the Decadal Plan for LTER into a proposal that will allow us to move forward on a path to achieve these goals," said Robert Waide, executive director of the LTER Network Office. "The LTER Network is committed to developing an approach that integrates research and education across the entire educational continuum."

Providing teachers with content knowledge and increasing student preparation and interest in STEM disciplines is an urgent need across the US. Collectively, the four LTER research sites will partner with 22 K-12 schools/districts in their regions, focusing exclusively on middle schools and high schools serving more than 250 science and mathematics teachers and 70,000 students across the United States.

"Ultimately, our plan is to develop, implement and disseminate our models through the LTER Network Office, which each year interacts with upwards of 1,000 teachers and impacts nearly 500,000 students of diverse ethnicities across the United States," said Moore.

Collaborators on the project aim to develop models of professional development that integrate the research efforts of scientists with the professional development needs of teachers. They plan to include a teacher-in-residence program, research internships for teachers, placement of graduate students into K-12 classrooms, professional development workshops leading to graduate credit and degrees, and professional learning communities.

Additionally, grant collaborators will examine existing K-12 curriculum to refine and extend current learning pathways leading to environmental science literacy and associated mathematics. The themes for this activity will include carbon cycling, water systems, and biodiversity in socio-ecological systems.

Core partners on the NSF-funded grant are Greeley-Evans School District #6 (CO); Poudre School District (CO); Michigan State University (MI); Plainwell Community Schools (MI); University of California, Santa Barbara (CA); Santa Barbara School District (CA); Cary Institute of Ecosystem Studies (NY); Towson University (MD); Baltimore City and County Public Schools (MD); University of Northern Colorado (CO); University of Wyoming (WY); and the LTER Network Office (NM).

*McOwiti O. Thomas, Bob Waide (LNO) &
John Moore (SGS/CSU)*



experiment nearby. Waves of ecology, art, and native knowledge flowed through the conversation, converging upon a common concern: All of us observing with different tools but seeing the same thing—intense human activity creating a rapidly changing climate. Could braiding together these diverse artistic and scientific perspectives communicate the possible consequences to the wider world? Perhaps multiple ways of seeing could enliven public curiosity and concern for the natural world and foster personal and policy decisions that promote sustainability.



Clockwise from top left: lunch by the river bank (photo by Doug Yates); one of many lively discussions (photo by Mary Beth Leigh); textile artist Karin Franzen reflects in the sun (photo by Teresa Hollingsworth); Roger Ruess shows the depth of sediment deposition from the recent flood (photo by Mary Beth Leigh); landing at an alder stand (photo by Mary Beth Leigh)

It was a crisp, sunny late summer's day in interior Alaska when the group embarked down the braided Tanana River. Navigating the riffles and sand bars recently rearranged by the previous month's 100-year flood, the group observed the substantial reshaping of the shoreline and, in some instances, the incredible depth of new sediment deposition left behind. Alternating stands of alder, black spruce, white spruce, and bright golden birch drifted by on either shoreline. At the first stop on a sandbar ecologists shared their knowledge of plant successional patterns and pointed out the pioneering willows on a possible trajectory toward tall white spruce on the opposite bank. In turn the artists asked a barrage of challenging questions and exchanged memories of landscape and vegetation change over years of family picnics, painting, and photography on the Tanana River.



After a riverside lunch, the artist-scientist group hiked on to a huge grassy meadow laid bare by a recent wildfire. The afternoon sun warmed the thick amber grasses, and gentle wind breezing through them created subtle music. We alternately stood, knelt, sat, and lay in the grass basking in the sun, careful not to harm young pine seedlings planted in an

The Tanana River field trip will lead to a public event that will integrate performing and visual arts and scientific presentations, as well as a dance piece developed by local Alaska Native middle school children. This was the second annual artist-scientist field trip held at Bonanza Creek. The first focused on climate change and wildfire and led to a unique free public event entitled, "In a Time of Change: A Performance by Writers, Artists and Scientists" in March, 2008. The event featured poetry readings, a play, original songs, visual art, and an original modern dance piece based on plant succession, rounded off with scientific presentations by LTER ecologists.

Mary Beth Leigh & Terry Chapin,
BNZ/Institute of Arctic Biology,
University of Alaska Fairbanks

Phenology across LTER

Phenology, in the words of Aldo Leopold, is a “horizontal science” that cuts across and binds together multiple biological disciplines (Leopold and Jones 1947). It is a far-reaching but poorly understood aspect of the environmental sciences. Although phenological research has been a component of LTER at several sites over the years, it has not received the attention or resources to bring it to the forefront as an effective theme for interdisciplinary and cross-site synthesis.

With the blossoming of the USA National Phenology Network (USA-NPN; <http://usannpn.org>), it is appropriate to assess the status of phenological knowledge across the LTER Network and to consider how the LTER Network might beneficially interact with the USA-NPN. At the 2006 LTER All Scientists Meeting, a working group on phenology was well attended with 10 LTER sites, the LTER Network Office (LNO), and the Chinese Environmental Research Network (CERN) represented. The workshop recommended a follow-on workshop to evaluate the status of phenological research across the LTER Network, to build a community of interest that could facilitate phenological analysis and synthesis across the Network, and to commence a cross-site synthesis of some extant phenological data.

Subsequently, LNO sponsored a workshop February 26 to March 2, 2007 at the Sevilleta LTER field station. Participants included John Anderson (JRN), Geoff Henebry (KNZ), Mark Losleben (NWT and USA-NPN), John O’Keefe (HRF), Dave Shaw (AND), Kristin Vanderbilt (SEV), Karen Wetherill (SEV), and Jess Zimmerman (LUQ). The workshop produced three main products:

- (1) an initial inventory of LTER phenology datasets;
- (2) a white paper summarizing the findings of the workshop; and
- (3) the establishment of a website (<http://globalmonitoring.sdstate.edu/LTER-phenology/>) to facilitate information interchange.

The inventory and white paper can be found on the website.



Participants from the 2007 Phenology across LTER workshop at the Sevilleta Field Station braving the elements. Left to right: Shaw (AND), Zimmerman (LUQ), Vanderbilt (SEV), Wetherill (SEV), Henebry (KNZ), Losleben (NWT and USA-NPN), Anderson (JRN), and O’Keefe (HRF) (photo by Geoff Henebry).

Geoff Henebry, Mark Losleben, and Andy Bunn (Western Washington University) convened a special session on phenology at the Fall 2007 American Geophysical Union meeting entitled “Observing, Analyzing, and Modeling Phenologies at Multiple Scales”. The session featured four presentations, one talk, and three poster presentations arising from the Sevilleta workshop:

◆ Bradley B, K Wetherill, K Vanderbilt, and J Nickeson. 2007. Integrating ground observations of phenology with remotely sensed measurements: A 2007 growing season experiment at Sevilleta LTER. EOS Trans. AGU, 88(52), Fall Meet. Suppl., Abstract B53D-04.

◆ Henebry, GM. 2007. Phenology across the LTER network: Initial findings, future directions. EOS Trans. AGU, 88(52), Fall Meet. Suppl., Abstract B51A-0041.

◆ Losleben MV. 2008. Phenology of Net Ecosystem Exchange: A simple estimation method. EOS Trans. AGU, 88(52), Fall Meet. Suppl., Abstract B51A-0040.

◆ Shaw DC, C Creel, G Downing, S Remillard, and K O’Connell. 2007. Plant phenology patterns at three sites on the H.J. Andrews Experimental Forest, Oregon, 1987 to 2007. EOS Trans. AGU, 88(52), Fall Meet. Suppl., Abstract B51A-0039.

We welcome your interest in phenology across LTER, as well as your comments and contributions to the website.

Reference

Leopold, A., and S.E. Jones. 1947. A phenological record for Sauk and Dane Counties, Wisconsin, 1935-1945. Ecological Monographs 17(1):81-122.

Geoff Henebry (ghenebry@lternet.edu), KNZ, Geographic Information Science Center of Excellence, South Dakota State University

Eyes North

National Science Board visits Alaskan LTER sites

September snow blanketed the Arctic tundra as the small plane flew through Anaktuvuk Pass in the Brooks Range, over recent tundra burns and the melting permafrost belowground. Landing on the unsealed airstrip, the eager passengers disembarked, happy to reach solid ground after the delays. They piled into field station vehicles for the final leg and a hot meal at Toolik Field Station, home of the Arctic LTER and proposed National Ecological Observatory Network (NEON) core site. It was the first morning of two successful research visits in September 2008 to LTER-research sites, coinciding with the National Science Board's (NSB) annual retreat in Fairbanks, Alaska. The NSB is the governing body of the National Science Foundation (NSF), one of the federal funding partners on all 26 LTER sites.

On this particular day the scientists had the full attention of the visitors, including six NSF Board members, Deputy Director Kathie Olsen, and Assistant Director for Biological Sciences Jim Collins. The team spent a full day visiting with the scientists and learning about LTER, NEON, and Arctic Observing Network (AON) science.

Two days later the entire NSB and NSF Director Arden Bement visited the Caribou-Poker Creeks Research Watershed site, home of Bonanza Creek LTER and another proposed NEON core site, and nearby Poker Flat Research Range facilities in the boreal forest surrounding Fairbanks. "To have the Board members hear about the science on the ground and straight from the scientists was priceless," said Collins. "Not only did NSF and the NSB benefit but it was a great opportunity for these colleagues to spend valuable time together working on the future of ecological observatory networks and research, which will benefit the biological sciences community for years to come," he added.

Senior scientists and managers from LTER and NEON worked closely with NSF staff in planning and leading both visits to highlight NSF's investments in high-latitude research and global and

Clockwise from top: Dave Schimel speaking with National Science Board members at Toolik Lake field station (Photo by Sonya Malilino); NSF Director Arden Bement (right) listens to Jay Jones (UAF) and other NSF PIs at the Caribou-Poker Creek Watershed research site outside Fairbanks, AK (Photo by Sonya Malilino); Dave Schimel, NEON, (back left, facing camera) and Jim Collins, NSF Asst. Dir. for BIO, (back right, facing camera) lead the discussion on the tundra at Toolik Field Station, AK (Photo by Kris R. Nielsen).

continental observing systems. NSF's Sonya Malilino, an NSB Executive Secretary, lauded the scientists' efforts and their benefits to biological sciences research and infrastructure. "The freezing temperatures and logistical considerations were the perfect demonstration of the challenges and

costs of conducting research operations in remote areas," said Malilino. "This first-hand experience will be close to mind when [Board members get] back in the Board room in D.C. making decisions about issues affecting how we conduct scientific research in this country. Our community will reap the benefits of this in-reach for years to come."

NSF wishes to thank the following people for their generous contributions of time and expertise: Gus Shaver and John Hobbie (The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA), Dave Schimel and Tony Beasley (NEON, Inc), and Terry Chapin, Jay Jones, Brian Barnes, Sydonia Bret-Harte, Mike Abels, Buck Sharpton, and Roger Smith (University of Alaska, Fairbanks).

Michelle Kelleher, NSF



SGS LTER unveils new research, education, and outreach facility

The new Shortgrass Steppe (SGS) Research and Interpretive Center (RIC) is located eight miles north of Nunn, CO, midway between Greeley, CO, and Cheyenne, WY. The station is at the edge of over 200,000 acres of public lands, rolling grasslands that support livestock grazing, as well as pronghorn antelope, prairie songbirds, and raptors. The area lies at the heart of current debates about livestock grazing, suburban encroachment, threatened bird species, prairie dogs, and emerging infectious diseases such as bubonic plague and West Nile virus. Students and researchers have been studying the grasslands at the research site since 1939 and now work on every continent of the globe, as well as serve as scientists and managers here in the Western U.S.

Since 1998, SGS researchers and staff, with the support of National Science Foundation, Colorado State University, University of Northern Colorado, and our partners at the United States Department of Agriculture's Agricultural Research Service (USDA-ARS), have been working to build a modern facility that will further increase our capability for excellence in scholarship and education. The new SGS RIC buildings include a premier classroom/conference center and new comfortable housing for up to twenty people, all with a state-of-the-art cyberinfrastructure to provide easy

to use and reliable computing resources and access to historical and current data and publications. The RIC facilities are designed for running workshops and have two five-bedroomed houses to support visiting scientists, land managers, and students who stay at the field station. We plan in the future to build additional houses and a research laboratory for our scholarship activities. The entire station will represent the world-class activities at the site, and give the broader scientific community further capabilities to conduct research, education, and outreach.



The US Forest Service uses the prairie just outside the new classroom for hands-on training methods of range measurements at a recent workshop (photo by Mark Lindquist)

The design of the new state-of-the-art facilities can be described as ecologically sensitive with architectural features that are compatible with the rolling hills and short statured vegetation of the surrounding prairie. The buildings are nestled into the east side of the hill to take advantage of wind protection, but rise sufficiently that the classroom/meeting areas and living rooms in the houses have unobstructed views of both the Rocky Mountains to the west and the grassland bluffs and shortgrass steppe to the east. The views from inside the buildings are amazing and it is not uncommon to see herds of antelope riding along the contours of the land and raptors hunting in the prairie dog town below. The proximity and accessibility to the ecosystem, off a sheltered patio, presents a unique opportunity for educators to use their surroundings and gives students a true sense-of-place in the prairie.

We are excited to welcome you as our guests, and SGS staff is ready to support new research and educational activities, so please check out our new digs and spread the word. Plan your next meeting with us in mind. If you are interested in using the SGS RIC, please contact us at (970) 491-4996.

*Nicole E. Kaplan, Ingrid C. Burke,
& Michael F. Antolin, SGS*



Justin Derner, USDA-ARS Scientist gives a presentation for a US Forest Service workshop in the new seminar room (Photo by Mark Lindquist)

Happy times, sad times

as SGS dedicates new facility, honors scientists, and bids other scientists farewell

With music, dance, and barbecue, the new Shortgrass Steppe (SGS) Research and Interpretive Center (RIC) was dedicated on August 23rd at the new facility across the street from the SGS LTER headquarters northeast of Fort Collins, CO. The weather cooperated to provide a beautiful setting for the gathering of about 100 SGS researchers, students, and friends.

The dedication event was bittersweet because it was also a recognition of the many contributions to the SGS LTER, the new RIC, and Colorado State University (CSU) of Indy Burke and Bill Lauenroth as they left CSU to begin their new positions at the University of Wyoming. The RIC's establishment was due in large part to Burke's persistent efforts over at least a decade to convince CSU and the USDA ARS (who jointly manage SGS) and NSF of the benefit of such a facility on the grasslands.

Burke, who joined SGS LTER in the early 1990s, is the new director of the Haub School and Ruckelshaus Institute of Environment and Natural Resources (<http://www.uwyo.edu/news/showrelease.asp?id=25102>). Lauenroth, who has been with SGS since its inception at CSU, has

joined the Department of Botany (<http://uwadmnweb.uwyo.edu/botany/default.asp>). Both scientists have served as lead Principal Investigators at SGS, and plan to participate in the project from the University of Wyoming.

Burke and Lauenroth were presented with "Going with the Flow", a watercolor painting of Pingree Park by local artist Sue Schongar Whitten.

Meanwhile, SGS LTER staff and senior researchers again presented our activities at CSU's Ag Day on September 6. In addition to the educational and research displays, we added an "Ask a Scientist" section where questions about the shortgrass steppe could be answered. It was a great success despite a cool and blustery day.

In a related event four LTER researchers were recognized at the USDA Agricultural Research Service's Colorado/Wyoming Resource Day, held in Fort Collins, CO on November 18. Jack Morgan, Research Leader of the ARS Rangeland Resources Research Unit, presented Bill Lauenroth, Indy Burke, Daniel Milchunas and Mark Lindquist with plaques honoring the outstanding service of the four through their visionary leadership, teamwork, scientific contributions, and outreach activities involving the Shortgrass Steppe LTER Project, which has been engaged with ARS' range research program at Central Plains Experimental Range since the early 1980's.



Top: Mike Antolin (left) and Jim Detling (right) talk to Larry Penley (center), President of CSU, at the SGS LTER's 'Ask a Scientist' booth at the 2008 Ag Day (photos by Sallie Sprague). **Center:** Dr. Jack Morgan (ARS) and each of the honorees: Dr. Daniel Milchunas, Dr. Indy Burke, Mr. Mark Lindquist, and Dr. Bill Lauenroth (photo by Pam Freeman). **Bottom:** Drs. Indy Burke and Bill Lauenroth were presented with "Going with the Flow," a watercolor painting of Pingree Park by local artist Sue Schongar Whitten (photo by Pam Freeman).



Recently Published

Ecology of the Shortgrass Steppe: A Long-Term Perspective, ed. W.K. Lauenroth & I.C. Burke, 536 pp. (see <http://www.oup.com/us/catalog/general/subject/LifeSciences/Ecology/?view=usa&ci=9780195135824>)

Sallie Sprague, SGS

Unlocking t 'Sea S

**New LTER Children's b
the fascinating world
field-work and c**

Inspired by scientific research from two National Science Foundation Long-Term Ecological Research (LTER) sites, a story unfolds inviting young readers to join a scientific inquiry. The quest begins off the West Coast of the United States in the California Current and travels down to the polar waters west of the Antarctic Peninsula near Palmer Station. Separated by thousands of miles of Pacific Ocean, a seabird, a whale and a penguin engage readers in an inquiry process as they explore two distinctly different ecosystems.

Intended for young readers ages 5 to 10 years, basic ecological concepts are uncovered ranging from the characteristics of animals and changes in the ecosystem to diversity, adaptations and the interdependence of organisms in the marine environment.

As the story unfolds, a mystery unravels and points squarely over time to one tiny animal that links them all.

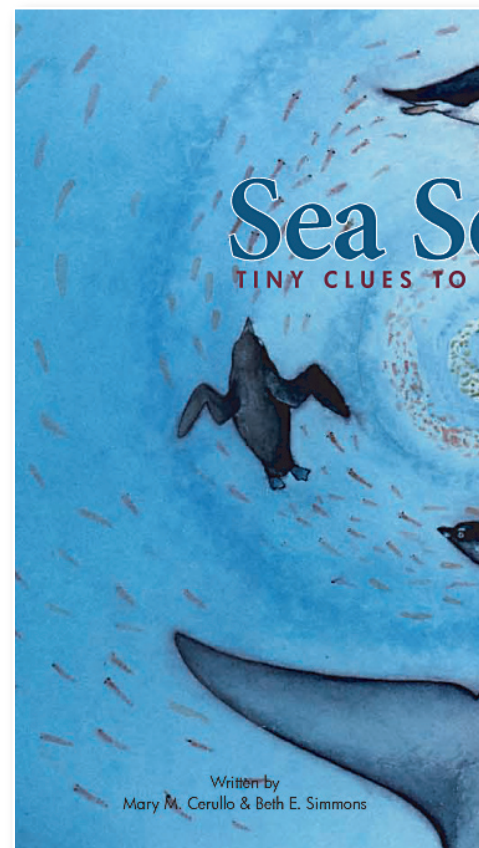
The combined efforts of award-winning children's author Mary M. Cerullo and Education Outreach Coordinator Beth E. Simmons bring years of science and education experience together to create *Sea Secrets: Tiny Clues to a Big Mystery*—the third book in the NSF supported LTER Children's Book Series. Graphic artist, illustrator and designer Kirsten Carlson harmoniously blends field sketches, watercolors and photographs to help

tailor the book to a wide audience bringing together the various ways of learning science. The creators of the book wanted to tap into the innate curiosity in readers and have them think as young scientists. It prompts questions as they read and integrates photographs from the field, immersing them in the scientific process. The story encourages readers to forge new connections between science and their daily lives and promotes the interconnectedness of all things in the environment.



The authors noted that much of the information surrounding the topic of zooplankton (a key link in marine food webs) was at best foreign to many, embedded in the practices of science research and unknown to the general public. To harvest the relevant research from each site required drawing upon local and international resources over a three-year period. The lead Principal Investigators of LTER sites, other affiliated scientists and experts, graduate students, education outreach coordinators, writers, authors, illustrators, editors, publishers, teachers and their students were all included in the process. Endorsed as a product of the International Polar Year

(IPY) 2007-2008, *Sea Secrets* is a part of the Polar Books Club (www.unep.org/publications/polarbooks) and underscores each LTER site's dedication to the process of promoting science literacy. It is a vehicle to encourage discussions on more complex topics infusing excitement into reading and learning science.



Additional financial support from the LTER Children's Book Fund and the National Science Foundation has allowed for the development of an activity guide. The guide is a growing collection of resources, case studies, fact sheets, experiments, and fun activities widening the appeal to K – 12 grade levels, supporting the effort to take learning, “beyond the book”. Each site also has a direct link to the book's



the clues of secrets'

ook draws readers into of science exploration, ocean discovery



Far left: 1st grade classroom in Stafford, Virginia (Photo by Beth Simmons).

Left, far bottom left, and far bottom right: book cover and spot art from book showing a penguin and a whaletail (courtesy University California San Diego).

Above right: sample text and graphics as they appear in 'SeaSecrets'.

Below: cub scouts in Germany (Photo by Kirsten Carlson).

Explore and Collect the Clues



Cassin's Auklet

It's a bright, sunny day off the coast of San Francisco and scientists are on a small island to study Cassin's auklets. Sarah's dad is one of the scientists and today Sarah is helping. It's the spring nesting season and Sarah's task is to count auklet parents, eggs, and chicks.



She slowly makes her way along the rocky shore, looking inside hidden spots where the auklets like to nest. But many of the nests are filled with cold eggs.



be integrating SeaSecrets into the schedule. Co-author Beth Simmons conducted a read-aloud at a local 1st grade classroom in Stafford, Virginia. Feedback from teacher and a taped audio recording are posted on the book's website (<http://cce.lternet.edu/outreach/seasecrets>).

SeaSecrets has also received publicity locally, including a write up in the Scripps Institution of Oceanography (SIO) e-magazine (http://explorations.ucsd.edu/Around_the_Pier/2008/Nov/Simmons/), in the Marine Biological Laboratory (MBL) webpage (in development), the Southwest National Marine Educators Association (SWMEA) newsletter (<http://www.swmea.org/newsletter/printed/summer08.newsletter.pdf>), and SignOnSanDiego (<http://entertainment.signonsandiego.com/events/family-days-sea-secrets>).

Books can be purchased from Moonlight Publishing or Amazon.com. A book signing and Family Days event will be held at Birch Aquarium at SIO in La Jolla California, on February 21st from 11 – 3 pm. For more information about the book, please contact Beth Simmons (besimmons@ucsd.edu).

Beth E. Simmons, CCE/MCM

website <http://cce.lternet.edu/outreach/seasecrets> or <http://pal.lternet.edu/outreach/seasecrets>. Over time, you'll find kids art, additional photographs from each LTER site, recommended reading lists, downloadable lessons and other resources to utilize.

Meanwhile, illustrator Kirsten Carlson is working with a local cub scout troop in Germany, giving the book crucial international exposure. Co-author Mary Cerullo is planning two upcoming teacher workshops in February and March, in Maine where she will



Andrews Summer Institute introduces 'Ecosystem Informatics'

An informatics revolution is underway in ecosystem science and natural resources policy and management. Many key research areas—climate change, water, earth hazards, forest/stream processes, ocean ecosystems—are limited by common informatics problems. The problems include: accurately representing biophysical processes in mathematical terms; obtaining, storing, retrieving, and analyzing multiple datasets; testing hypotheses using various models and model versions; assessing uncertainty in predictions; and scaling or extrapolating findings among systems.

These problems are at the core of Ecosystem Informatics (EI), a novel, interdisciplinary approach to education and research that provides a unifying framework for studying complex problems in natural and managed ecosystems. EI is at the intersection of (1) computer science (bringing algorithms and representations for manipulation, modeling, and prediction based on large data sets and complex models); (2) mathematics (bringing a cohesive analytic framework); and (3) ecosystem science (bringing complex systems rich in interactions, changing contexts, and challenging links into the natural resource management and policy arena). Therefore, EI is essential for sustaining long-term ecological research.

At the H.J. Andrews LTER, the Ecosystem Informatics Summer Institute provides opportunities for students from ecology, computer science, and mathematics to work in interdisciplinary teams on ecosystem science topics in old-growth forest and stream ecosystems. In the summers of 2009 and 2010, 15 students will spend 10 weeks at the H.J. Andrews LTER and Oregon State University (Corvallis) working with interdisciplinary faculty teams. The program will present students with new career opportunities, a chance to acquire collaborative skills, hands-on field experience, preparation for graduate research, and exposure to contemporary natural resource management issues. The EISI program includes course credits, lodging, stipend, and travel assistance.



The Summer 2009 projects include:

» Moths, meadows, and metapopulations: Students will study the ecology of moth species and their responses to climate change and habitat loss using machine learning and visualization to understand how moth distributions respond to environmental change and by developing and applying mathematical models of metapopulation dynamics.

» Wood in rivers: Students will study the ecology of wood in rivers and how wood responds to natural disturbances and logging, using machine learning and visualization to understand wood distributions and dynamics, and by developing and testing mathematical models of wood and its effects on streams.

» Eco-hydrology and stream networks: Students will study how water use by old-growth forest ecosystems responds to climate variability and logging using visualization to understand the complex interactions among climate and water, by developing mathematical models of stochastic hydrologic processes, and by scaling these up to large landscapes.

» Wireless technology for forest-atmosphere interactions: Students will study fluxes of carbon and water between forests and the atmosphere using new wireless technology, apply machine learning

Adam Martinez of Oregon State University (OSU) found Andrews LTER an ideal place to study beetles (Photo by Lina DiGregorio).

and visualization techniques to display complex airflow patterns, and develop and apply mathematical models of airflow dynamics in steep forested terrain.

» Vegetation mapping and change: Students will study vegetation dynamics in an old-growth forest landscape integrating satellite remote sensing, vegetation plot data, and models of vegetation succession.

Applications must be submitted by February 16, 2009. Information and application details are at <http://eco-informatics.engr.oregonstate.edu/>

*Julia Jones, Desiree Tullos,
& Katherine Hoffman, AND*

REUs hit their stride

The Andrews Forest LTER was again host to several Research Experience for Undergraduates (REU) students in 2008. Adam Martinez, a junior in biology at Oregon State

See "REUs", p. 11

REUs (continued from p. 10)

University (OSU), put together an online field guide of the carabid ground beetles of the H.J. Andrews Experimental Forest. Working with Dr. Christopher Marshall, Curator of the Oregon State Arthropod Collection (OSAC), Martinez took high-resolution images of specimens of all 100 carabid beetles known to live at the Andrews Forest. He then gathered information about each species and made the data and associated images available online.

This new pairing of technology and taxonomy data has been dubbed “cybertaxonomy.” Many of Martinez’s photographs are so stunning that they have been used in the Oregonian newspaper and on the OSU website. The new online field guide is available at <http://osac.science.oregonstate.edu/>.

Garrett Wohlsein, a senior in Environmental Engineering at OSU, did his REU work in plant community ecology and insect community ecology. Wohlsein worked with Dr. Charles Halpern of the University of Washington in a vegetation

survey crew and with Drs. Elizabeth Borer and Eric Seabloom on a nutrient network project. Says Wohlsein, “The REU program was an invaluable experience because it allowed me to explore and expand my interests in science.”

Lina DiGregorio, AND

International LTER marches on

The International Long Term Ecological Research (ILTER) Network was created during the LTER’s Annual Scientists Meeting (ASM) in 1993, with the goal of developing a “network of networks” that would conduct long-term studies on ecosystems around the world. In the ensuing years, ILTER has steadily expanded its membership and fledged from its US LTER-centric early beginnings to a vibrant international multi-centric organization. It now boasts 40 member networks and numerous regional sub-groups with their own regular meetings. The latest to join are Spain and Portugal during ILTER’s annual meeting this past August in Stará Lesná, Slovakia. In addition to member networks ILTER is working with nascent networks, such as Chile, which attended this year’s meeting as an observer. A map of ILTER member countries can be found on the new ILTER website (<http://www.ilternet.edu>) hosted by the UK Environmental Change Network, the home institution of ILTER Chairman Terry Parr (term 2007-2011).

ILTER has extended its research role by forming partnerships with other international organizations, including the United Nations Environment Programme (UNEP) with whom ILTER has an MOU regarding the establishment of a Global Climate Change Adaptation Network. Under this arrangement, ILTER research sites will collaborate with regional and international centers to supply information on climate change impacts. The goal of the new network is to minimize global change-related stresses—such as water scarcity, biodiversity loss, and climate-related disasters—on developing countries.

ILTER has applied to become a formal partner in GEO (Group on Earth Observations), a voluntary partnership of governments and international organizations that is coordinating efforts to build a Global Earth Observation System of Systems (GEOSS). The Network is active in the GEO/GEOSS plans to develop a global biodiversity observation network (GEOBON). ILTER Chair Terry Parr is on the GEOBON organizing committee and David Blankman, Director of Information Management for LTER-Israel, is leading its information technology implementation group.

The ILTER Science subcommittee is leading a research initiative to investigate how cultural differences in the perception and use of ecosystem services constrain the resilience of social-ecological systems. The work is being conducted by developing site-specific feedback models for one selected site representing a biome in each member network.

Information management is central to the success of the ILTER, and the Network is taking steps to create an ILTER-wide information management system. In Stará Lesná, ILTER adopted Ecological Metadata Language (EML) as the ILTER metadata standard. All participating country networks agreed to provide basic discovery level metadata in English to a centralized metadata cache. ILTER also endorsed the ILTER Network Data Access Policy, Data Access Requirements, and General Data Use Agreement, a document modelled on the US LTER’s data policy.

There are lots of opportunities for US LTER scientists to contribute to the strengthening of long-term ecological research around the world. Irrespective of whether or not you have ongoing international projects or are hoping to initiate some, the US LTER International committee is willing to help and learn about your activities. For more information contact committee co-chair Patrick Bourgeron.

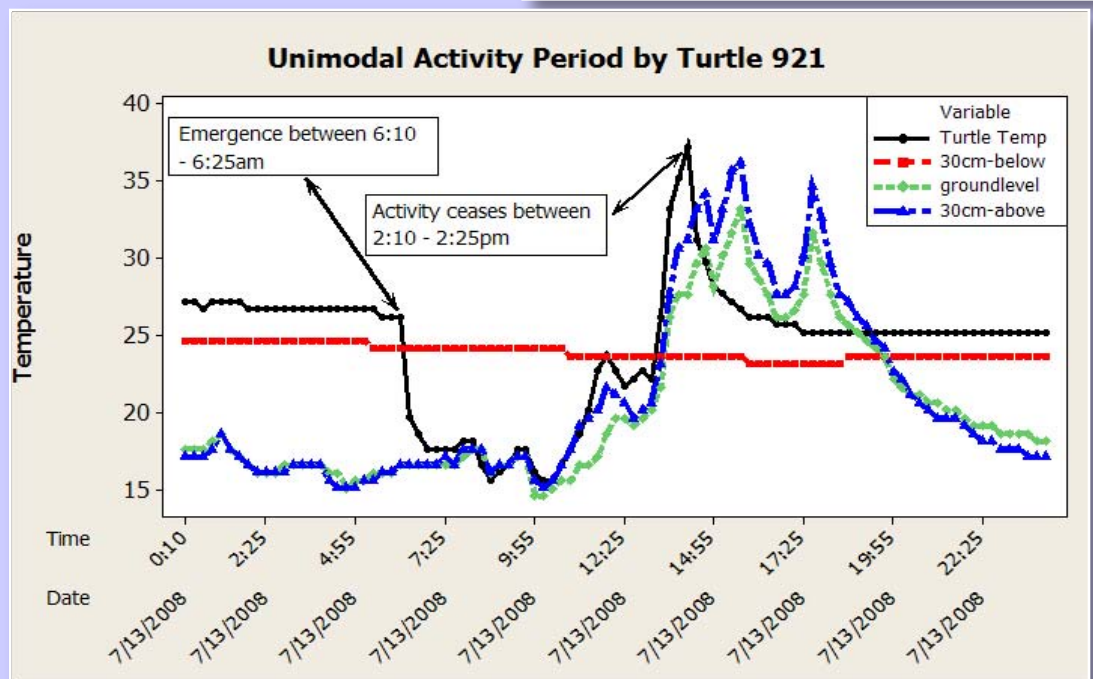
*Kristin Vanderbilt, SEV
& Steve Hamburg, HBR*

Update on Sevilleta's Box Turtle project

Together with Emily Stinson, REU student from Hamilton College, we set out to examine the activity and behavior of desert box turtles using Thermochron iButtons (miniature temperature data-loggers) glued harmlessly to their shells. Box turtles are ectothermic or 'cold-blooded', which means that they are dependent upon their environment to regulate body temperature. For this reason, a data-logger recording temperature at pre-programmed intervals will capture the timing and duration of turtle movements. In other words, the turtle iButton will read a higher temperature once the animal emerges from a cool burrow to bask in the sun, and will record the time spent basking, before the turtle again retreats to its burrow.

Emily and I attached iButtons to 21 wild box turtles then released them. When we recapture the animal, we download the data and reset the iButton to begin recording anew. Our data from the handful of animals recaptured to date is exciting. We can clearly see when the animals emerge from their burrows in the morning, how much time they spend active, and approximately when they retreat to shelter once the day becomes too hot (a graphical example of this data is attached below). We are eager to continue recapturing animals and analyzing the data to better understand the ecology of an otherwise obscure inhabitant of the Sevilleta LTER.

Ian White Murray, SEV



Clockwise from top left: A released 'iButtoned' box turtle (photo by Emily Stinson); the Sevilleta on an overcast, humid morning—a perfect time for turtle activity (photo by Ian Murray); a graphical illustration of turtle activity (by Ian Murray); and a male box turtle who has had run-ins with a predator (photo by Ian Murray).

Interop project launched

The ecological community needs “cyber-infrastructure that enables open, stable, persistent, robust, and secure access to well-described and logically organized data”, says Bill Michener (LNO), lead-PI on a new NSF Interop Project (NSF Program Solicitation 07-565).

To address these needs the project will develop a prototype of a virtual data center to seamlessly interconnect the many existing biodiversity, ecological, and environmental data centers. Michener heads a list of collaborators from Oak Ridge National Laboratory, USGS National Biological Information Infrastructure, National Evolutionary Synthesis Center, National Center for Ecological Analysis and Synthesis, and the Global Biodiversity Information Facility. Beginning in early 2009 the group will hold semi-annual week-long meetings to investigate the adoption and adapting of basic open system interoperability standards. In addition to the technical aspects of creating a virtual data center, a Community Engagement Working Group will bring together dozens of representatives from scientific societies and environmental observatories to address the socio-cultural issues of community-based interoperability networks.

Data catalog gets new keyword search

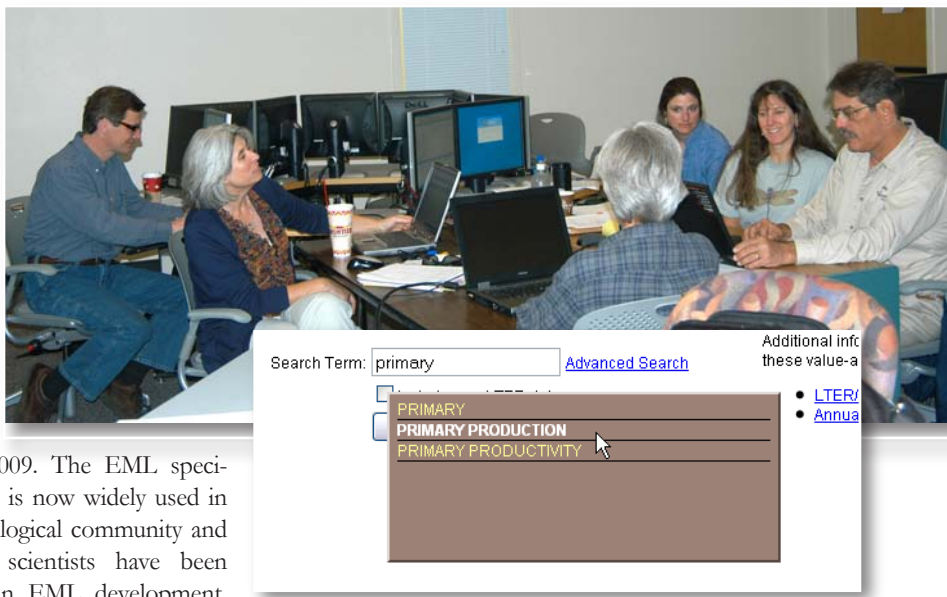
The LTER Data Catalog now has enhanced search capability, thanks to the direct efforts of John Porter (VCR) and Duane Costa (LNO) working through the LTER Information Management Committee Controlled Vocabulary working group. The Data Catalog's search box (<http://metacat.lternet.edu>) now does auto-completion with keywords and title words taken directly from the metadata documents in the metacat. While one or more controlled vocabularies for documenting LTER data sets are still in the works this intermediate step takes advantage of investments already made by site metadata authors.

New EML release expected

The first significant new release of Ecological Metadata Language (EML) since LTER's adoption of the standard is in the final stages of preparation before being made public in

early 2009. The EML specification is now widely used in the ecological community and LTER scientists have been active in EML development, including Margaret O'Brien (SBC), who is acting coordinator for the new release. The upcoming EML 2.1.0 release addresses bugs which cause the schema, a structurally descriptive digital template, to be invalid with respect to Internet standards. Other enhancements represent significant improvements in EML. For example, several metadata elements were retyped to constrain their content, and in other cases to increase flexibility. In the literature schema two elements were made optional so that EML could accommodate articles-in-press.

For the most part, EML 2.1 does not include major new features, or require a shift in use or implementation. The release of the EML 2.1.0 schema is being coordinated with the releases of Morpho (EML management tool) and Metacat (XML database) so that documents written against the updated schema can be submitted as soon as possible. O'Brien observes: “There was a deliberate decision to balance the impact on instance authors with necessary schema maintenance, and to prepare the schema for the next phase of planned improvements and features.” The new versions are all expected in early 2009.



Top: The cross-site working group to develop an LTER project database held its first meeting in the LNO training lab November 18-19, 2008. **L-r:** Jonathan Walsh (BES), Margaret O'Brien (SBC), Kristin Vanderbilt (SEV), Suzanne Remillard (AND), Ken Ramsey (JRN) and back to the camera, Corinna Gries (CAP) (photo by McOWiti Thomas). **Inset:** The new metacat keyword search completion feature displays existing EML document keywords as selection choice.

Although the changes in EML 2.1.0 are small, they are nonetheless incompatible with documents authored under previous versions and will require changes to extant metadata documents. Document authors should see the 'Readme' that accompanies the distribution for a complete list of the bugs addressed (<http://knb.ecoinformatics.org/software/eml/>), usage information and examples. Existing EML 2.0-series documents can be converted to EML 2.1.0 using the XSL style sheet that accompanies the release.

If you or your site is involved in an LTER related informatics project that you would like highlighted in this column please send email to jbrunt@LTERnet.edu.

James Brunt, LNO

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

Plankton dynamics

in the McMurdo Dry Valley lakes during the transition to Polar Night

Research on the lakes of the McMurdo Dry Valleys (MCM) began with the advent of the International Geophysical Year (IGY) in the late 1950's. IGY research revealed the physical/chemical nature of the lakes, showing that they were the only year-round liquid water environments on the continent, and inferred that the biological systems in the permanently ice-covered lakes must possess novel physiological strategies that allow them to survive at low temperature and under extended darkness. The seminal studies during IGY provided the framework for subsequent hypotheses driven research which now forms the basis for the ongoing MCM LTER lake program (now in its 15th season; www.mcm.lter.org) and the MCM dry valley lake Microbial Observatory (<http://www.homepage.montana.edu/~lkbbonney/>).

Data collected on Lakes Bonney, Hoare and Fryxell (all in the Taylor Valley) as part of the MCM LTER have shown that most organisms in the lakes are not just "surviving the extremes" but are actively feeding, growing and reproducing. As such, they are ecosystems in which we can identify and begin to understand physiological and genomic adaptations in the context of one of the most extreme environments on our planet. Unfortunately, almost all "hands-on" research on the MCM lakes has been restricted to the austral spring and early summer (~October through January) when logistical support has allowed access to the area.

Although studies during the spring/summer period have yielded a quantum increase in our understanding of the lakes, the unique aspects of physiological adaptation, biodiversity and ecosystem function during the permanently cold and prolonged darkness of the Antarctic winter will never be understood without extended season research. Through an International Polar Year (IPY) grant from NSF-OPP we were able to conduct the first research on these lakes during the transition from 24 hour sunlight to total darkness between November 2007 and April 2008.

The overarching theme of this research was that the onset of darkness induces a cascade of physiological changes that alters the functional roles of autotrophic and heterotrophic microplankton within the lakes. This overarching theme was addressed through an interdisciplinary and international study of selected biological components of the lakes using genomic and physiological tools to understand not only how individual organisms survive, but how they control ecosystem function during this seasonal transition. This theme

is directly relevant to MCM LTER and IPY objectives, and the data will be critical to our knowledge of how polar organisms survive and function within high latitude ecosystems characterized by extreme cold and prolonged darkness. The theme also contributes directly to the international Scientific Committee on Antarctic Research (SCAR) program "Evolution and Biodiversity in the Antarctic" (EBA; <http://www.eba.aq/>).

By virtue of perennial ice covers, low advective stream flow, and saline bottom waters, lakes in the MCM are permanently stratified and have a unique and diverse set of thermodynamic and geochemical conditions. Water temperatures range from -5 to 6 °C and fluctuate

less than 2 °C seasonally. Superimposed on these stable cold temperatures is a low light environment where measurable photosynthetically available radiation (PAR) penetrates the ice only from early October to mid-March.

Data collected during spring and early summer as part of the MCM LTER and Microbial Observatory programs have revealed multiple, well-developed phytoplankton and bacterial maxima associated with nutrient gradients down the water column. Strong microbial linkages have been defined in all of the MCM lakes and point to the tight coupling of carbon and other nutrients and the reliance of the system on phytoplankton photosynthesis during the short summer period (Figure 1).

See "Planktons," p. 15

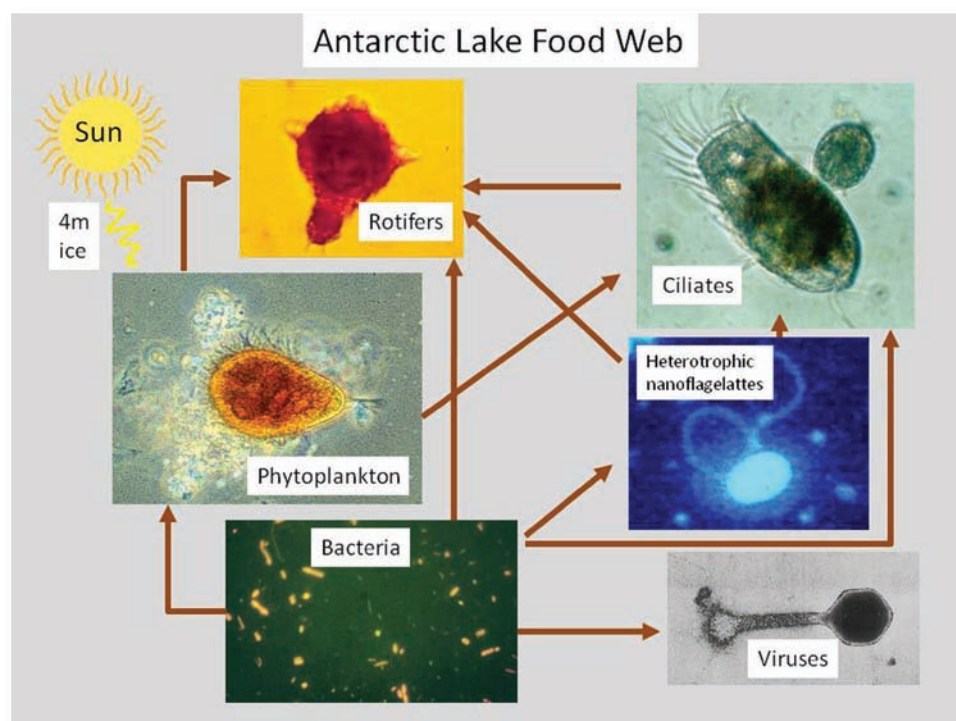


Figure 1. Schematic showing the microbially dominated foodweb that exists in the lakes of the McMurdo Dry Valleys. Few metazoans exist within the lakes.

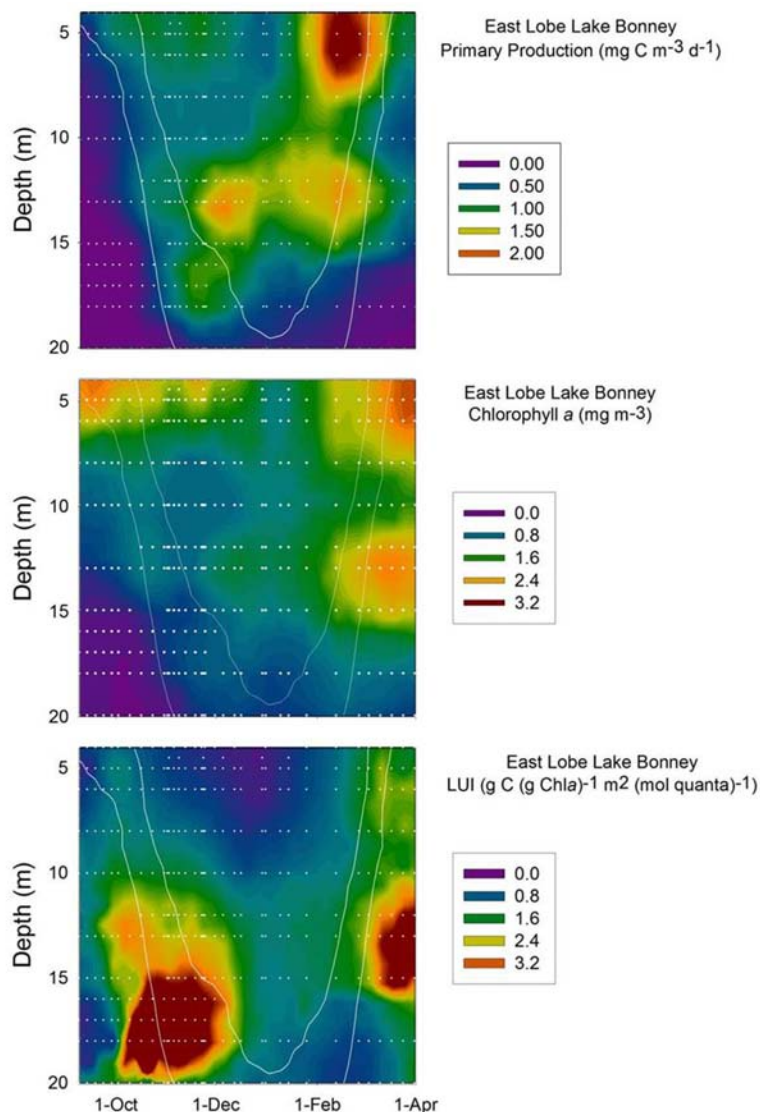
Planktons (continued from p. 14)

We currently know little about food-web dynamics in late summer, autumn, or the long dark winter. Based on the summer to winter transition data processed thus far, we can now produce a picture of annual bacterial and phytoplankton productivity in all lakes. Preliminary analyses of these data show that chlorophyll-a continues to increase after phototrophic primary production has ceased (Figure 2). This is due in part to cryptomonad phytoplankton switching from light driven metabolism to phagotrophy on bacteria, which is a winter survival mechanism shown to occur in other Antarctic lakes. A mid-season drop in photosynthetic efficiency apparently occurs as the result of phosphorus deficiency by the phytoplankton, a fact we corroborated through nutrient bioassay experiments which showed significant stimulation of light mediated $^{14}\text{CO}_2$ incorporation by the addition of phosphorus. A late season



Figure 2. (left): Primary productivity, chlorophyll-a and photosynthetic efficiency (Light Utilization Index; LUI) in the east lobe of Lake Bonney during the transition from 24 h sunlight to total darkness. The graphs represent a composite of data collected between 1991 and 2008. White dots represent data used to create the graph; inner and outer white lines represents PAR levels of 0.25 and 0.50 $\mu\text{mol quanta m}^{-2}\text{s}^{-2}$, respectively.

Figure 3 (above): Early winter operations on the lakes in the McMurdo Dry Valleys.



increase in photosynthetic efficiency apparently results from the leaching of phosphorus from sediment released from the ice permanent cover.

Clearly, IPY-funded research into the polar night has provided the MCM LTER with a window of opportunity to collect new data during a time of year that that will allow us to refine our understanding of lake ecosystem processes. The permanently ice-covered lakes being studied by the MCM LTER are the only known environments on the Antarctic continent that contain liquid water throughout the year. As such, these lakes are truly an oasis for life in what would otherwise appear to be an inhospitable environment.

*John C. Priscu, MCM/
Department of Land Resources and
Environmental Sciences
Montana State University
Bozeman, MT*

Calendar

Coming Events of Interest to the LTER Community

Publications Committee defines roles and responsibilities

The LTER Publications Committee has released a document entitled *LTER Publications Committee Role and Responsibility* covering what we do and why we do it. This is the document approved by the LTER Executive Board last spring - but edited slightly to reflect the fact that it is no longer a proposal - and with the inclusion of more specific guidelines for determining what is and is not appropriate for the US LTER Science and Synthesis Series. Members of the Publications Committee approved the changes.

You can find a link to the document on the LTER intranet (<http://intranet.lternet.edu/modules.php?name=UpDownload&req=getit&lid=640>).

For further information please contact Alan K. Knapp, Chair, LTER Publications Committee

JANUARY 2008

January 26–27: IM Executive Committee Meeting, LTER Network Office, CERIA Building Rm 360, University of New Mexico, Albuquerque, NM. Contact George Garcia (gmgarcia@lternet.edu) for details.

FEBRUARY 2008

February 9–11: Long Term Hydrologic Change: Disturbance Workshop. New England Center Hotel and Conference center at the University of New Hampshire, 15 Strafford Ave, Durham, NH 06824. Organizer: Dan Bain (dbain@pitt.edu).

February 17–19: Multi-site workshop on lawns and residential landscapes research. CAP LTER, Phoenix AZ. Organizer: Marcia Nation (Marcia.Nation@asu.edu).

February 25: LTER Executive Board Meeting, National Science Foundation, Arlington, VA. Contact George Garcia (gmgarcia@lternet.edu) for details.

February 26: NSF/LTER Annual Mini-symposium, National Science Foundation, Arlington, VA. Contact George Garcia (gmgarcia@lternet.edu) for details.

MARCH 2008

March 30–April 2: Workshop on Changing Snow and Ice conditions and Ecosystems Response? Woods Hole, MA. Organizer: Hugh Ducklow (hducklow@mbf.edu).

March 31–April 4: Future Scenarios of Landscape Change. Petersham, MA. Contact David Foster (drfoster@fas.harvard.edu) for details.

MAY 2008

May 12: Science Council Meeting, La Jolla Shores Hotel, San Diego, CA. Contact George Garcia (gmgarcia@lternet.edu) for details.

May 12: Executive Board Meeting, La Jolla Shores Hotel, San Diego, CA. Contact: Contact George Garcia (gmgarcia@lternet.edu) for details.

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