LTER NETWORK NEWS

Newsletter of the Long-Term Ecological Research Network

Winter 1992-1993, Issue 12

The Freshwater Imperative

Sustaining freshwater systems in a changing world

Momentum is gathering to develop a "Freshwater Initiative" for the United States. As a result of the collective effort of an ad hoc committee of several scientists, professional societies and individuals, the initial steps are now being taken. In June 1992, the National Science Foundation, in cooperation with other federal agencies, provided funds to identify opportunities and frontiers in inland water research (limnology, aquatic ecology). The goal is to provide a predictive understanding of inland aquatic ecosystems and resources as related to global environmental change. The Steering Committee intends to focus on fundamental research issues in inland aquatic ecosystems (including humans as an integral part) to examine a continuum of spatial and temporal scales, and to define the boundaries of their discussions by the nature of the question or issue.

This process requires the active participation and support of the science community. The Committee envisions that it will take several meetings over a year and a half to develop a reasonable consensus on priority items and to prepare a final document for publication. During this period, the Committee will hold a workshop with invited members of the professional community, meet with colleagues at professional meetings to obtain additional input and inform others of activities and progress, and invite opinions from colleagues who are under-represented on the Committee or who are from emerging research areas.

The final document will identify and analyze key issues, highlight issues which provide unusual opportunities or research frontiers, discuss significant advances that can be achieved, and provide a discussion of how recommendations may be implemented.

The Steering Committee seeks compelling ideas on inland water research. All comments received will be acknowledged and thoughtfully considered. Please write to one of the co-chairs:

Robert J. Naiman
Center for Streamside Studies
University of Washington
Seattle, Washington 98195

John J. Magnuson
Center for Limnology
University of Wisconsin
Madison, Wisconsin 53706

In this issue:

JERRY F. FRANKLIN

Peaks in the Brooks Range above the Atigun River crossing of the Dalton Highway and the Alaska Pipeline (foreground). See pages 8 and 9 for more photos of the August 1992 field trips to the two Alaska LTER sites.

An open letter to the LTER community. . .

A Year at the LTER Network Office

October 20, 1992

Dear LTER Colleagues,

Last year I applied for and was fortunate enough to receive an NSF Mid-Career Fellowship in Environmental Biology to study comparative landscape ecology. I wanted to learn how to use the powerful computer network available at our LTER Network GIS/Remote Sensing Laboratory to compare at nested spatial scales the spatial heterogeneity of the remote sensing scenes that include our LTER sites. The LTER Network Office and staff have been my gracious hosts and trainers.

Consequently, 1992 has been an unusually good year for me and a real challenge. When I arrived in Seattle, I had to learn enough about Unix and *vi* (a text editor) and a complex of SPARK SUN stations, a Macintosh and a PC before I could begin to get into the software for image analysis and GIS: a maze for any gray matter, especially if the analyst, too, is graying. This was the first time I had dealt with quantitative analyses from such large datasets, or a computer that works all night while I ponder how to keep it busy on succeeding nights.

In spite of the expected frustrations, I have found the whole process demystifying, and rather satisfying. This experience could only have been possible, at least for me, with the break from the press of responsibilities at one's home institution that a Mid-Career Fellowship can offer. Had I known the technologies beforehand, I could have completed more analyses than I will have when I return home in January 1993.

John Vande Castle and I are working on the Landsat scenes of your sites, comparing them with the other sites', and calculating vegetation indices for each 1991 thematic mapper scene masked for clouds, cloud shadow and water. We have a long way to go but, when complete, these intermediate products may be of use to you.

Each day, I am reminded of the magnitude of our intersite database as it exists in the remote sensing data from the sites. We have yet to scratch the surface of this resource. We have yet to build an annual time series of such extensive data. Yet, it is not in the least too early to consider and plan for the analyses to be done five, even 10 years from now with this rich database.

JOHN J. MAGNUSON

John Magnuson (left) with John Vande Castle and Rudolf Nottrott in the LTER GIS/Remote Sensing Laboratory.

One general, long-term goal could be to analyze temporal and spatial heterogeneity of a diverse set of ecosystems at the same grain and at nested sets of spatial scales. A fundamental ecological idea that has reappeared in many forms is that the temporal behavior of ecological systems is influenced greatly by structural complexity. Our ability to deal with this issue in a general way across ecosystems and landscapes is limited, in part, because measures of spatial heterogeneity depend on the scale of measurement, and that differs greatly among our subdisciplines and ecosystems. Remote sensing may provide the only tool we have to observe landscapes as different as forests, lakes and prairies at the same spatial scales.

The University of Washington and the LTER Network Office are good places to spend a year: good colleagues, a good support system, a good library and, for those of you interested in quantitative analyses of the LTER remote sensing database, a powerful facility for analysis.

Sincerely,

John

John J. Magnuson is on research leave at the LTER Network Office in Seattle, Washington from the North Temperate Lakes LTER site and the University of Wisconsin-Madison.

The SBI Implementation Plan

Applying ecological science to society's environmental problems

James Gosz, Executive Director

The Ecological Society of America's Sustainable Biosphere Initiative (SBI) calls for the application of ecological science to societal problems. To develop activities that further the SBI agenda, the Project Office was established in Washington, D.C. in January 1992 through a grant from the National Science Foundation (NSF), with additional support from the National Aeronautic and Space Administration, the Environmental Protection Agency (EPA), the USDA Forest Service, and the U.S. Fish and Wildlife Service.

Project Office Staff & Activities

The combined education and experience of the Project Office staff complement the integrative, cross-disciplinary aims of the SBI. Program Assistant Stephanie Cirillo holds a degree in resource management and has experience in project development and coordination in the environmental field. Dr. Richard (Rick) Haeuber, Associate Director, received his PhD in public policy. His research and career experience have focused on environmental policy.

The Project Office has already evolved into an effective communication and coordination center. Meeting the many requests for SBI representation in various forums in the past few months, staff have attended conferences sponsored by the United Nations, the Forest Service, NSF, EPA, and other scientific associations and societies concerned with ecological sustainability issues. Meetings with representatives of other federal agencies have led to the incorporation of the SBI into their environmental and scientific agendas.

The SBI Implementation Plan

With the broad applicability of the SBI—from the microbial to the global, the individual to the societal—Project staff created an implementation plan to focus their efforts. The SBI Implementation Plan has three primary objectives:

- to communicate with scientific communities, agencies, national and international programs, and industries,
- to identify new scientific issues, research and information needed for current and future research programs, and
- to catalyze development of new concepts through workshops, symposia, position papers and publications.

Components of the Plan are purposely interrelated to ensure development of activities that include more than one component. Staff are incorporating research priorities of biodiversity, global change and sustainable ecosystems into projects that foster collaboration between ecologists and educators, other researchers, and environmental decisionmakers. An early result of the Plan has been a collaborative effort between the SBI Office and individual scientists in developing concept papers on important topics that are expected to lead to workshops and funded research programs. Topics include: the role of cumulative effects of management on biodiversity and ecological processes, characteristics and dynamics of transition zones, status of biodiversity inventories and information networks, the role of restoration in sustainability, and new perspectives on change in ecological planning.

The Plan is also providing direction for the Intellectual Frontiers Project being developed by the ESA with the SBI Project Office, and the EPA with the Future Studies Group. This Project will identify structural and organizational learning barriers to cross-disciplinary knowledge and approaches receiving adequate consideration in research and policymaking institutions. The Office will first promote peer-generated research through a series of collaborative workshops, and then prompt new interdisciplinary concepts, research and projects through communication with scientific communities, agencies, and policymakers. It is also working with educational societies, such as the Association of American Colleges, to produce in-house general educational materials on sustainability and the SBI.

The SBI Project Office seeks the participation of individual scientists in its projects and activities. Comments and queries are welcomed, as are visits to the Office at 2010 Massachusetts Avenue NW, Suite 420, Washington, D.C., 202-833-8748.

JACK WEBSTER

James Gosz Named DEB Director at NSF

Dr. James R. Gosz, principal investigator of the Sevilleta LTER site, has been named Division Director for Environmental Biology at the National Science Foundation. Currently in Washington, D.C. directing the SBI Project Office for the Ecological Society of America, Dr. Gosz will assume his new responsibilities in January 1993.

Network Data Management. . .

LTER Network Support System

Simplified Access & New Capabilities

Access to the LTERnet Network Support System has recently been simplified. The system Internet name has been shortened from *LTERnet.Washington.edu* to LTERnet.edu. To reflect LTER's linkage with segments of the wider ecological research community, LTERnet now also has the name *ESnet.edu* (for Ecological Sciences Network). Despite these changes, previous LTERnet addresses will remain valid and synonymous with *LTERnet.edu* (Internet) or *LTERnet* (Bitnet).

New capabilities have been added to the LTERnet information system, including: query functions for the dataset catalog (both electronic-mail and direct access), a menu-driven information system access, and new mail paths between LTERnet and the USDA Forest Service. For the most recent copy of the LTERnet system overview document, which details these and other capabilities, send any message to *Overview@LTERnet.edu*.

1992 Data Managers Meeting Honolulu, HI

Data managers from all LTER sites participated in the annual LTER Data Management Meeting, August 7-9, 1992 in Honolulu, Hawaii, held in conjunction with the Ecological Society of America (ESA) meetings. After reviewing the year's progress, participants discussed a proposed all-site bibliography, further facilitation of data exchange, the LTER 10-year plan, the 1993 All Scientists Meeting, and other network-level projects. A detailed report of the meeting is available on-line (*Overview@LTERnet.edu* for directions). Listed below are 1991-92 activities and accomplishments not previously reported in the *News*, highlights of the 1992 meeting, and proposed activities.

1992 Meeting and Proposed Activities

- Recommendations to the Coordinating Committee were developed for enhancing data management capabilities at LTER sites during the next decade, focusing on Network infrastructure, education and curricula, intersite data access (including multimedia capabilities), and product development cooperation with the computer industry. Presentations and demonstrations will be prepared for the 1993 All Scientists Meeting and International Summit (see page 7).

1991-1992 Activities and Accomplishments

- The Interactive Data Access (IDA) working group conducted a survey of all sites on the status of data accessibility.
- The quality assurance/quality control working group conducted a Network-wide survey, and compiled results in a draft report, Electronically Collected Data in the LTER Network.
- Several data managers participated in the development of the proposed Intersite Detrital Inputs Removal and Trenching Study (DIRT) project, which involves eight LTER and non-LTER sites.
- With NSF funding, a symposium, Environmental Information Management and Analysis: Ecosystem to Biosphere Scales, has been scheduled for March 1993 in Albuquerque, New Mexico.
- A prototype for a comprehensive LTER Network bibliographic database, with possible links to the catalog of core datasets and the personnel database, will be developed.
- A standard protocol for site exchange of metadata (documentation, methods) will be developed, using existing documentation standards and tools to extract metadata in a format developed at the Central Plains site. These tools will simplify data exchange and form the foundation for automatic maintenance of the dataset catalog.
- A five-year Network data management plan will be drafted. Activities proposed include: expansion of the dataset catalog to incorporate all site long-term datasets, development of a data management tool kit, and increasing on-line documentation.

1993 meeting topics include: appropriate journals for publication, the All Scientists presentation, a refined common data exchange format, relationships with professional societies, and the global positioning systems (GPS) training workshop to follow the ESA meetings.

Rudolf Nottrott & John Porter

International Data Management. . .

美中学术交流委员会

FU SHEN

CERN - LTER Collaboration Advances

Following an exchange of research delegations from the Chinese Ecological Research Network (CERN) and the LTER Network in 1991 (see *Network News*, Winter 1991/1992), two recent developments have further advanced the collaboration. First, four LTER Data Managers traveled to Beijing in September 1992 to assist CERN scientists with research data management issues and, second, the National Science Foundation (NSF) has awarded funds to LTER researchers for a 1993 research data management training program for CERN.

LTER Data Managers Return to China

In cooperation with the National Academy of Science Committee for Scholarly Communication with the Peoples Republic of China (CSCPRC/NAS), the World Bank and the Chinese Academy of Sciences (CAS), LTER Data Managers returned to Beijing in September to contribute to the development of design plans for a data management system and data management training for CERN. James Brunt (Sevilleta), Tom Kirchner (Central Plains), Bill Michener (North Inlet), and Susan Stafford (H.J. Andrews) will be working with CERN personnel at the invitation of Dr. Zhao Jianping and Dr. Sun Honglie of CAS. The effort, lead by Bill Michener, represents a continuation of the collaboration begun at the 1990 LTER All Scientists Meeting, at which Dr. Zhao Shidong represented CERN.

One of the highlights of the trip was a two-day data management workshop during which the LTER group met with scientists responsible for data management at CERN field stations and sub-centers (disciplinary centers responsible for key efforts), and a synthesis center for data and training. Topics discussed included data management system design and training, and the modeling-data management interface. Some of these scientists will participate in the 1993 training program, described below.

CERN Data Managers to Attend Training in Albuquerque, New Mexico

With combined funding from NSF's International Programs and Environmental Biology divisions and CAS, a "proof-of-concept" prototype training course will be offered at theUniversity of New Mexico in Albuquerque in 1993. The proposal for the activity, submitted by Sevilleta LTER investigators James Gosz and James Brunt, was developed over the course of the collaboration through the combined efforts of Barbara Benson (North Temperate Lakes), Bill Michener, Susan Stafford (H. J. Andrews Experimental Forest) and Beryl Leach (CSCPRC Program Manager). Many other LTER Data Managers will also contribute to the development of the course.

The training will address basic concepts of managing long-term ecological research information across both networks. The primary audience will be CERN data managers and administrators responsible for design and development of a system of Research Data Management within CERN. LTER Data Managers will team-teach modules to illustrate the diversity of techniques and cover issues from broad principles of design and organization to specific implementation. The format will include lectures, demonstrations, discussions and hands-on computer experience.

This effort will establish groundwork for protocols and standards to facilitate the exchange of ecological research data internationally. Group discussions in the training course will focus on the needs for international collaboration and sharing of long-term datasets and will address the establishment of clear and attainable international data management objectives. The course will culminate in a curriculum development exercise for future training courses in China in which LTER and trained CERN data managers will work side by side in training other CERN data management personnel. Collaborative assistance of this kind will help to cement the bonds between CERN and LTER and should lead to broader international cooperation in ecological research.

James Brunt, Sevilleta LTER

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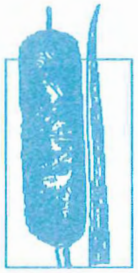


Konza Prairie-Hubbard Brook Collaborative Methane Study

In a collaborative project conceived through discussions at the 1992 LTER All Scientists Meeting, Alan Knapp (Kansas State University and Konza Prairie LTER) and Joseph Yavitt (Cornell University and Hubbard Brook LTER), are studying the role of cattail-dominated wetlands as a source of tropospheric methane. These wetlands are ideal systems for study since cattail (*Typha latifolia*) occurs throughout North America, and these plants act as conduits for methane release from sediments to the troposphere. Environmental controls and plant physiological mechanisms that determine fluxes are especially poorly known.

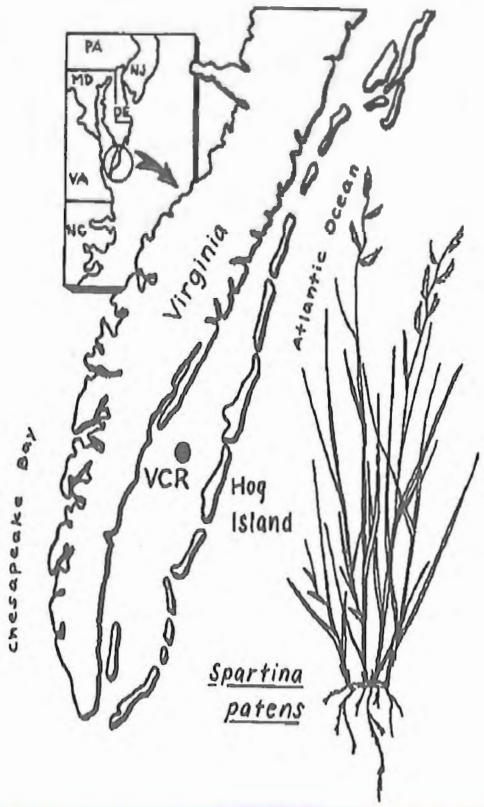
Drs. Knapp and Yavitt have obtained funding from the National Geographic Society to conduct experiments and field surveys of methane emissions from cattail-dominated wetlands along a latitudinal gradient. They have already carried out sampling at Sevilleta and Konza, where cattails are relatively inconspicuous but nevertheless important, to Cedar Creek, where cattail wetlands are prominent. Preliminary results suggest higher flux rates (per meter square basis) at Sevilleta and Konza than at Cedar Creek. They hope to add other LTER sites in future sampling. The data that result from this blending of ecological, plant physiological and geochemical research will be important for the development of more accurate global change models.

For further information: Alan Knapp, Kansas State University, Division of Biology, Ackert Hall, Manhattan, Kansas 66506-4901, 913-532-7094.

Virginia Coast Reserve LTER Participates In U.S. MAB Sustainability Workshop

LTER representation at the May 1992 U.S. Man and the Biosphere (MAB) Human Dominated Systems Directorate workshop on sustainability included several scientists from Virginia Coast Reserve (VCR) LTER site. Also in attendance was James Gosz, Sevilleta LTER, in his role as Director of the Sustainable Biosphere Initiative Project Office. The Directorate focuses on ecological systems that are significantly affected by human activities, with a central theme of ecological sustainability. The workshop was part of a program to explore issues in the context of environmental problems within three U.S. Biosphere Reserves: the Everglades and surrounding areas of south Florida, the New Jersey Pinelands, and the Virginia Coastal Reserve.

The VCR working group (Bruce Hayden, Joseph Zieman, Mark Brinson, John Porter, Barry Truitt) developed a hierarchical scheme for relating ecosystem types, ecological attributes, and sustainability goals that will be explored for possible application to other case studies. A follow-up workshop to include representatives from the social science community is planned for the spring of 1993.



For further information: 1993 workshop chair, Mark Harwell, 305-361-4157. For information on the Human Dominated Systems Directorate: 703-235-2946 or 2947.

1993 LTER All Scientists Meeting

Synthesis & Multi-Site Research in the LTER Network

The 1993 LTER All Scientists Meeting will be held September 19-24 in Estes Park, Colorado at the YMCA of the Rockies, site of the 1990 meeting. The meeting will follow an alternating presentation-workshop-poster session format with a specific focus on synthesis and multi-site long-term ecological research. In addition to highlighting this theme, objectives of the meeting are to: provide participants with a network-level perspective on long-term ecological research, present the LTER Network's 10-year plan, create opportunities for partnerships between LTER and other networks, long-term sites, scientific centers or programs, and encourage wider participation and develop leadership.

The scientific program is being developed by a committee of six scientists and two graduate students, who will also invite speakers, solicit leaders for workshops, and plan post-meeting reports. Suggestions for poster abstracts, workshop topics and leaders are currently being solicited. Meeting logistics will be arranged by the LTER Network Office in Seattle, Washington.

For further information: Caroline Bledsoe, University of California, Davis, 916-752-0388, csBledsoe@ucdavis.edu, cBledsoe@LTERnet.edu. *Or: John Vande Castle, LTER Network Office, 206-543-6249,* jVandeCastle@LTERnet.edu.

SCHEDULE
September 19-24, 1993

S	LTER Executive Committee Meeting, Evening talk on LTER's History		
	Morning	***Afternoon***	***Evening***
M	New Directions	Workshops	Poster Session
T	Multi-Site/Synthesis	Workshops	Poster Session
W	Long-Term Studies	Workshops	BBQ/Social
T	Scaling Beyond Sites	Workshops	Highlights
F	Field Trips, International LTER Summit - all day		
S	International LTER Summit - all day		

1993 Gordon Conference:

Hydrologic, Geochemical & Biological Interactions

In 1991 a Gordon Conference was established to promote discussion and interaction between hydrologists, geochemists and biologists working in forest ecosystems. The next conference is scheduled for August 2-6, 1993 at the Holderness School in New Hampshire. LTER principal investigator Charles Driscoll (Hubbard Brook LTER) is conference chair. The program will include four separate sessions:

- Monday, August 2, Upland Ecosystems
- Tuesday, August 3, Stream & Near-Stream Ecosystems
- Thursday, August 5, Wetland Ecosystems
- Friday, August 6, Lake Ecosystems

In addition, a keynote speaker and several session speakers will be scheduled daily, and a series of poster sessions will be presented throughout the meeting. John Aber (Harvard Forest LTER) has agreed to host a field trip to the Harvard Forest on August 4. LTER participation, and the participation of students, women and minorities, is particularly encouraged.

To comment on the conference program or to offer speaker suggestions, call Charles Driscoll as soon as possible at 315-443-2311 or via Fax at 315-443-1243.

ALASKA

Arctic Tundra LTER

Bears vs. Scientists

Two research assistants at the Arctic Tundra LTER site in Alaska had a close encounter with grizzly bears this past July. Jacques Finlay and Neil Bezzez were hiking in the Itkillik Valley of the Brooks Range, about 30 miles from the LTER site. A light snow was falling in a strong wind; it was so windy, in fact, that a sow bear with two small cubs did not hear them coming, and suddenly appeared from some willows about 25 feet away. The sow made one false charge and then charged again. Jacques turned just as she reached him, her claws ripping the sleeping pad on the back of his pack. The blow knocked him to his knees, and he received a bite on his shoulder that bruised but did not break the skin. At that point, the bear ran off. The encounter was a classic one, with everyone following the rules. The hikers deliberately made a lot of noise, and the surprised bear made a false charge. Even when contact was made, however, she did not follow through—despite the fact that a sow with cubs is considered the most dangerous of bears.

Jacques works with Breck Bowden at the University of New Hampshire. Neil is a graduate student with Parke Rublee of the University of North Carolina, Greensboro, and was employed by the Marine Biological Laboratory at Woods Hole, Massachusetts for the summer.

John Hobbie & Jacques Finlay

STEPHANIE MARTIN

John Hobbie, Arctic Tundra LTER principal investigator, describes long-term lake studies at Toolik, which began in 1975 with surveys of the biota, chemistry, and processes ranging from primary production to nutrient budgets.

JERRY F. FRANKLIN

Stacked for winter storage, these small greenhouses are used by student Sarah Hobbie to warm areas of tundra vegetation (staked in foreground) in LTER-related research currently funded by NSF and NASA. An LTER weather station is visible in the background (right).

JERRY F. FRANKLIN

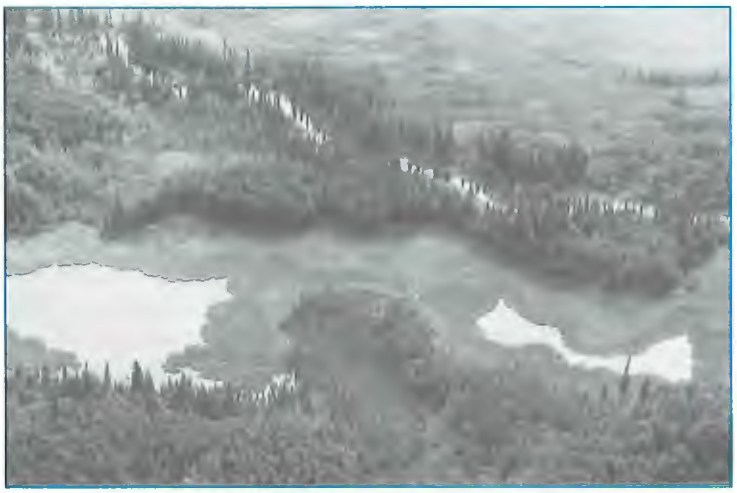
Toolik Camp sauna. Water for washing at the Camp is limited; waste water and sewage are trucked out.

STEPHANIE MARTIN

Limnocorrals for examining responses of nutrient and fish manipulation, Toolik Lake, Toolik Camp.

FIELD TRIPS

Bonanza Creek LTER



JERRY F. FRANKLIN

Typical northern floodplain forest with stunted black spruce in boggy areas and white spruce, shrub birch, alder and willow in the narrow frost-free border along an active river.

JERRY F. FRANKLIN

Bonanza Creek (BNZ) principal investigator Keith Van Cleve describes soil characteristics of the south-aspect upland forest. Also pictured are BNZ researchers John Yarie (left), Phyllis Adams and Joshua Schimel.

JERRY F. FRANKLIN

Looking out over the Tanana River floodplain from an older river terrace.

JERRY F. FRANKLIN

Muskeg, or grassy bog, underlain by permafrost, with stunted black spruce.

Early Winter

A record three-day snow followed by nearly a month of record-shattering low temperatures brought a premature close to summer field work at the Bonanza Creek (BNZ) LTER site. September's record cold set an average of -1.4°C, 8.5°C below normal. The storm arrived while trees were fully leaved and fall coloration had barely begun. Over a month later, 90 percent of the leaves remain on the trees.

The heavy, wet snow caused considerable damage, especially to birches. Balsam poplars tended to snap under the weight, but aspen suffered less damage. Many trees fell against powerlines, causing outages of up to seven days in the Fairbanks area. Crews spent many hours clearing roads and trails to reach the LTER study sites, but some on the floodplain could not be reached due to early formation of ice on the Tanana River. Many fall research activities, such as litterfall collections, had to be suspended; however, the conditions will provide unique research opportunities, such as following the decomposition of leaves *in situ*.

The early, heavy snow also impacted wildlife: small birds were caught before their fall migration, and unusually large numbers of robins, juncos, sparrows, and varied thrushes were observed feeding on chokecherries and at local bird feeders after the storm. Two hundred young trumpeter swans were abandoned on nearby Minto Flats—they had not developed adequately to begin fall migration.

Perhaps most unusual was the migration of 1,000 Delta caribou, which normally winter in the Alaska Range, through the Fairbanks and BNZ area. In early October, caribou swam the Tanana and headed north: many were seen in subdivisions west of town, and a number were killed crossing the highway. This is the first known occurrence of caribou in the vicinity in 50 years.

Leslie Viereck

H. J. ANDREWS EXPERIMENTAL FOREST

Linking Pattern and Process Across Scales

Old-growth Douglas-fir forests like these produce tremendous amounts of carbon.

by Mark E. Harmon & David A. Perry

One of the challenges facing each LTER site is how to strike a balance among the various approaches and scales required to address a problem. A central focus of research at H.J. Andrews has been to understand the linkages between structure and process within and across scales, with particular emphasis on system responses to changing climate, to human and natural disturbances, and their interactions. We will describe three examples of research that deal with different scales and interactions among scales.

Linking Terrestrial and Stream C & N Dynamics

If temperatures warm due to global climate change, one would expect decomposition of organic matter to increase; however, to understand the implications of this change a number of questions must be answered. To what degree are levels of soil organic matter (SOM) controlled by temperature? How labile is SOM and what will be the fate of N released as organic stores in soil drops?

To examine the question of temperature control, Tom Bell, Steve Hart and Dave Perry have transferred soils among forests across an elevation gradient equivalent to projected climate change. This experiment indicates that levels of SOM in our montane forests are strongly controlled by temperature. During the first six months of incubation (winter-spring), soil transferred 800 m down in elevation released 270 percent more N to resin bags than controls, while soils transferred from low to high elevation released 85 percent less than controls. Summer-fall incubations produced the same pattern, but the effects of transfer were somewhat less than in winter-spring incubations.

This soil-transfer experiment indicates that soil warming will pulse large amounts of net mineralized N into forest soils in our area. If absorbed by trees, the transfer of N from low C/N humus to high C/N tree tissues may increase productivity, creating a relatively strong sink for atmospheric CO_2 and a negative feedback to global warming. N not taken up by trees could be leached to streams, or released to the atmosphere as N_2 and N_2O (the latter creating a positive feedback to warming).

Stan Gregory and Gary Lamberti are currently examining the potential effect of N additions to stream productivity and trophic structure. Past studies on NPP suggest that base cations would rather quickly limit tree response to N. To further test this, Marla Gillam, Bob Griffiths, Peter Homan, Dave Perry, Phil Sollins, and Bill Winner have initiated growth chamber studies, funded by the U.S. Department of Energy through WESTGEC, in which C and N fluxes in tree-soil microcosms grown under varying temperature and CO_2 regimes will be measured. Results from these experiments and experiments conducted by Ruth Yanai from Cornell will be used to parameterize the TREEGRO model, thereby providing a starting point for modeling regional C and N fluxes associated with climate change.

Linking Landscape Patterns & Processes

A large part of our efforts over the past decade has been devoted to landscape-level issues, including interactions between landscape patterns and processes within local ecosystems. As one example, the proportion of successional stages influences the relative abundance of different animals, which feeds back to affect local food-webs and plant communities. The dramatic shift to early-successional habitat has led to an increase in elk and deer; their numbers are higher now than at any time in recent history. Elk are overgrazing alpine meadows in the Cascades, leading to accelerated erosion, and may be altering site N dynamics by heavy feeding on early successional N-fixing shrubs. On the other hand, spotted owls are old-growth dependent, top predators in a food chain that extends downward to small mammals, fruiting bodies of mycorrhizal fungi, and trees. We are interested in the degree to which reduced numbers of owls might be reflected in populations of small mammls and truffle-producing mycorrhizal fungi.

A key process mediated by landscape patterns is the propagation of disturbances. One idea Gay Bradshaw, Andy Hansen and Dave Perry are currently exploring is that landscapes may either dampen or magnify the spread of a given disturbance. For example, based on historic and recent fire patterns, we have hypothesized that the regional shift in age classes from old to young forests has altered the landscape from a dampening to a magnifying one. If true, this has direct implications for future fire regimes and cumulative impacts on local ecosystems. A future task is to link models of fire spread in different landscape types to our site-level studies of biological legacies and other factors that determine soil stability and resilience of local communities.

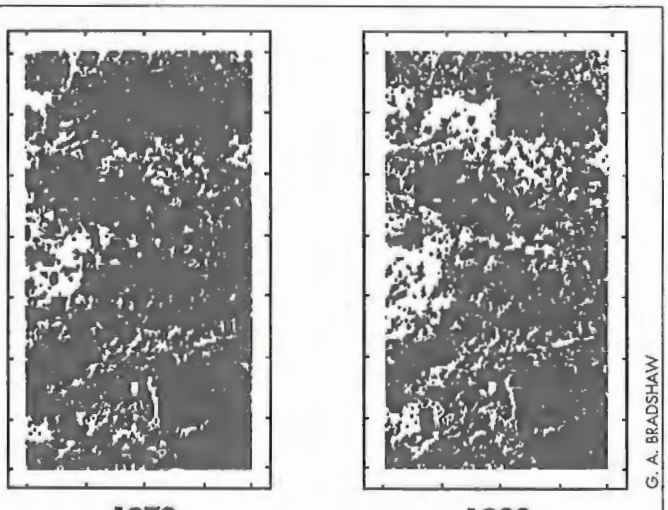
Regional Carbon Dynamics

The Pacific Northwest is an important region in which to study carbon dynamics. It contains a large area of extremely high biomass forest ecosystems (500-1500 Mg C/ha), and is currently being converted from a largely old-growth landscape to one of younger, plantation forests. Our initial examination of the effect of this transition involved the development of a stand-level forest model to examine the changes in carbon stores over succession. This analysis indicated considerable carbon efflux (2 Pg) may have resulted from past timber harvest within western Oregon and Washington.

More recently, Warren Cohen, Bill Ferrell, Mark Harmon, Peter Homan, Phil Sollins, and Dave Wallin have started to expand beyond single stands to consider the region as a whole. Remotely sensed imagery is being used to observe where and when forests were harvested and to predict the age structure of forests. Regional temperature and moisture gradients are being used as driving variables for forest and soils models so that carbon stores within forests are a function of climatic variables as well as time since disturbance.

Parameterization and validation of this region model is requiring synthesis of much of the process- and stand-level data collected in past IBP and LTER efforts. Finally, Bill Ferrell, Steve Garman, and Mark Harmon are examining the degree harvesting methods have changed over the last century, so that we may predict how carbon stores in forest products have changed. Our ultimate goal is to integrate the stand age, climatic, and carbon stores models to predict past and future changes of carbon stores within the Pacific Northwest region.

For further information: Mark Harmon or David Perry, Oregon State University, Department of Forest Science, Peavy Hall 154, Corvallis, OR 97331, 503-750-7333/737-6588.



Landsat images showing areas of non-forest (mainly forest sites cut in the previous 25 years, shown in white) and natural and older managed forest (black) across an area of 2,584 km² (68 x 38 km) in the central Cascade Mountains of Oregon. H.J. Andrews is located in lower center.

LUQUILLO EXPERIMENTAL FOREST

Describing the Impacts of Disturbance

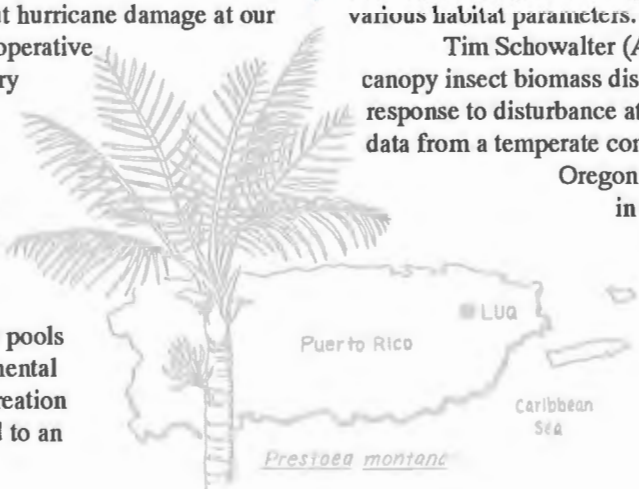
by Robert B. Waide & Ariel E. Lugo

Luquillo Experimental Forest (LUQ) LTER enters its fifth year in the process of consolidating knowledge gained during the three years since Hurricane Hugo and formulating further research objectives. The excitement generated by our selection as an LTER site and the subsequent initiation of our hurricane experiment has continued in our research group.

Disturbance

The Luquillo Experimental Forest is subject to hurricanes, landslides, non-hurricane related treefalls, and human disturbance. A goal of the LUQ LTER has been to describe the frequency, intensity, spatial distribution, areal extent, and immediate and long-term effects of these disturbances. We believe that the forest is a mosaic of patches recovering from overlapping and varied effects of different disturbances. The impact of any disturbance is conditioned by geomorphology and by stand age, structure, and composition. We have made good progress in quantifying the parameters of these disturbances and understanding how they interact with each other to produce the landscape mosaic, as well as the structure and function of particular patches.

Since 1989, Hurricane Hugo has dominated research and thinking concerning disturbance in the LUQ LTER. Many results of studies on the impact of Hugo and the short-term features of recovery were reported in a special issue of Biotropica published at the end of 1991 and edited by LTER researchers Lars Walker, Jean Lodge, Nick Brokaw, and Bob Waide. This volume includes studies from the Caribbean, Mexico, and the North Inlet LTER site in South Carolina, enabling us to put hurricane damage at our site into a larger perspective. Cooperative studies with David Foster and Emory Boose at the Harvard Forest LTER are modeling landscape-level effects of hurricanes and reconstructing hurricane disturbance history for both Puerto Rico and New England. Whendee Silver (Yale) recently compared above- and belowground nutrient pools following the creation of experimental gaps and Hurricane Hugo. The creation of experimental gaps did not lead to an immediate loss of soil nutrients.



Climate and Hydrology

A geographically-based ecosystem model that simulates basic forest dynamics as a function of meteorological inputs and hydrological simulations was also developed for LUQ LTER by Fred Scatena, Charles Hall, and Win Everham. The model design uses a readily accessible spatial and temporal computing structure, called GEOPLOT, into which additional modules can be placed. Presently the model incorporates meteorologic and hydrologic models with a biotic response model. Much of the hydrologic model was derived from a USDA Soil Conservation Service model called Simulator for Water Resources in Rural Basins (SWRRB). The present GEOPLOT version differs from the original SWRRB model in that it is spatially distributed with each computational cell responding to varying meteorological inputs, soil properties, slope and vegetation. The PROSPER evapotranspiration model has also been calibrated to the LTER experimental watersheds. Both hydrologic models will be tested rigorously in the coming year.

Patch Dynamics

Grid-based population studies carried out at El Verde and Bisley by Mike Willig, Larry Woolbright, Doug Reagan, Jess Zimmerman, Bob Waide, and Win Everham have demonstrated that anthropogenic and natural disturbances are both important in determining distribution. The principal factor structuring tree populations in a 16-ha grid at El Verde was previous land use, with topography also playing an important role. The distribution of hurricane damage over the grid was determined by a combination of species composition and topography. Variation in density of snails, insects, and frogs over the grid was significantly related to various habitat parameters.

Tim Schowalter (Andrews LTER) found that canopy insect biomass distribution, herbivory, and response to disturbance at El Verde was comparable to data from a temperate coniferous rain forest in western Oregon and a temperate deciduous forest in North Carolina. Total mass intensities at El Verde are about an order of magnitude higher, indicating higher levels of productivity. Only Lepidoptera and ants showed a significant response to disturbance.

Roman Dial (Stanford) demonstrated that the downwind edge of forest gaps had higher numbers of flying insects and insectivorous lizards. Lizard exclusion experiments showed that canopy-dwelling anoles are limited by non-locally recruited flying insects, and that lizards in turn limit large, non-cryptic, leaf-dwelling arthropods. This latter effect resulted in increased defoliation when lizards were removed. Investigation of two lizard species overlapping in habitat requirements found crown-by-crown competitive exclusion in areas where trees had been isolated by disturbance.

JAMES HALFPENNY

ARIEL E. LUGO

(Top right) Lateral buttresses and a heavy load of epiphytes and lianas are characteristic features of tropical forests.

Bromeliads such as these cover exposed surfaces of tree branches and influence the chemical composition of throughfall. Many bromeliads were stripped from the trees by Hurricane Hugo in 1989 and, after three years, the number has not reached pre-hurricane levels.

New Personnel

Several new scientists have recently become members of the Terrestrial Ecology Division staff. Jess Zimmerman (Utah) is directing activities at the El Verde Field Station and investigating plant phenology and the population dynamics of understory shrubs. Randall Myster (Rutgers) is conducting a series of experiments on the effect of seed rain, seed predation, and differential initial conditions on subsequent regeneration on landslides. Xiaoming Zou (Colorado State) has begun a study of the control of phosphorus dynamics in forest soils. Doug Schaefer (Dartmouth) is initiating a study of atmospheric deposition across elevation, exposure, and disturbance gradients.

Mike Keller (formerly of NCAR) has joined the staff at the Institute of Tropical Forestry to conduct studies of the effects of land use change and disturbance on atmospheric chemistry. Robert Walker (formerly of Florida State) will focus on economic assessments of resource use in the tropics for ITF. Whendee Silver (Yale) has taken a post-doctoral position at ITF and will continue her studies on the effect of disturbance on nutrient cycling. Mitch Aide (Utah) has joined the Biology Department at the University of Puerto Rico-Rio Piedras and will initiate studies of herbivory shortly. Alberto Sabat (SUNY-Albany) has also joined the department and will continue his studies of the demography and reproductive behavior of the Sierra Palm.

Facilities Upgrade

Construction of a new dining hall and remodeling of kitchen and bathroom facilities were slated for completion at the El Verde Field Station in October. This work was made possible by the NSF and will alleviate overcrowding at the station.

For further information: *Robert Waide, Terrestrial Ecology Division, Center for Energy and Environmental Research, PO. Box 363682, San Juan, PR 00936-3682, 809-767-0334, or Ariel Lugo, Institute of Tropical Forestry, Call Box 25000, Rio Piedras, PR 00928-2500, 809-766-5335.*

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Recent Publications

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CALENDAR

Winter 1992 - Spring 1993

DEC 1 ***NSF Program Deadline: Networking & Communications Research.*** Aubrey Bush, 202-357-9717. ***Target Date: Animal Developmental Mechanisms*** (Sarah Bruce, 357-7989). ***Biochemistry and Molecular Structure & Function*** (Marcia Steinberg, 357-7945). ***Biophysics*** (Arthur Kowalsky, 357-7777). ***Cell Biology*** (Maryanna Henkart, 357-7474). ***Genetics & Nucleic Acids*** (Philip Harriman, 357-9687). ***Plant & Microbial Developmental Mechanisms*** (Judith Plesset, 357-7949).

15 ***NSF Program Deadline: Biological Sciences.*** Research Planning Grants, Career Advancement Awards for Women Scientists and Engineers (202-357-7332), ***Integrative Biology & Neuroscience*** (357-7905), ***Molecular & Cellular Biosciences*** (357-9880). ***Target Date: Biological Sciences. Animal Behavior*** (Fred Stollnitz, 357-7949). ***Animal Systems Physiology*** (Barbara Zain, 357-7975). ***Ecological Studies*** (Tim Schowalter, 357-9734). ***Ecology*** (Joann Roskoski, 357-9734). ***Endocrinology*** (Elvira Doman, 357-7975). ***Functional Physiological Ecology*** (Vince Gutschick, 357-7975). ***Integrated Plant Biology*** (Machi Dilworth, 357-7652). ***Systematics & Population Biology*** (James Rodman, 357-9588). ***Population Biology*** (Conrad Istock, 357-9728).

31 ***NSF Deadline: Alan T. Waterman Award Nominations.*** Susan Fannoney, National Science Board, 202-357-7512.

JAN 15 ***NSF Target Dates: Cognitive, Computational, & Theoretical Neurobiology.*** Donald Edwards, 202-357-7040. ***Developmental Neuroscience*** (Steven McLoon, 357-7042). ***Neural Mechanisms of Behavior*** (Christiana Leonard, 357-7040), ***Neuroendocrinlogy*** (Kathie Olsen, 357-7040). ***Neuronal & Glial Mechanisms*** (Sanya Springfield, 357-7471). ***Sensory Systems*** (Christopher Platt, 357-7428).

FEB 1 ***NSF Program Deadline: Biological Field Stations & Marine Laboratories.*** James Callahan, 202-357-7652. ***Doctoral Dissertation Research in Environmental Biology*** (Elizabeth Behrens, 357-9596).

4 ***Fellowship Application Deadline: Charles Bullard Fund for Forest Research.*** Harvard Forest, Harvard University, Petersham, Massachusetts. To support research and study in Forest Biology and Ecology, Management of Forest Resources, Public Policy on Forests and the Environment. (Secretary to the Committee, 508-724-3302).

APR 1- 4 ***LTER Meetings: Executive & Coordinating Committees.*** Jornada LTER site, Las Cruces, New Mexico (Adrienne Whitener, 206-543-4853, *aWhitener@LTERnet.edu*).

12-15 ***Joint Workshop: GCTE Focus 3. Global Change and Forested Ecosystems.*** Pack Forest, near Mount Rainier, Washington. Co-sponsored by the LTER Network Office and IGBP-GCTE. (John Vande Castle, 206-543-4853, *jVandeCastle@LTERnet.edu*).

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