The Network Newsletter Vol 13 No 1 Spring 2000

LTER

The Network Newsletter

Special Issue:

The LTER All Scientists Meeting

Plans, Preparation, Products!

A letter from Bob Waide
Executive Director, LTER Network Office

In anticipation of the upcoming All Scientists Meeting, this issue of the Network Newsletter focuses on the history and future of cross-site and synthetic research conducted by LTER scientists. From the beginning of the LTER program, cooperation among scientists has been one of the most important attributes of the network. The LTER concept itself encourages interdisciplinary cooperation within sites and fosters the development of research teams with common scientific goals. The stability of these research teams over time provides us with a unique opportunity to build understanding of our study ecosystems through a combination of long-term monitoring and experiments and short-term mechanistic studies.

The growth in size of the LTER Network has been accompanied by increasing expectations. The image of the LTER program as groups of scientists focused on narrowly defined ecological systems has gradually given way to a different perception. This emerging view describes the LTER Network as a community of scientists connected in many different ways. Within the LTER community, groups coalesce around disciplines, system attributes, organisms, approaches, and concepts. Familiarity, trust, and common goals encourage the formation of new connections and partnerships. The power of this organizational model has led to several notable successes in cross-site synthesis, some of which are described in this Newsletter. Each of these successes, however, has raised the bar for subsequent efforts. More than ever before, the LTER Network is expected to generate integrative studies across disciplines and ecosystems. More than ever before, we need to marshal our resources to achieve this goal.

The excellent article by Jack Webster provides an example of what can be accomplished with the LTER model. The long-standing cooperation among stream ecologists within the LTER Network has produced an impressive series of projects, publications, funded proposals, and partnerships with colleagues outside of the Network. The key points for successful intersite collaboration enumerated by Webster provide a time-tested vision for the development of new collaboratories. Emergent collaborations based on common technologies (imaging spectroscopy efforts at Jornada and Sevilleta, BigFoot project, GTOS/NPP Demonstration Project) and disciplines (social sciences) provide other examples of promising cross-site efforts.

It is significant that Webster's article was prompted by a meeting of LTER aquatic scientists held in Salt Lake City, occasioned by the addition of three new coastal sites to the network. The importance of intersite workshops in developing collaborations is emphasized by Webster, and the history of stream studies in the LTER Network is prominently tied to a series of such workshops organized and held from 1983 to the present. These independent workshops were complemented by regularly scheduled get togethers at the annual NABS meeting. In addition, important advances were made at the All Scientists Meetings held in 1990 and 1993. The Climate and Information Management groups are other collaborations that have made excellent use of regular meetings to facilitate progress on key issues.

The upcoming All Scientists Meeting provides an opportunity for the development of other collaborations within the LTER Network. Over sixty workshops have already been proposed, and many of these workshops will undoubtedly lead to the development of continuing interactions. Biological legacies, disturbance, spatial and temporal variability, hydrology, chemical weathering, primary productivity, biodiversity, canopy studies, education, and social science are thematic areas that have already demonstrated broad appeal. I hope that further workshops will yet be proposed on other topics.

The Y2K All Scientists Meeting presents an important opportunity to include non-LTER scientists in cross-site investigations. By holding the ASM before the annual meeting of ESA, we hope to attract colleagues who are not presently associated with LTER sites. Furthermore, we have made a concentrated effort to insure that International LTER networks will be rep

continued on page 6

Inside this Issue

This LTER Network Newsletter is in full color on the LTER Web site:
http://www.lternet.edu/Newsletter

The Network News
Vol 13 No 1 Spring 2000

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

LTER

The National Science Foundation

The University of New Mexico

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

Edited, designed and produced by
Patricia Sprott
psprott@lternet.edu
Printed on recycled paper with soy-based inks at Academy Printer
This publication is available in its entirety on the LTER World Wide Web Site:

http://www.lternet.edu

Konza Prairie LTER graduate students receive national recognition for work on grassland insects

John Blair

Two Kansas State University graduate students won top awards for their presentations of Konza Prairie LTER research at the national Entomological Society of America meeting, held December 12-16 in Atlanta, Georgia. David Stagliano and Clint Meyer received first and second place awards, respectively, for best oral presentations in the area of insect behavior and ecology.

David Stagliano's presentation was titled "Aquatic insect production and functional structure in a tallgrass prairie headwater stream" and Clint Meyer's presentation was "Secondary production and energetics of a dominant grass-feeding grasshopper in a tallgrass prairie." Both students are pursuing MS degrees in Entomology at KSU under the direction of LTER scientists Matt Whiles and Ralph Charlton.◆

Clint Meyer, a graduate student at Konza LTER won an award for his oral presentation at the national Entomological Society of America meeting. Back at Konza, Meyer assists Konza's SLTER students with sorting insects in the Environmental Education Lab.

David Stagliano (right), a graduate student at Konza LTER won a first-place award for his oral presentation on aquatic insects at the national Entomological Society of America meeting.

A helicopter is used to spread Wolastonite (below) over Watershed 1 to study the addition of the calcium-silicate at HBR LTER

Hubbard Brook LTER Begins 50-Year Study of Acid Rain

Jennifer Kitchel

Long-term studies of the movement and storage of nutrients in forests, soils and streams at the Hubbard Brook Experimental Forest indicate that calcium has been depleted from soils over the last 50 years. This depletion is due, in part, to atmospheric inputs of strong acids (acid rain). These acids leach base cations (calcium, magnesium, potassium and sodium) from soil into streamwater. Loss of base cations reduces percent base saturation and diminishes soil fertility.

Calcium is the predominant base cation in soils and stream water. In New England ecosystems, calcium is primarily derived from the weathering of calcium-silicate minerals present in glacial till or bedrock. Calcium is an essential plant nutrient required for the formation of cell walls and membranes, the synthesis of important compounds and the regulation of cell permeability. Trees require calcium to form wood. Calcium also acts as a buffer, neutralizing inputs of acid from precipitation.

To investigate the consequences of calcium loss in a northern hardwood ecosystem, scientists from the U.S.D.A. Forest Service and cooperating institutions including Cornell University, the Institute of Ecosystem Studies, Syracuse University, and the University of Michigan, experimentally added 55 tons of calcium to a 12 hectare watershed (watershed 1) in the Hubbard Brook Experimental Forest (HBEF). The calcium was added in the form of Wolastonite, a calcium silicate mineral, to match natural sources of calcium at the site as

cont. next page

closely as possible. The Wollastonite was applied by helicopter in one–ton increments. Prior to the application it was pelletized with a biodegradable binder to minimize wind dispersal.

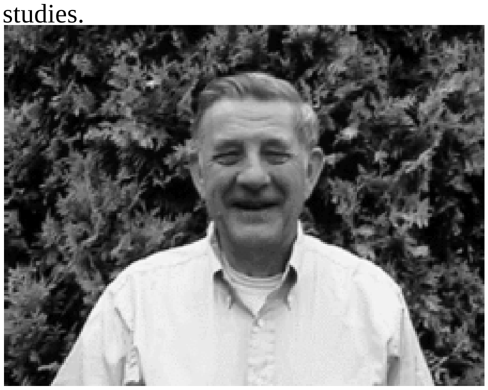
Over the next 50 years, researchers at HBEF will investigate the response of soil, water and forest organisms to the addition of calcium. Results of this study will provide insight into the cumulative effects of disturbance and atmospheric deposition on forest health and ecosystem function in northern hardwood forests and on the biogeochemistry of nutrient base cations. The study will also provide information on the sustainability of northern hardwood forests growing on soils like those at Hubbard Brook and on the ability of forest ecosystems to recover from the effects of acid rain. Moreover, the study results may inform environmental policy and forest management practices. This experiment was funded by the National Science Foundation.◆

Coweeta LTER: Swift Retires, Swank Completes Fellowship in England

Brian D. Kloeppel

Lloyd Swift, Jr. Retires from the USDA Forest Service

A celebration honoring 43 years of accomplishments and contributions to Coweeta Hydrologic Laboratory by Lloyd W. Swift, Jr. was held at The Dillard House in Dillard, GA on 19 February 2000. Lloyd has been a Co-Principal Investigator of Coweeta LTER research since the establishment of the LTER program in 1980. Lloyd was also an original member of the LTER Network Climate Committee. Lloyd plans to enjoy retirement while traveling and completing several long term studies.



Coweeta LTER's Lloyd W. Swift Jr

Wayne Swank Visiting Fellowship in Durham, England

Wayne T. Swank participated in a Visiting Fellowship at Hatfield College, Durham University in Durham England from 4 October to 12 December 1999. Wayne was hosted by Tim Burt, a Professor in Geography. Tim and Wayne have collaborated on hydrologic research for about 19 years. During Wayne's visit, he presented six seminars and visited five universities. Several papers, proposals, presentations, and exchange visits to Coweeta by English researchers are being facilitated as a result of this visiting fellowship. ◆

Palmer LTER: Making *News*, Making Names

Karen Baker

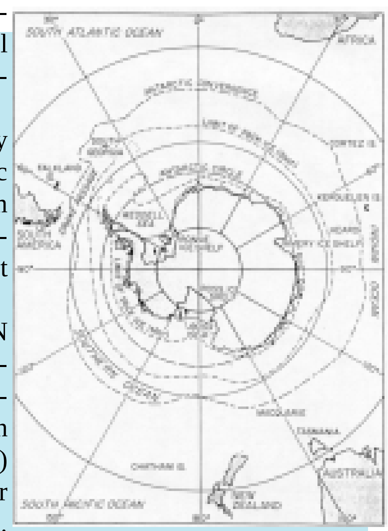
An article in a recent issue of *U.S. News and World Report* features Palmer researchers William Fraser and Donna Patterson, mentioning the LTER program.

"Antarctic Meltdown: Is the Heatwave on the Antarctic Penninsula a Harbinger of Global Climate Change?" by Charles W. Petit, who visited Palmer during the past research season is available online at

http://www.usnews.com/usnews/issue/000228/warming.htm

As a result of the recommendation David Karl (Principal Investigator, PAL LTER) formulated and submitted to the Advisory Committee on Antarctic Names (ACAN), the term Southern Ocean has been approved for U.S. Government use.

In September 1998 ACAN had forwarded Karl's recommendation, with ACAN endorsement, to the Foreign Names Committee, (FCN) which has jurisdiction over the naming of ocean areas. Recently the Foreign Names Committee reported its decision to the full U.S. Board on Geographic Names.



The Southern Ocean Karl, D.M. 1993. Microbial processes in the southern oceans.Pages 1-63 in E.I.Friedmann (ed.), *Antarctic Microbiology*.Wiley-Liss, New York.

According to the report, "The Committee's most significant decision during the reporting period [April-October 1999] was the adoption of the term Southern Ocean as a standard name for the body of water surrounding the continent of Antarctica. . . ."

The FNC staff found that the term enjoyed some usage in general geographic references (e.g., *The Times Atlas*) and wide usage in scientific and research literature. The National Science Foundation in particular favored the adoption of the term because, in the absence of a Board-approved name, its publications were inconsistent with community literature. In a parallel activity, the International Hydrographic Organization has decided (through a referendum of its member states) to use the term Southern Ocean in the next draft of its Special Publication No. 23, "Limits in the Oceans and Seas." ◆

Niwot Ridge LTER Installs 'TundraCam'

Tim Seastedt

The 'TundraCam' is the latest addition to the "virtual fieldtrip" program at Niwot Ridge. This real-time, directional and magnification photometric device allows web surfers to look from the Continental Divide, across the main LTER study areas, and on down to Denver and the plains.

See the TundraCam Online at:
http://tundracam.colorado.edu/

The TundraCam is a live and interactive webcam located at an elevation of 11,600 feet in the Colorado Front Range. The camera is above timberline on Niwot Ridge, about 25 miles west of Boulder. The peaks at the head of the ridge form the Continental Divide.

This camera can be controlled by anyone; a robotic arm and special software allow the camera to be panned and zoomed from a web browser. The software allows multiple users to control the camera at one time.

The camera is mounted on a weather tower located at the Tundra Laboratory, one of several research labs within the biosphere. Research conducted at this site is focused on a wide variety of topics, from alpine ecology to snow hydrology to atmospheric chemistry.

The camera is used for both research and educational purposes. The camera enables real-time monitoring of factors such as weather conditions, snow drifting and snow-melt patterns, or vegetation changes. Students can use the camera as part of a virtual field trip to the site, or to revisit the site after an actual field trip.

The TundraCam is located within a Biosphere Preserve (designated by UNESCO, the U.S. State Department, and the U.S. Forest Service), which has also been selected by the National Science Foundation as the alpine tundra component of the Long Term Ecological Research (LTER) program. The research facilities at the area are operated by the University of Colorado'sMountain Research Station, part of the Institute of Arctic and Alpine Research. ◆

An Introduction to the New Land Margin Long Term Ecological Research Sites

A recent National Science Foundation competition folded three land-margin studies into the LTER Network, which now totals 24 sites. All three projects are located in coastal regions, including Sapelo Island, Georgia, the Florida Everglades and Florida Bay in South Florida, and the coastal area of Santa Barbara, California.

Florida Coastal Everglades (FCE LTER)

Daniel L. Childers, Lead Principal Investigator
Joe Boyer, Jim Fourqurean, Rudolf Jaffe, Joel Trexler, and Ron Jones, Co-Principal Investigators

Estuaries and coastal landscapes experience a range of stresses, both natural and man-induced. Among these, cultural eutrophication affects most U.S. coastal ecosystems. Cultural eutrophication is defined as nutrient-enrichment of an ecosystem by human influences. As a result, most coastal ecological research in the U.S. has been conducted in systems that are experiencing eutrophication. In the new Florida Coastal Everglades LTER project (FCE), which was recently funded by the National Science Foundation, we will investigate how variability in regional climate, freshwater inputs, and disturbance affect land-margin ecosystems (Figure 1). Our research is entirely focused on Everglades National Park (Figure 2). More specifically, we will be quantifying long-term regional controls of population and ecosystem dynamics in an oligotrophic (low nutrient) wetland-dominated coastal landscape. The scientific team that will conduct this long-term research is made up of over 15 research scientists: a) from several departments at Florida International University; b) from several other universities around the country, and; c) from both state and federal agencies (including the South Florida Water Management District and the Biological Resources Division of the U.S. Geological Survey). The coastal Everglades is a particularly appropriate system for long-term research of this kind for several reasons:

1. the entire system is oligotrophic—very low in nutrients—and phosphorus is the limiting nutrient;
2. the south Florida climate is quite variable from year to year, to the point that the difference between rainfall in wet and dry years is nearly as large as the average annual rainfall;
3. the Everglades is the focus of the largest watershed restoration effort ever implemented, and this restoration will dramatically change the timing and amount of freshwater being put into the system (Figure 3);
4. a number of large and diverse datasets already exist for this system from ongoing research projects.

The guiding hypothesis behind our LTER research is that regional processes mediated by water flow control ecological dynamics at any location within the coastal Everglades landscape. The low-salinity regions of Everglades estuaries are excellent places to test this hypothesis because it is here that fresh water draining from phosphorus-limited Everglades marshes mixes with water from the more nitrogen-limited coastal ocean. In this low salinity (oligohaline) zone of the Shark River Slough estuary, we see a clear increase in ecosystem productivity that we hypothesize is a result of nitrogen being provided by the fresh-

Fig. 3: Ongoing restoration, looking east along the C111 canal in the Southern Everglades. Levees yet to be removed are in the foreground, and levees have been removed in the background to allow greater freshwater inputs into the marshes to the right.

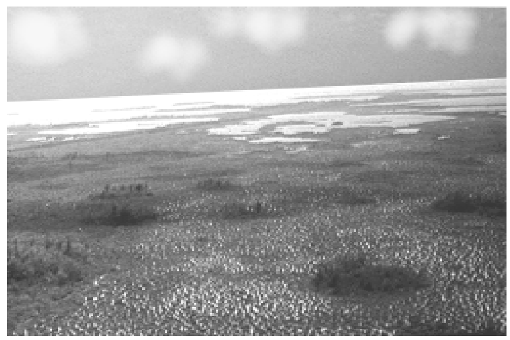


Fig. 2: Aerial photograph of the Southern Everglades portion of Everglades National Park, looking through the coastal Everglades to the Florida Bay estuary.

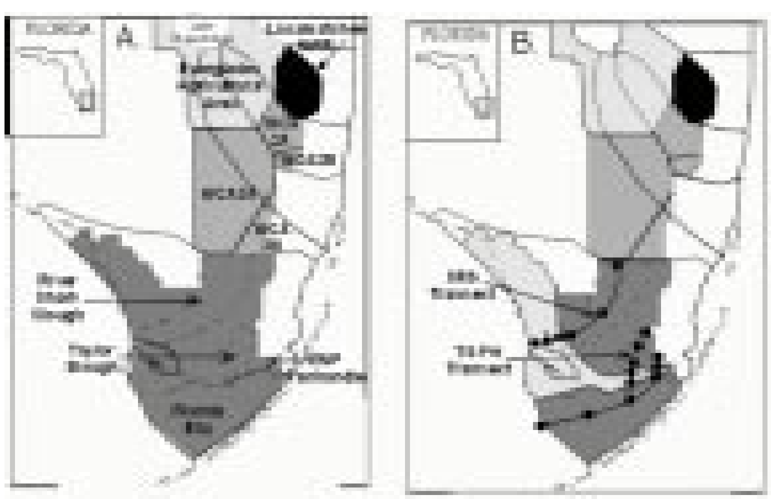


Figure 1: Map of south Florida showing (a) major components of the current and historical Everglades; note locations of Shark River Slough, Taylor Slough, the Everglades National Park (ENP) Panhandle, and Florida Bay, all within the ENP Boundaries; and (b) showing locations of our Everglades transects, with study sites shown as dots (six along the SRS transect and 11 along the TS/Ph transect, including Florida Bay); dark gray indicates freshwater marsh and light gray is mangrove forest.

See the INTERIM Florida Coastal Everglades LTER Web site: http://www.fiu.edu/~ecosyst/lter/home.html

Figure 4: A permanent water sampling station in a freshwater Everglades marsh.

Figure 5: A permanent water sampling station in an Everglades mangrove estuary.

water Everglades and phosphorus being provided by the Gulf of Mexico via tidal inputs. This oligohaline productivity peak coincides with the region that once supported huge wading bird colonies and rookeries. Interestingly, we do not see this kind of oligohaline productivity peak in the estuaries associated with the Southern Everglades because Florida Bay removes the phosphorus from the Gulf of Mexico before it can reach the low salinity regions.

We will be conducting this long-term research along freshwater to marine gradients in two Everglades National Park drainage basins, one through Shark River Slough and one through Taylor Slough and the Southern Everglades, including Florida Bay (Figure 1). Along each transect we will have a number of permanent study sites where we will study a number of ecological parameters. One way to envision this type of transect design is to imagine that we will be following parcels of water as they flow through freshwater marshes and mangrove estuaries to Florida Bay and/or to the Gulf of Mexico. At each station along these transects (Figure 1), we will install automatic samplers that allow us to continuously sample the water flowing past that location (Figures 4 & 5). At each site we will also be quantifying: a) primary productivity of marsh plants, mangroves, seagrasses, periphyton, and estuarine algae; b) the ecological dynamics of organic matter dissolved in the water; c) the accumulation or loss of organic matter from soils and sediments, and; d) the ecological dynamics and productivity of fish and aquatic invertebrates.

Modelling is a very important component of our coastal Everglades LTER research. We will be using process-based simulation models to link key components, such as the relationships between dissolved organic matter and the microbial processes that can utilize this organic source to drive ecosystem energetics. Our data synthesis will also include hydrologic models to simulate water movement along our experimental transects. The FCE LTER project database will be developed in a Geographic Information System (GIS) that will also integrate these data with information from other related projects. Finally, our GIS database will be linked to a FCE LTER web site to maximize the exchange and dissemination of information within the LTER Network and with the scientific community in general.

Georgia Coastal Ecosystem (GCE LTER)

J. T. Hollibaugh and S. J. Pennings, Lead Principal Investigators; M. Alber, J. O. Blanton, D. A. Bronk, W.-J. Cai, A. G. Chalmers, C. B. Craft, D. Di Iorio, L. A. Donovan, R. E. Hodson, S. B. Joye, G. Lin, M. A. Moran, S. Y. Newell, C. Ruppel, and R. G. Wiegert, Co-Principal Investigators

A group of scientists from the University of Georgia, the UGA Marine Institute, Georgia Institute of Technology, Skidaway Institute of Oceanography and Indiana University are gearing up to join the LTER network as the Georgia Coastal Ecosystems LTER. The study site, a barrier island and marsh complex, is located on the central Georgia coast in the vicinity of Sapelo Island and the Altamaha River, one of the largest and least developed rivers on the east coast of the US. The group will investigate the linkages between local and distant upland areas mediated by water - surface water and ground water - delivery to the coastal zone, examining the relationship between variability in environmental factors driven by river flow, primarily salinity, and ecosystem processes and structure.

The upland-estuarine interface of the study area consists of (1) the riverine estuary of the Altamaha River, (2) the lagoonal estuaries bordering the mainland and Sapelo Island, and (3) the tidal marsh complexes fringing small hammocks distributed throughout the coastal area. The salinity regimes of these estuaries result from the interaction of river discharge and ocean tides. The lagoonal estuaries adjacent to upland areas are also influenced, though to a lesser and more localized extent, by local surface runoff and groundwater seepage directly to the marsh.

The most southerly estuary is Altamaha Sound, which lies at the mouth of the Altamaha

The Georgia Coastal Ecosystems LTER study sites

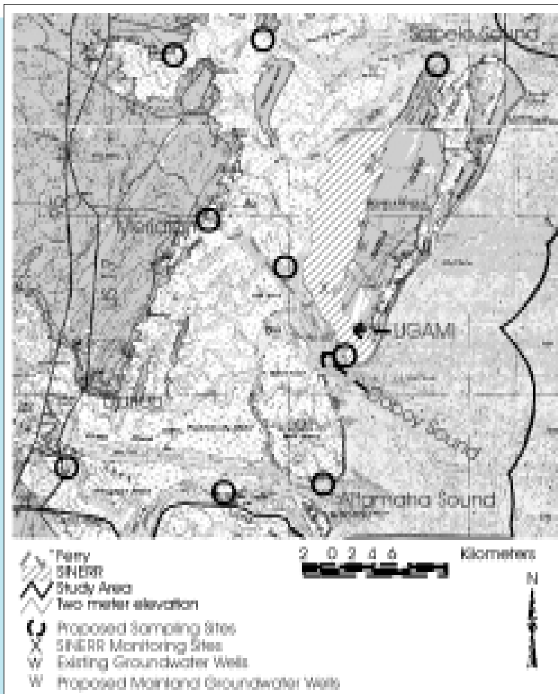
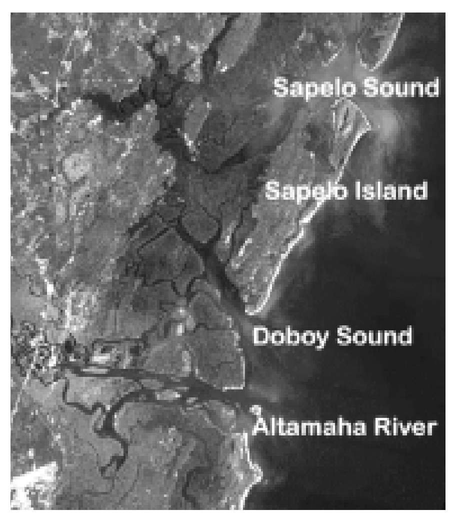


Figure 1. Proposed LTER Study Area, McIntosh County, Georgia. River water quality sampling site located at head-of-tide (54 km upstream from estuary mouth) is not shown.



An Introduction to the New Land Margin Long Term Ecological Research Sites

Georgia Coastal Ecosystems (GCE LTER) *continued*

River, the largest river in Georgia. Altamaha Sound is strongly river-dominated and constitutes a complex delta made up of low islands, marshes and tributaries. Doboy Sound, located to the north of Altamaha Sound, connects to the coastal ocean via a pass between Sapelo Island and the marsh complexes of Wolf/Queen Islands. Freshwater from the Altamaha River is transported into upper Doboy Sound through the connecting Intercoastal Waterway and marsh channels. Tidal exchange with the Altamaha's plume in the coastal ocean can also deliver low salinity water to Doboy Sound. Thus, mixing with sea water occurs under most conditions, so that water reaching Doboy Sound has low salinity but is not fresh. The third estuary, Sapelo Sound, is at the northern edge of the study area. Like Doboy Sound, it is a lagoonal estuary with no large streams discharging directly into it. Fresh water enters as precipitation, groundwater or as small volumes of surface inflow.

The new LTER will take advantage of the long term record of scientific study and ecosystem preservation that have been established by the University of Georgia Marine Institute (UGAMI) on Sapelo Island and the Sapelo Island National Estuarine Research Reserve (SINERR). Additionally, the Georgia Rivers LMER (GARLMER), which is concluding in October 2000, examined processing of materials transported through the intertidal zone of the Altamaha River and of four other Georgia coastal rivers. UGAMI studies of the Sapelo Island marshes began in 1954 and have resulted in over 800 publications. These publications, GARLMER data, long-term SINERR monitoring records, and aerial photographs dating back to 1953 provide a perspective on long-term changes in the system and will help in interpreting data collected during the LTER project.

A general organizing principle of this study is that the structure and function of coastal ecosystems is affected by the variability of an environmental factor (e.g., salinity) as well as by the mean value experienced at a given location. The hierarchy of spatial and temporal variation produces a cascade of ecological effects across multiple scales. At time scales spanning the range from hourly to annual, and spatial scales ranging from um to km, coastal ecosystems are influenced by both natural and anthropogenic perturbations (physical and chemical) that affect both the variability and the mean of important ecosystem properties (for example, hurricanes or flood control projects alter river hydrographs, which in turn affect sediment distributions and transport, estuarine salinity, etc.). We postulate that the scales of detectable change in ecosystems and associated physical and chemical systems indicate the scales of the most critical forcing. We propose to use the existing gradient (mean and variability) of one important variable, salinity, to separate the effects of different means from the effects of different variances for key ecosystem properties with inherent spatial and temporal scales ranging from um to km and minutes to years.

Field studies will focus on hydrodynamics and hydrology, assessment of ground water inputs, and the relationship of flows and fluxes to morphology. Complementary studies will include DIC, O2 and NO3 fluxes, sediment biogeochemistry, and plant, animal, and microbial community composition, density and diversity. Specific processes that will be addressed by field studies and numerical simulations include: 1. Influence of hydrological processes (evaporation, transpiration, groundwater input, marsh circulation) on the salt balance at different places in the creek-marsh complex, 2. angiosperm production, community structure and population genetics, and 3. the interactions of prokaryotes and eukaryotes in marsh grass decomposition. Evidence suggests that both fungi and bacteria play critical roles in decomposition in the intertidal marshes of the Georgia coast, and that fungal processing of standing-decaying marsh grass is key to the transfer of this material to animals.

The impacts of human activities in the watershed are an important component of the long term variation we expect to detect in this study. The coastline of Georgia is currently among the least developed in the United States, but is projected to see rapid urbanization over the next few decades. The headwater tributaries of the Altamaha River drain much of central Georgia, including an area of southeast Atlanta, which currently has one of the highest population growth rates in the US. At the same time, coastal Georgia is also experiencing growth. The study area currently has low population density, but the urbanization and growth that characterize Savannah to the north and Brunswick to the south are beginning along the I-95 corridor in McIntosh County, with development of coastal waterfront property proceeding rapidly as well. Models and related studies of the impact of land use change on salinity distributions within the Altamaha estuary, freshwater runoff and river discharge were begun in GARLMER and with funding from the Georgia Coastal Zone Management Program. As part of the LTER, we will expand these studies to include the effects of land use changes on river water quality. ◆

The LTER All Scientists Meeting

Plans, Preparation, Products!

A letter from Bob Waide
Executive Director, LTER Network Office

continued from page 1

resented at the meeting. At present, we anticipate that between 50-100 of our colleagues from international sites and networks will join us in Snowbird. We further anticipate the presence of researchers from long-term sites managed by government agencies. A special invitation has gone out to agency representatives to attend the ASM in order to improve interactions and cooperation between LTER and other long-term research programs.

The Network Office has set aside funds to encourage the development of cross-site activities arising from the All Scientists Meeting. These funds will support three kinds of activities. We will facilitate small planning meetings by workshop organizers. We will support post-ASM meetings to follow up on promising collaborations. Finally, we will provide short-term support for researchers who wish to dedicate 1-3 months to a specific cross-site research project. In addition, we will use the resources of the Network Office to facilitate the development of proposals from ideas arising from the ASM.

As you prepare for the All Scientists Meeting, I urge you to set as a priority for your participation the development of cross-site and cross-discipline research activities. The ASM is our opportunity to take full advantage of the benefits of a research network. I further encourage you to consider the characteristics of successful intersite collaboration and effective leadership described by Jack Webster, and to apply his suggestions to the development of new research collaborations. ◆

Santa Barbara Coastal (SBC LTER)

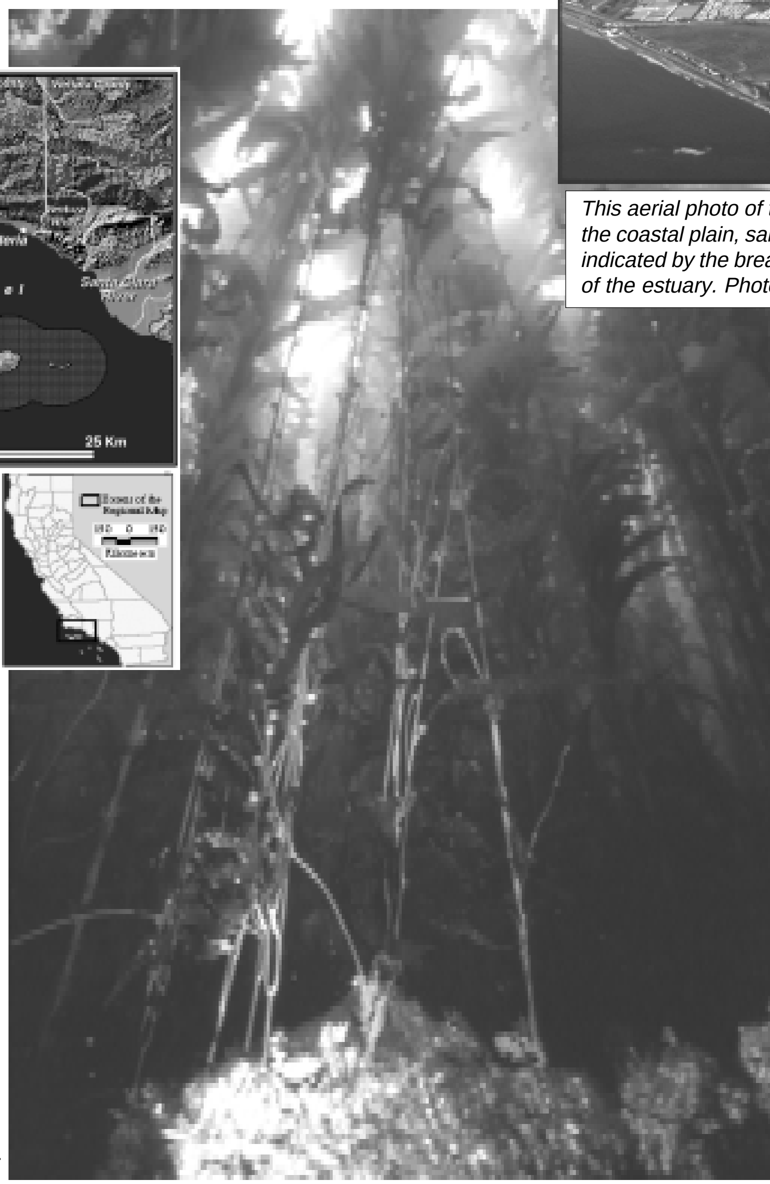
Dan Reid, Lead Principal Investigator, Scott Cooper, Steve Gaines, Sally Holbrook and John Melack, Co-Principal Investigators

The Santa Barbara Coastal LTER Project will focus on ecological systems at the land/ocean-margin. This location is typical of many semi-arid regions in that it includes a large number of watersheds with episodic stream flow that vary in size and land use. The focal coastal ecosystem of our proposed research will be giant kelp (*Macrocystis pyrifera*) forests, which are extremely important to the ecology and economy of coastal areas along the west coast of North and South America. Kelp forests occur on shallow coastal reefs and are affected in both positive and negative ways by land and the open ocean through the movement of water carrying constituents (e.g. sediments, nutrients, larvae, pollutants) from these different sources. Kelp forests have a unique trophic structure in which producers (macroalgae) and consumers (sessile invertebrates that filter plankton) compete for space. Competition between macroalgae and sessile invertebrates can be mediated by the relative supply of nutrients and particulate organic matter to the reef.

The Santa Barbara Coastal LTER Study Area

Although several lines of evidence suggest that the effects of terrestrial runoff on kelp forests in the Santa Barbara Channel can be large, the relative contributions of land vs. ocean derived constituents in structuring this and other coastal ecosystems in the region is poorly understood. Interdisciplinary research coordinated among 22 investigators is proposed that will examine questions and hypotheses related to all five core areas of research shared by LTER sites. The key issues that will specifically be addressed are (1) spatial and temporal scales over which terrestrial runoff and ocean forcing perturbs kelp forest ecosystems, (2) patterns and processing of organic matter in the ecosystem, (3) patterns of organic and inorganic inputs and their movement from the land to the coastal zone, (4) the effects of terrestrial runoff on patterns and controls of primary production in kelp forests, and (5) the effects of terrestrial runoff on the long-term population dynamics of key kelp-forest species and on trophic interactions. Regional studies will combine satellite imagery and field measurements of discharge from 3 primary and 12 secondary watersheds with modeling of solute and sediment-discharge relationships to determine patterns of runoff entering the Santa Barbara Channel. Detailed sampling of water chemistry and short and long-term experiments will be done in the three primary watersheds to determine smaller scale processes that are critical in controlling overall export to coastal waters. Satellite imagery combined with detailed measurements of ocean currents, waves, suspended sediment, subsurface irradiance, and seawater chemistry collected from moored instruments in the kelp beds offshore of the three primary catchments will be used to determine the timing, spatial extent, and residence time of runoff in the coastal zone and the degree to which they are modified by ocean processes.

This aerial photo of the Carpinteria watershed depicts the coastal plain, salt marsh and coastal reef, which is indicated by the breaking waves offshore of the mouth of the estuary. Photo courtesy Wayne Ferren.



Looking underwater at the kelp forest of the Santa Barbara coast, which is the focal coastal ecosystem of the SBC LTER. Photo courtesy Ron McPeak.

The effects of runoff on patterns of primary production will be investigated for both phytoplankton and macroalgae (the two major groups of primary producers found in kelp forests). Phytoplankton production will be estimated from optical data collected from moored instruments and satellites, chlorophyll concentration data collected from moored instruments and ocean cruises and C14 uptake experiments. Kelp production will be estimated from in situ measurements of growth and survival of tagged individuals and aerial photos of surface canopy area. Experiments will be done to evaluate factors that control primary production and the degree to which they are influenced by land and ocean processes. Short and long-term experiments and modeling will be done to determine the extent to which changes in nutrient supply due to runoff alter trophic interactions of the unique food web. ◆

An Example to Follow: Intersite Research among Stream Ecologists at LTER sites

Jack R. Webster
Department of Biology, Virginia Tech

With the All Scientists Meeting approaching, and its emphasis on intersite activities, it might be useful to review some of the history of LTER intersite activities. For various reasons LTER stream ecologists have been particularly successful with intersite studies. This historical summary of LTER stream intersite research is biased because it only includes activities in which I was involved and which I remember, but I think it is fairly comprehensive.

Collaboration among LTER sites actually began before LTER existed — back in the IBP days. In 1974 a group of Coweeta researchers led by DAC Crossley visited the Andrews site. At the time both sites were planning watershed logging experiments and wanted to insure research comparability. A paper comparing the stream sites was presented at the AIBS meeting that summer (Sedell et al. 1974). In the early days of LTER there was money available for intersite workshops, and the network office funded a series of three meetings of stream ecologists (Table 1). These workshops allowed LTER stream ecologists and stream ecologists from non-LTER sites to get together and generate the collegiality, trust, and appreciation of others' research that is essential for any collaborative research. One product of these workshops was a short paper describing stream research at six of the 11 LTER sites (Webster et al. 1985).

Figure 2. Participants in the Stream Solute and 15N Workshop at Coweeta in July 1995.

The organic matter workshop at Coweeta in 1985 (Fig. 1) began a fruitful intersite collaboration that didn't actually bear fruit for 12 years. At the 1990 All Scientists Meeting in Estes Park, we decided that we should use NABS meetings to continue these efforts since it would save money and allow non-LTER researchers to participate.

A second organic matter workshop was held in Calgary in 1993. This was an actual "working workshop" — we attempted to synthesize data on stream organic matter budgets from a variety of streams throughout North America and a few other sites in Australia, Europe, and Antarctica. I spent much of the following summer making a preliminary analysis of the results of these efforts. This analysis was then sent to each participant requesting they fill in any missing data from their site and confirm or recalculate any numbers that were clearly outliers. The resubmitted data were then reanalyzed, and eventually we (Webster and Meyer 1997) produced a series of papers describing the 35 streams (7 LTER and 14 other sites) and including 8 synthesis papers on various aspects of organic matter budgets. A clear consensus of this publication was that stream organic matter dynamics reflect the terrestrial setting of the streams.

Each of the All Scientists Meetings has also been an opportunity for stream researchers to interact and plan collaborative efforts. After the 1990 meeting, Meyer et al. (1993) produced a small book describing characteristics of the streams at each of 12 LTER sites. The intent of this publication was to stimulate intersite research among stream ecologists by helping identify sites with attributes that would permit useful comparisons.

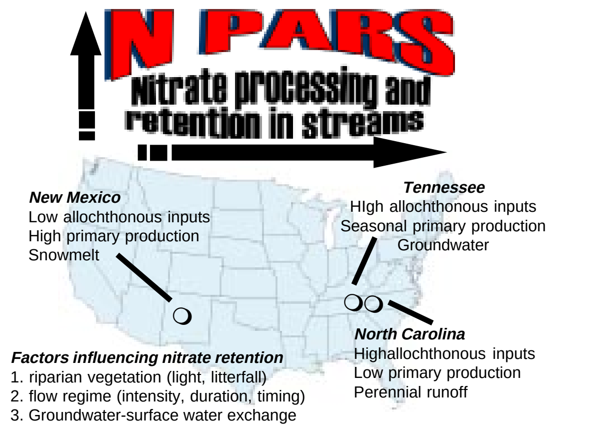


Figure 4. The recently funded NPARS (Nitrate Processing And Retention in Streams) project continues the use of 15N to study nitrogen in streams. (H.M. Valett, J.R. Webster, P.J. Mulholland, S.A. Thomas, C.N. Dahm, C.G. Peterson)

In addition to intersite work on stream organic matter dynamics, collaboration of stream ecologists working on nutrient dynamics began in 1989 with a workshop organized by Nick Aumen at the University of Mississippi. The report of the topics discussed at this meeting (Stream Solute Workshop 1990) has been a useful synthesis of our understanding of nutrient dynamics in streams at that time. This collaboration of stream ecologists interested in nutrients led to a funded NSF proposal by Donna D'Angelo, Bruce Peterson, and Judy Meyer for another workshop at Coweeta (Fig. 2). Again, this was a working workshop with participants actually out in streams getting their feet wet helping with data collection. The workshop included demonstrations of solute injections and data analysis, 15N addition, stable isotope analysis, and nitrogen modeling. One product of this workshop was that the demonstration 15N addition ended up as a published paper (Hall et al. 1998). Another product was a successful intersite proposal to NSF for the LINX project (Lotic Intersite Nitrogen eXperiment, Fig. 3). In this study, we

Table 1. Workshops involving stream ecologists at LTER sites. This list does not include the stream workshops held at All Scientists Meetings.

Title	Date/Location	Organizer	Support
LTER Stream Workshop	11-13 July 1983 Kansas State University	Dick Marzolf	Supported by LTER
LTER Stream Workshop	29 October 1984 Denver, Colorado		Supported by LTER
LTER Workshop on Stream Organic Matter Budgets	18-19 October 1985 Franklin, North Carolina	J. Webster	Supported by LTER
Workshop on Stream Organic Matter Dynamics	23-24 May 1993 Calgary, Alberta	J. Webster and Judy Meyer	Unsupported[1]
Workshop on Solute Dynamics in Stream Ecosystems	1-5 February 1989 Oxford, Mississippi	Nick Aumen	University of Mississippi[1]
Stream solute and ^{15}N workshop	15-18 July 1995 Coweeta	Donna D'Angelo, Bruce Peterson, and Judy Meyer	Supported by a grant from NSF

[1]Page costs for publications from both of these workshops were supported by LTER.

used 6-week 15NH4 additions to streams to determine NH4 uptake length and uptake rate, nitrogen turnover rates, and food web transfer of nitrogen Field research was completed in September 1998. Successful coordination of LINX was achieved through several mechanisms. First, at least one of the principal investigators (Mulholland, Webster, Meyer, Peterson) visited each of the sites during the ^{15}N injection. Second, a post-doctoral associate (Jennifer Tank) went to each of the sites to organize the data collection and insure that the same techniques were used at every site. Third, nearly all of the researchers involved in the LINX regularly attend the NABS meeting, and a day prior to each NABS meeting was set aside for a LINX meeting to compare progress, discuss initial results, and eventually to plan synthesis efforts. As of January 2000, we have presented 36 papers at meetings, four papers are in press, another four are submitted, and many more are planned.

Figure 1. Participants in the Stream Organic Matter Workshop held at Coweeta in October 1985.

Another intersite stream study is currently underway, the NPARS project (Nitrate Processing And Retention in Streams, Fig. 4). This study is an outgrowth of LINX but is a much more intensive study of six streams at three sites. We are using short-term additions of 15NO3 to examine effects of riparian vegetation, flow regime, and groundwater interaction on nitrate retention.

Successful intersite collaboration depends on eight characteristics. There must be (1) collegiality, (2) trust, and (3) respect among the participants. These relationships are developed through long-term interactions, such as are available through LTER, and through (4) site visits. The opportunity to visit other sites is essential. It not only brings participant together, but it allows everyone to kick the rocks and smell the mud. This first hand acquaintance with other sites cannot be replaced by pictures.

In order to develop successful collaboration there must also be (5) incentive for the participants. This incentive may be potential publications (not just a footnote to a workshop-authored paper) or monetary research support. Enthusiasm and bootlegged data collection can only carry an intersite project a short ways. Collaborative, intersite research is expensive and achieving significant funding is difficult (Peterson 1993), but the important contributions made by intersite studies such as the River Continuum Study (Minshall et al. 1983) underscore their value.

A (6) baseline of data and prior research is also essential. Because of the existence of this sort of data, the LTER network is a wonderful opportunity for intersite research.

Time and patience (7)— Intersite research goes slowly. The synthesis of stream organic matter budgets was finally published 12 years after the first workshop. It take time to develop the essential relationships among collaborators and the synthesis is always limited by the slowest link.

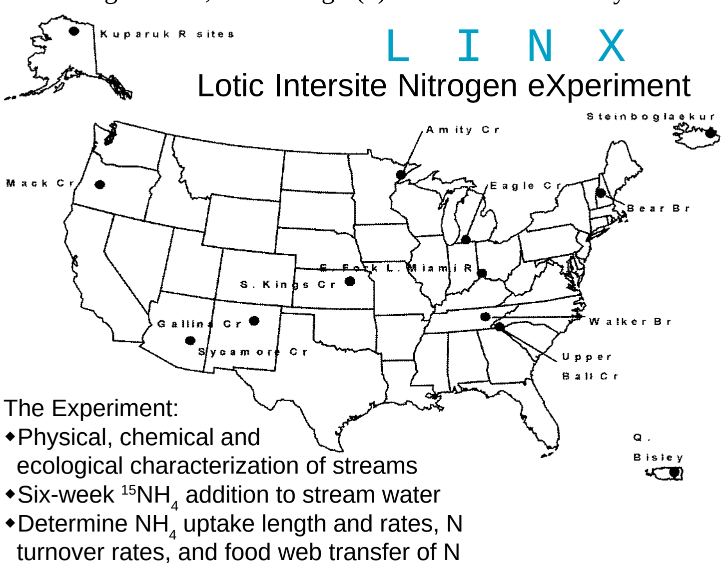


Figure 3. The LINX (Lotic Intersite Nitrogen eXperiment) study was funded in 1996 to study nitrogen dynamics in streams throughout North America.

Finally, an intersite effort cannot be successful without (8) effective leadership. Cullen et al. (1999) listed traits of an effective leader of a collaborative effort (Table 2) that apply well to leadership of intersite studies. To this list I add patience and realism — realism that not everyone will contribute equally and patience to work with people who might not have equal enthusiasm.

Usually it is the combined efforts of several people that provides effective leadership, and I particularly thank Judy Meyer, Pat Mulholland, Bruce Peterson, Jennifer Tank, and Nick Aumen for their role in leading the interactions among stream ecologists within LTER and within the larger community.◆

Table 2. Characteristics of an effective leader of a collaborative effort. Modified from Cullen et al. (1999)

◆**Commitment to excellence and an ability to set high standards**

◆**Strong knowledge of the subject area**

◆**Skill at synthesizing and seeing the big picture**

◆**Strong appreciation of the importance of collaborative research**

◆**Intellectual curiosity and a vitality for learning across disciplinary boundaries**

◆**Willingness to take risks by presenting tentative solutions and allowing others to build on and correct them**

◆**Ability to stimulate all collaborators to ask questions and to re-examine deeply held assumptions.**

Literature Cited

Cullen, P.W., R.H. Norris, V.H. Resh, T.B. Reynoldson, D.M. Rosenberg, and M.T. Barbour. 1999. Collaboration in scientific research: a critical need for freshwater ecology. Freshwater Biology 42:131-142.

Hall, R.O., B.J. Peterson, and J.L. Meyer. 1998. Testing a nitrogen-cycling model of a forest stream by using a nitrogen-15 tracer addition. Ecosystems 1:283-298.

Meyer, J., T. Crocker, D. D'Angelo, W. Dodds, S. Findlay, M. Oswood, D. Repert, and D. Toetz. 1993. Stream research in the LTER network. LTER Network Office, Seattle, Washington.

Minshall, G.W., R.C. Petersen, K.W. Cummins, T.L. Bott, J.R. Sedell, C.E. Cushing, and R.L. Vannote. 1983. Interbiome comparison of stream ecosystem dynamics. Ecological Monographs 53:1-25.

Peterson, B.J. 1993. The costs and benefits of collaborative research. Estuaries 16:913-918.

Sedell, J.R., F.J. Triska, W.R. Woodall, and J.R. Webster. Mineral cycles in stream ecosystems. Paper presented at AIBS meeting, Arizona State University, Tempe, Arizona. June 16-21, 1974 Bulletin of the Ecological Society of America 55:27.

Stream Solute Workshop. 1990. Solute dynamics in streams. Journal of the North American Benthological Society 9:95-119.

Webster, J.R. and J.L. Meyer (editors). 1997. Stream organic matter budgets. Journal of the North American Benthological Society 16:3-161

Webster, J.R., E. Blood, S.V. Gregory, M.E. Gurtz, R.E. Sparks, and M. Thurman. 1985. Long-term research in stream ecology. Bulletin of the Ecological Society of America 66:346-353.

LTER Crosses Disciplines, Agencies to Excel in Remote Sensing Research and Applications

Imaging Spectroscopy Focuses on Jornada and Sevilleta LTER Sites

Greg Asner, Department of Geological Sciences and Environmental Studies, University of Colorado

For the past several years, a unique form of remote sensing called imaging spectroscopy has been taking place in the skies above the Jornada and Sevilleta LTER sites in New Mexico. Imaging spectroscopy is unique because the recorded data contain the full solar reflected spectrum of the imaged landscape (Figure 1). This complete spectrum can provide information about vegetation and soil properties not obtainable from traditional multispectral remote sensing instruments, such as Landsat, which collect data in a few broad regions of the spectrum. For example Landsat measures six separate spectral bands while the hyperspectral sensor measures in more than 200 contiguous spectral bands.

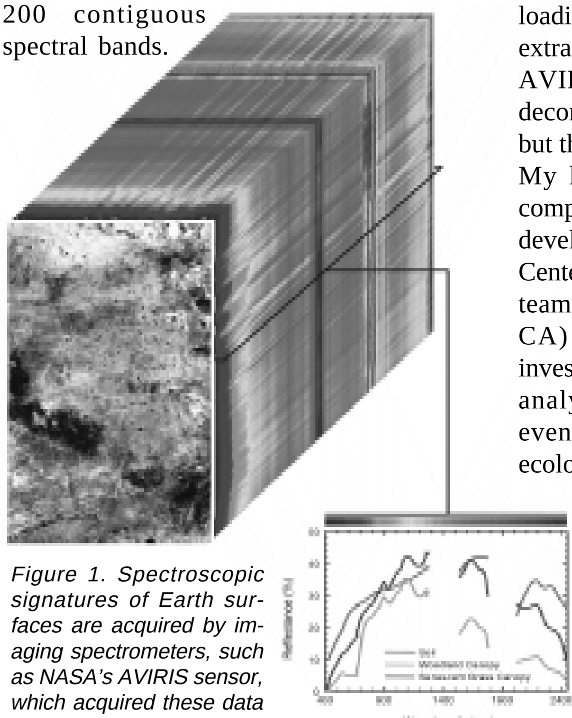


Figure 1. Spectroscopic signatures of Earth surfaces are acquired by imaging spectrometers, such as NASA's AVIRIS sensor, which acquired these data over the Jornada LTER site. Each image pixel has an associated signature that provides information about the physical and chemical composition of the observed area.

The full spectral coverage enables spectroscopy analysis based in physics, chemistry, and biology, which is not possible with the multispectral approach. Our efforts are underway to advance and improve the interpretation of spectral signatures of arid and semi-arid ecosystems, which in turn will greatly improve our ability to assess climate and land-use impacts in these regions.

NASA's premier imaging spectrometer called the Airborne Visible and Infrared Imaging Spectrometer (AVIRIS) has been tasked to collect hyperspectral data over the Jornada and Sevilleta. During these AVIRIS overflights, field campaigns have been coordinated to collect spatial information on vegetation and soil properties. These data sets are providing us with the means to develop new approaches for estimating ecologically important variables such as vegetation and bare soil extent, leaf area index, standing litter quantities, water stress, and vegetation phenology (Figure 2). These biophysical and ecological quantities are then used in models of biogeochemistry, physiology, fire fuel loading, and grazing intensity. Our methods to extract this biophysical information from the AVIRIS imagery include spectral signature deconvolution and radiative transfer models, but they require intensive computer resources. My lab has a high-performance Beowulf computing cluster based on the original design developed at NASA's Goddard Space Flight Center. We are working with NASA's AVIRIS team (Jet Propulsion Laboratory, Pasadena, CA) and Jornada and Sevilleta LTER investigators to provide an efficient processing, analysis and validation effort that could eventually support detailed regional scale ecological studies at the two sites.

See these images in color: http://www.lternet.edu/Newsletter

While the AVIRIS effort continues, our group is preparing for the launch into Earth orbit of the first spaceborne imaging spectrometer, which is scheduled for this summer. Part of NASA's New Millenium Program, the Earth Observing-1 (EO-1) satellite is a technology demonstration, and it will carry the Hyperion instrument to collect hyperspectral data over a select number of test sites including the Jornada and Sevilleta. If successful, Hyperion will represent a true milestone in demonstrating new Earth remote sensing technology, hopefully paving the way toward the next generation of high performance globally available imaging spectrometer measurements.

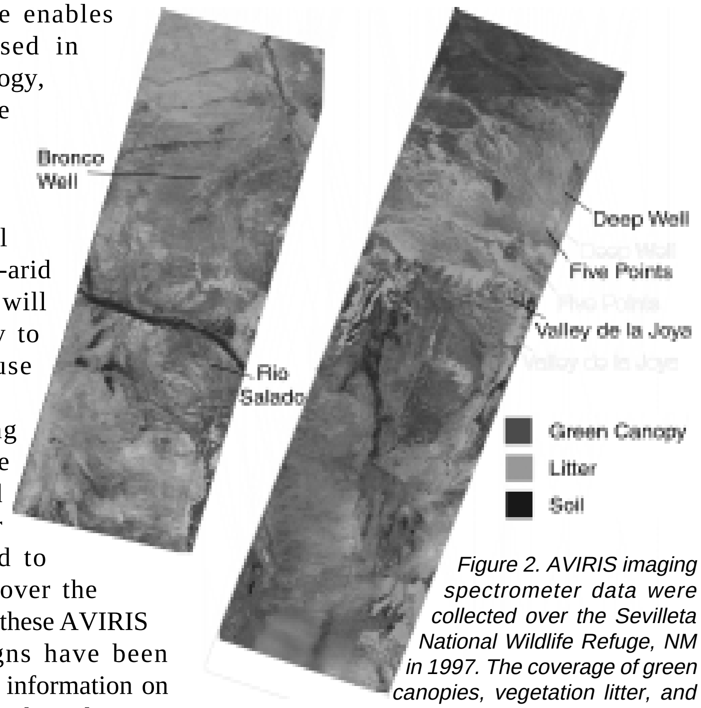


Figure 2. AVIRIS imaging spectrometer data were collected over the Sevilleta National Wildlife Refuge, NM in 1997. The coverage of green canopies, vegetation litter, and bare soils within 20 x 20 m image pixels was successfully measured using a method called hyperspectral unmixing.

I believe that this technology will revolutionize our ability to remotely measure vegetation, soil and other Earth properties with unparalleled physical and chemical detail. For us, the Jornada and Sevilleta LTER sites will continue to be a major focus of research toward this goal. ◆

For more information on this project, please contact:
◆Greg Asner, Department of Geological Sciences and Environmental Studies Program
University of Colorado, Boulder, CO
◆Robert Green, NASA AVIRIS Program
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA
◆Barbara Nolen, Jornada LTER, Las Cruces, NM
◆Greg Shore, Sevilleta LTER, Department of Biology, University of New Mexico
Albuquerque, NM
◆Carol Wessman, Department of EPO Biology and CIRES, University of Colorado, Boulder, CO

New Satellite Opens Doors for GTOS/GTNET Demonstration Project

John Vande Castle, LTER Network Office

The new NASA satellite called "Terra" was launched successfully in December 1999 with MODIS and four other sensors on board.

Terra (formerly known as EOS AM-1) is the flagship of NASA's Earth Observing System (EOS), a major international science program to monitor climate and environmental change. Terra is collecting a new global data set to enable research into the ways that

Earth's lands, oceans, atmosphere, ice, radiant energy, and life function as a whole system. In February 2000, Terra reached final orbit and acquired its first images, some of which are now available to the public.

Learn more about Terra on the website http://terra.nasa.gov/

These data are integral to the GTOS/NPP Demonstration Project. Data products from the MODIS instrument on board Terra will be compared with global validation sites as part of a collaborative Demonstration Project of the Global Terrestrial Observing System (GTOS). The collaboration, known as the GTOS - Net Primary Productivity (NPP) Demo Project will distribute global product map imagery of NPP, leaf are index (LAI) measures and land cover classifications to GTOS sites for evaluation with ground-based measurements. This validation effort will complement a more intensive effort within NASA's "BigFoot" validation project. The goal will be to translate this standard product to regionally specific crop, range, and forest yield maps for land-management applications.

Learn more about the GTOS/ GTNET Demo Project on the website: (http://www.ilternet.edu/gtnet/)

'BigFoot' Blazes Trails for LTER Remote Sensing

Warren Cohen, Oregon State University

MODIS (the Moderate Resolution Imaging Spectrometer) is the principal high temporal frequency mapping sensor on-board NASA's Terra satellite. The MODIS instrument acquires data in 36 spectral bands at spatial resolutions from 250 m to 1 km over the entire globe every two days. A series of land products will be produced from these data by the MODIS Land Discipline Group (MODLand). These products will include surface reflectance, spectral vegetation indices, land cover, the absorbed fraction of photosynthetically active radiation (FPAR), leaf area index (LAI), net primary productivity (NPP), and land surface temperature. These, and other MODIS products, will play an important role in measuring and monitoring surface variables. Validation of these global data products is crucial for establishing the accuracy of the data products for the scientific user community, and to provide feedback for improving the data processing algorithms.

The BigFoot field sites have active science programs concentrating on CO^2, water vapor, and energy exchange using flux tower measurements. The "footprint" over which gas flux data are collected varies, but is roughly 1 km or less. For the BigFoot analysis, this footprint will be extended to 25 km^2 to include multiple 1 km MODIS cells, hence the project name. BigFoot investigators will focus on validation of the MODLand land cover, LAI, FPAR, and NPP products. We will develop fine grain (25 m resolution) surfaces of land cover, LAI, FPAR, and NPP, aggregate these to 1 km resolution, then assess the similarities and differences between these surfaces and the MODLand products.

Project History

The BigFoot project grew from an LTER-sponsored workshop held in 1996.

At the most recent LTER All Scientists Meeting (Estses Park, CO 1993) one of the workshops focused on NASA/LTER interactions, which were nascent at the time. Participants in the workshop, led by John Vande Castle and Steve Running, explored validation protocols and scaling issues that lead to an improved understanding of several MODLand products. The workshop ultimately produced a proposal from 14 LTER sites and the Network Office to Diane Wickland, Manager of the Terrestrial Ecology Program at NASA.

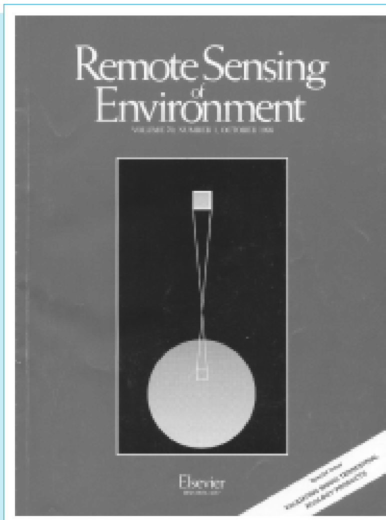
The focus of the proposal was to conduct preliminary studies that would lead to eventual "validation" of global ecological data layers developed by the MODIS Land Discipline Group within the context of NASA's Earth Observation System. Two proposals (including a subsequent, more refined proposal), have been funded, and we are now completing the first year of the subsequent proposal.

Our goals, in addition to providing MODLand product validation, are (1) to explore the errors and information losses that accrue when extrapolating field data to coarse grain (1 km) surfaces, (2) determine if there is a fundamental grain size at each site, above which error rates accelerate when modeling land cover, LAI, FPAR, and NPP, (3) develop a better understanding of the climatic and ecological controls on net primary production and carbon allocation within and among biomes, and (4) to learn how flux tower measurements of net ecosystem exchange (NEE) and field measurements of NPP co-vary, and how to translate between them using ecological models.

We will be working at four field sites: a boreal forest, a tallgrass prairie, a mixed deciduous-conifer forest, and a mixed corn and soybean agricultural system.

The core BigFoot products will be: field-collected data sets of land cover, LAI, FPAR, NPP, and related variables; and 25 km^2 surfaces at 25 m spatial resolution of land cover, LAI, FPAR, and NPP for each site. These surfaces will be developed from field data, Landsat imagery, image classification, geostatistical analysis, and ecosystem process models. Errors in each data layer will be characterized using independent field data. Explicit examination of scaling from field measurements, to fine grain (25 m) surfaces, to coarse grain (1 km) MODLand grids is a central theme of BigFoot. The fine grain surfaces will be aggregated to several resolutions, up to 1 km, to determine if there is a grain size above which information loss rapidly increases. Through these analyses, we hope to characterize error due to scaling differences versus error due to algorithm definitions. It is theoretically possible for any single MODIS grid cell to not accurately estimate land cover, LAI, FPAR, or NPP, but for multiple cell estimates within and across sites to be accurate. A cross-site comparison of MODLand and BigFoot surfaces will permit us to assess MODLand data product accuracy and gain an understanding of the source of errors at both the site and cross-site level. ◆

Learn more about the BigFoot Project: http://www.fsl.orst.edu/larse/bigfoot



A special issue issue of *Remote Sensing of Environment* (October 1999, Elsevier), features work done within the context of a proposal, which resulted from a 1996 workshop. That workshop was a follow-up to the ideas generated at the 1993 All Scientists Meeting (Estes Park)

Articles include: data validation, broad-application atmospheric correction techniques, scaling issues in landcover classifications, estimating LAI and NPP using remotely sensed information, identifying relationships between LAI and Landsat TM data, integrating multiple disciplines, scales and ecosystems to maximize effectiveness of modeling and synthesis activities, and coordinating flux measurements and modeling activities into a global terrestrial monitoring network. ◆

NETWorking LTER Functioning as a Network

LTER Scientists Prepare for Y2K All Scientists Meeting

Social Science Committee Develops Themes for LTER

J. Morgan Grove, BES LTER
USDA Forest Service
Northeastern Research Station

In January 2000, LTER scientists and colleagues from other large interdisciplinary projects funded by NSF gathered in Tempe, Arizona to craft this agenda. After reviewing case studies of projects that have successfully bridged the social/natural science divide, it was agreed that there remains much to be accomplished.

During this workshop, sufficient consensus emerged concerning the integration of humans and ecosystems to allow for discussion to advance to more specific issues. Considering LTER ecologists have defined and implemented a core set of concepts to understand the long-term dynamics of ecosystems for the LTER Network, the workshop participants agreed that a core set of social patterns and processes analogous to the ecological core areas would greatly aid the integration of social sciences into LTER research. Although preliminary core social science patterns and processes were defined in the Workshop, and consensus was reached on a broad conceptual framework for investigating integrated human ecosystems, participants fully expect that further definition would be needed before these core research areas can be implemented throughout the LTER Network. They proposed a future workshop series where discussion on three domains of ideas could serve as a road map for integration: one workshop would further detail the proposed core social science patterns and processes and their articulation with ongoing research. Another would formulate multi-scale investigatory frameworks considered key to implementing integrated research projects. The third workshop would focus on practical approaches to integration and propose specific pilot projects to pursue. Taken together, these efforts would help to form long-term research initiatives to better understand the complex interactions between human, biological, and earth systems.

Based upon the January workshop, Chuck Redman, Pete Nowak, Jennifer Edmonds, and Morgan Grove worked together to develop a set of workshops for the LTER All Scientists' Meeting. These workshops include:

- Strategies for the integration of social, life, and earth sciences for the LTER network.
- Spatial and temporal scales issues in the social and ecological sciences.
- Data: methods, tools, and protocols for integrated research
- A framework for integrating core social science areas for the LTER Network and opportunities for cross-site comparisons.

A particular goal of these workshops is to identify research projects where the collaboration among social, biological, and earth scientists would lead to a better understanding of the mechanisms that govern ecosystem dynamics.

With this in mind, Chuck Redman and Morgan Grove worked with Lauren Kuby to submit an incubation grant proposal to NSF's Biocomplexity competition. If funded, four research proposals would be identified and a set of workshops would be held focusing on 1) practical issues to help the research projects implement integrated research; 2) ways the proposed social science core areas would be implemented in the pilot projects; and 3) strategies for accommodating multiple spatial and temporal scales of human ecosystems.

Finally, participants from the Tempe workshop have nearly completed a revised White Paper that will be sent to LTER PIs and posted to the LTER Network site.

JANUARY 2000 SOCIAL SCIENCE WORKSHOP PARTICIPANTS

LTER Representatives

- CAP LTER Chuck Redman, Nancy Grimm, Ann Kinzig, Lauren Kuby, and Ed Hackett
- BES LTER Morgan Grove, Bill Burch, and Steward Pickett
- NTL LTER Steve Carpenter and Peter Nowak
- BNZ LTER Terry Chapin
- CWT LTER Ted Gragson
- KBS LTER Craig Harris
- LTER Network Office Bob Waide

Scientists Outside of LTER

- Tom Baerwald, NSF/BCS
- Anthony de Souza, National Research Council (Geography)
- Grant Heiken, Los Alamos National Labs
- Peter Kareiva, NOAA (Ecology)
- Emilio Moran, Indiana University (Anthropology)
- Elinor Ostrom, Indiana University (Political Science)
- Sander van der Leeuw, Sorbonne (Anthropology)
- Tom Wilbanks, Oak Ridge National Laboratory (Geography)
- Brent Yarnell, Penn State (Geography)

LTER Aquatic Scientists Review Past Successes to Plan for Future Collaborations

John Hobbie, ARC LTER, PIE LTER
Marine Biological Laboratory, The Ecosystems Center, Woods Hole, MA

On 5-6 February 2000, 29 scientists from 13 LTER sites met in Salt Lake City to share project information and decide upon ASM workshops for comparative aquatic studies. Established sites represented were AND, ARC, CAP, CWT, LUQ, MCM, NTL, PAL, PIE, and VCR. New sites were California/Santa Barbara (SBC), Florida Coastal Ecosystems (FCE), and Georgia (GCE). Roberta Marinelli (Polar Programs) and Phil Taylor (Ocean Sciences) represented the National Science Foundation while Robert Waide and James Brunt attended from the Network Office.

The meeting included a description of the present and planned aquatic research at the sites. To illustrate the possible ways that cross-site research has operated within the LTER program, Stan Gregory reported on LIDET, George Kling described a workshop on CO_2 cycling in lakes, Jack Webster described the series of Stream Workshops held over the years, and Bruce Peterson reported on the LINX project on nitrogen cycling in streams (this began with LTER funding). Chuck Hopkinson described the cross-site LMER research on the characterization of organic matter in rivers.

The preliminary list of topics suggested for the ASM includes: regulation of organic matter preservation in wetland sediments; human modifications of hydrologic cycles: effects on nutrient dynamics and local and regional scales; strategies for examining the role of species interactions on ecosystem processes; and cross-site measurements of the geographical distribution of microbial species and their relation to ecosystem properties.

The meeting was sponsored by the LMER (Land Margin Ecosystem Research) Coordinating Office–its last official act now that the funding for the LMER sites has been transformed into new LTER sites.

Announcing the Long Term Ecological Research Network's

◆ *All Scientists Meeting* ◆

Long-term Ecological Research in the New Millennium: Unifying Concepts and Global Applications

August 2–4, 2000

Immediately preceding the ESA Annual Meeting

in Snowbird, Utah

◆ ***Featuring*** plenary speakers, workshops, informal discussion groups, and business and planning interactions
◆ ***Open*** to all interested scientists, researchers and students
◆ ***Workshops*** will emphasize group discussions and products such as publications, future research proposals, and cross-site project agreements — Please pre-register on the Web site
◆ ***Poster sessions*** daily — Submit your abstract on the Web site

Sample Workshop Categories

◆Opportunities for Cross-site Comparisons
◆Organic Matter Dynamics and Net Primary Production
◆Data Management & Movement
◆Population Studies/Biodiversity
◆Remote Sensing
◆Landscape Studies and Scaling
◆Climate/Meteorology
◆Schoolyard LTER — and beyond
◆Ecosystem Processes, Legacies, and Management
◆Social and Economic Research
◆Land-margin Ecosystems
◆Rhizosphere, Soils, and Nutrients
◆Workshops for Graduate Students
◆Hydrology/Geomorphology

INTERNATIONAL NETWORKING *at the* LTER Y2K ALL-SCIENTISTS MEETING

More than 50 scientists—from the 20 ILTER Networks as well as several other countries are expected to participate in the activities:
◆Five workshops have been co-organized by foreign scientists (check web site for details)
◆Workshop CS-1 will focus specifically on international long-term cross-site research
◆Wednesday evening —a special reception for ILTER members to commemorate the 7th anniversary of the ILTER network (created during the "International Summit" held at the All Scientists Meeting in 1993)

All US LTER scientists are encouraged to take this opportunity to meet their foreign counterparts to learn more about the LTER research being pursued outside the U.S. and to explore opportunities for cross-site collaboration.

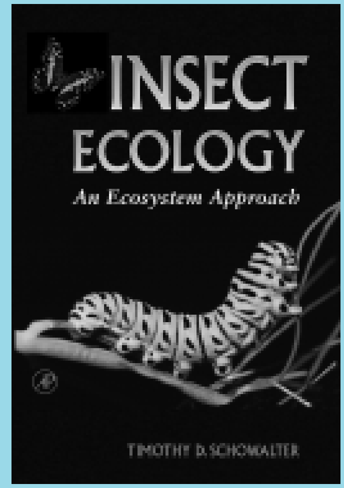
Meeting Organizers

Robert Parmenter (505) 277 6348
(parmentr@sevilleta.unm.edu)
Robert Waide (505) 272 7311
(rwaide@lternet.edu)

for more details, see the website
http://www.lternet.edu/allsci2000

Publications

Recent Contributions from the LTER Community



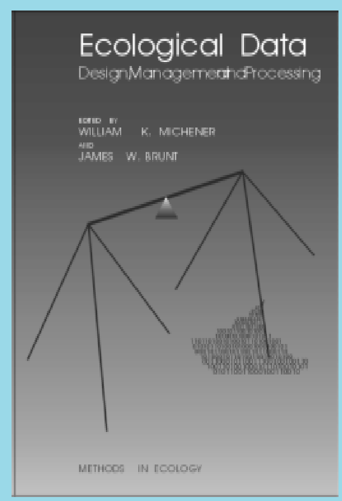
Timothy Schowalter
Academic Press

Insect Ecology
by Tim Schowalter

Insects are a dominant group of organisms on Earth, in terms of both their species diversity and their ability to affect ecosystem structure and function, often in conflict with our management goals. Insect ecology is integral to all current environmental issues, including biodiversity conservation, ecosystem health, land use, climate change, and air and water pollution.

This text integrates traditional emphases on insect diversity, life history adaptation, and species interactions with current perspectives on insect roles in ecosystems subject to environmental changes. Insects respond to environmental changes in ways that mitigate or exacerbate change. Many species have demonstrated remarkable capacity to thrive in human-altered landscapes, whereas other species and their ecological functions are threatened by anthropogenic changes in environmental conditions. This integration of insect ecology with ecosystem ecology will contribute to understanding, prediction and resolution of the consequences of environmental changes.

Intended to provide a state-of-the-art insect ecology text and reference book that synthesizes the variety of interactions between insects and their environment, the text includes numerous references to LTER objectives and data, and many acknowledges many LTER collaborators.



William K Michener, James W Brunt, Editors
Blackwell Scientific

Ecological Data
Edited by William Michener and James Brunt

Ecologists are increasingly tackling difficult issues like global change, loss of biodiversity, and sustainability of ecosystem services. These and related questions are enormously challenging, requiring unprecedented interdisciplinary collaboration and rapid synthesis of massive amounts of diverse data into information and, ultimately, our knowledge base. This book addresses these issues, providing a much needed resource for those involved in designing and implementing ecological research, as well as students who are entering the environmental sciences. Chapters focus on the design of ecological studies, data management principles, scientific databases, data quality assurance, data documentation, archiving ecological data and information, and processing data into information and knowledge.

Publications

Recent Contributions from the LTER Community

Abrahams, A. D., G. Li, C. Krishnan, and J. F. Atkinson. 1998. Predicting sediment transport by interrill overland flow on rough surfaces. *Earth Surface Processes and Landforms* 23: 481-92.

Acker, Steven A.; McKee, W. Arthur; Harmon, Mark E.; Franklin, Jerry F. 1998. Long-term research on forest dynamics in the Pacific Northwest: a network of permanent forest plots. In: Dallmeier, F.; Comiskey, J. A., eds. Forest biodiversity in North, Central, and South America and the Caribbean: Research and Monitoring; 1995 May 23-25; Washington, DC. New York, NY: The Parthenon Publishing Group, Inc.: 93-106. (Jeffers, J. N. R., ed; Man and the Biosphere Series; 21).

Baer, S.G., J.M. Blair and A.K. Knapp. 1999. Manipulation of soil resource heterogeneity in a tallgrass prairie restoration. Pages 78-87 In Proceedings of the Sixteenth North American Prairie Conference (J.T. Springer, ed.), University of Nebraska at Kearney, Kearney, NE.

Belnap, J., and D. A. Gillette. 1998. Vulnerability of desert soil surfaces to wind erosion: the influences of crust development, soil texture, and disturbance. *Journal of Arid Environments* 39: 133-42.

Benke, A.C., A.H. Huryn, L.A. Smock, and J.B. Wallace. 1999. Length-mass relationships for freshwater macroinvertebrates in North America with particular reference to the southeastern United States. Journal of the North American Benthological Society 18: 308-343.

Blair, J.M., T.C. Todd and M.A. Callaham, Jr. 2000. Responses of grassland soil invertebrates to natural and anthropogenic disturbances. Pages 43-71 In *Invertebrates as Webmasters in Ecosystems* (D.C. Coleman and P.F. Hendrix, eds.) CAB International Press, New York, NY.

Bolstad, P.V., K. Mitchell, J.M. Vose. 1999. Foliar temperature-respiration response functions for broad-leaved tree species in the southern Appalachians. *Tree Physiology* 19: 871-878

Bond, R. S. 1999. Professional forestry, forestry education and research. Pp. 220-225 In: C. H. Foster (Ed.), *Stepping Back to Look Forward - a History of the Massachusetts Forest.* Harvard Forest, Petersham, MA.

Bowman, W.D., A. Keller, and M. Nelson. 1999. Altitudinal variation in leaf gas exchange, nitrogen and phosphorus concentrations and leaf mass per area in populations of *Frasera peciosa*. *Arctic, Antarctic, and Alpine Research* 31: 191-195.

Braudrick, Christian A.; Grant, Gordon E. 2000. When do logs move in rivers? *Water Resources Research*. 36(2): 571-583.

Bremer, D.J., and J.M. Ham. 1999. Effect of spring burning on the surface energy balance in a tallgrass prairie. *Agricultural and Forest Meteorology* 97: 43-54.

Brock, B.L., and C.E. Owensby. 2000. Predictive models for grazing distribution: a GIS approach. *Journal of Range Management* 53:39-46.

Brooks, P.D., M.W. Williams. 1999. Snowpack controls on nitrogen cycling and export in seasonally snow-covered catchments. *Hydrologic Processes* 13:2177-2190.

Callaham, M.A. Jr. and J.M. Blair. 1999. Influence of differing land management on the invasion of North American tallgrass prairie soils by European earthworms. *Pedobiologia* 43:507-512.

Carrillo, C. J., and D. M. Karl, Dissolved inorganic carbon pool dynamics in northern Gerlache Strait, Antarctica, *Journal of Geophysical Research*, 104(C7), 15873-15884, 1999.

Catosvky, S. and F. A. Bazzaz. 1999. Elevated CO2 influences the responses of two birch species to soil moisture: implications for forest community structure. *Global Change Biology* 5: 507-518.

Cavitt, J.F. 1999. Effects of prairie fire and grazing on brown thrasher nest predation. Pages 112-119 In Proceedings of the Sixteenth North American Prairie Conference (J.T. Springer, ed.), University of Nebraska at Kearney, Kearney, NE.

Chase, T.N., R.A. Pielke, T.G.F. Kittel, J.S. Baron, and T.J. Stohlgren. 1999. Potential impacts on Colorado Rocky Mountain weather and climate due to land use changes on the adjacent Great Plains. *Journal of Geophysical Research* 104:16673-16690.

Cissel, John H.; Swanson, Frederick J.; Weisberg, Peter J. 1999. Landscape management using historical fire regimes: Blue River, Oregon. *Ecological Applications.* 9(4): 1217-1231.

Coleman, D.C., J.M. Blair, E.T. Elliott and D.H. Hall. 1999. Soil invertebrates. Pages 349-377 in G.P. Robertson, C.S. Bledsoe, D.C. Coleman and P.S. Sollins, editors. *Standard Soil Methods for Long Term Ecological Research*. Oxford University Press, New York.

Coleman, D.C., and P.F. Hendrix (eds.) 2000. Invertebrates as Webmasters in Ecosystems. CAB International Press, Wallingford, U.K., 336pp.

Cooper-Ellis, S., D. R. Foster, G. Carlton and A. Lezberg. 1999. Forest response to catastrophic wind: results from an experimental hurricane. *Ecology* 80: 2683-2696.

Crist, Thomas O. 1998. The spatial distribution of termite activity in shortgrass steppe: a geostatistical approach. *Oecologia* 114: 410-416.

Crossley, D. A. Jr. and David C. Coleman. 1999. Microarthropods. pp. C59-C65 in Malcolm E. Sumner (ed.-in-chief). 1999. Handbook of Soil Science. CRC Press, Boca Raton.

Crossley, D. A. Jr. and David C. Coleman. 1999. Macroarthropods. pp. C65-C70 in Malcolm E. Sumner (ed.-in-chief). 1999. Handbook of Soil Science. CRC Press, Boca Raton.

Currie, W. S. and K. J. Nadelhoffer. 1999. Dynamic redistribution of isotopically labeled cohorts of nitrogen inputs in two temperate forests. *Ecosystems* 2: 4-18.

Currie, W. S., K. J. Nadelhoffer and J. D. Aber. 1999. Soil detrital processes controlling the movement of 15N tracers to forest vegetation. *Ecological Applications* 9: 87-102.

Derner, J.D., and D.D. Briske. 1999. Does a tradeoff exist between morphological and physiological root plasticity? A comparison of grass growth forms. *Acta Oecologica* 20:519-526.

de Soyza, A. G., W. G. Whitford, J. E. Herrick, J. W. Van Zee, and K. M. Havstad. 1998. Early warning indicators of desertification: Examples of tests in the Chihuahuan desert. *Journal of Arid Environments* 39: 101-12.

Dolloff, C.A., and J.R. Webster. 2000. Particulate organic contributions from forests to streams: debris isn't so bad. Pages 125-138 *in* Riparian management in forests of the continental eastern United States, E.S. Verry, J.W. Hornbeck, and C.A. Dolloff (editors). Lewis Publishers, Boca Raton, Florida.

Downs, M. R., R. H. Michener, B. Fry and K. J. Nadelhoffer. 1999. Routine measurement of dissolved inorganic 15N in streamwater. *Environ. Mon. & Assess.* 55: 211-220.

Elliott, K.J., J.M. Vose, W.T. Swank, and P.V. Bolstad. 1999. Long-term patterns in vegetation-site relationships in a southern Appalachian Forest. *Journal of the Torrey Botanical Society* 126(4): 320-334.

Eve, M., W. G. Whitford, and K. M. Havstad. 1999. Applying satellite imagery to triage assessment of ecosystem health. *Environmental Monitoring and Assessment* 54: 205-7.

Foreign Names Committee, Foreign Names Committe Report: The Foreign Names Committee held its 317th meeting on July 28th, adopting the term 'Southern Ocean' as a standard name for the body of water surrounding the continent of Antarctica. Proposal to consider adoption of this name for official use was received from Dr. David M. Karl, Professor of Oceanography at the University of Hawaii. 1999.

Foster, D. R. 2000. The primeval forest. *Sanctuary* 39: 9-12.

Foster, D. R. and G. Motzkin. 1999. Historical influences on the landscape of Martha's Vineyard: Perspectives on the management of the Manuel F. Correllus State Forest. Harvard Forest Paper No. 23.

Foster, D. R. and J. O'Keefe. 2000. New England Forests Through Time. Insights to Conservation and Management from the Harvard Forest Dioramas. Harvard Forest and Harvard University Press. Petersham and Cambridge.

Foster, D. R., M. Fluet and E. R. Boose. 1999. Human or natural disturbance: landscape-scale dynamics of the tropical forests of Puerto Rico. *Ecological Applications* 9: 555-572.

Fraser, W. R., D. L. Patterson, P. Duley, and M. Irinaga, Seabird research undertaken as Part of the NMFS/AMLR ecosystem monitoring program at Palmer Station, 1998/99, in Administrative Report LJ-99-10, United States AMLR Antarctic Marine Living Resources Program, AMLR 1998/99 Field Season Report: objectives, accomplishments and tentative conclusions, edited by Martin, J., p. 155-158, Southwest Fisheries Science Center, Antarctic Ecosystem Research Group, La Jolla, CA, 1999.

Fredrickson, E., K. M. Havstad, R. Estell, and P. Hyder. 1998. Perspectives on desertification: Southwestern United States. *Journal of Arid Environments* 39: 191-207.

Garman, Steven L.; Swanson, Frederick J.; Spies, Thomas A. 1999. Past, present, and future landscape patterns in the Douglas-fir region of the Pacific Northwest. In: Rochelle, James A.; Lehmann, Leslie A.; Wisniewski, Joe, eds. *Forest fragmentation: wildlife and management implications*. Leiden, The Netherlands: Koninklijke Brill NV: 61-86.

George, L. O. and F. A. Bazzaa 1999b. The fern understory as an ecological filter: growth and survival of canopy tree seedlings. *Ecology* 80: 846-856.

George, L. O. and F. A. Bazzaz. 1999a. The fern understory as an ecological filter: emergence and establishment of canopy tree seedings. *Ecology* 80: 833-845.

Gibson, D.J., J. Connolly, D.C. Hartnett and J.D. Weidenhamer. 1999. Designs for greenhouse studies of interactions between plants. *Journal of Ecology* 87:1-16.

Gibson, D.J., J.S. Ely and S. L. Collins. 1999. The core-satellite species hypothesis provides a theoretical basis for Grimes classification of dominant subordinate, and transient species. *Journal of Ecology* 87:1064-1067.

Griffiths, R. P.; Homann, P. S.; Riley, R. 1998. Dentrification enzyme activity of Douglas-fir and red alder forest soils of the Pacific Northwest . *Soil Biology and Biochemistry*. 30(8/9): 1147-1157.

Guo, Qinfeng, Philip W. Rundel, and David W. Goodall. 1999. Structure of desert seed banks: comparisons across four North American desert sites. *Journal of Arid Environments* 42: 1-14.

Harmon, M. E., K. J. Nadelhoffer and J. M. Blair. 1999. Measuring decomposition, nutrient turnover and stores in plant litter. Pp. 202-240 In: G. P. Robertson, C. S. Bledsoe, D. C. Coleman and P. Sollins (Eds.), *Standard Soil Methods for Long Term Ecological Research*. Oxford University Press, New York.

Harmon, M.E., K.J. Naddlehoffer and J.M. Blair. 1999. Measuring decomposition, nutrient turnover and stores in plant litter. Pages 202-240 in G.P. Robertson, C.S. Bledsoe, D.C. Coleman and P.S. Sollins, editors. *Standard Soil Methods for Long Term Ecological Research*. Oxford University Press, New York.

Hart, Stephen C.; Perry, David A. 1999. Transferring soils from high- to low-elevation forests increases nitrogen cycling rates: climate change implications. *Global Change Biology*. 5: 23-32.

Hartnett, D.C., and G.W.T. Wilson. 1999. Mycorrhizae influence plant community structure and diversity in tallgrass prairie. *Ecology* 80:1187-1195.

Heneghan, L. D.C. Coleman, D.A. Crossley, Jr. and Z. Xiaoming. 1999. Nitrogen dynamics in decomposing chestnut oak (Quercus prinus L.) in mesic temperate and tropical forest. *Elsevier Science* 13: 169-175.

Heneghan, L., D.C. Coleman, X. Zou, D.A.Crossley, Jr., and B.L. Haines. 1999. Soil microarthropod contributions to decomposition dynamics: Tropical-temperate comparisons of a single substrate. Ecology 80: 1873-1882.

Hoch, G.A and J.M. Briggs. 1999. Expansion of eastern red cedar in the northern Flint Hills, Kansas. Pages 9-15 In Proceedings of the Sixteenth North American Prairie Conference (J.T. Springer, ed.), University of Nebraska at Kearney, Kearney, NE.

Hood, E., M. W. Williams, and D. Cline. 1999. Sublimation from a seasonal snowpack at a continental, mid-latitude alpine site. *Hydrologic Processes* 13:1781-1797.

Hooper, D.U., and L.C. Johnson. 1999. Nitrogen limitation in dryland ecosystems: responses to temporal and geographical variation in precipitation. *Biogeochemistry* 46:247-293.

Horii, C. V., M. S. Zahniser, D. D. Nelson, J. B. McManus and S. C. Wofsy. 1999. Nitric acid and nitrogen dioxide flux measurements: a new application of tunable diode laser absorption spectroscopy. In: Conference Proceedings of 1999 Annual SPIE Meeting, Denver, CO, July 1999.

Huryn, A.D., and J.B. Wallace. 2000. Life history and production of stream insects. Annual Review of Entomology 45: 81-108.

Hutchens, J.J. and E.F. Benfield. 2000. Will forest defoliation by gypsy moth impact detritus processing in southern Appalachian streams? American Midland Naturalist. 143: 131-138.

Jasienski, M. and F. A. Bazzaz. 1999. The fallacy of ratios and the testability of models in biology. *Oikos* 84: 321-326.

Jones, Julia A.; Swanson, Frederick J.; Wemple, Beverley C.; Snyder, Kai U. 2000. Effects of roads on hydrology, geomorphology, and disturbance patches in stream networks. *Conservation Biology*. 14(1): 76-85.

Karl, D. M., A farewell tribute to the Antarctic Research Vessel Polar Duke, *Oceanography*, 12(2), 7-17, 1999.

Kay, F. R., H. M. Sobhy, and W. G. Whitford. 1999. Soil microarthropods as indicators of exposure to environmental stress in Chihuahuan desert rangelands. *Biology and Fertility of Soils* 28: 121-28.

Kepner, R., A. Kortyna, R. Wharton, P. Doran, D. Andersen and E. Roberts. 1999. Effects of research diving on a stratified antarctic lake. *Water Research* 34(1):71-84.

Kepner, R., D.W. Coats, R. Wharton, Jr.. 1999. Ciliated protozoa of two antarctic lakes: analysis by quantitative protargol staining and examination of artificial substrates. *Polar Biology* 21:285-294.

Knapp, A.K., N. Bargman, L.A. Maragni, C.A. McAllister, D.J. Bremer, J.M. Ham and C.E. Owensby. 1999. Elevated CO2 and leaf longevity in the C4 grassland dominant *Andropogon gerardii*. *International Journal of Plant Sciences* 160:1057-1061.

Lascara, C. M., E. E. Hofmann, R. M. Ross, and L. B. Quetin, Seasonal variability in the distribution of Antarctic krill, *Euphausia superba*, west of the Antarctic Peninsula. *Deep-Sea Research*, 46(6), 951-984, 1999.

Lefer, B. L., R. W. Talbot and J. W. Munger. 1999. Nitric acid and ammonia at a rural northeastern U.S. site. *J. Geophys. Res.*, 104: 1645-1661.

Lefsky, M. A.; Cohen, W. B.; Acker, S. A. [and others]. 1999. Lidar remote sensing of the canopy structure and biophysical properties of Douglas-fir western hemlock forests. *Remote Sensing of Environment*. 70(3): 339-361.

Li, G., and A. D. Abrahams. 1999. Controls of sediment transport capacity in laminar interrill flow on stone-covered surfaces. *Water Resources Research* 35: 305-10.

McLachlan, J. S., D. R. Foster and F. Menalled. 2000. Anthropogenic ties to late-successional structure and composition in four New England hemlock stands. *Ecology* 81: 717-733.

McMillan, B.R., D.W. Kaufman and G.A. Kaufman. 1999. Rare species of small mammals in northeastern Kansas tallgrass prairie. Pages

120-126 In Proceedings of the Sixteenth North American Prairie Conference (J.T. Springer, ed.), University of Nebraska at Kearney, Kearney, NE.

Melillo, J.M. 1999. Warm, warm on the range. *Science* 283:183-184.

Moline, M. A., and B. B. Prezelin, Optical fractionation of chlorophyll and primary production for coastal waters of the Southern Ocean. *Polar Biology*, 23(2), 129-136, 2000.

Monger, H. C., D. R. Cole, J. W. Gish, and T. H. Giordano. 1998. Stable carbon and oxygen isotopes in Quaternary soil caronates as indicators of ecogeomorphic changes in the northern Chihuahuan Desert, USA. *Geoderma* 82: 137-72.

Motzkin, G., P. Wilson, D. R. Foster and A. Allen. 1999. Vegetation patterns in heterogeneous landscapes: the importance of history and environment. *Journal of Vegetation Science* 10: 903-920.

Motzkin, G., W. A. Patterson III, and D. R. Foster. 1999. A historical perspective on pitch pine scrub oak communities in the Connecticut Valley of Massachusetts. *Ecosystems*: 2: 255-273.

Mun, H. T., and W. G. Whitford. 1998. Change in mass and chemistry of plant roots during long-term decomposition on a Chihuahuan Desert watershed. *Biology and Fertility of Soils* 26: 16-22.

Murray, A. E., K. Y. Wu, C. L. Moyer, D. M. Karl, and E. F. DeLong, Evidence for circumpolar distribution of planktonic Archaea in the Southern Ocean. *Aquatic Microbial Ecology*, 18(3), 263-273, 1999.

Musick, H. Brad, Gerald G. Schaber, and Carol S. Breed. 1998. AIRSAR studies of woody shrub density in semiarid rangeland: Jornada del Muerto, New Mexico. *Remote Sensing of Environment* 66: 29-40.

Nadelhoffer, K. J., B. A. Emmett, P. Gundersen, O. J. Kjønaas, C. J. Koopmans, P. Schleppi, A. Tietema and R. F. Wright. 1999. Nitrogen deposition makes a minor contribution to carbon sequestration in temperate forests. *Nature* 398: 145-148.

Nadelhoffer, K. J., M. R. Downs and B. Fry. 1999. Sinks for N additions to an oak forest and a red pine plantation at the Harvard Forest, Massachusetts, USA. *Ecological Applications* 9: 72-86.

Nadelhoffer, K. J., M. R. Downs, B. Fry, A. Magill and J. D. Aber. 1999. Controls on N retention and exports in a fertilized watershed. *Environ. Mon. & Assess*. 55: 187-210.

Nash, M. S., W. G. Whitford, J. Van Zee, and K. M. Havstad. 1998. Monitoring changes in stressed ecosystems using spatial patterns of ant communities.*Environ. Mon. & Assess.*51: 201-10.

Nash, M. S., John P. Anderson, and Walter G. Whitford. 1999. Spatial and temporal variability in relative abundance and foraging behavior of subterranean termites in desertified and relatively intact Chihuahuan Desert ecosystems. *Applied Soil Ecology* 359: 1-9.

Nilsen, E.T., J.F. Walker, O.K. Miller, S.W. Semones, T.T. Lei, and B.D. Clinton. 1999. Inhibition of canopy tree seedlings by *Rhododendron maximum*: could allelopathy be a cause? American Journal of Botany 86(11):1597-1605.

Olson, R. J., J. M. Briggs, J. H. Porter, G. R. Mah, and S. G. Stafford. 1999. Managing Data from Multiple Disciplines, Scales, and Sites to Support Synthesis and Modeling. *Remote Sensing Environment.* 70:99-107.

Orwig, D. A. and D. R. Foster. 1999. Stand, landscape and ecosystem analyses of hemlock woolly adelgid outbreaks in southern New England: an overview. In: Sustainable Management of Hemlock Ecosystems in Eastern North America. Symposium Proceedings.

Orwig, D. A. and M. D. Abrams. 1999. Impacts of early selective logging on the dendroecology of an old-growth, bottomland hemlock-white pine-northern hardwood forest on the Allegheny Plateau. *J. Torrey Bot. Soc.* 126: 234-244.

Parendes, Laurie A.; Jones, Julia A. 2000. Role of light availability and dispersal in exotic plant invasion along roads and streams in the H.J. Andrews Experimental Forest, Oregon. *Conservation Biology.* 14(1): 64-75.

Parsons, Anthony J., John Wainwright, Peter M. Stone, and Athol D. Abrahams. 1999. Transmission losses in rills on dryland hillslopes. *Hydrological Processes* 13: 2897-905.

Pearson, S.M., M.G. Turner, and J.B. Drake. 1999. Landscape change and habitat availability in the southern Appalachian Highlands and Olympic Peninsula. *Ecological Applications* 9(4): 1288-1304.

Perry, David A. 1998. The scientific basis of forestry. Annu. Rev. Ecol. Syst. 29: 435-466.

Post, D. A.; Grant, G. E.; Jones, J. A. 1998. New developments in ecological hydrology expand research opportunities. EOS, *Transactions*, American Geophysical Union. 79(43): 517, 526.

Potosnak, M. J., S. C.Wofsy, A. S. Denning, T. J. Conway, and D. H. Barnes. 1999. Influence of biotic exchange and combustion sources on atmospheric CO2 concentrations in New England from observations at a forest flux tower. Journal Geophysical Research 104: 9561-9569.

Raab, T.K., D.A. Lipson and R.K. Monson. 1999. Soil amino acid utilization among species of the *Cyperaceae*: Plant and soil processes. *Ecology* 80:2408-2419.

Rainey, S. M., K. J. Nadelhoffer, S. L. Silver and M. R. Downs. 1999. Effects of chronic nitrogen additions on understory species abundance and nutrient content in a red pine plantation. *Ecological Applications* 9: 949-957.

Reich, P.B., D.S. Ellsworth, M.B. Walters, J.M Vose, C. Gresham, J.C. Volin, and W.D. Bowman. 1999. Generality of leaf trait relationships: a test across six biomes. *Ecology* 80(6): 1955-1969.

Reich, P.B., D.S. Ellsworth, M.B. Walters, J.M. Vose, C. Gresham, J.C. Volin, and W.D. Bowman. 1999. Generality of leaf traits: a test across six biomes. *Ecology* 80:1955-1969.

Reilly, J., R. Prinn, J. Harnisch, J. Fitzmaurice, H. Jacoby, D. Kicklighter, J. Melillo, P. Stone, A. Sokolov and C. Wang. 1999. Multi-gas assessment of the Kyoto Protocol. *Nature* 401: 549-555.

Reynolds, J. F., R. A. Virginia, P. R. Kemp, A. G. DeSoyza, and D. C. Tremmel. 1999. Impact of drought on desert shrubs: Effects of seasonality and degree of resource island development. *Ecological Monographs* 69: 69-106.

Reynolds, J. F., and J. Wu. 1999. Do landscape structural and functional units exist? In Integrating Hydrology, Ecosystem Dynamics, and Biogeochemistry in Complex Landscapes. J. D. Tenhunen, and P. Kabat(eds.), 273-96. Berlin: John Wiley and Sons.

Ross, R. M., L. B. Quetin, K. S. Baker, M. Vernet, and R. C. Smith, Growth limitation in young Euphausia superba under field conditions. *Limnology and Oceanography*, 45(1), 31-43, 2000.

Schartz, R.J. and R.R. Janke. 1999. Evaluation of native legumes for use as cover crops. *Journal of Sustainable Agriculture* 15:45-59.

Schlesinger, W. H., A. D. Abrahams, A.J. Parsons, and J. Wainwright. 1999. Nutrient losses in runoff from grassland and shrubland habitats in Southern New Mexico: I. rainfall simulation experiments. *Biogeochemistry* 45: 21-34.

Schlesinger, W. H., and A. M. Pilmanis. 1998. Plant-soil interactions in deserts. *Biogeochemistry* 42: 169-87.

Schowalter, T.D. and M.D. Lowman. 1999. Forest herbivory: insects. Pages 253-270 in L.R. Walker, editor. Ecosystems of Disturbed Ground. *Ecosystems of the World 16*. Elsevier, Amsterdam.

Smith, D. A., E. E. Hofmann, C. M. Lascara, and J. M. Klinck, Hydrography and circulation of the west Antarctic Peninsula continental shelf, *Deep-Sea Research*, 46(6), 925-949, 1999a..

Smith, M.D., D.C. Hartnett, and G.W.T. Wilson. 1999. Interacting influence of mycorrhizal symbiosis and competition on plant diversity in tallgrass prairie. *Oecologia* 121:574-582.

Smith, R. C., E. Domack, S. Emslie, W. Fraser, D. Ainley, K. S. Baker, J. Kennett, A. Leventer, E. Mosley-Thompson, S. E. Stammerjohn, and M. Vernet, Marine Ecosystems sensitivity to historical climate change: Antarctic Peninsula, *BioScience*, 49(5), 393-404, 1999b.

Soranno, P.A., K.E. Webster, J.L. Riera, T.K. Kratz, J.S. Baron, P. Bukaveckas, G.W. Kling, D. White, N. Caine, R.C. Lathrop, and P. Leavitt. 1999. Spatial variation among lakes within landscapes: ecological organization along lake chains. Ecosystems 2:395-410

Stapanian, M A., C C. Smith and E J. Finck. 1999. Weather effects on winter birds: the response of a Kansas winter bird community to weather, photoperiod, and year. Wilson Bulletin 111:550-558.

Swanson, Frederick J.; Johnson, Sherri L.; Gregory, Stanley V.; Acker, Steven A. 1998. Flood disturbance in a forested mountain landscape. *BioScience*. 48(9): 681-689.

Swift, L.W. Jr. and R.G. Burns. 1999. The three R's of roads: redesign, reconstruction, and restoration. *Journal of Forestry* 97(8): 40-44.

Tian, H., J. M. Melillo, D. W. Kicklighter, A. D. McGuire and J. Helfrich. 1999. The sensitivity of terrestrial carbon storage to historical climate variability and atmospheric CO2 in the United States. *Tellus* 51B: 414-452.

Todd, T.C., J.M. Blair and G.A. Milliken. 1999. Effects of altered soil water availability on a tallgrass prairie nematode community. *Applied Soil Ecology* 13:45-55.

Toetz, D. 1999. Multiple limiting nutrients in a subalpine stream, Colorado Front Range. *Journal of Freshwater Ecology* 14:349-355.

Towne, E.G. 1999. Bison performance and productivity on tallgrass prairie. *Southwestern Naturalist* 44:361-366.

Towne, E.G. 2000. Prairie vegetation and soil nutrient responses to ungulate carcasses. Oecologia 122:232-239.

Tracy, K. N., D. M. Golden, and T. O. Crist. 1998. The spatial distribution of termite activity in grazed and ungrazed Chihuahuan Desert grassland. *Journal of Arid Environments* 40: 77-89.

Turner, D.P, W.B. Cohen, R.E. Kennedy, K.S Fassnacht and J.M. Briggs. 1999. Relationships between leaf area index and Landsat TM spectral vegetation indices across three temperate zone sites. *Remote Sensing of the Environment* 70:52-68.

Urban, Dean L.; Acevedo, Miguel F.; Garman, Steven L. 1999. Scaling fine-scale processes to large-scale patterns using models derived from models: meta-models. In: Mladenoff, David J.; Baker, William L., eds. *Spatial modeling of forest landscape change: approaches and applications*. Cambridge, UK: Cambridge University Press: 70-98.

Vallino, J.J. (2000) Improving marine ecosystem models: use of data assimilation and mesocosm experiments. *J. Mar. Res.* 58: 117-164.

Vose, J.M., and P.V. Bolstad. 1999. Challenges to modelling NPP in diverse eastern deciduous forests: species-level comparisons of foliar respiration responses to temperature and nitrogen. *Ecological Modelling* 122: 165-174.

Wainwright, J., A. J. Parsons, and A. D. Abrahams. 1999. Field and computer simulation experiments on the formation of desert pavement. *Earth Surface Processes and Landforms* 24: 1025-37.

Wainwright, J., A. J. Parsons, and A. D. Abrahams. 1999. Rainfall energy under creosotebush. *Journal of Arid Environments* 43: 111-20.

Walker, J.F., T. Lei, S. Semones, E.T. Nilsen, B.D. Clinton, and O.K. Miller. 1999. Suppression of ectomycorrhizae on canopy tree seedlings in *Rhododendron maximum L. (Ericaceae)* thickets in the southern Appalachians. *Mycorrhiza* 9:49-56.

Walker, L.R. 1999. Patterns and processes in primary succession. Pages 585-610 in L.R. Walker, editor. Ecosystems of Disturbed Ground. *Ecosystems of the World 16*. Elsevier, Amsterdam.

Walker, L.R., editor. 1999. Ecosystems of Disturbed Ground. Ecosystems of the World 16. Elsevier, Amsterdam. Walker, L.R. and M.R. Willig. 1999. An introduction to terrestrial disturbances. Pages 1-16 in: L.R. Walker, editor. Ecosystems of Disturbed Ground. *Ecosystems of the World 16*. Elsevier, Amsterdam.

Wall, D. H., and R. A. Virginia. 1999. Controls on soil biodiversity: insights from extreme environments. *Applied Soil Ecology* 13: 137-50.

Wallace, J.B., S.L. Eggert, J.L. Meyer, and J.R. Webster. 1999. Effects of resource limitation on a detrital-based ecosystem. Ecological Monographs 69: 409-442.

Wallace, J.B. and J.J. Hutchens. 2000. Effects of invertebrates in lotic ecosystem processes. pp. 73-96 In: D. C. Coleman and P. F. Hendrix (eds.) *Invertebrates as Webmasters in Ecosystems*. CABI Publishing, Oxon, United Kingdom.

Webster, J.R., E.F. Benfield, T.P. Ehrman, M.A. Schaeffer, J.L. Tank, J.J. Hutchens, and D.J. D'Angelo. 1999. What happens to allochthonous material that falls into stream? A synthesis of new and published information from Coweeta. *Freshwater Biology* 41: 687-705.

Whigham, D.F., M.B. Dickinson, and N.V.L. BROKAW. 1999. Background canopy gap and catastrophic wind disturbances in tropical forests. Pages 223-252 in L.R. Walker, editor. Ecosystems of Disturbed Ground. *Ecosystems of the World 16*. Elsevier, Amsterdam.

Whitford, W. G. 1999. Effects of repeated drought on soil microarthropod communities in the northern Chihuahuan Desert. *Biology and Fertility of Soils* 28: 121-28.

Whitford, W. G., A. G. de Soyza, J. W. Van Zee, J. E. Herrick, and K. M. Havstad. 1998. Vegetation, soil, and animal indicators of rangeland health. *Environ. Mon. & Assess.*51: 179-200.

Wilig, M.R. and L.R. Walker. 1999. Disturbance in terrestrial ecosystems: salient themes, synthesis, and future directions. Pages 747-767 in L.R. Walker, editor. Ecosystems of Disturbed Ground. *Ecosystems of the World 16*. Elsevier, Amsterdam.

Williams, M.W., D. Cline, M. Hartman, T. Bardsley. 1999. Data for snowmelt model development, calibration, and verification at an alpine site, Colorado Front Range. *Water Resources Research* 35:3205-3209.

Williams, M.W., R. Sommerfeld, S. Massman, and M. Rikkers. 1999. Correlation lengths of meltwater flow through ripe snowpacks, Colorado Front Range, USA. *Hydrologic Processes* 13:1807-1826.

Willig, M.R. and M.A. McGinley. 1999. The response of animals to disturbance and their roles in patch generation. Pages 633-658 in L.R. Walker, editor. Ecosystems of Disturbed Ground. *Ecosystems of the World 16*. Elsevier, Amsterdam.

Wilson, G.W.T., and D.C. Hartnett. 1998. Interspecific variation in plant responses to mycorrhizal colonization in prairie grasses and forbs. *American Journal of Botany* 85:1732-1738.

Wondzell, Steven M.; Swanson, Frederick J. 1999. Floods, channel change, and the hyporheic zone. *Water Resources Research.* 35(2): 555-567.

Wright, C.J. and D.C. Coleman. 1999. The effects of disturbance events on labile phosphorus fractions and total organic phosphorus in the southern Appalachians. *Soil Science* 164(6): 391-402.

Special Issue

Tim Kratz and Tom Frost (NTL LTER) have edited a special issue of *Freshwater Biology* (April 2000, Blackwell). "The Ecological Organization of Lake Districts" is a collection of papers resulting from an international workshop held to evaluate the landscape ecology of different lake districts around the world. The issue includes several papers from the NTL-LTER sites, a paper from Toolik Lake and one from McMurdo Dry Valleys, Antarctica, as well as many international papers.

Calendar

Coming events of interest to the LTER Community

May 8-12, 2000
The **International Boreal Forest Research Association** announces an **International Science Conference**, "The Role of Boreal Forests and Forestry in the Global Carbon Budget", to be held in Edmonton, Alberta, Canada. For more information, please review the web site: www.nofc.forestry.ca/carbon

May 18-21, 2000
Palmer LTER announces their **Annual Science Meeting**
University of Hawaii at Manoa. For more information, please see the web site: http://www.crseo.ucsb.edu/lter/meetings/00palpi/

May 23 - 25, 2000
The Institute of Landscape Ecology, the Slovak Academy of Sciences Faculty of Horticulture and Landscape Engineering, Slovak Agricultural University, the Slovak Ecological Society and Long Term Ecological Research announce "Current State and Perspectives in the Central and Eastern Europe" in Nitra, Slovak Republic. For more information, please, contact: Institute of Landscape Ecology, Slovak Academy of Sciences, Branch Niitra Akademická 2, P.O. Box 23B, SK-949 01 NITRA, Slovak Republic Phone: ++421 87 356 01 (-4) Fax:421 87 356 08 Contact:Lubos Halada (nrukhala@savba.sk), Peter Gajdoš (nrukgajd@.savba.sk)

July 13, 2000
Jornada LTER announces its Tenth Annual **Jornada Symposium**. For more information, please see the JRN LTER web site: http://jornada.nmsu.edu/

August 2-4, 2000—The **LTER Network's All-Scientists Meeting,** Snowbird, Utah. Please see the Web: http://www.lternet.edu/allsci2000

August 6-10, 2000— ESA's 85th Annual Meeting Snowbird, Utah. For more information, see the Web site: http://www.sdsc.edu/~ESA/esa.htm

16-20 July 2001
DETECTING ENVIRONMENTAL CHANGE: SCIENCE AND SOCIETYOrganised by: NERC Centre for Ecology and Hydrology and Environmental Change Research Centre, UCL with UK Environmental Change Network, in association with The International Long Term Ecological Research Network in London, UK
The Conference will focus on the detection and understanding of long-term changes in natural and disturbed environmental systems. It will review methods of environmental change detection across different disciplines by bringing together scientists and stakeholders concerned with monitoring in terrestrial, freshwater, marine, hydrological, atmospheric, and social systems.
For more information, contact: Dr Catherine E Stickley, Environmental Change Research Centre, Department of Geography, University College London, 26 Bedford Way, London WC1H 0AP, UK

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

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