LTER
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Another successful All Scientists Meeting

A section of the audience in the plenary hall during the 2009 All Scientists Meeting at Estes Park, CO. Photo: McOwiti O. Thomas

The 2009 LTER All Scientists Meeting held at the YMCA of the Rockies in Estes Park, Colorado from September 13-17, 2009 was, by all accounts, a very successful meeting following previous meetings held there in 1990, 1993 and 2006. The Program Committee, working with the LTER Network Office (LNO), created a program that clearly resulted in an exciting and productive meeting.

Logistics for the meeting were handled by the LNO in collaboration with The Schneider Group, a company specializing in meeting organization. There were pre-ASM meetings for information managers, graduate students, education representatives, international attendees, and the LTER Executive Board.

Six plenary presentations on LTER science and research were given by Phil Robertson, Jim Collins, Dave Schimel, Bill Clark, Laura Ogden, and Carol Brewer, as well as evening presentations on the prehistory and future of LTER (Dave Coleman and Henry Gholz).

However, the most important aspects of the meeting were the discussions of research and planning for future activities. These took place in over 75 working group meetings in seven working group sessions, producing a variety of products and 29 requests for follow-on activities.

Adding to the working group sessions were over 400 poster presentations held during four evening mixers in a large new meeting hall at the YMCA. J. Megan Waltz (KBS) won first prize in the student poster contest, with honorable mention going to Rebecca Hewitt (BNZ), Julia La Roche (ARC), Ashley Keiser (CWT), Robert Stewart (PIE), and Marko Spasojevic (NWT). Wade Sheldon (GCE), won the photo contest for both the "Elk" and "non-Elk" categories while Mike Stukel (CCE), John Bain (VCR), Brian Voigt (BES), won the respective "LTER Scientists", "Scenery", "Silly" photo categories. Don Henshaw (AND)

See "ASM", p. 3

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

In This Issue

The Network News

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Editorial

View from the Chair

Stock clipart

Thanks to all who made the 2009 All Scientist Meeting such a rousing success – once again we had a chance to see collectively what makes the Network shine: outstanding ecological science that transcends the boundaries of individual sites. Much of the historical strength we display as a network comes from a foundation of solid site-based science – questions asked and addressed at individual sites that require a long-term context to be answered well. But more and more our visibility arises from cross-site work that places local patterns and processes in a wider geographic context. Connecting the dots at these larger scales requires exactly the sort of network we've become; in fact it's fair to say that we've been one of the strongest forces in continental-scale connectivity science (see, for example, the June 2008 issue of *Frontiers in Ecology and the Environment*).

The Network's synthesis initiatives, first described in our Decadal Plan, embody this perspective and the further recognition that socioecological questions are among the most important and recalcitrant issues that face us today. A meaningful approach to understanding climate change impacts, mitigation, and adaptation, for example, cannot divorce the biophysical from the social, and our emphasis on interdisciplinary science positions the network well to address exactly these sorts of challenges. All of our new initiatives take this approach and will be well positioned for pushing frontiers in their respective areas: Cryosphere Disappearance, Coastal Zone Vulnerabilities, Inland Climate Change, and Future Scenarios of Land Use and Climate Change (for full descriptions see *www.lternet.edu/decadalplan/*.

Recognition of the Network's achievements comes in many forms, and one of the more unique and memorable will be the American Institute of Biological Sciences Distinguished Scientist Award, to be bestowed on the Network in May 2010 in honor of our 30th anniversary. This is a tremendous honor and reflects splendidly on all of us and our collective accomplishments as a network. It's great to be so recognized.

One of our biggest challenges as we tackle large-scale questions of national import is to have in place a data infrastructure sufficient to the task. This is why one of our highest network priorities is to complete the design and implementation of the LTER Network Information System (NIS), including the revision and documentation of site data. The NIS is designed to facilitate the automated discovery and retrieval of site-based data in such a way that it becomes easily accessible by a variety of users, especially those attempting to address fundamental large-scale synthetic questions. Early efforts such as ClimDB, and more recent efforts like EcoTrends, illustrate the potential power of such systems. Funding for the centralized piece of this is now in place, with the National Science Foundation's generous support through stimulus dollars. We are now working on securing funding for the site-based piece, and looking forward to having a truly functional NIS in place in the coming years.

The Network is currently in a great place. We are well-positioned to address some of the nation's most important and basic socioecological and environmental science questions. And we are the charter member of an emerging constellation of environmental observatories that jointly will address the critical environmental challenges of the future. What a great place to be!

By Phil Robertson, LTER Chair, KBS

ASM (continued from p. 1)

Megan (KBS) "waltzed" away with the Best Student Poster prize. (Photo: McOwiti O. Thomas).

was the winner of the ASM trivia contest.

In addition to the many positive comments by meeting attendees, very useful information came from the post-ASM survey. Eighty-four percent of the attendees thought the meeting was either excellent or very good while nobody thought it was "poor". Nobody indicated they were dissatisfied with LNO responses to requests.

Michell Thomey (SEV) in the dining hall. (Photo: McOwiti O. Thomas).

Networking opportunities are a critical component to the success of the ASM. To that end, respondents were asked to respond to various activities designed to enhance the networking experience. Attendees were satisfied with the opening mixer (84%), poster session space (88%), local attractions (84%), and poster session length (84%), while slightly less were satisfied with the main plenary speakers (70%) and the mixer entertainment (52%).

The plenary speakers ***L*** to ***R***: William Clark (Kennedy School of Government, Harvard), David Coleman (University of Georgia), Jenna Jadin (AIBS Public Policy Office), John Magnuson (NTL), Jim Collins (NSF), and Carol Brewer (University of Montana) . (Photo: McOwiti O. Thomas).

Although a number of people didn't like the YMCA food, they did like the beer selected by the LNO for the mixers!

Many factors were rated in importance with respect to participants' decision to attend the meeting. Workshop content (51%), networking opportunities (82%), availability of LNO support to attend ASM (42%), and meeting with peers of similar expertise (75%) were rated extremely important factors in the decision to attend, while the poster sessions (58%), social activities (52%), and ASM location (53%) rated important. Not important in the decision to attend the ASM were the local attractions (48%). Finally, 51% of the respondents said they would like to see the ASM return to the YMCA of the Rockies (in 2012, while 60% would prefer the month of September for the meeting.

Looking forward to the next ASM, some modifications in the meeting organization will be considered to improve on the future ASM experience.

The post-ASM survey showed that people prefer the meeting in September, although one week later would help with students and scientists just starting a semester.

The plenary presentations could be shortened to permit more time for working group meetings and free time.

There could be at least one free afternoon or time before dinner for a break to permit ad hoc discussions, or time to enjoy local attractions in the area and perhaps get into town for a good meal.

The mixer and poster sessions could go later in the evening even if the refreshments and snacks have to be cleaned up earlier since participants did not seem to like the earlier closing time of the poster session in the 2009 meeting.

The YMCA seems to know how to make good pizza, as noted by people at the opening mixer, so perhaps some improvements in the food can be made.

Education Committee meeting. (Photo: McOwiti O. Thomas).

Since it is difficult for the LNO to prepare and assist with meetings held prior to the ASM while also preparing the main event, additional meetings held in conjunction with the ASM could be held as "follow-on" meetings rather than the "pre-meeting" events.

Although the YMCA in Estes Park seems to be a preferred venue for ASM, all of these plans will be considered within recommendations coming from the LTER Science Council and Executive Board as planning for the 2012 meeting continues.

By John Vande Castle and Marjorie McConnell, LTER Network Office

It wasn't all work and no play at ASM; these folks went for a fun horse ride in the park. (Photo: McOwiti O. Thomas).

Barbara Benson retires

Colleagues pay tribute to a stalwart of LTER Information Management and Science

Barbara J. Benson, information manager and scientist at the North Temperate Lakes (NTL) LTER for 26 years as and former chair of the LTER Network Information Management Committee, has retired. Barbara retired in October 2009, but will continue several aspects of her research and utilize her information management talents as an emeritus member of the Center for Limnology and the NTL LTER team.

Barbara's career exemplifies how important individual contributions can be in shaping the evolution of the LTER program. Former colleagues say that her attention and leadership in information management has helped LTER achieve and maintain leadership in the field.

Barbara Benson explains details of her poster to an upcoming scientist, showing that she has not forgotten her mentoring ways. (Photo: McOwiti O. Thomas).

Starting as a math major, Barbara earned her Ph.D. in Botany at the University of Wisconsin-Madison. Her interests, skills, and persistence led to her being hired to develop and manage NTL's data and information management system, which has significantly helped researchers analyze the rich sets of dynamics seen in the north temperate lakes and their surrounding landscapes.

In addition to developing the excellent information management system at NTL, Barbara provided leadership at the LTER Network level. In 2003, she succeeded Susan Stafford as chair of the Network's Information Management Committee, serving until 2006. She also served on the Network Information System Advisory Committee, most recently as Co-Principal Investigator on the LTER Network Planning Grant, and as a member of the team for cyberinfrastructure (CI) planning.

Those who know and have worked with Barbara appreciate her quiet leadership style, her pleasant assertiveness, and her ability to grasp the big picture in the midst of details.

Barbara is also a practicing ecologist who enjoys working with complex problems. The diversity of her contributions is apparent in the NTL's 2006 Oxford Synthesis volume[1], in which she is lead author or coauthor on six of the 15 chapters. At the most recent All Scientists Meeting in Estes Park, CO, in September 2009, Barbara presented a paper on a CI-Team project, and a poster on trends, variability, and extreme events in lake ice..

At NTL, our approach to data and information management has always been to identify and recruit a strong and highly qualified professional scientist as our information manager. Our logic was that an information manager who was also a researcher and publishing scientist would design and implement a system that scientists could use effectively. This model has been healthy for NTL and the LTER Network during our first 25 plus years, and Barbara filled it exceptionally well. These multiple roles placed considerable stresses but also opportunities on Barbara, all of which she took in stride and performed with conscientious grace.

Barbara Benson receives an award from former LTER Chair, John Magnuson, during the 2009 ASM at Estes Park, CO.(Photo: McOwiti O. Thomas).

Barbara has been important to LTER. The network and the individual programs, especially NTL, have been enriched and empowered through her unique combination of skills and personal attributes.

Barbara, we hope that your retirement is designed with the same care you have shown to LTER and its research endeavor. We also hope that you save a small part of yourself to continue interacting with LTER and your former colleagues and friends.

By John J. Magnuson, Tim Kratz, & Dave Balsiger, NTL

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In Memoriam: Stanley Dodson

Stanley Dodson holding up a jar of Daphnia from Lake Mendota. (Photo: Bill Feeny).

We are saddened to report that Stanley Dodson passed away Sunday, August 23, 2009 after a tragic bicycle accident in Colorado. Stanley had been a North Temperate Lakes (NTL) PI since 1996.

Professor Dodson received his PhD from the Zoology Department of the University of Washington in 1970, having focused on size-selective predator-prey interactions and zooplankton community structure. His graduate work built on the landmark paper by Brooks and Dodson (1965), done while Stanley was an undergraduate at Yale. He joined the Department of Zoology at University of Wisconsin in 1970, and retired earlier this year after a long and productive career.

Stanley's research covered a breadth of topics, including population ecology of Daphnia, zooplankton community dynamics, kairomones in planktonic species, ecotoxicology and bioassessment. His recent NTL research addressed the effects of land use on zooplankton communities and productivity-diversity relationships in lakes. His broad interests in ecology and teaching led to publication of a multi-authored text (Dodson 1998) and an assemblage of key readings in ecology (Dodson 1999). His interests in freshwater ecosystems led to the publication of a textbook on Limnology (Dodson 2005). One of his important contributions at Wisconsin was a course that guided undergraduates into ecology internships.

Stanley had an exceptional *joie de vivre*. He relished his role as an advisor and teacher, often taking unconventional and memorable approaches to engaging students and getting them to appreciate the natural world. As he wrote in the introduction to his Limnology text book, "There is even room for the occasional poem or story about a beautiful lake or stream." Stanley's last seminar in the department was entitled "Widening Ripples," his way of nudging us all to think about the ripples that radiate away from our own lives to others and the world around us. The "ripples" of Stanley's life have left a lasting legacy. He will be sorely missed.

By Jeff Hardin, Jim Kitcell, & Emily Stanley, University of Wisconsin

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Digging in the dirt: trans-Atlantic studies on across-boundary systems

It has been ten years since I first saw the Georgia coastal ecosystems – as a visiting scientist at the University of Georgia Marine Institute (UGAMI), Sapelo Island. Two years earlier, I had met my host, Steve Pennings, at the Bamfield Marine Station (now Bamfield Marine Sciences Centre). During my two months' stay at Sapelo, we worked together on the decomposition of saltmarsh detritus of different origin through the action of different saltmarsh detritivores, finally confirming interspecific differences in the contributions of various detritivore species to the decomposition of various common species of detritus in saltmarshes (Zimmer et al., 2002, 2004).

One of our most fascinating results (at least to me) was our discovery that the saltmarsh crab, Armases cinereum, was an omnivore that fed not only on detritus but also on detritivores (Buck et al. 2003). Consequently, we suggested that this crab acted as a vector of saltmarsh-derived nutrients to the coastal forests (and vice versa) (Zimmer et al., 2004), but were unable at the time to provide strong evidence for this hypothesis.

The experience of being introduced into this fascinating marine-terrestrial ecotone by Steve Pennings, Tracy Buck, and Steve Newell was my inauguration into saltmarsh ecology. Since then, I have been intrigued by the very special beauty and atmosphere of the Georgia saltmarshes, particularly compared to European saltmarshes that are way more diverse in terms of vegetation, but less species-rich in terms of the potentially detritivorous maro-fauna. Looking back, I can say that I spent two precious months at a wonderful place, getting to know many nice and helpful people.

Back in Kiel, it took me some time to establish a saltmarsh team of my own, but I finally managed to transfer my fascination to some of my students. The first was Malte Mews , who studied the role of detritivore and detritus diversity in decomposition processes in ring-shaped field mesocosms in a variety of habitats. On Sapelo Island, he carried out a long-term decomposition study in situ that he set up together with Sebastian Fraune (a Diploma student of mine: photo "slightly dirty") in June and terminated in September 2006. The major outcome of that particular study was a surprise to us (and contradicted previous findings both from other habitat types and from Sapelo Island): deritivores other than the periwinkle, Littoraria irrorata, had little influence on decomposition processes in the upper saltmarsh (Mews & Zimmer, in prep.).

Malte Mews (left) and Sebastian Fraune (right) are slightly dirty after having set-up ring-shaped field mesocosms in the Sapelo saltmarsh. (Photo: S. Fraune, self timer).

More recently, in 2007, I gathered five students to spend two months on Sapelo Island to study the detritivorous soil fauna and their contribution to decomposition processes along a habitat gradient, from the aquatic to the terrestrial environment. Their stay on Sapelo resulted from my association since 2005 with GCE-LTER, and was supervised by Steve Pennings.

In 2008 one of the students, Franziska Seer, who had worked with Gregor Putze and Yuri Zablotski on Sapelo in 2007, came back to collect a second set of samples from a long-term (24 months) decomposition study. We are still analyzing the corresponding data, but our results already show that detritus-specific differences in decomposition rates are, in the long run, overruled by habitat-specific processes (Seer & Zimmer, in prep.); and that at no time during the long-term process do macro-detritivores significantly affect decomposition.

The last set of litter bags of this long-term field study are currently being recovered from the field by Christine Ewers. Christine had been working with Anika Beiersdorf and Kazik Wieski since 2007 on the effects of predator/prey-interactions--the previously mentioned crab (Armases), the periwinkle (Littoraria), and the coffee bean snail (Melampus bidentatus)--on the decomposition of low-quality detrital subsidies from coastal forests into the upper saltmarsh. The captivating results suggest a positive joint effect of omnivorous crabs and detritivorous snails on the decomposition of, and nutrient release from, low-quality detritus (Ewers et al., in rev.).

This particular project influenced my current research within GCE-LTER, which focuses on the wharf crab, Armases cinereum. My diploma student Lena Hübner spent her summer 2009 at UGAMI on Sapelo Island to re-assess the feeding ecology of this so-called saltmarsh crab in detail. She did this both in the field through a capture/re-capture approach and occasional behavioural observations and in the lab through the comparative analysis of the morphology of feeding appendages, feeding preferences, the activity of various digestive enzymes, the composition of gut microbiota, the stable isotope signatures of crabs, and potential food sources. Already, we can show that the woods rather than the saltmarsh are home to this important key player in saltmarsh decomposition processes and nutrient fluxes.

In the European saltmarshes, my diploma student Philipp Eereveld and my Master of Science student Lena Kempener are currently working on the effects of the detritivorous fauna on the decomposition of a formerly widespread saltmarsh cord grass (Spartina anglica) and the currently spreading couch grass Elytrigia atherica. They are also investigating how these interactions are affected by saltmarsh predators, particularly lycosid spiders, through both field and lab decomposition studies in combination

Malte Mews, the Lord of the Rings, at the Marine Institute on Sapelo Island. Mews is 'shielded' by the ring-shaped mesocosms he used in his field study. (Photo: S. Fraune).

with PCR and stable isotope-based analyses of predator/prey interactions. Another major aspect of saltmarsh ecology is currently covered by my PhD student, Ulf Evert: how will the predicted increase in frequency and severity of storm events, in combination with increased plant biomass as a result of eutrophication of coastal waters, translate into the thickness of detrital mats (photo: "Spartina wrack at Sapelo")? To-date, we have strong evidence of a reduction of dicotyledonous plants in favour of monocots upon addition of increasing detrital mass. However, even grasses are inhibited by the detritus and its leachates; it seems that the physical effect of covering and shading the soil promotes growth of the saltmarsh grasses.

Although the corresponding studies have thus far been based in German saltmarshes, we have a strong link with GCE-LTER that will, hopefully, result in continuing collaboration between our group and people from Sapelo Island. We hope to become involved in the recently implemented continental-scale network for studying the effects of windstorms on coastal ecosystems (Hopkinson et al., 2008. Front. Ecol. Environ. 6(5): 255-263), and to spend time and conduct research on Sapelo. Ultimately, we hope this so far one-sided collaboration–not counting a visit by Steve Pennings and, later, his group to my lab—will expand to become a true exchange program with funding opportunities for student research.

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By Martin Zimmer, Christian-Albrechts-Universität zu Kiel, Germany.

View from DC

LTER at 30

This is a busy period for LTER, both within the community and at the National Science Foundation (NSF). There were nine site reviews in 2009 and there are 12 projects with renewal proposals due in February for review by a panel next spring. In addition, NSF is in the process of commissioning the third decadal, external review of the LTER program.

But of more immediate importance is the new, one-time, 5-year award made recently to the LTER Network Office using American Recovery and Reinvestment Act ("stimulus") funding. Although made to the LNO, this award provides a unique opportunity for the entire community to move LTER toward becoming the type of integrated network envisioned by ISSE. Arguably the most critical part is the support provided to move the LTER Network Information System to a new structural and functional level – essentially to completion. This is an opportunity for LTER to make major advances in its scientific capabilities through advances in its capacity to handle (collect, store, communicate, and use) large, complex datasets—not just from across the LTER network, but beyond—through effective linkages with the emerging observatory platforms such as the National Ecological Observatory Network (NEON) and Ocean Observatory Initiative (OOI), the International LTER (ILTER), the new network of urban science seeded by the ULTRA-Ex (Urban Long-Term Research Areas: Exploratory Research Projects) competition, and through more complete participation of the social sciences and other non-traditional LTER disciplines, sites, and scientists.

As the LNO works to complete the operational plan for the use of the stimulus funds, it is essential that the whole LTER community come together to support one direction for NIS development. These are not research moneys in the usual sense, provided for experimentation, or leading to several different products. Rather, they were provided for the development of one truly functional NIS to enable the LTER network, as a whole, to make a major leap forward in the level of its future science and education. It will be particularly important to mobilize the LTER Information Managers and their counterparts outside LTER for this effort, so that the results meet functional expectations at the site level, multi-site, and full network levels and beyond.

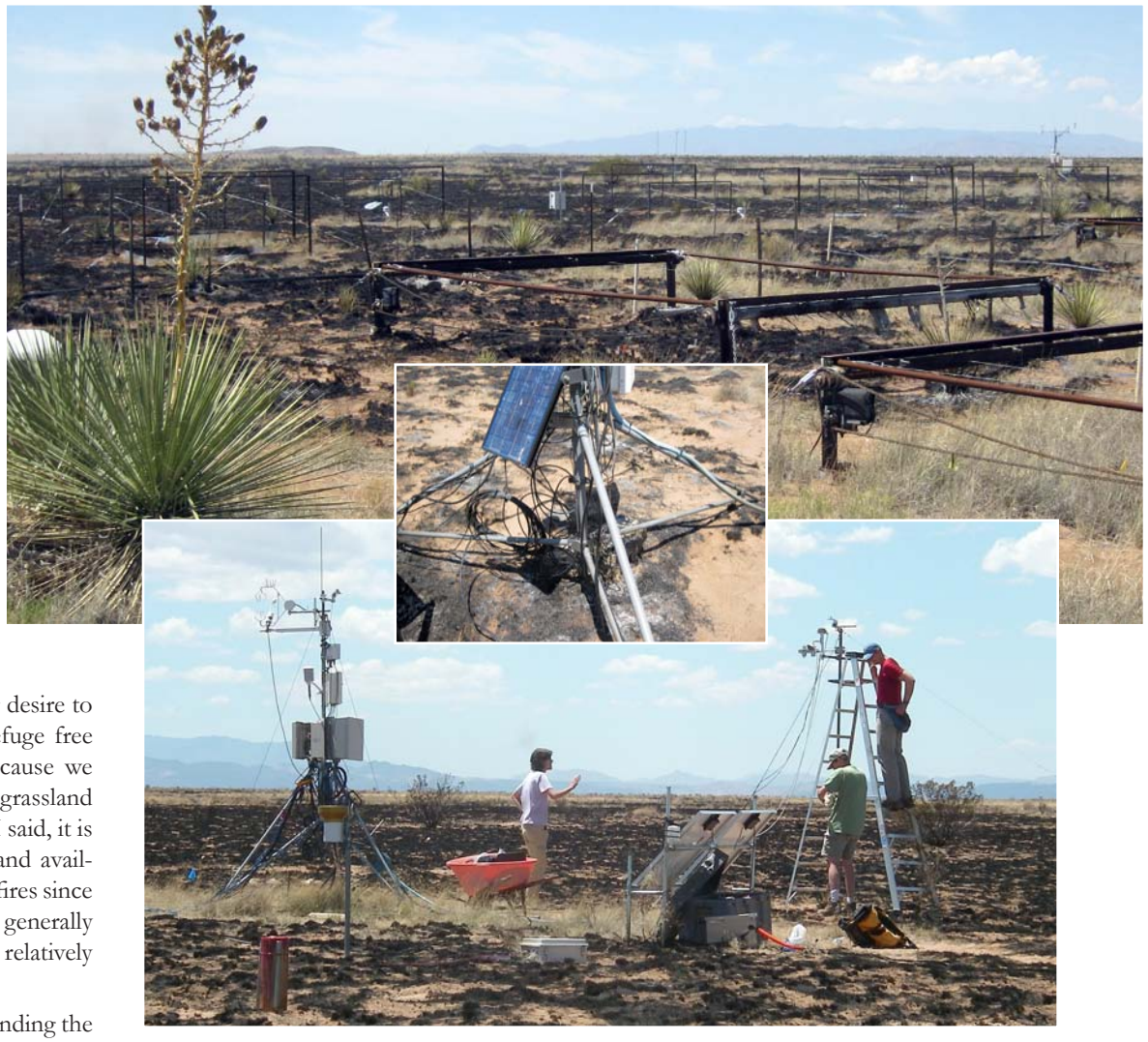
At the same time, NEON has now successfully completed the Final Design Review and OOI has entered the construction phase--two national observational programs that will complement the LTER research program and lead to synergistic results. Also, NSF/BIO now funds four different centers for the support of synthesis. As NCEAS moves into the final two years of its highly productive and sustained run, NSF is working to define a new competition to meet the ever expanding and clear need for synthesis in the ecological sciences, while also recognizing the very different state of science and environmental issues facing society today as compared with 1995, when NCEAS was established.

This changing landscape also requires increasing involvement of NSF in LTER management. In particular, Dave Garrison from the Bio-Oceanography program in the Geosciences Directorate is now leading mid-term reviews of most of the coastal and marine projects. The Social, Behavioral and Economic Sciences Directorship has also increased its involvement, making available substantial supplement support for further integration of social sciences and LTER (Rita Teutonico and Deborah Winslow joined Tom Baerwald at the recent LTER All Scientists Meeting in Estes Park, CO). Also at the meeting were DeAndra Beck, who represented the Office of International Science and Engineering and attended a very exciting two day ILTER workshop on ecosystem services; Todd Crowl, who will replace me as the LTER Program Director for the year; and Matt Kane, who will back Todd up.

By Henry Gholz, Program Director, NSF/BIO/DEB

I eat my words; but I won't waste the new research opportunity

In June 2009 I was meeting with biologist Jon Erz at the Sevilleta National Wildlife Refuge when I learned about their plans to conduct a 1600 hectare management burn in summer 2010 on the northern half of McKenzie Flats. This was an area of desert grassland that has not burned for decades. The southern boundary of this management burn would be just north of several of our long-term monitoring and experimental sites.



Above: Damage to the nighttime warming experiment at the Sevilleta LTER the day after a wildfire burned through the area in August 2009. ***Inset***: Fire damage to a solar panel, sensor cables and battery box at the Deep Well meteorological station on the Sevilleta following a wildfire. ***Below:*** Lee Vierling checks on the function of the tower based NDVI sensor at the grassland eddy flux tower after the fire, assisted by fellow SEV researchers Marcy Litvak and Don Natvig. (Photos: Renee Brown).

At the time I reiterated our desire to keep that part of the Refuge free from prescribed fires because we needed large areas of unburned grassland for reference sites. And besides, I said, it is nice to have a section of grassland available for natural, lightning caused fires since they are often quite patchy and generally burn fairly small areas, unlike the relatively large fire planned for 2010.

On 4-5 August 2009, while attending the Ecological Society of America meeting in Albuquerque, I was informed that multiple dry lightning strikes, high winds, and hot temperatures had combined to start a wildfire that ultimately burned about 3200 hectares, including the proposed 2010 management burn area. The fire started near the southern portion of McKenzie Flats and quickly burned through graduate student Michell Thomey's rainout shelters, the monsoon rainfall manipulation experiment, the grassland drought plots, and the small mammal exclosure experiment. Some of our small mammal trapping webs and net primary productivity (NPP) plots were toasted, as well.

The fire eventually burned north all the way to Black Butte and then east to the main access road. In the process it managed to burn through more of Michell's rainout shelters, partially through the warming experiment, and much of our NutNet experiment. It seems that the only places that didn't burn were a 15x15 meter area around the grassland flux tower, sparing all instrumentation and solar panels, and the fire seasonality experiment.

As Rahm Emanuel once (reportedly) said, never let a good crisis go to waste. In response to the unexpected fire, we plan to test a set of hypotheses on recovery dynamics and microbial-plant-consumer linkages under experimental climate change in this recently burned desert grassland. We are also discussing cross-site collaborations with the Arctic (ARC) and Santa Barbara Coastal (SBC) LTER sites that have also recently experienced wildfires, and the Konza Prairie (KNZ) LTER site, which has a regularly imposed experimental burning regime.

By Scott Collins, SEV

ENDURANCE excites MCM lake scientists

Members of the McMurdo (MCM) LTER researching perennially ice covered lakes are thrilled by access to a new tool which is revolutionizing our view of one of the lakes, West Lake Bonney (WLB). The Environmentally Non-Disturbing Under-ice Robotic ANtarctic Explorer (ENDURANCE) is an autonomous underwater vehicle capable of generating for the first time 3-D biogeochemical whole-lake datasets.

The ENDURANCE robot is equipped to measure a comprehensive suite of physical and biogeochemical indices in the water column. These parameters include temperature, conductivity, pH levels, redox, chlorophyll-a, turbidity, dissolved organic matter, and photosynthetically active radiation, as well as imagery of the lake bottom and the underside of the ice. It collects these data by swimming just under the ice cover and lowering its science package through the water column along a 100 m x100 m horizontal grid (Figure 1). Sonar mapping of the bathymetry and lake ice thickness and imaging of the underwater glacier face of Taylor Glacier is also part of the suite of measurements. All of these efforts go toward testing our two main hypotheses:

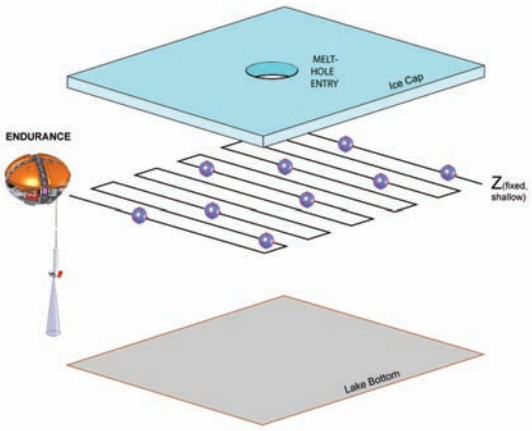


Fig. 1: ENDURANCE is deployed through a large hole in the ice which is made by using heat to widen a smaller hole made with a mechanical drill. A heated building is place over the hole to house the vehicle when it is out of the water. During most operations, the vehicle never leaves the underside of the ice, but instead stops at the 100 m grid points and lowers the science package to within 1 m of the bottom where it takes an image and then returns to the vehicle.

1. The low kinetic energy of the system (diffusion dominates the spatial transport of constituents) produces an ecosystem and ecosystem limits that vary significantly in three dimensions.

2. The whole-lake physical and biogeochemical structure remains static from year to year.

ENDURANCE has already completed one field season in the dry valleys, mapping out about 2/3 of WLB, and first-pass mapping and imaging the face of Taylor Glacier. In our first field season, imaging the glacier face was hindered by poor visibility once the streams started flowing. The changing conditions also impacted our spatial biogeochemical mapping. To overcome this in year two we will arrive earlier in the field season and finish before any significant melt occurs. During the first season we also made repeated measurements at a node point near the base. The change in turbidity over the season is clearly seen in the data (Figure 2). ENDURANCE was designed and built by Stone Aerospace of Austin, Texas. The National Aeronautics and Space Administration (NASA) funded the design, construction, and science of ENDURANCE, while the National Science Foundation's Office of Polar Programs has provided considerable logistical support in Antarctica. Two MCM LTER Principal Investigators, Peter Doran and John Priscu (Figure 3), are responsible for ENDURANCE science, and for making sure that the data collected are compatible and conform to LTER standards. Data analysis and synthesis is being aided by software tools developed by UIC's Electronic Visualization Lab. Ideally we would like to have ENDURANCE work in other MCM lakes in the future, but our current funding is only for WLB.

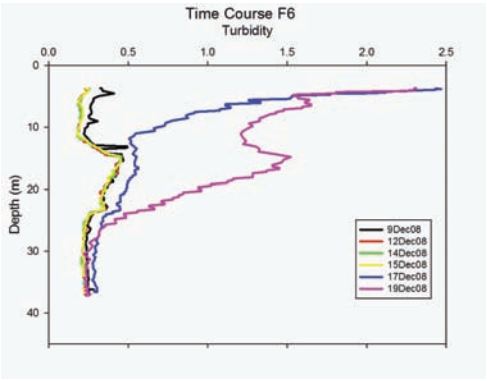


Fig. 2: Results from repeated measurements at the same grid point through the first season shows the evolution of more turbid water with time.

A second field season began in October 2009 and we will be operational at WLB until the first week of December. Doran and Priscu, along with other MCM LTER lakes personnel, will work closely with the 2009 ENDURANCE team of seven engineers from Stone Aerospace and an undergraduate from University of Illinois at Chicago, in addition to carrying out their regular MCM research.

By Peter Doran, MCM, Earth and Environmental Sciences, University of Illinois at Chicago, Chicago, IL

Peter Doran and John Priscu (MCM) examine the science package (sonde) on ENDURANCE. Sensors on the sonde are checked and recalibrated between each run. (Photo courtesy of MCM LTER).

CAP LTER's summer ecology program for low-income children

Summer in the city often involves more time inside than outside, particularly for low-income children who cannot afford to attend summer camps. This summer, I developed an ecology program for around 25 low-income children ages 7-14, using the kits and lesson plans developed by CAP LTER's Schoolyard program, "Ecology Explorers."

As the Programs Coordinator for "Helping Hands Housing Services Casa de Paz Sahuaro," my goal was to pull kids away from their televisions and MP3 players and get them outdoors to learn and have fun. Children attending my summer ecology program were from families that lived in Casa de Paz Sahuaro, an apartment complex owned by Helping Hands Housing Services. Helping Hands is a non-profit organization whose mission is to break the cycle of poverty for low-income families by providing permanent affordable housing and comprehensive support services.

Children from Casa de Paz Sahuaro set pitfall traps using Ecology Explorers protocols. (Photos: Katie Mills).

While an undergraduate at Arizona State University, I worked as an outreach intern for Ecology Explorers, helping promote and recruit teachers for the program at community events and conventions, and providing administrative support. Three years later, I decided to partner again with Ecology Explorers to reach these underprivileged children at Helping Hands.

Casa de Paz Sahuaro is located at the base of North Mountain in Phoenix. While the children may have limited space to play inside, behind their apartments is a whole new world for exploration and learning. I wanted the kids to see the creepy crawlers and the variety of feathered friends that live right in their backyard!

In two separate outings, we hiked almost half a mile up the mountain and set arthropod pitfall traps. Our first collection only yielded a few bugs, including a beetle, a bee, and a small spider, but that did not dampen our young explorers' enthusiasm and curiosity.

We reset the traps and, two days later, found more exciting creatures, including a medium-sized scorpion. The kids put their findings in a display case to examine them more closely and to remember the types of arthropods they discovered in the desert behind their apartments.

After their discoveries on the ground, our kids looked to the skies and the trees using binoculars and guide books from the bird kit. The bilingual guides gave the mostly Spanish-speaking parents a chance to participate with their kids. Working in pairs or as families, they observed a variety of birds that were right outside their windows and made bird feeders to attract even more.

Thanks to Ecology Explorers, children at Casa de Paz Sahuaro had an opportunity to gain an appreciation of and learn about their environment through hands-on science activities.

By Katie Mills, Programs Coordinator, Helping Hands Housing Services Casa de Paz Sahuaro

Harvard Forest Schoolyard LTER teacher published in *Biology Letters*

Katie in the bog. (Photo: Aaron Ellison)

Ms. Katie Bennett, a long-time participant in the Harvard Forest's Schoolyard LTER Program and a National Science Foundation (NSF) Research Experience for Teachers (RET) collaborator on ant and pitcher-plant research, has published her first paper in Biology Letters, the rapid communication journal of the Royal Society of London. In the paper Katie, who is a 5th-grade teacher at Ashburnham's J.R.Briggs Elementary School in northern Worcester County, Massachusetts, along with Harvard Forest Senior Ecologist Aaron Ellison, used a creative field experiment to distinguish between competing hypotheses about how carnivorous pitcher plants attract prey. Their work shows clearly that prey are attracted to pitcher plants by nectar, not color, settling a long-standing debate about mechanisms underlying prey capture by pitcher plants. The research was supported by an NSF RET supplement award to Bennett, who also received a second RET supplement to continue her research on pitcher plants last summer.

Bennett also presented a poster on her pitcher plant research with Dr. Aaron Ellison at a well-attended session during the August Ecological Society of America (ESA) annual meeting in Albuquerque, NM.

By Pam Snow, HFR

Paper: Bennett, K. F., and A. M. Ellison. 2009. Nectar, not colour, may lure insects to their death. Biology Letters. doi:10.1098/rsbl.2009.0161

Poster: Bennett, K. F., and A. M. Ellison. 2009. Nectar, not color, may lure insects to their death.

Mangrove forest recovery in the Everglades following Hurricane Wilma

On October 24th, 2005, Hurricane Wilma made landfall on the south western shore of the Florida peninsula. This major disturbance destroyed approximately 30 percent of the mangrove forests in the area. However, the damage to the ecosystem following the hurricane provided researchers at the Florida Coastal Everglades (FCE) LTER site with the rare opportunity to track the recovery process of the mangroves as determined by carbon dioxide (CO_2) and energy exchanges, measured along daily and seasonal time scales.

The FCE flux tower located in the Everglades National Park, which became operational in 2004 as a means to investigate mangrove forest-atmosphere exchanges of carbon, water, and energy, turned out to be just the right instrument for this important study.

The damaged mangrove forest site provided an ideal setting for studying resiliency and recovery of a forest following a major disturbance. Studies of carbon and energy flows serve as key metrics for forest recovery as these fluxes converge to either pre-disturbance patterns or some new steady state. These flows of carbon, water vapor, and measurable heat between the forest and the atmosphere, were determined with a tower-mounted eddy covariance system.

Following the sudden loss of biomass and leaf area after Wilma, the net ecosystem production (NEP), which is the sum of photosynthetic assimilation and respiratory losses of carbon, was substantially reduced compared to the pre-disturbance value. Nighttime processes of respiration remained relatively constant before and immediately after the disturbance; therefore, the net effect of respiration processes in the ecosystem was not dramatically affected (Figure 1). This result suggests that dead biomass, which remained within the flux footprint, was decomposing slowly and not contributing much to higher ecosystem respiration rates.

Immediately after Wilma, a reduction in carbon sequestration during daytime hours (Figure 1) was attributed to the loss of mangrove biomass and leaf area. This overall reduction of NEP can be observed through several years following the hurricane (Figure 2). Additionally, mortality of the mangroves continued for several years after Wilma while sediment surface elevations decreased, probably due to the decomposition of belowground organic matter. However, the magnitude of NEP following the disturbance (800 to 850 g C m^{-2} yr^{-1}) was still much greater than those values (mean±1 standard deviation) determined for a global dataset of temperate terrestrial evergreen (398±42 g C m^{-2} yr^{-1}) and deciduous (311±38 g C m^{-2} yr^{-1}) forests (Luyssaert et al., 2007).

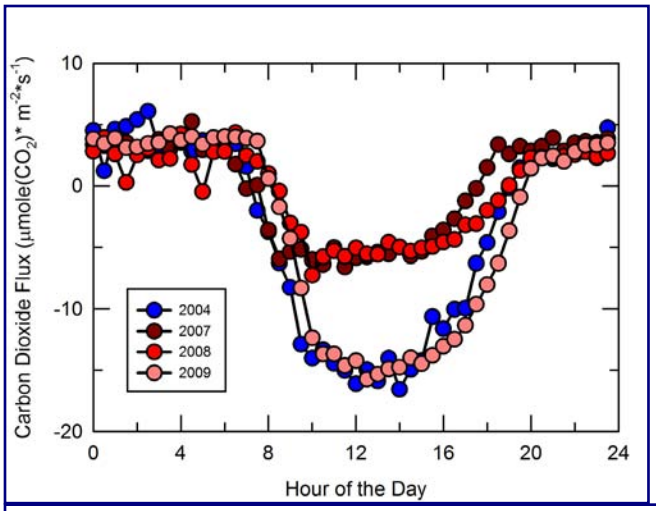


Fig 1. Carbon dioxide fluxes for the month of April over the span of 5 years. While nighttime fluxes are similar, there is a difference in the daytime carbon fluxes before and after Wilma. The total carbon dioxide sequestrated by the ecosystem in 2009 was greater than the amount in 2007 and 2008; however the flux over the entire year has not reached pre-disturbance values.

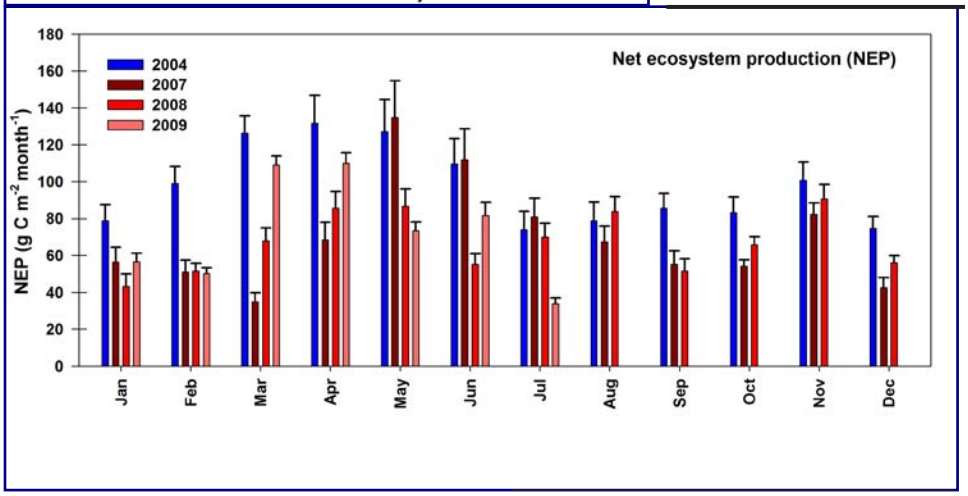


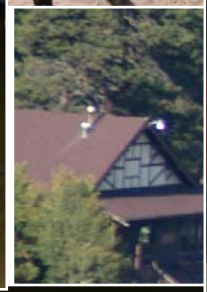
Fig. 2. Monthly net ecosystem production (NEP) during 2004 and 2007. NEP is the difference between gross primary production through photosynthesis and ecosystem respiration, which includes all respiratory losses of CO2.

Still, this disturbed ecosystem is rapidly recovering as evidenced by increases in NEP and leaf area index, and rapid growth of saplings in the forest understory. We continue to track the recovery of the ecosystem structure and function through the metrics of NEP and its components—namely, gross ecosystem production and ecosystem respiration. This study is unraveling some of the mysteries behind mangrove forest recovery through near real-time monitoring of biophysical and microclimatological processes.

By Daniel Sarmiento, Jordan Barr, Vic Engel, Jose D. Fuentes, Thomas J. Smith, & Jay C. Zieman, FCE

Reference

Luyssaert, S., et al. (2007), CO2 balance of boreal, temperate, and tropical forests derived from a global database, Global Change Biology, 13, 2509-2537.



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Education News

Graduate students hold successful symposium at ASM

A section of the student audience during the Grad Student Symposium at ASM. (Photo: McOwiti O. Thomas).

LTER graduate students gathered for their third Graduate Student Symposium (GSS) on September 13th, 2009, at Estes Park, CO, before the formal opening of the All Scientists Meeting. Based on student feedback about previous graduate student symposia, this symposium was designed to inform newer students about the general structure of the LTER network, to expose participating students to ongoing LTER social research, and to foster cross-site collaborations among students.

By all accounts, the GSS was a great success. Over 180 people attended, representing all 26 sites, the International LTER (ILTER), the LTER Network Office (LNO) and the National Science Foundation (NSF).

The symposium began with a general introduction of the LTER Network by several speakers—Amber Hardison (VCR), Chelse Prather (LUQ), Bob Waide (LNO), and Todd Crowl and Henry Gholz (both from NSF)—who also described the graduate students' role in the Network. Terry Chapin (BNZ) spoke next, about his successful integration of social and ecological sciences in Alaska, in the process providing a valuable introduction to this year's ASM theme.

Chapin's talk was followed by a selection of current and recent graduate student research talks highlighting collaborative research within the LTER: Marko Spsojevic (NWT) discussed his cross-site dissertation work; Brian Voigt (BES) highlighted socio-ecological research that he is conducting; and Becky Ball (MCM) shared her experience as part of a successful collaboration from a 2006 GSS working group. These speakers did an excellent job of showing students the variety of opportunities for collaboration within the Network.

After lunch, students participated in a careers panel featuring former LTER graduate students representing a variety of career paths, including academia, the private sector, and state and federal government agencies. The expert panel consisted of Shawn Dalton (BES), Stuart Grandy (KBS), Dan Childers (FCE, CAP), Todd Crowl (LUQ), Sherri Johnson (AND), Meredith Knauf (NWT), and John Kominoski (CWT, ILTER). The panelists fielded student questions and shared their unique perspectives on possible career paths after graduation.

The symposium concluded with students self-selecting into eight concurrent student-led working groups to discuss topics for potential collaboration: 1) Potential inter-site comparisons of carbon studies in the LTER network, 2) The impacts of intra-annual precipitation variability on ecosystems, 3) Comparisons of top-down controls on autotrophic biomass in aquatic and terrestrial ecosystems, 4) Restoration Ecology & Ecosystem Restoration – What does it mean across LTER sites or projects?, 5) Identifying the benefits and barriers to graduate student cross-site socio-ecological research in urban systems, 6) Cross-site discussions comparing the ecological impacts of physical changes in the cryosphere, 7) Engineering global change experiments, and 8) Integrative understanding and cross-site comparison of socio-ecological research in non-urban ecosystems.

Terry Chapin addresses Grad students. (Photo: McOwiti O. Thomas).

All of these working groups were well-attended, and several groups planned to continue collaborating outside of the ASM. Indeed, many students indicated in a post-GSS survey that these working groups were their favorite part of the whole ASM. Among the students who responded to the post-GSS survey, 92% rated their overall experience positively, and we hope that these symposia will continue to bring graduate students closer together at future ASMs.

We would specifically like to thank all of the participants who made this symposium possible, especially the LNO and the GSS planning committee comprised of Luke Cole (VCR), Michele Romolini (BES), Jessica Savage (CDR), and Kirsten Schwarz (BES).

Looking forward, both Chelse and Amber will be graduating soon and rotating out of their positions as Graduate Student Committee (GSC) co-chairs. Therefore, graduate students who are interested in becoming more involved in LTER leadership by taking on the GSC co-chair role are urged to get in touch with Chelse (cprather@nd.edu) and Amber (amber@vims.edu) for more information. We further encourage all grad students to take an active interest and to participate in the GSC elections this fall.

By Chelse Prather (LUQ) & Amber Hardison (VCR), GSC co-Chairs

FCE student researcher gets planet named after him

Felix Varela Senior High school student Christopher Sanchez has always been enthusiastic about the research he conducts with FCE scientists. But this year turned out to be special: in his third year working in the FCE Research Experience for Secondary Students (RESSt) program, Chris had a minor planet named in his honor after winning Second Place in "Plant Science" and a $1500 cash award at the 2009 Intel International Science and Engineering Fair (see *www.azstarnet.com/sn/education/300136.php* and *www.societyforscience.org/intelisef09/intelisef-09gao.pdf* for additional information).

Above: FCE RESSt Chris Sanchez at INTEL ISEF with poster. (Photo:Nick Oehm). ***Left***: Sanchez pouring dispensing sulfuric acid into beakers filled with soil or plant samples. (Photo: Teresa Casal).

Chris's project, which wowed judges at the regional, state, and international science fairs this year, was called "Interpreting the hydrologic history of an Everglades wetland through microscopic characterization of phytoliths." In addition to the awards, he was offered an internship to work with a leading phytolith researcher at the University of Nevada.

Chris also received Superior in the Botany division at the 54th South Florida Regional Science and Engineering Fair where he was awarded Best Biological project and received the George Avery Award by the Florida Native Plant Society. He was one of 12 senior high students to represent Miami Dade County Public Schools at the 54th State Science and Engineering Fair of Florida, where he also got Second Place in the Botany division and a $40,000 scholarship to the Florida Institute of Technology.

Chris described his experience as "mind-blowing." He noted: "I began working in (Dr. Gaiser's) lab on what would become my science fair project, scanning through thousand year old soil for these little siliceous plant deposits known as 'phytoliths.' Both Drs. Saunders and Gaiser have been unbelievable mentors. They were always around to help me out when I was stumped by a question or not sure how to proceed, and they always pointed me in the right direction. Working with the FCE LTER has no doubt been a life changing experience."

FCE RESSt intern Erikamarie Gil was also recognized for outstanding achievements, winning one of 30 Planet Connect Grants from the National Environmental Education Foundation. She was the only Florida recipient and will use the $1000 award to raise awareness about south Florida native plants. Erikamarie is working with FCE staff to identify plants and construct a dichotomous key, photographic identification guide and GIS map for students and teachers to use at the habitat reclamation area created as a joint venture between FCE and the CEMEX Florida East Coast Quarry.

The FCE Research Program for pre-college students began in 2002 with a single high school student enrolled in our RESSt program. Since then FCE researchers have worked with over 33 students on an individual basis and an additional 30 in small group settings. This past year an additional nine students worked directly with FCE researchers.

FCE also announces a new program called Datadventures! Check out our FCE Files Data Movie on our Education and Outreach pages http://fcelter.fiu.edu/education_outreach/ Also check FCE LTER on Facebook and Twitter! FCE looks forward to hearing from you!

By Susan Dailey, Associate & Nick Oehm, Coordinator, Education and Outreach, FCE

Mud, mice, maggots, and 5th-graders!

Sixteen 5th graders from Cottonwood Valley Charter School (CVCS) in Socorro, NM and their teacher, Karen Gram, embarked on an adventure at the Sevilleta Bosque Ecosystem Monitoring Program (BEMP) site on Monday, October 19, 2009.

"What does B stand for in BEMP?" I asked. Silence. Then I heard, "Riparian forest" quietly spoken by a girl just to my right. "Yes! It's the forest along the Rio Grande. 'Bosque' means 'forest' in Spanish."

"E stands for ..." "Ecosystem!" shouted the kids. "Yes! An ecosystem is comprised of living and nonliving things. What are some nonliving things in the bosque?" I asked. Students answered, "Water," "soil," "air," and – my favorite – "dead leaves." "What are some living things in the bosque?" again I asked. "Coyotes," "horses," "saltcedar"… Well, sure - that's species-specific. Usually kids say "trees." Others said "Siberian elm," "Russian olive," and "cottonwoods." Wow! They really know their trees! They showed me their field notebooks with each of these species listed and drawn. "I'm impressed!" Karen told me that the BEMP education coordinator, Kimi Scheerer, worked with them on this in the classroom recently.

"M stands for monitoring. You're watching, collecting information, and writing it down. Finally, P stands for Program – you are part of a program that monitors 25 sites. So 24 other K-12 classes are out this week, just like you are, collecting data in the bosque!"

To focus the students' attention while we were on site, I asked them to create a list of animals or evidence of animals they saw, heard, or smelled. Our goal was to have at least 16 – one for every student there. "Open up your field notebook and start writing!" Karen said. "Ants!" one student observed as he looked at the ground. We got our first!

As we approached the site, I had them huddle around eme.me. "Something happened to the site since the last time you were here," I was so excited to share this with them. "A mud flood!" one of the children screamed.. "How did you know?" "Kimi told us!" (On September 17, the Rio Grande peaked at 5,000 cubic feet per second (cfs), where the mean for the past 35 years was 433 cfs, and deposited four inches of mud on our site.)

Clockwise from top: BEMP Field Coordinator Jennifer Schuetz (back row, 3rd left) joins CVCS 5th graders and their teacher, Karen (back row, right) for a group photo; discusses findings after collecting rain fall, litter fall, and groundwater depth data at the Sevilleta BEMP sites (Photos: McOwiti O. Thomas).

We headed in and immediately had our boots swallowed by mud . Each of our 10 litterfall tubs was filled with four inches of mud. We scooped out the mud with our hands. Some children molded clay pots from the mud. In some tubs, a thin, black layer had formed at the bottom, adjacent to the tub. I told them this mud was anoxic and had them – smell it – "Poo!" was how they described the smell.

One rain gauge was lying on the ground. "Horses knocked it over," I guessed. The other rain gauge looked a little funny to me, so I checked it out. Uh oh! "Okay kids, go ahead and beep that south well – go on, go on!" I pulled the teacher aside and showed her the rain gauge. In it was a decomposing mouse, with a mix of gooey blood, guts, hair, a sweet mouse nose and front teeth, and maggots! I asked, "Do you think it's okay to show the kids?" "Oh yeah!" She said, smiling widely. "This is real biology!"

So I did, and that was the hit of the day! They kept on asking to see it over and over, to look from the side, from the top and from the other side. It smelled so bad that I was a little afraid of losing my lunch, but the kids took it in stride. One girl wearing cowboy boots and hat said, "That's normal for me to see!" I didn't know how to respond.

When the tasks were completed, we shared a list of at least 16 animals or evidence of animals that we had seen: ants, a mouse, coyote, horse, maggots, butterflies (hm, I didn't see any...), beetles, roly-polies, birds ... I can't even remember them all. Good thing they had field notebooks and wrote them all down..

Well, all fun must come to an end; some students were happy to get out of that mud-infested place. Some were hungry, some ready to go back to school. Some were tired after being so excited. As we turned around to head back, one boy showed me his triangular clay pot, housing an earthworm. Another animal!

For the icing on the cake, we saw tracks in the mud from a porcupine while we were leaving.... What a cool day. Man, I am tired!

By Jennifer Schuetz,
BEMP Field Coordinator, SEV

Keeping computing safe in the Internet age

Once a computer is connected to the internet, it becomes vulnerable to attacks from a variety of sources, including hackers, botnets, phishing, viruses, Trojan horses, etc. Attacks on computers are variously motiviated. Some want to steal CPU cycles like in a botnet; others want to steal the information in the computer; while some wish to take over the computer completely and release it only if you pay money to the attackers. These activities are not the product of pizza-laden, twinkie suckers in dark bedrooms--in most cases they are the result of organized criminal activities.

Being proactive about computer security can be made easier by following some simple steps.

Choose good passwords. One of the ways attackers try to infiltrate is by simply guessing a users password. It is often not even a real person doing the guessing, but another computer running a script or program. The script enables the attacker to try thousands of username/password combinations quickly. Use mixed case as well as at least one numeral or special character and at least 6 characters long. You can get an estimate of the "strength" of your password by using a reputable online password strength analyzer. For example, Microsoft provides secure (HTTPS) access to their password checker. (*www.microsoft.com/protect/fraud/passwords/checker.aspx*)

Do not believe email from strangers or corporations that ask ANY information of you. Email claiming to be from a popular site or a site seemingly well-known to you is used as a lure to gain access to personal information and is called "Phishing." A popular and effective phishing attack claims to be an email from someone in authority at your campus computing center and that in order to take care of something important you must go and log in and verify credentials or provide additional information. The dangerous ones pretend to be from a bank or financial institution. Note that it is a standard policy for any legitimate service provider to never ask for this type of information.

Know the source of any downloaded application, document, or data. That little program may look like what you want, but unless it is from a verifiable source it may be filled with a virus or a botnet. Even after downloading a package always scan it with your virus protections software before opening it or have a real-time virus scanner enabled.

Anti-virus/Anti-spam software and firewalls are programs that are very important in keeping the computer safe. Keep them updated because new viruses are released all the time. Many institutions provide software for free to faculty, staff, and students. In addition, there are some free on-line products that can be obtained for personal use. A recommended free anti-virus software is AVG free which can be found at *www.free.avg.com* for Microsoft and Linux operating systems. For a free spam checker, try *www.malwarebytes.org/*.

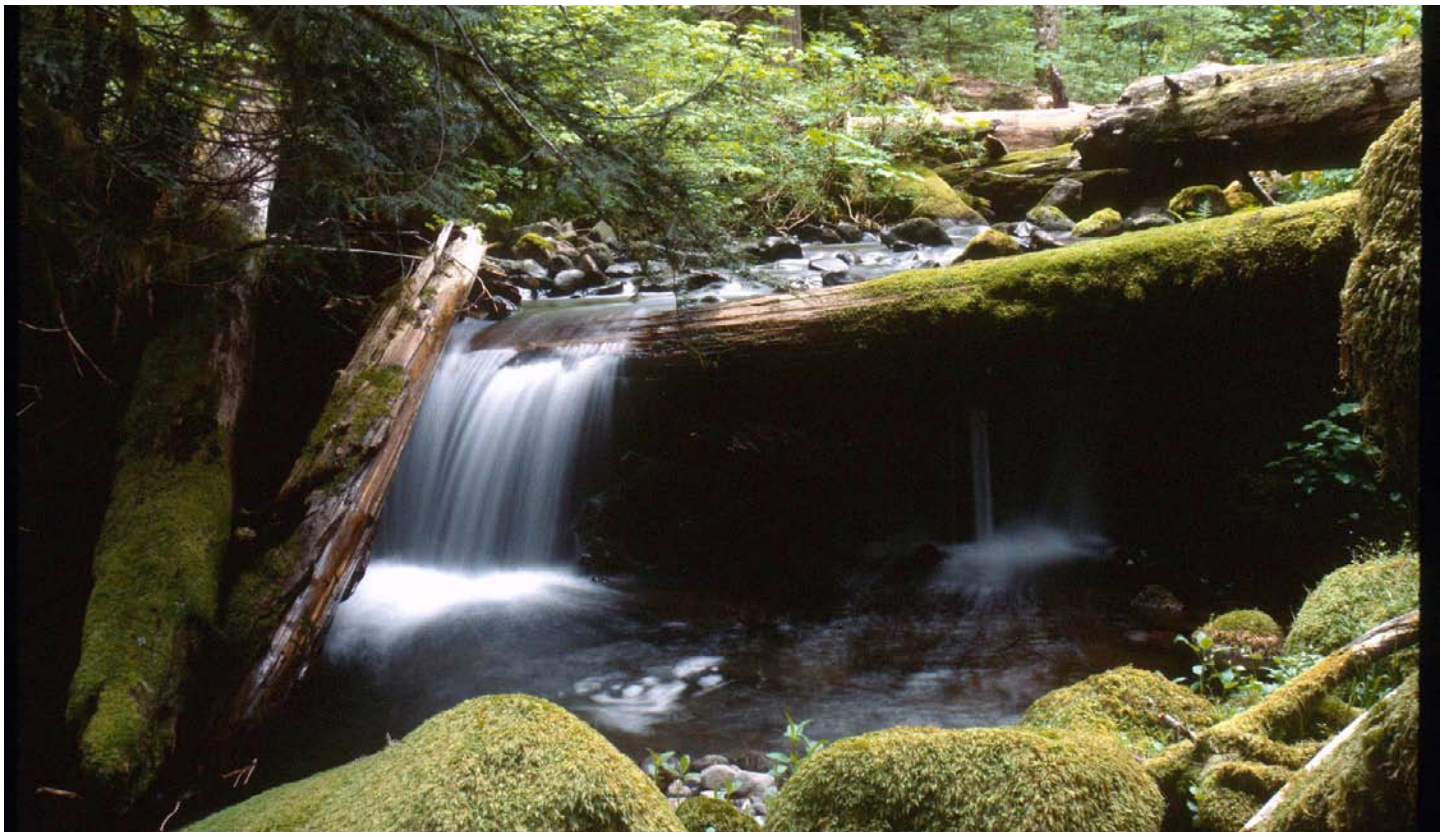
Keep in mind, that there is no way to completely secure a system from online evil doers, short of disconnecting it from the Internet, so choose your passwords thoughtfully, scan everything that is downloaded before installing it, and do not click on links in emails. By following safe computing habits, your computer and the information it contains can be safeguarded from some of the internet villains of today.

By Florence "Dez" Wyman,
Systems Administrator, LNO

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

Hydrologic effects from ecosystem responses to climate and land use changes

A report of an ASM working group, September 2009



Streams from LTER sites, like this stream at the HJ Andrews Forest, are critical sources of water supplies for aquatic ecosystems and human use. It is critical to understand climate change and land use change effects on streamflow and water quality; LTER sites are key sources of data on this topic. (Photo: Al Levno).

Of all the ecosystem services, a sustainable supply of high-quality water may be the most important. Streamflow from forests provides two-thirds of the water supply in the United States. Nationwide, high quality water supplies depend entirely on a range of natural ecosystem types. Climate change, drought, outbreaks of insects and pathogens, wildfire, and ecological succession are altering ecosystems' ability to provide abundant, clean water from the headwaters of our water-supply systems.

Simultaneously, public land management is changing in response to wildfire and endangered species concerns; private lands have undergone major changes in ownership and management; and many other ecosystems have declined in their capacities to sustain natural processes needed to maintain clean water due to conversion to exurban development.

While the near-term, local hydrologic effects of these land-use changes are relatively well understood, ongoing and cumulative climatic changes in ecosystems will likely have widely varying effects on sustainable water supplies to downstream areas. As a result, many regions face a difficult balancing act between additional development, flood protection, water supply for urban areas and agriculture, and water releases for endangered species protection.

A group of 65 LTER scientists representing 21 sites met at the All-Scientists' Meeting in September 2009 to discuss the question, "How will ongoing and projected changes in ecosystem conditions affect water supplies?" The participants concluded that a sustainable supply of clean water is one of the most important and fundamental ecosystem services on which humans depend, and that future water supplies are likely to change in ways that may be difficult to predict. Climate change is expected to increase periodic hydrologic drought, increase the intensity of floods, and compromise water quality. Predictions of future water supplies and water quality are highly uncertain, in part, because multiple ecosystem processes provide adaptation and resilience to climate variability.

Predictions of future water supplies also depend on historical land use, which established the expected water yields used for planning, even though land-use changes continue to modify ecosystems and water supplies. In addition, land-use change may exacerbate or mitigate adverse climate change effects on water supply. Experience from LTER sites over the past 30

See "Climate Change", p. 19

Climate Change (cont. from p. 18)

or more years, recounted during the working group session, provides an initial assessment of current understanding about ecosystem adaptation and resilience to climate variability and change, and the effects of these processes on water supply.

However, more synthesis is clearly needed to further develop regional perspectives on this topic. Below we summarize the initial findings reported during the workshop and suggest a possible follow-up workshop to broaden and deepen the LTER network synthesis on how ecosystem adaptation and resilience may affect future freshwater supplies in response to climate change and land use change.

LTER sites are detecting a wide range of trends in streamflow. In Polar Regions, river flows have increased annually (ARC), increased in autumn (NWT), or flow variability is very high (MCM). Streamflow has increased in one forested site (HBR) and decreased only in spring in another (AND). In grassland sites (KNZ), streamflow has both increased and decreased.

Many distinctive trends in precipitation, temperature, and snow/ice have already been detected at LTER sites that are likely to affect future streamflow and water supply. Polar and alpine sites report that declining ice cover and permafrost melt has augmented streamflow at seasonal or interannual time scales (ARC, BNZ, NWT, MCM). Forested sites with annual snowpacks report declining duration and amounts of seasonal snow (AND, HBR, NWT). Precipitation has increased steadily over 45-100 years at several sites (HBR, HFR, KNZ, SEV, SGS), but has not changed at others (AND, ARC, CWT, NWT), and has reportedly decreased at one (MCM). Several sites in a range of climatic settings expect, or have detected, an increased frequency of extreme precipitation events (ARC, CAP, HBR, KNZ, LUQ, MCR). Some of these sites also report increased drought (LUQ, KNZ) or evidence of increased evapotranspiration and landscape drying (ARC). Climate at many sites is coupled with sea surface temperatures and ocean-atmosphere interactions, producing multi-year oscillations (the El Niño-Southern Oscillation) or decadal oscillations (the Pacific Decadal Oscillation (PDO), North Atlantic Oscillation (NAO)) in precipitation and/or temperature (AND, CAP, FCE, SEV, SGS).

Land use changes such as forest harvest, as shown in this 1988 photo of Watershed 1 in the Andrews Forest, have influenced streamflow in a variety of ways that may interact with climate change. (Photo courtesy of Andrews LTER).

Streamflow trends also may be attributed to changing land-use trends. LTER sites reported effects on water supply or water quality from land use changes, including urbanization and suburbanization (BES, CAP), forest cutting, replanting, and regeneration (AND, CWT, HBR, HFR), cultivation (KNZ), grazing (JRN, SEV), dams (PIE), and multiple concurrent changes (MCR). Land-cover changes were seen as especially likely to interact with climate change to create compound, synergistic, or antagonistic "multiple stressors" on water supplies. For example, many western, snowmelt-dependent regions where population has been increasing, especially in urban areas, may experience altered seasonality of runoff due to snowmelt timing or reduced snowpack, compounded with increased water demand.

Climate changes manifested in altered precipitation, temperature, and snow do not produce simple effects on water supplies because of the adaptability and resilience of ecosystems and socio-economic responses to climatic changes. In fact, LTER sites report a variety of vegetation adaptations to climate change or climate variability, including altered phenology, shifts in plant species composition, and tree mortality. Altered disturbance regimes, such as increased lightning storms and fires in the tundra (ARC) or tree mortality due to hemlock woolly adelgid (CWT), whose northern expansion is limited by minimum winter temperatures (HFR), may either mitigate or exacerbate climate change effects on water supplies. Disturbances, including deforestation, desertification, vegetation conversion, urbanization/suburbanization, fire-induced landscape changes, invasive species, and sea-level rise all potentially interact and contribute to changes in soil water, evapotranspiration, streamflow, and water quality, with likely implications for ecosystem resilience to these combined stressors.

Workshop organizers agreed that records and analyses at a subset of LTER sites would benefit from a continued, more focused effort to study this topic.

By Julia Jones (AND), Cliff Dahm (SEV), Nancy Grimm (CAP), Mark Williams (NWT)

High-elevation snow pack at H.J. Andrews Forest: Snowpacks have important influences on water resources and are affected by land use as well as climate change. (Photo: Al Levno).

Integrating science, society, and education for sustainability

One of the highlights of the All Scientists Meeting was Bill Clark's plenary talk entitled "Integrating Science and Society." Clark emphasized the great urgency, but also the tremendous opportunity that we now have to bring science into the arenas of political and social action, which can lead to both attention and action on global environmental problems.

Throughout the planet, environmental changes are moving rapidly, with environmental tipping points potentially just around the corner. According to Clark, the growing public awareness of the urgency of these changes and the political opportunity provided by the new administration in Washington gives science a chance to exert influence on policy, but only if scientists skillfully frame the issues and identify measurable goals.

Clark identified three essential criteria for science to effectively influence the beliefs and behavior of social and policy actors: credibility, salience, and legitimacy. He laid out a road map toward making science, and particularly sustainability science, more useful and impactful. His talk energized those of us who see the value and urgency for sustainability science and set the stage for the subsequent workshop.

Immediately after the talk, Clark and over 60 members of his audience convened in a workshop to further discuss the integration of science, society, and education for sustainability. The workshop was organized and led by Nancy Grimm (CAP), assisted by Jeannine Cavender-Bares (CDR), Ted Gragson (CWT), Scott Collins (SEV), Morgan Grove (BES), Charles Redman (CAP), and Chris Boone (BES, CAP). The workshop's goals were to 1) compare and contrast the Integrative Science for Society and Environment (ISSE) and existing sustainability science frameworks, and 2) develop a statement of how the objectives of sustainability science and education can be met using the power of long-term research and the LTER network.

Participants included many of the key individuals at the heart of the burgeoning sustainability science community, including many of the LTER scientists who authored the Integrative Science for Society and Environment (ISSE) framework. The workshop included practitioners, educators, and students; natural and social scientists from all corners of the LTER network; and international participants from countries as far away as Scotland and Finland, who are working to bring sustainability science into public consciousness and the policy arena. Highlights included a lively debate about the core concepts of the ISSE, and general agreement that the ISSE conceptual framework integrates social and ecological research frameworks.

Several other discussion themes echoed Clark's plenary talk. One was the need for co-production of knowledge by scientists and users (not scientists bestowing the prescriptions on the users), or between research and problem solving. Some saw the ISSE as research framework that needed a direct pathway that links research and problem solving. Thus, stakeholders need to drive the process of asking questions and investigating their answers as much as researchers (although it was acknowledged that researches are stakeholders). Participants debated whether LTER should act as a boundary spanning institution – an organization that operates at the interface between science and policy, influencing both the generation of new knowledge and the application of that knowledge.

Finally, the group acknowledged that since the core of sustainability is the coupling of social and ecological systems, social scientists must be part of the sustainability conversation and seated at the table from the beginning when questions that require investigation are formulated, not appended onto the process after the questions have been posed.

In discussing the next steps, participants stressed the key element of sustainability education from elementary to graduate school. To this end, the workshop launched a multi-institution sustainability science seminar series as a concrete first step. This interactive series, the first of which took place via webcast in late October, involves a number of LTER scientists and students from the University of Minnesota (Jeannine Cavender-Bares, Sarah Hobbie, and Steve Polasky, all from CDR), Arizona State University (Arnim Wiek and Nancy Grimm, CAP), Harvard University (Bill Clark & Steve Wofsy, HFR), Florida International University (Jim Heffernan, FCE), Princeton, and the Universidad Autonoma de Mexico (Patty Balvanera, ILTER).

A summary of the seminar (as well as the opportunity to participate in the dialog by leaving comments) can be seen in a newly-established sustainability science blog, http://blog.lib.umn.edu/sustain/sustainability_science/.

By David Bael,
Graduate Student Fellow, CDR

IMC holds annual meeting at ASM

The Information Management Committee (IMC) conducted its annual meeting on September 13, 2009, during the Annual Scientists Meeting at Estes Park, CO. The committee chair's position rotates every three years, and so the current co-chairs Corinna Gries (CAP) and Nicole Kaplan (SGS) handed leadership to Margaret O'Brien (SBC) and Don Henshaw (AND), whose terms will expire in 2012.

The membership of Information Managers executive subcommittee (IM-Exec) also changed, with two members, John Campbell (HBR) and Todd Ackerman (NWT), rotating off. That subcommittee is charged with planning and implementing LTER Executive Board and National Science Foundation decisions among the IMC. The current membership of IM-Exec is Emery Boose (HFR, 2012), Suzanne Remillard (AND, 2011), Corinna Gries (NTL, 2011), Sven Bohm (KBS, 2010), Hap Garritt (PIE, 2010). Gries also serves as our liaison to the LTER Executive Board.

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IMC (cont. from p. 20)

The IMC also experienced some turnover in the last year. Most notable was Barbara Benson, who retired as the information manager at NTL and was replaced by Gries (who moved over from CAP). Other new members of the IMC include John Chamblee (CWT), Hope Humphries (NWT) and Sue Welch (MCM), who replaced Barrie Collins, Todd Ackerman, and Chris Gardner, respectively. We welcome our new collaborators, and wish our outgoing members the best of luck in their new endeavors.

The IMC is taking on new challenges in the coming years that will enhance data use and interoperability, both within and beyond LTER. Our "units dictionary" will launch its web services early in 2010, and parts of our "controlled vocabulary" are already in place for dynamic searches of the network data catalog. A new dataset quality group has been formed to establish metrics and guidelines for use of data described by Ecological Metadata Language.

Furthermore, the recent infusion of stimulus funds into the LTER Network Office means that we can now proceed with plans to integrate databases at our central office and deliver content to sites for their individual needs. Overall, the IMC continues to be a very active group within LTER, in their local scientific domains, and in the informatics community at large.

By Margaret O'Brien (SBC) & Don Henshaw (AND), co-Chairs

EcoTrends update

The EcoTrends project has been busy for the past several months reaching out to the scientific, technical, and education communities, supporting new science initiatives, and completing the products envisioned at the outset of the project.

In late April and early May, 2009, five science-driven working groups, each led or co-led by different people from across the network, formed to explore cross-site trends in disturbance (Deb Peters, JRN), state change (Brandon Bestelmeyer, JRN), primary productivity and species richness (Scott Collins, SEV, and Alan Knapp,), biogeochemistry (Peter Groffman, HBR and Charles Driscoll, HBR), and animal populations (Michael Willig, LUQ, Paul Stapp, SGS, and Robert Waide, LNO), using data available in EcoTrends.

All of the groups met again in September at the 2009 ASM in Estes Park, CO, picking up more scientists and polishing ideas for papers (at least one per group). Researchers were able to access a lot of data very quickly, but also found gaps where they knew that data existed, but were not yet incorporated into EcoTrends. They also provided valuable feedback on better ways to allow users to explore, visualize, and download the data from the website for future synthesis projects.

In October of 2008 (Washington, DC) and August of 2009 (Albuquerque, NM), EcoTrends participated in two faculty development workshops hosted by the Ecological Society of America (ESA) and the National Ecological Observatory Network (NEON), entitled, "Using Continental-scale Data to Teach Undergraduate Ecology." The all-day workshops were designed for faculty from minority-serving undergraduate institutions to explore how existing continental-scale data from services like EcoTrends could be used in classroom exercises to address four key ecological challenges (biodiversity, biogeochemistry, climate change, and ecohydrology); discover and discuss educational needs and obstacles to teaching about continental-scale ecology; and generate recommendations to inform the development of NEON's physical and cyber infrastructure from the point of view of education. Each workshop involved 1-2 webinars and 1-2 days of meeting.

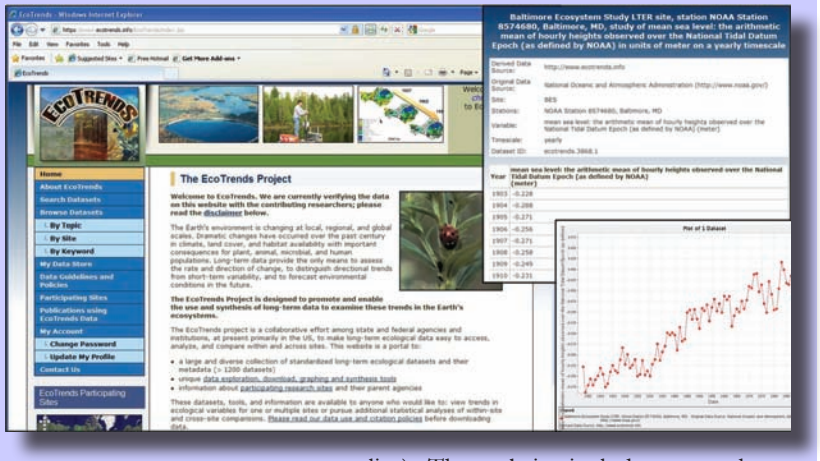

Fig. 1: A screenshot of the EcoTrends website

In total, approximately 30 faculty members from across the United States participated. They explored the EcoTrends website, developed outlines of several potential classroom assignments, and provided valuable feedback on how best to facilitate educators and students to discover and explore data from the EcoTrends website in the future.

EcoTrends has recently passed a milestone: the website at *www.ecotrends.info/* is freely available to the public after a one-time registration (during which the user is required to agree to abide by the data use policy). The website includes more than 15,000 datasets from 50 sites, aggregated to a monthly or yearly timestep, that can be discovered, viewed, and downloaded. Contributing researchers are taking advantage of the next few months to check their data and make updates or corrections. In addition, the EcoTrends book, "Long-term Trends in Ecological Systems" (edited by Deb Peters, in prep.), is nearly complete and will be submitted to the USDA ARS publications office in November 2009. Publication is expected by Fall 2010, with each site receiving several copies free of charge and copies available for free download from the USDA ARS publications website.

[Fig. 1: A screenshot of the EcoTrends website home page (*www.ecotrends.info/*) and an example of downloadable data in a table and plot]

For more information about EcoTrends, please visit *www.ecotrends.info/* or contact project leader Debra Peters (debpeter@nmsu.edu) or coordinator Christine Laney (chrlaney@nmsu.edu).

By Christine Laney, JRN, Project Coordinator, EcoTrends

Alpine ecology workshop in Switzerland

In late 2008, Niwot Ridge (NWT) LTER graduate students and scientists attended a workshop in Lausanne Switzerland organized by a research group headed by Antoine Guisan at the University of Lausanne. Funded by the International Program of the National Science Foundation (NSF), the objectives of the workshop were threefold: 1) to combine European and American expertise to evaluate the threat of climate change to plant diversity at high-elevations (alpine and subalpine ecosystems); 2) to train American graduate students in the use of state-of-the-art species distribution models; and 3) to establish better collaboration between European and American scientists working in high-elevation ecosystems.

Graduate student Anthony Darrouzet-Nardi blogged the workshop at *http://anthony.darrouzet-nardi.net/scienceblog/*. The following account is excerpted from his blog.

At the Niwot Ridge, a lot of the research is focused on understanding ecological processes such as biogeochemical cycles and the biotic interactions of plants, which the workshop dubbed a "process-based" approach. In contrast, the group in Lausanne uses a statistical modeling approach that measures species distribution in the field and then attempts to back out (extrapolate?) the conditions under which they occur in order to make predictions about other places or times. This might be called a "statistical modeling" approach.

During discussions at the meeting, we talked about how these two approaches complement each other and how they might be combined to make better projections of species distributions and ecosystem processes. The advantage of using Niwot Ridge's process-based approach is that mechanistic knowledge improves our power to make predictions. The disadvantage is that, in order to focus on these mechanisms, we typically ignore spatial heterogeneity, which reduces our predictive power. In contrast, the spatial statistical modeling does a good job of incorporating differences over large areas, but does not have the mechanistic basis of the process-based models.

We discussed how we could combine the two approaches, and it was a brain twister. However, a post-doc working with Antoine Gusian and the intellectual lead of the workshop, Chris Randin, put forward an idea that we could use process-based models (like CENTURY) to create spatially explicit layers that can be used in statistical modeling. This type of approach had not, to our knowledge, been used for ecosystem modeling before. In subsequent discussions, we delved further into how the two approaches complemented each other and how they could be used together to make better projections of species distributions and ecosystem processes in a changing climate.

The collaborations initiated at this workshop are continuing. In particular, Chris Randin received a post-doc from the Swiss equivalent of NSF to test his novel approach with the NWT LTER team in Boulder Colorado, and was in residence from January-June 2009.

By Mark W. Williams (NWT), Bill Bowman (NWT), & Antoine Guisan (University of Lausanne, Switzerland)

Participants in the joint Swiss-U.S. alpine plant modeling workshop below the Diablerets massif (hidden by the thick fog), near Lake Geneva, Switzerland, October 2008. (Photo courtesy of Antoine Guisan program).

"Frontier in Ecosystem Ecology of Northern Forests" in Japanese LTER sites

An International Summer School

The GCOE-INeT international summer school, a field training program focused on "Frontier in Ecosystem Ecology of Northern Forests," was held June 14-20, 2009 in the Hokkaido University's experimental forests. The experimental forests are part of the Japan Long-Term Ecological Research Network (JaLTER) and GCOE-INeT is one of Hokkaido University's educational programs funded by the Japan Society for the Promotion of Science, and the Ministry of Education, Culture, Sports, Science and Technology (see *www.ees.hokudai.ac.jp/gcoe/en/index.html* for further information on the GCOE). Nineteen Ph.D students from eight countries (Australia, Bangladesh, China, India, Japan, Malaysia, the Philippines and UK) participated in the program.

Analyses of ecosystem processes across various space and time scales are essential to clarifying ecosystem functions and services as influenced by climatic changes, air pollution, land-use changes, and disturbances (both natural and anthropogenic). The main aim of the program was to encourage participants to develop research projects that include international perspectives. The program included a field session, a poster session, lectures, review discussions, and training on proposal writing that apply to ecosystem ecology.

After welcoming remarks by Prof. Yasuhiro Yamanaka (Hokkaido University), who is leader of GCOE-IFES program, the opening session saw Prof. Myron Mitchell (SUNY-ESF, Syracuse, NY) give a keynote lecture titled "Temperate Forest Watersheds: Responses to Atmospheric Pollutants and Climate Change." Subsequent lectures by Profs. Hideaki Shibata, Toshiya Yoshida, and Kentato Takagi (Hokkaido University) during the field course focused on various topics related to ecosystem ecology. The field programs included issues such as research site, approach, and instruments. Topics included "Community structure and functions in Northern Forests," "Soil process and biogeochemistry in snow-dominated regions," "Spatial patterns of ecosystem function and structure in landscapes," and "Carbon cycling and forest management in forest catchment." All field activities were held in Hokkaido University's experimental forests, which is a JaLTER core site.

Above: GCOE-INeT Summer School 2009 participants at headquarter office of North Hokkaido Experimental Forests, JaLTER core-site, Nayoro, Hokkaido, Japan. ***Right***: Field session in Uryu Experimental Forest of Hokkaido University, Japan (JaLTER core-site)

The field sessions were closely associated with the proposal training session, which taught participants how to develop research proposals on the specific research themes introduced at each site during the field session. Based on observations and discussions during the field session, participants formed groups and each member was asked to discuss and prepare a summary of possible research proposals, including the "research theme," "research questions," "research hypothesis," and "approach." Each group then provided a brief summary of their discussion, followed by an active joint question and discussion period.

All the students were very active and showed positive attitudes during the entire program. Many interactive discussions, communication, and information exchange occurred among the participants. These interactions took place not only during the formal program, but also during informal social activities.

The organizing committee believes that the summer school experience is an invaluable resource that can help the students further their current research and facilitate future international communications and collaboration. Consequently, the summer school will be held once a year through 2012 and will utilize the various JaLTER sites and research stations in Hokkaido University.

The program organizing committee, comprising Hideaki Shibata (Chair),

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ILTER (cont. from p.23)

Takashi Kohyama (Vice Chair), Toshiya Yoshida, Kentaro Takagi, Karibu Fukuzawa, Masahiro Nakaoka (Hokkaido University), Myron J. Mitchell (visiting professor, State University of New York, College of Environmental Science and Forestry, USA), would like to thank all the staff of the GCOE unit, experimental forests, and Field Science Center for Northern Biosphere of Hokkaido University for their support. The committee would also like to thank the International and US-LTER Networks, as well as the International Project Office of the Global Land Project, the International Geosphere and Biosphere Program, and the International Human Dimension Program, for identifying and recruiting the participants, and for their helpful cooperation throughout these activities.

By Hideaki Shibata, Hokkaido University, (JaLTER, Japan) Karibu Fukuzawa, Hokkaido University (JaLTER, Japan) & Myron J. Mitchell, SUNY-ESF, USA

Calendar

Coming Events of Interest to the LTER Community

JANUARY 2010

January 14: CAP LTER Annual Poster Symposium. Carson Ballroom, Old Main, Arizona State University, Phoenix, AZ.

FEBRUARY 2010

February 18-22: 176th annual meeging of the American Association for the Advancement of Science (AAAS), San Diego Convention Center, CA.

MARCH 2010

March 4: LTER-NSF Mini-Symposium. National Science Foundation. George Garcia (*gcarcia@LTERnet.edu*) at the LTER Network Office for details.

March 3 & 5: LTERExecutive Board Meeting. National Science Foundation. George Garcia (*gcarcia@LTERnet.edu*) at the LTER Network Office for details.

MAY 2010

May 12-13: LTER Science Council meeting, Plum Island LTER. Contact George Garcia (*gcarcia@LTERnet.edu*) at the LTER Network Office for details.

STOP PRESS!

Sally Koerner (SEV) has been elected LTER Graduate Student Co-Chair, replacing Amber Hardison. Sally will be transitioning into her new position in January, 2010.

Sally Koerner