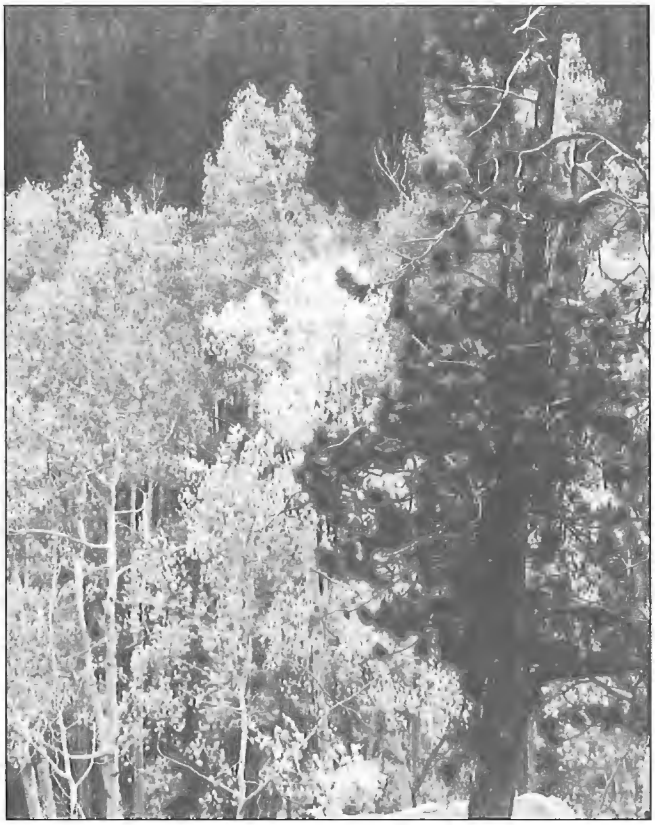
NETWORK NEWS

LTER

Newsletter of the Long-Term Ecological Research Network *Spring/Summer 1993, Issue 13*



Autumn at Estes Park, Colorado near the YMCA of the Rockies.

LTER International Summit

September 23-24,1993 Estes Park, Colorado

Global scientific interest in developing long-term ecological research programs is expanding very rapidly, reflecting increased appreciation of their importance in assessing and resolving environmental issues. Many countries have either implemented or are planning ecological research programs of this type. However, contacts among these programs have generally been informal and opportunistic, often occurring in connection with conferences focused on other topics. To share information and experience and explore the potential potential for collaboration, an international gathering of representatives of established and nascent programs will be hosted by the U. S. Long-Term Ecological Research Network in conjunction with the third LTER All Scientists Meeting in Estes Park, Colorado September 18-24. The distinguished group of scientists invited to the LTER International Summit include leading representatives from long-term ecological research efforts in the United Kingdom, China, France, Canada, Australia, Mexico, New Zealand, Italy, Taiwan, Germany, Portugal, Russia, Sweden, Finland, Norway, and Central and South America, among other countries.

The agenda for the International Summit will provide an opportunity for attendees to exchange information in presentations on:

- the status of their current or planned long-term ecological research programs,
- the potential value of international networking among research programs oriented to long-term ecological research, and
- the relationship of an international LTER network to other international programs and networks of sites.

Summit workshops will address information exchange and communication systems, including the potential value, problems, costs, and logistics; common measurement programs and/or protocols across an international LTER network; multi-site experiments, including identification of potential hypotheses and topics; and mechanisms to nurture development of major long-term ecological research sites in Third World countries, including the potential for collaborative projects.

In this issue:

1993 LTER ALL SCIENTISTS MEETING

September 18-24 ● YMCA of the Rockies ● Estes Park, CO

The 1993 LTER All Scientists Meeting will be held September 18-24 in Estes Park, Colorado at the YMCA of the Rockies, site of the 1990 meeting. In addition to the many U. S. Long-Term Ecological Research scientists and students who will gather for the week-long series of presentations, workshops, working groups, and poster sessions, this year's meeting will include nearly 30 representatives from over a dozen countries with existing or proposed long-term ecological research programs who will convene for a two-day summit at the close of the week (see page1).

It is expected that the International Summit participants will observe and participate in all aspects of the All Scientists Meeting, including workshop sessions, field trips and informal social events.

The scientific program for the All Scientists Meeting, developed by a committee of LTER scientists with input from the LTER Coordinating Committee, will feature sessions addressing new directions for the Network, multi-site research, synthesis and comparative research, and global perspectives.

1993 All Scientists Meeting
PROGRAM & SPEAKERS

(additional speakers to be confirmed)

- **New Directions for the LTER Network**
  Richard Berk, Department of Sociology, UCLA
  Penny Firth, Environmental Biology, NSF
  Jerry Franklin, LTER Chair
  David Kingsbury, Human Genome Project, Johns Hopkins

- **Inter-Site & Synthetic Research**
  Mark Harmon, H. J. Andrews Experimental Forest
  Bruce Hayden, Virginia Coast Reserve
  William Parton, Central Plains Experimental Range
  Susan Stafford, H. J. Andrews Experimental Forest
  Jack Webster, Coweeta Hydrologic Laboratory

- **Global Perspectives**
  John Magnuson, North Temperate Lakes
  H. H. Shugart, Jr., Virginia Coast Reserve

NATIONAL CENTER FOR ECOLOGICAL SYNTHESIS

The joint Ecological Society of America (ESA)-Association of Ecological Research Centers (AERC) Committee on Ecological Synthesis has issued its report to the National Science Foundation, **National Center for Ecological Synthesis: Scientific Objectives, Structure, and Implementation.** Based on a workshop attended by a diverse group of 45 ecologists in October 1992, the report recommends a broad scientific agenda for the Center. The Center's projects would involve the diversity of ecological subdisciplines as well as key interdisciplinary links with atmospheric, biological, earth, oceanic, and social sciences. The report outlines the scientific mission of the Center, and compares alternative organizational models and mechanisms for implementing a national center for ecological synthesis.

Members of the ESA-AERC Committee on Ecological Synthesis are Jim Brown (co-chair), Steve Carpenter (co-chair), Simon Levin, Patrice Morrow, and William Schlesinger. The report was prepared by a subcommittee of workshop attendees including Jim Brown, Steve Carpenter (chair), Kay Gross, Joel Kingsolver, Simon Levin, Jim MacMahon, Patrice Morrow, and Paul Risser. Also in attendance at the workshop were AERC President Orie Loucks and John Hobbie, organizer of a 1989 AERC workshop on the topic.

For a copy of the report, write to: Linda Holthaus, Center for Limnology, University of Wisconsin, 680 N. Park Street, Madison WI 53706-1492.

GCTE FOCUS 3

Global Change & Terrestrial Ecosystems

LTER - IGBP Workshop ● Seattle, Washington ● April 12 - 15, 1993

The LTER Network Office hosted an International Geosphere-Biosphere (IGBP) Global Change and Terrestrial Ecosystems (GCTE) Focus 3 workshop April 12 - 15, 1993 at Pack Forest, near Seattle, Washington to discuss key questions and issues regarding global change and managed forests. Also discussed were theoretical and conceptual aspects of the consequences of global change for forest productivity or the role of forests in the global carbon balance, where key experiments should b e conducted, what measurements or observations should be made, and experimentation logistics. An expected product of the activity is a revision of the current operational plan for production forestry (*Global Change Report No. 21*, IGBP).

LTER representatives John Aber (HFR), Jerry Melillo (HFR), John Vande Castle (NET), and Richard Waring (AND), joined others from Australia, Sweden, the United Kingdom, Chile, Japan, The Netherlands, Venezuela, Finland, New Zealand, Canada, Portugal, Switzerland, South Africa, and the United States.

Contact: John Ingram, Project Officer, GCTE Focus 3 Associate Office, Department or Plant Sciences, University of Oxford, South Parks Road, Oxford, OX1 3RB, UK, or John Vande Castle, LTER Network Office, 206-543-6764, jVandeCastle@LTERnet.edu.

FOCUS 4

The IGBP-BAHC Weather Generator Program

The Weather Generator project of the Biospheric Aspects of the Hydrologial Cycle (BAHC), an activity of the International Geosphere Biosphere Programme (IGBP), grew out of concerns that General Circulation Models (GCMs) had some shortcomings. In establishing the program, IGBP ecologists and hydrologists hope to be able to downscale weather and climate information to meaningful spatial and temporal scales.

One of the start-up tasks of the Weather Generator project is the identification of the modeling needs of ecosystem modelers. Other key tasks include making coarse scale GCM output data (about one point every 500 km) into higher spatial resolution output data. The resolution goal is the level of existing observational networks (one point about every 50 km). At the same time, the project aims to provide the variables that ecologists and hydrologists really want. In the next task level, coarse scale observational data (stations roughly every 50 km) will be downscaled to the 1 to 10 km level.

The Weather Generator project proposes to: (1) define, jointly with GCTE and the other foci of BAHC, the ingredients of a Weather Generator, (2) coordinate the development, jointly with contributing projects, of methods to downscale the coarse-scale information of global models into the scales needed for ecosystem and hydrologic research, (3) test the results of this downscaling procedure with simulated and empirical data sets of present-day climate, and (4) facilitate distribution and use of the Weather Generator and associated data sets. It is the responsibility of BAHC to direct Focus 4 research andcoordinate worldwide efforts in this area.

Improvements are expected in both the low-resolution data used to drive the Weather Generator and the collection of algorithms comprising it. These improvements will be reported annual ly in the BAHC Newsletter. The first report issued (set for completion spring 1993) will contain a compendium of currently existing algorithms. An internal publication, for members of BAHC-Focus 4, will be distributed on a semi-annual basis. As part of this task, BAHC-Focus 4 will endeavor to establish linkages with and between the climate community and the community of potential users to strengthen the project and accelerate its development.

In 1993, Focus 4 will hold a meeting and a workshop, and write the IGBP proposal for the Weather Generator. A Weather Generator would have obvious value for LTER if the sites use GCM output data in their site ecosystem studies.

Bruce Hayden (Virginia Coast Reserve) is serving as a member of Focus 4. The CED Bulletin, a periodic bulletin board on LTERnet, will serve as the LTER forum for IGBP-BAHC Focus 4 activities.
Contact: Bruce P. Hayden, Department of Environmental Sciences, Clark Hall, University of Virginia, Charlottesville, VA 22903, 804-924-0545/7761, bph@LTERnet.edu (Internet).

THE UNITED KINGDOM ENVIRONMENTAL CHANGE NETWORK

J. MICHAEL SYKES

The U. K. Environmental Change Network (ECN) moves into the implementatin phase during 1993, with nine terrestrial sites scattered across England, Scotland and Northern Ireland. The entry into the Network of seven English and Welsh river sites heralds the development of an analogous series of freshwater sites in ECN terrestrial sites scattered across England, Scotland and Northern Ireland. The entry into the Network of seven English and Welsh river sites heralds the development of an analogous series of freshwater sites in ECN.

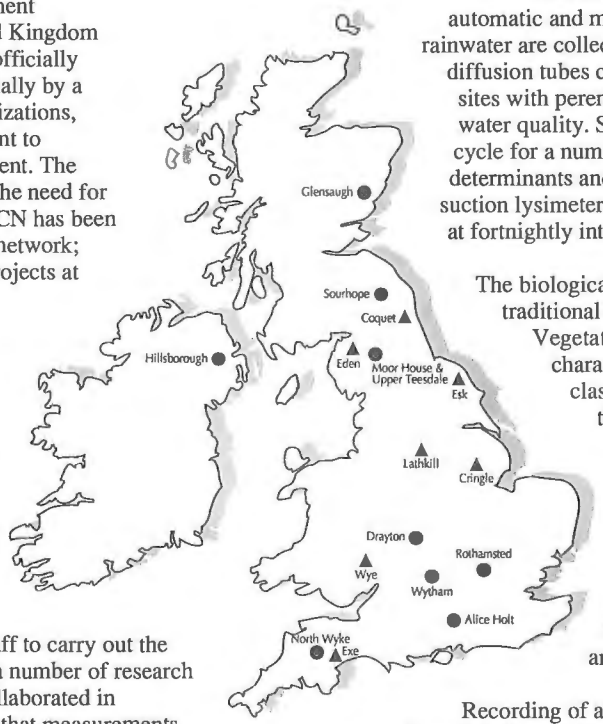
In 1989 a Working Party on Long-Term Reference Sites, chaired by Dr. Bill Heal of the Natural Environment Research Council (NERC), recommended the establishment of a network of sites across the United Kingdom for environmental monitoring. ECN, officially launched in 1992, is supported financially by a consortium of nine major U. K. organizations, each of which has a strong commitment to environmental research and management. The Network is a community response to the need for long-term data on the environment. ECN has been designed as an integrated monitoring network; although closely related to research projects at several of the sites, it is not explicitly process-oriented.

The ECN's primary purpose is to identify and quantify environmental changes associated with human activities, distinguishing man-made change from natural variations and trends and giving early warning of undesirable effects. The operation of the Network depends on the voluntary collaboration of the sponsoring agencies in providing sites and the necessary funding for staff to carry out the monitoring program. Scientists from a number of research institutes and the universities have collaborated in devising protocols intended to ensure that measurements are standardized at all the sites and that there are appropriate quality assurance procedures. Managers at each site are responsible for ensuring that the protocols are followed and that the data are sent in standard format to a central data facility.

The Sites

In selecting sites we have attempted to capitalise on established sites with known management history and to take advantage of existing data and understanding. A list of 24 such terrestrial sites was drawn up which represented the broad range of climate, soil, habitat and land management in the United Kingdom. It has been possible to recruit nine terrestrial sites into the network so far; it is expected that two others will be committed this year and that others will join later. The sites range from intensively-managed lowland agricultural establishments to semi-natural upland areas, the largest being about 80 km^2.

Terrestrial (●) and Freshwater (▲) Sites, January 1993



The Measurements

Standardized recording of an agreed suite of selected environmental attributes and variables has started in 1993 with the aim of continued long-term integrated monitoring. The nature of the measurements demands that some are concentrated on a small area of 1 ha, while others are more extensive and cover the whole site. A number of physical and chemical features of the environment are being recorded. Meteorological recording uses both automatic and manual systems; regular samples of rainwater are collected for chemical analysis, and diffusion tubes collect some pollutants such as NO^2; sites with perennial streams will record discharge and water quality. Soils are being sampled on a five-year cycle for a number of chemical and physical determinants and soil water is being extracted by suction lysimeters from two soil horizons for analysis at fortnightly intervals.

The biological part of the program relies on traditional methods of data collection. Vegetation at the sites will be surveyed and characterized by using an existing national classification. Permanent quadrats will then be located to cover the range of variation and will be recorded at intervals of three years to examine any shifts in species composition and frequency. Linear features such as hedgerows and vegetation boundaries are of particular interest. At agricultural sites additional measurements will be made of grass and cereal production.

Recording of animals has been directed towards groups thought to be good indicators of environmental change. Animal groups with wide distributions can be used for intersite comparisons of possible changes with time; those for which there are already national monitoring schemes, and into which results from ECN sites can feed, such as common birds, have particular attraction. Bat surveys will use existing, well-tried techniques to assess year-to-year changes in populations of this climate-sensitive mammal, which can be monitored using ultrasonic detectors. Frogs are known to be sensitive to some pollutants and there is a marked geographical trend in their spawning dates whose pattern may be affected by climatic changes; spawning dates and breeding success will be monitored. Surveys of changes in rabbit populations should provide information on how changes in weather, disease and land-use affect their numbers.

next page . . .

LTER - NASA Collaboration

November, 1992 Workshop — Albuquerque, New Mexico

Representatives of the Long-Term Ecological Research Network and the National Aeronautic and Space Administration's (NASA) Earth Observing System (EOS) program met at the Sevilleta National Wildlife Refuge in New Mexico for a workshop to expand a collaboration initially begun in discussions at the 1990 LTER All Scientists Meeting. Scientists from both the ecological and remote sensing communities participated, as well as administrators from NSF and NASA. In addition, other members of the LTER community were called upon to document current and future interests for collaborative ventures utilizing satellite-derived data.

The workshop contributed to further collaboration by identifying potential areas for mutual studies, setting an agenda for these studies, and identifying key individuals to participate. As a result of the activity, new instrumentation is proposed for LTER sites to improve interpretation of remotely sensed data under changing atmospheric conditions. Specific areas of research collaboration and mutual data acquisitions were identified and, to initiate interaction beyond the workshop, NASA scientists and administrators were invited to participate in the September 1993 LTER All Scientists Meeting at Estes Park, Colorado. LTER representatives were invited to attend NASA meetings for the testing of the next generation satellite sensors, in particular, MODIS.

For more *information or a copy of the workshop report and subsequent meeting reports: John Vande Castle, LTER Network Office, University of Washington, College of Forest Resources, AR-10, Seattle, WA 98195, 206-543-6249,* jvc@LTERnet.edu.

ENVIRONMENTAL INFORMATION MANAGEMENT & ANALYSIS SYMPOSIUM

May 20-22, 1993, Albuquerque, New Mexico

An international symposium, *Environmental Information Management and Analysis: Ecosystem to Global Scales*, will be held at the University of New Mexico, Albuquerque, May 20-22, 1993. Sponsored by a grant from the National Science Foundation, the symposium will be hosted by James W. Brunt (SEV), William K. Michener (John W. Jones Ecological Research Center), and Susan G. Stafford (AND). The program will include interdisciplinary discussions of long-term and broad-scale environmental research efforts, relevant technologies, and future directions for data management and analysis.

Technical sessions will focus on geographic information systems, scientific database design and management, and analytical approaches to addressing questions at ecosystem to global scales. Formal papers will be presented by invited speakers, leading scientists from a variety of disciplines, including ecology, geography, computer science, remote sensing, and statistics. Relevant special topics will be addressed in both formal and informal sessions. The primary objectives of the symposium are to identify state-of-the-art technologies for managing and analyzing environmental data and to facilitate future and long-term and broad-scale research efforts.

To receive registration materials send a fax to 505-277-5355, or electronic mail to eim@sevilleta.unm.edu, *providing both fax and phone numbers. Participation is limited to 250.*

ECN, continued

A number of invertebrate groups have also been included in the program. Moths and butterflies are already monitored nationally and it is planned that ECN sites will link with these existing programs, as well as other groups monitoring spittle bugs, crane-flies and ground beetles, which have no existing national networks, but are also included as indicators of environmental change.

The ECN program is managed by a central coordination unit based at the Institute of Terrestrial Ecology's Merlewood Research Station in Cumbria. In addition to the ECN Coordinator the team consists of a data manager, a statistician and the managers of the two NERC-sponsored sites. An ECN database is being developed at Merlewood to handle and make accessible the large quantities of data which the program will produce. A meta-information system will contain vital information describing the origin of the data, and their spatial and temporal characteristics, as well as their quality. Digital map information describing the spatial variability of measurements within and between ECN sites is being established in a geographical information system; this is integrated with the database and with the meta-information, for spatial analysis and modeling. The database will be accessible to registered users over the JANET network.

The Next Phase

ECN recording has begun in earnest in 1993, a trial year during which the measurement protocols will be tested and after which some modifications may be necessary. The next phase is the expansion of the Network into the aquatic environment—beginning with the selection of seven river sites across England and Wales at which a wide range of measurements were started in April 1992. Possible sites, measurements and funding mechanisms for other rivers and lakes in the United Kingdom are under consideration. At a later stage it is envisaged that the scope of the program might be extended by including estuarine and marine sites in ECN.

J. Michael Sykes is Coordinator of the U. K. Environmental Change Network at the Natural Environment Research Council's Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU, 05395-32264 (phone), ME_ML@UK.AC.NMW.VA *(e-mail).*

John Gordon Torrey

The Harvard Forest suffered a great loss in January with the death of John Torrey, Professor and Director, Emeritus. As a Harvard faculty member for 30 years and a member of the National Academy of Sciences, John led a brilliant scientific career in the field of plant development and microbial symbioses. More importantly, he was a great mentor and teacher who guided the personal development of students, colleagues and friends through his wise understanding of science and people and his balanced approach to life.

PHOTOS COURTESY OF DOTTIE SMITH, HARVARD FOREST

John's last achievement in biology was an unexpected one. As Director of the Harvard Forest from 1984 to 1990, John reoriented the Forest towards field biology and ecological studies and served as principal investigator on the LTER proposal and project. John's ability to work with people and the University administration provided the impetus and foundation for the inter-disciplinary and multiple-institution program that has developed at the Harvard Forest. This accomplishment, in a field well outside his own, is one of many testaments to his special abilities.

Following retirement John directed his energies toward his other passion: art collecting, particularly 19th Century British and American etchings. His family, colleagues, and the Harvard Forest group were kept entertained and challenged by his new discoveries and writings until his untimely, though peaceful passing at home shortly after Christmas.

— David R. Foster, Harvard Forest

Denise Gaudreau Memorial Fund

Denise Gaudreau, Research Associate at the Harvard Forest, passed away in May 1992 from the effects of progressive multiple sclerosis. Denise had degrees from Brown (S.B.) and Yale (Ph.D.) universities and came to Harvard University as a Charles Bullard Fellow on sabbatical leave from Southampton College on Long Island. Following her fellowship she became a permanent member of the Harvard Forest research staff, working on Late-Quaternary vegetation history of the northeastern United States and the relationship between topography, climate and plant migration.

In recognition of Denise's scientific and academic accomplishments and her interest in the role of women in science, the American Quaternary Association (AMQUA) has established the Denise Gaudreau Award for Excellence in Quaternary Studies. The award will be given at AMQUA meetings to a female doctoral candidate working in any field of Quaternary studies in recognition of her scientific accomplishments and demonstration of original thinking. *Contributions may be sent to: Denise Gadreau Memorial Fund, c/o Dr. Wayne Wendland, Treasurer, AMQUA, Illinois State Water Survey, 2204 Griffith Drive, Champaign, IL 61820.*

LTER Watershed Modeling Workshop

Twenty scientists representing seven LTER sites and other research stations met on June 17-19, 1992 in Denver, Colorado to discuss ecological and hydrological applications of watershed modeling. Organized by Hank McKellar (North Inlet LTER) and George Leavesley (U. S. Geological Survey), the workshop was designed to familiarize participants with a range of models that conceptualize hydrologic systems. Such models offer a common framework to explore intersite differences in biogeochemical routing on hillslopes and in channels, nutrient dynamics, and hydrological and ecological responses to disturbances, including climate and land-use change.

The four models presented represent different ways to conceptualize the linkages and spatial distribution of hydrologic processes over the landscape. PROSPER is a model of atmosphere, plant, and soil moisture relations without spatial resolution. TOPMODEL, a physically based hydrologic model, utilizes the variable source area concept in which a watershed is composed of saturated and unsaturated zones or cells defined by topography and soil hydraulic characteristics. Precipitation-Runoff Modelling System (PRMS) is a distributed parameter model which analyzes the watershed as a mosaic of hydrologic response units (HRUs) characterized by slope, aspect, vegetation, soil, and elevation. The Modular Hydrologic Modelling System (MHMS) is a modeling environment that permits combinations of process modules to be assembled to characterize different landscapes and climatic regimes. MHMS offers the promise of a common model framework to explore how different conceptualizations of hydrologic processes affect model behavior.

Workshop participants also considered the role of hydrologic modeling and research among LTER sites. Studies of fluxes of water, sediment, nutrients, energy, and organic and inorganic solutes and their effects on ecological systems are a common theme of research at most LTER sites. Understanding differences in the paths, rates, and patterns of water movement which drive many of these fluxes represents an important area for intersite comparison. Also emphasized was the importance of characterizing the wide range of LTER sites in terms of common gradients, such as the residence time of water in the system or recharge to runoff ratios.

Several key areas for intersite comparisons were identified, examining (1) the strength of hydrologic coupling between landscape elements, (2) linkages between hydrologic and ecologic processes, (3) relations between hydrologic fluxes and disturbances; and (4) the importance of hydrologic processes in increasing sensitivity of sites to environmental change. Workshop participants also agreed to raise the visibility of hydrologic science and modeling within the LTER Network, and to increase awareness in the broader geophysical community of the opportunity for collaboration at the diverse LTER sites.

For more information: Gordon Grant (H. J. Andrews LTER), USDA Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97331, 503-750-7329, gGrant@LTERnet.edu.

Long-Term Decomposition Team Experiment: An Update

We are now entering the third year of the Long-Term Decomposition Experiment Team (LIDET), with a total of 28 sites and over 35 investigators. Most sites have completed the second year of field work and laboratory data analysis is progressing. All sites received first-year data summaries, files and supporting documentation last fall; second-year data should be available by early summer 1993. Drs. Aber, Moorhead, Parton, and Rastetter are in the middle of a comparative study of decomposition models, and are completing a manuscript summarizing that effort. We have also completed a draft manuscript for submission by LIDET to *BioScience*. A brief snippet from the conclusions section is included below:

"To answer the challenges of global change research there is a need to understand ecosystem behavior over longer temporal and larger spatial scales than have been traditionally examined in ecology. Several solutions to this problem of scaling-up are possible. Synthesis of past results from individual investigators is a critical step, but uneven geographic distributions, study durations, and methodological incompatibilites all limit the end result. An alternative is to design group or team experiments, such as LIDET, that can be carried out simultaneously at many sites. In addition to standardizing methods and predetermining spatial and temporal limits, this approach has benefits for the individual sites involved. These include placing the results of an individual site in a larger context, allowing general access to novel analytical methods (i.e, NIR), and creating a real sense of participation in global change research."

— Mark Harmon

THE VIRGINIA COAST RESERVE

Succession, disturbance and system state-change

JERRY FRANKLIN

Hog Island tidal creek, with *Spartina alterniflora* (foreground) and *Myrica cerifera* (background).

Fourteen barrier islands form the seaward margin of the Virginia Coast Reserve (VCR). Landward there are shallow bays, deep channels, mudflats, salt marshes and a contiguous upland ecosystem on the edge mainland. VCR LTER research at the Reserve focuses on succession, disturbance and system state-change. It is a good place for such research. A wide range of marine and terrestrial successional sequences are evident, both in the patterns of the current landscape and in historical records such as aerial photographs (1949-1990) and land surveys (1852-1949). It is not clear that terminal seral stages are ever reached, because the frequency of disturbance is high.

In addition to succession and disturbance, fundamental transitions of system states have occurred. In the 20th century alone, terrestrial forests and farmland have changed to salt marsh; maritime forests to grasslands; and clear-water lagoons with seagrass meadows to mud-bottomed, turbid water lagoons.

Contemporary rates of landscape change are very rapid. Erosion of the shoreline along the VCR barrier islands averages 5 meters per year and locations with rates two to three times higher are common. The rapid changes (in both ecological and human terms) make the site ideal for the study of long-term ecosystem dynamics.

In our research we have identified four processes (disturbance, groundwater availability, sea-level changes and succession) which dominate the VCR landscape. We are currently working on five major experiments (three of them manipulative) to test and expand our understanding of pattern and process in a barrier island system.

Parramore Pimples Experiment

The Virginia Coast Reserve is in the process of installing its Parramore Pimples Draw Down Experiment. The pimples of Parramore Island (which owe their name to their appearance on aerial photographs) are small, nearly circular mesas of sand, which are 30 to 50 meters in diameter and perched on a saline to brackish marsh surface. Elevations vary from a high of 2 meters to a low of several centimeters. The pimples rest on a substrate that has saline porewater, but the pimples themselves have a lens of fresh water. The fresh-water lens is replenished by rainwater and drawn down by evapotranspiration. There is no stream flow, and mixing with adjacent saline groundwater is minimal.

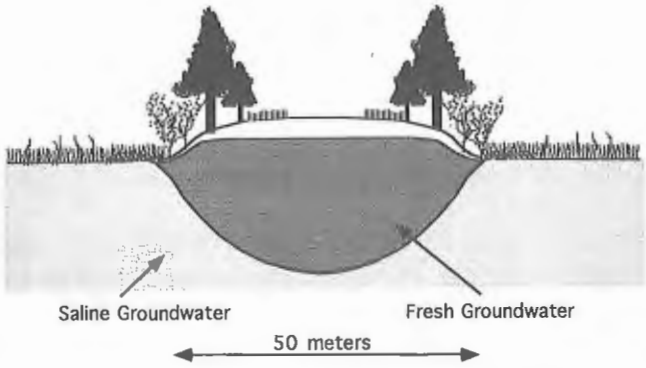


Figure 1. *Schematic of a Parramore Pimple. Central features are isolated fresh groundwater, and concentric rings of vegetation from saltmarsh to fresh shrubland to forest, grassland, and center desert.*

Vegetation cover varies with pimple size and elevation. The smallest pimples are covered by a *Spartina patens* grassland. Larger pimples have a series of concentric zones. An arid "desert" in the center is surrounded by a sparse grassland, an eastern red cedar (*Juniperus virginiana*) forest

next page. . .

ring, followed by an *Iva* sp. shrub zone, then a *Spartina patens* grassland ring around the pimple and, finally, a *Distichlis spicata* and *Spartina alterniflora* marsh. The largest of the pimples are forested with a central parkland.

Lack of horizontal groundwater mixing makes the Parramore Pimples act as natural lysimeters, making them an ideal place for studying the relationships between soil water and vegetation. We will install solar-powered water pumps to draw down the groundwater; for a 50-meter diameter pimple, for example, the water table will be drawn down by up to 3 mm per day on the sunniest days, a rate comparable to a thick stand of shrubs. We will control the rate of draw down and remove water from one pimple, pumping it onto an adjacent pimple of similar structure, thereby augmenting natural rainfall. A third pimple will be designated as a control and all three will be monitored. The experiment will allow us to test our understanding of hydrologic and vegetation processes, as well as determine system responses to changes in climatic rainfall regimes.

Disturbance Experiments

At the VCR, nature provides ample opportunities to follow the consequences of disturbance. Waves and surges from coastal storms move large volumes of sand across the barrier islands, creating overwash fans. Some of these fans cross the island and form platforms in the lagoons on which new marshes develop. We monitor the vegetation recovery from these disturbances, record the changes in extent of the various land-cover types of the islands, and follow the evolution of new landscapes. The data from these programs are used to parameterize models of landscape and ecosystem dynamics. Sand deposition on the islands also results in greater volumetric catchments for rainwater and larger freshwater reserves which is used by vegetation and lost as evapotranspiration. Sand deposition, integrated over time, gives rise to the freshwater resources needed to support high leaf area index vegetation, such as forests.

Sea Level and Marsh Lowering Experiment

Relative sea levels along the mid-Atlantic coast have been rising about 25 cm per century for the last 500 years. During 1992, we began a series of marsh surface lowerings as proxy studies for marsh changes in response to accelerated sea-level rise. In these experiments, sediments below the rooting zone are excavated at low tide and the marsh surface is permitted to sink lower in the water column. We hypothesize that *Spartina alterniflora* will change from the short form to the intermediate form in response to accelerated sea-level rise. These mechanical alterations of the marshes will be replicated during the 1993 field season and *Spartina alterniflora* productivity in the lowered and control areas will be determined.

Marsh Flume Experiment

Sea-level rise in marsh environments is often manifested as greater frequency of tidal submergence. For a given marsh, the frequency of tidal submergence is changed as sea level rises. We are installing a series of small flumes and control plots to test the hypothesis that the frequency of submergence regulates marsh community structure in the high marsh. Flooding frequency will be increased using small pumps to move water from tidal creeks to marsh surfaces within the flume. The semi-porous side-walls of the flumes will retard the rate of water flow on the ebb tide increasing flooding duration. Changes in sediment pore water chemistry and shifts in plant community composition and productivity will be measured. These flumes will be installed during 1993 as a prototype for a more extensive and replicated series of experiments in subsequent years.

North Hog Chronosequence

The ages of landscape elements on Hog Island have been determined from aerial photographs (1949-1990) and field surveys (1852-1949) using geomorphological techniques (Figure 2). From this data set the successional chronosequence for the Hog Island Transect No. 1 has been established. *(see page 11)*

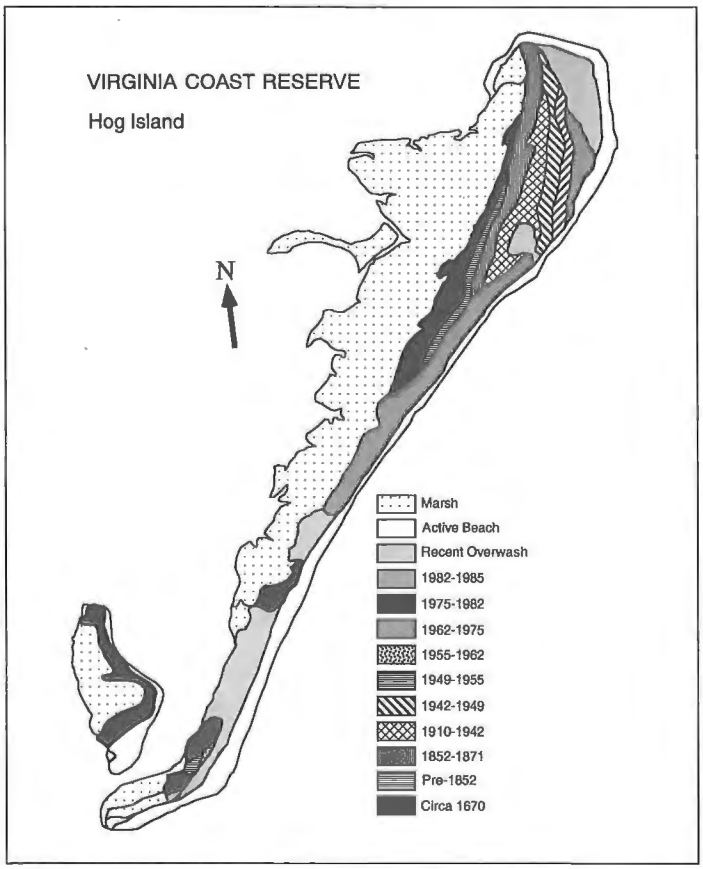


Figure 2. *Ages of landscape elements on Hog Island. Areas indicate dates between which the elements were created. Marshes have not been dated.*

JORNADA EXPERIMENTAL RANGE

Testing the relative variance in ecosystem properties over space and time

The Jornada LTER is organized to test a hypothesis that during desertification the distribution of soil resources changes from spatially homogeneous, as seen in semi-arid grasslands, to spatially heterogeneous, as seen in creosotebush and mesquite shrublands. This vegetation change has occurred during the last 100 years over much of southern New Mexico and West Texas. The change in the spatial distribution of soil resources is reflected by increasing spatial heterogeneity in other aspects of ecosystem function, for instance in the distribution and abundance of higher animals. Long-term studies at the Jornada LTER are designed to test the relative variance in ecosystem properties over space and time.

Using a set of 15 permanent plots for studies of net primary productivity (NPP), Laura Huenneke (New Mexico State University) finds that the mean NPP does not vary between grassland and shrubland communities, but the spatial variation in production is much higher in shrublands than in grasslands. Looking at soil nutrient pools, Ross Virginia (Dartmouth College) has extrapolated data from the permanent plots to provide a landscape-level estimate of the storage of organic carbon in grassland and mesquite shrubland communities.

To a depth of one meter, the pool of carbon in grassland soils is about 5160 g/m, whereas the pool in mesquite ranges from 4320 to 4920 g/m^2 depending on cover. He finds that not only the spatial variation of soil C is greater in shrublands, but the total stock of soil C has been reduced as a result of desertification. Working as a postdoctoral associate of William Schlesinger (Duke University), Antonio Gallardo finds that the amount of soil microbial biomass is increasingly limited by the availability of organic carbon in recently desertified habitats.

Soils of the Jornada Basin are also the source of a variety of trace nitrogen gases to the atmosphere. Nitric oxide (NO) and nitrous oxide (N_2O) are lost as byproducts of nitrification and denitrification. Anne Hartley (Duke University) finds that the emission of NO is relatively low when soils are dry, but it increases by a factor of 41 within 10 minutes after the application of a simulated rainstorm to creosotebush soil. Earlier work by Bill Peterjohn (Duke University) also showed a dramatic increase in soil microbal activity upon the wetting of dry soils.

Walt Whitford (NMSU and EPA, Las Vegas) finds evidence that jackrabbit populations are higher in grasslands than in shrublands. By deep-rooting, shrubs have year-round access to soil moisture, and rabbits can extract this moisture by browsing stems. The original semi-arid grassland communities did not provide an equivalent source of moisture during drought periods. Thus, shrublands are spatially more variable, but temporally less variable, from the point of view of NPP and the herbivore populations that the plants support.

Modeling efforts underway at the Jornada include both "patch" models of local processes and landscape models of basin-wide properties. Initial model simulations run by Jim Reynolds (Duke University) and his coworkers confirm that shrubland NPP is less variable temporally than grassland NPP, except for plant reproductive effort. Within the next year, we hope to extend these models to predict the spatial and temporal distribution of NPP and nitrogen cycling on the Jornada landscape as a function of the pathways and seasonal distribution of overland flow.

For more information: William H. Schlesinger, Departments of Botany and Geology, Duke University, Durham, NC 27706, 919-684-5412, dcalic@dukevm.

REX KING/USDA

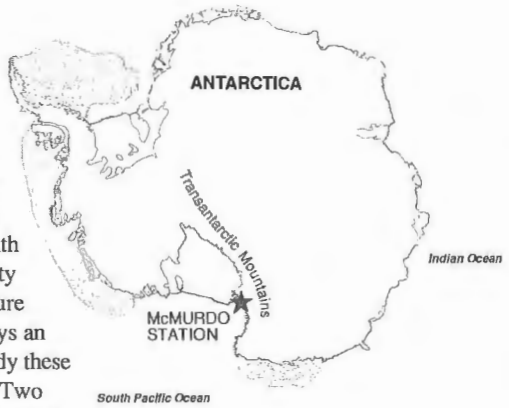
BARBARA SALLACH

(Top) Expanse of grassland, predominantly black grama, Jornada Experimental Range, 1938. (Bottom) Grassland of earlier in the century (above) has disappeared on the Range, replaced by patchy shrubland dominated by tarbush, mesquite and yucca.

NSF FUNDS NEW ANTARCTIC LTER SITE

A Long-Term Ecological Research (LTER) site for the Taylor Valley in the McMurdo Dry Valleys (MCM), approximately 100 km west of McMurdo Station, Antarctica has been funded through the Division of Polar Programs at the National Science Foundation. An interdisciplinary team of scientists has been assembled—the majority with extensive field experience in the Antarctic who have made substantial contributions to the understanding of dry valley ecosystems.

The dry valleys are among the most extreme deserts in the world, far colder and drier than those represented in any previously established LTER site. The perennially ice-covered lakes, ephemeral streams, and extensive areas of soil within the valleys are subject to low temperatures, very limited precipitation, and salt accumulation. The biological systems in the valleys are relatively simple (e.g., no vascular plants or vertebrates and very few insects). Trophic interactions and biogeochemical nutrient cycles are largely limited to microbial populations and micro-invertebrates. Species diversity and abundance are low, as would be predicted for such extreme environments. Despite this simplicity, complex interactions among species and between the biological and physicochemical environment exists in the lakes, streams, and soils. Furthermore, interactions between various components of the ecosystems enhance the overall productivity of the dry valley landscapes. All ecosystems are shaped to varying degrees by climate and material transport, but nowhere is this more apparent than in the dry valleys.



The obvious effects of an extreme environment coupled with the general simplicity of ecosystem structure makes the dry valleys an ideal location to study these basic relationships. Two central hypotheses embody this central theme: (1) the structure and function of Taylor Valley ecosystems are differentially constrained by physical and biological factors, and (2) the structure and function of dry valley ecosystems are modified by material transport.

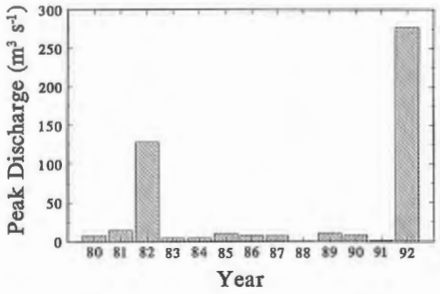
The MCM LTER project will address these hypotheses and the five core areas of LTER research emphasis through a program of systematic environmental data collection, long-term experiments, and model development. Research efforts will focus on the integration of the biological processes within—and material transport between—the lakes, streams and terrestrial ecosystems comprising the Taylor Valley landscape.

For more information: Robert A. Wharton, Jr., Biological Sciences Center, Desert Research Institute, 7010 Dandini Boulevard, Reno NV 89512, 702-673-7323, rWharton@LTERnet.edu *(Internet).*

100 - Year Flood Event at Konza Prairie Research Natural Area

Kings Creek is the principal stream draining the Konza Prairie Research Natural Area, and its 1,046-ha drainage basin lies entirely within Konza boundaries. Since 1979, Kings Creek has been part of the U. S. Geological Survey (USGS) Hydrologic Benchmark Network. In addition to discharge records from the USGS gauging station located on a fifth-order reach of the main channel, discharge has been monitored continuously at weirs on four upstream tributaries since 1986.

A major flood event occurred in Kings Creek on July 22, 1992 following several days of heavy rain. Floodwaters destroyed the gauging tube and walkway at the station, reaching a height of nearly 5 m above the streambed. Although direct discharge measurements were not possible at the USGS station, a prediction equation that relates peak flows to water depth indicates a peak discharge of 277 cubic m. Based on flood recurrence models for streams in the region, a flood of this magnitude would have an estimated recurrence interval of 100 years. The previous highest flow recorded at this station was 128 cubic m on July 1, 1982 (see figure). Although no major changes occurred in the course of the stream channel, large quantities of bed material (mainly limestone and shale gravel or cobble) were scoured and re-deposited along with large debris dams. Rates of periphyton production and chlorophyll *a* per unit area declined to almost 0 immediately after the flood, but primary production recovered within two weeks, and exceeded pre-flood levels for several weeks after that. Chlorophyll *a* had not reached pre-flood levels after one-and-a-half months. Data on recovery of invertebrate populations are still being analyzed. We hypothesize that the flood will have minimal impacts on a stream biota that is adapted to the lesser spates and frequent dry episodes common in upland prairie streams.



For more information: Lawrence Gray, Department of Biology, Ottawa University, 1001 South Cedar, Box 83, Ottawa, KS 66067, 913-242-5200, ext. 5467, or Walter Dodds, Division of Biology, Ackert Hall, Kansas State University, Manhattan, KS 66506.

VCR, from page 9

Surveys of soil nutrients along the 120-year chronosequence were reported on at our annual LTER project symposium in January 11-12, 1993. Landscape age within the chronosequence is being correlated with primary production, soil organic matter and water table elevations. These studies will form the benchmark for succession studies on new landscapes created by coastal storms.

Information on recent VCR research has been compiled in a 1993 symposium volume available from: Bruce P. Hayden, Environmental Sciences, University of Virginia, Clark Hall, Charlottesville, VA 22903, 804-924-7761, BHayden@LTERnet.edu.

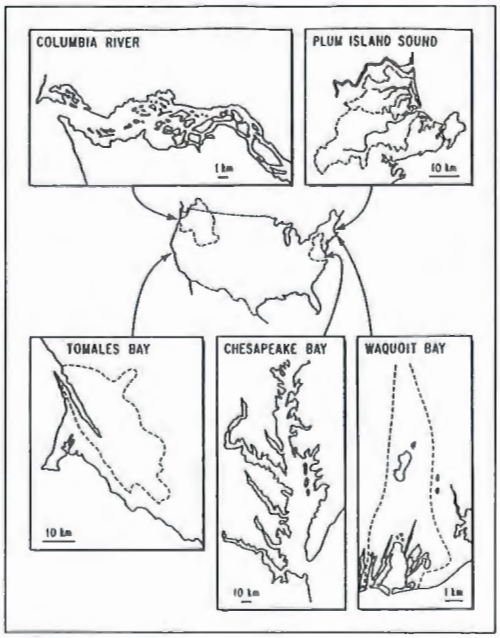
LAND-MARGIN ECOSYSTEM RESEARCH PROGRAM

Recent Activities

The third annual Land-Margin Ecosystem Research (LMER) Scientists Meeting was held at the Marine Biological Laboratory, Woods Hole, Massachusetts, in November 1992. Forty-seven participants attended from the five LMER projects, plus representatives from the Coastal Ocean Program of NOAA, the National Science Foundation (NSF), the Smithsonian Environmental Research Center, NSF's Coastal Ocean Process Program, and the Waquoit Bay National Estuarine Research Reserve.

The agenda included talks on the Coastal Ocean Program and on remote sensing in coastal waters. Workshops focused on the identification of future cooperative and comparative research among the LMER projects, with themes of: vertical coupling, the exchange of nutrients and organic matter between benthic and pelagic systems; land-water coupling, the discharge of water, nutrients, organic matter, and sediments from the land into coastal waters; geographic information systems (GIS), the use of GIS for environmental information storage and analysis as well as for the input of spatial data to models; and biological-physical modeling, the incorporation of biological processes into physical models of water movement.

Land Margin Ecosystems Research (LMER)



Program Goals and the Comparative Approach

The comparative approach to ecological research is an efficient way to predict responses of all coastal systems. The LMER Program is first striving for a thorough understanding of the patterns and processes common to the LMER sites and other well-studied systems such as Narragansett Bay. The longer-term goal is to incorporate the knowledge of processes and controls into predictions of the results of future changes, including land use and climate change, on coastal ecosystems in many geographic regions. One type of comparative study is a regression of characteristics of various landscapes on rates or processes. For example, it may be possible to build up a regression equation that will relate population density in areas of different land use to nutrient discharge into coastal waters.

Another type of comparative study under consideration involves taking measurements of one process along an environmental gradient in very different ecosystems. This is a good way to gain understanding of the controls of a particular process so that a prediction may be made of the activity or rate of the process under changed environmental conditions. Different parts of Chesapeake Bay, for example, have different patterns and rates of ammonium flux from the sediments. A future study may be carried out to relate this to variables such as the deposition of algae from the spring bloom.

LMER Coordination Office

The National Science Foundation has funded an LMER coordination office at the Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA 02543, staffed by Executive Assistant Debbie Scanlon, 508-548-3705, extension 496. John Hobbie (Arctic Tundra LTER) is serving as coordinating committee chair and Chris D'Elia, University of Maryland, as co-chair. An LMER Personnel Directory and a report on the November 1992 Annual LMER All Scientists Meeting are now available.

— John Hobbie

*The **LTER Network News** is published twice a year and distributed in limited quantities at no cost. Address queries to:*

STEPHANIE MARTIN, EDITOR
University of Washington, AR-10
Seattle, Washington 98195
Ph: 206-543-6764/Fax: 206-685-0790/3091
E-mail: *sMartin@LTERnet.edu* or *sMartin@LTERnet*

RECENT & NEW PUBLICATIONS OF INTEREST

China and Global Change: Opportunities for Collaboration. 1992. A report on the developing global change research program in China conducted with the assistance of the Committee on Scholarly Communication with the People's Republic of China. The Chinese Ecological Research Network (CERN)-LTER scientific exchange is cited. National Research Council, National Academy Press, HA 384, Washington, D.C. 20418. 228 pages.

Collected Data of the first ISLSCP Field Experiment: Volume 2: Satellite Imagery (1987-1989). Published on CD-ROM by the National Aeronautic and Space Administration (NASA).

***Ecological Modelling* Vol. 67 No. 1.** A special issue devoted to large-scale ecological modeling in the LTER Network. Elsevier Science Publishers B.V., P. O. Box 330, Amsterdam, The Netherlands. (Available May 1993.)

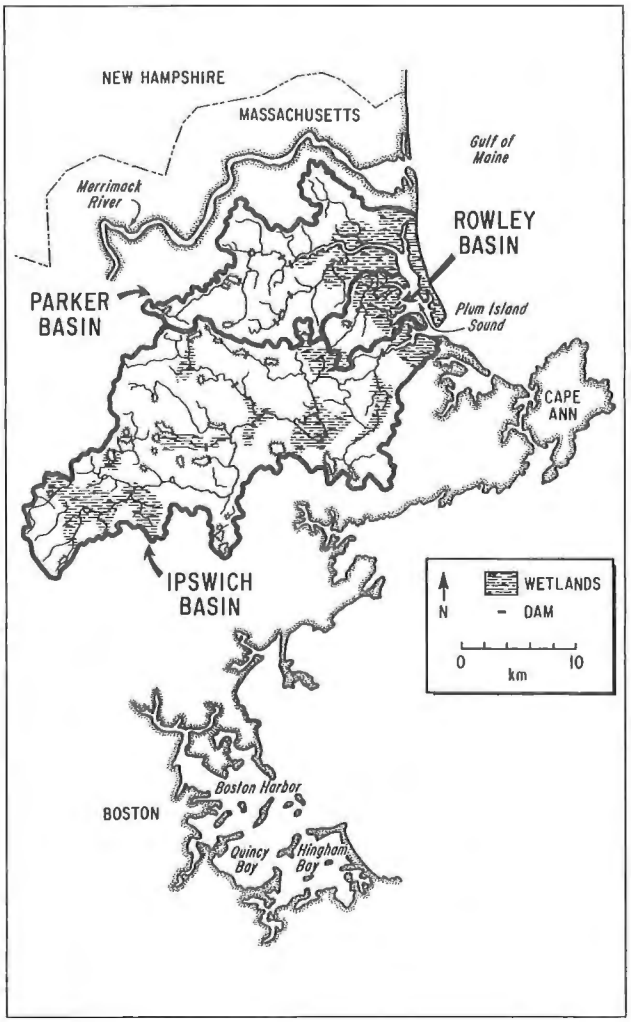
***Journal of Geophysical Research.* Volume 97, No. D17,** pages 18,343-19,109; November 30, 1992. Special issue with over 60 articles dedicated to the FIFE program on Konza Prairie LTER.

***Stream Research in the LTER Network.* LTER Publication No. 15.** Judy Meyer, technical editor. A catalog of current stream research conducted at the 11 LTER sites supporting stream research. (Available fall 1993 from the LTER Network Office.)

Plum Island Sound LMER

In 1992, Plum Island Sound, in the Acadian biogeographic province, was added to the LMER Network. This brings the total number of LMER investigations to five with studies now focused in three different biogeographic provinces, two in the Oregonian Province, two in the Virginian and one in the Acadian. The Plum Island Sound Comparative Estuarine Study (PISCES) is being led by C. Hopkinson and includes L. Deegan, A. Giblin, J. Hobbie (Marine Biological Laboratory), J. Finn (University of Massachusetts) and R. Buchsbaum (Massachusetts Audubon Society).

The Plum Island Sound System (630 km^2) has a relatively small, bar-built estuary. Three formerly glaciated upland watersheds (585 km) drain into the estuary and have markedly different land covers, from the Parker River watershed (155 km^2), a largely undisturbed drainage basin with extensive upland, bottomland hardwood and cedar swamp forests, to the larger (404 km2) and much more "developed" Ipswich River watershed. "Bedroom" communities of the Boston metropolitan region occupy the southwestern, upstream portion of the Ipswich watershed. Expansive river wetlands extensively process nutrient- and sediment-laden upland runoff before it enters tidal portions of the estuary. The well-mixed estuary has a tidal prism (2.6 m tide) that transports 65 times more water on a daily basis than mean freshwater input from the watershed. The Plum Island Sound system contains the greatest expanse of tidal wetlands in New England.



PISCES is focused primarily on the effects of organic matter inputs. Research investigates two broad questions: 1) What is the importance to estuarine ecosystems of organic carbon and organic nitrogen inputs from watersheds with various land covers and uses? and 2) Does the interaction of inorganic nutrients with the quantity and quality of organic carbon and organic nitrogen play an important role in determining the trophic structure, production, and trophic efficiency in estuaries? In systems dominated by inorganic nutrient inputs, our preliminary models indicate we can expect short and efficient foodwebs beginning with large phytoplankton species. In contrast, our models suggest that systems dominated by low-quality organic matter inputs will be characterized by long, inefficient foodwebs beginning with bacteria, with an active microbial loop community and with intense competition for nutrients between bacteria and primary producers.

PISCES applies a combination of experimental, comparative ecosystem, and descriptive studies to evaluate specific hypotheses within the two broad research questions. To help us reach conclusions and construct models that are generally applicable across a wide range of coastal systems, experimental and descriptive findings from Plum Island Sound will be "validated" by conducting comparative studies at different coastal LTER and LMER sites that represent end-members in our analysis of interactions between organic matter and inorganic nutrient loading.

There are four components to the effort: (1) quantification of organic carbon andnutrient exports from watersheds with different land use, (2) descriptive measurements of organic matter fluxes and experimental determination of controls of processes in the Plum Island Sound estuary, (3) comparative ecosystem experiments at other LTER or LMER sites to assess the generality of results obtained in Plum Island Sound, and (4) modeling to predict the effects of land use and climate changes on estuarine trophic structure and function.

— Charles Hopkinson

RECENT PUBLICATIONS

Abrams, M. D. 1992. Fire and the development of oak forests. *BioScience* 42:346-353.

Autry, A. R. and J. W. Fitzgerald. 1993. Relationship between microbial activity, biomass and organosulfur formation in forest soil. *Soil Biology and Biochemistry* 25(1):33-39.

Bentivenga, S. P. and B. A. D. Hetrick. 1992. The effect of prairie management practices on mycorrhizal symbiosis. *Mycologia* 84:522-527.

Bentivenga, S. P. and B. A. D. Hetrick. 1992. Relationship between mycorrhizal activity, burning, and plant productivity in tall-grass prairie. *Canadian Journal of Botany* 69:2597-2619.

Blair, J. M., D. A. Crossley, Jr. and L.C. Callaham. 1992. Effects of litter quality and microarthropods on N dynamics and retention of exogenous 15-N in decomposing litter. *Biol. Fertil. Soils* 12:241-252.

Briggs, J. M., and D. J. Gibson. 1992. Effects of fire on tree spatial patterns in a tallgrass prairie landscape. *Bulletin of Torrey Botanical Club* 119:300-307.

Burt, T. P. and W. T. Swank. 1992. Flow frequency responses to hardwood-to-grass conversion and subsequent succession. *Hydrological Processes* 6(2):179-188.

Caine, N. 1992. Sediment transfer on the floor of Martinelli snowpatch, Colorado Front Range, USA. *Geografiska Annaler* 74A (2-3):133-144.

Chellemi, D. O., K. O. Britton, and W. T. Swank. 1992. Influence of site factors on dogwood anthracnose in the Nantahala Mountain range of western North Carolina. *Plant Disease* 76(9):915-918.

Clark, B. K., D. W. Kaufman, G. A. Kaufman, S. K. Gurtz, and S. H. Bixler. 1992. Population ecology of thirteen-lined ground squirrels in ungrazed tallgrass prairie manipulated by fire. Pages 51-54 *in* D. D. Smith and C. A. Jacobs (eds.). Proceedings of the Twelfth North American Prairie Conference, Recapturing a Vanishing Heritage. University of Northern Iowa.

Coleman, D. C., E. P. Odum, and D. A. Crossley, Jr. 1992. Soil biology, soil ecology, and global change.*Biology & Fertility of Soils* 14:104-111.

Collins, S. L. 1992. Fire frequency and community heterogeneity in tallgrass prairie vegetation. *Ecology* 73:2001-2006.

Davis, M. A. 1992. The effects of pocket gophers on survivorship, growth, and reproduction in large beardtongue. *In* D. D. Smith & C. A. Jacobs, eds. Proceedings of the Twelfth North American Prairie Conference. University of Northern Iowa Press, Cedar Falls, IA.

Davis, M. A., J. Villinski, S. McAndrew, H. Scholtz and E. Young. 1991. Survivorship of *Penstemon grandiflorus* in an oak woodland: combined effects of fire, pocket gophers, and plant characteristics. *Oecologia* 86:113-118.

DeLucia, E. H., S. A. Heckathorn and T. A. Day. 1992. Effects of soil temperature on growth, biomass allocation and resource acquisition of *Andropogon gerardii* Vitman. *New Phytol.* 120:543-549.

Dighton, J. D. and D. C. Coleman. 1992. Phosphorous relations of roots and mycorrhizas of *Rhododenron maximum L.* in the southern Appalachians, N. Carolina. *Mycorrhiza* 1:175-184.

Duguay, C. R., and E. F. LeDrew. 1992. Estimating surface reflectance and albedo from Landsat-5 Thematic Mapper over rugged terrain. *Photogrammetric Engineering and Remote Sensing* 58:551-558.

Dyer, M. I., C. L. Turner and T. R. Seastedt. 1993. Herbivory and its consequences. *Ecological Applications* 3:10-16.

Duszynski, D. W., M. J. Patrick, L. Couch, S. J. Upton. 1992. Eimerians in harvest mice, *Reithrodontomys spp.*, from Mexico, California, and New Mexico and Phenotypic Plasticity in oocysts of *Eimeria arizonensis*. *Journal of Protozoology* 39(5):644-648.

Evans, E. W. 1992. Absence of interspecific competition among tallgrass prairie grasshoppers during a drought. *Ecology* 73:1038-1044.

Farley, G. 1992. Additions to the "Birds of the Sevilleta National Wildlife Refuge" List. *NMOS Bulletin* 20:31-32.

Furbish, D. J. 1991. Spatial autoregressive structure of meander evolution. *Geological Society of America Bulletin* 103:1576-1589.

Gleeson, S. and D. Tilman. 1992. Plant allocation and the multiple limitation hypothesis. *American Naturalist* 139:1322-1343.

Glenn, S. M., S. L. Collins, and D. J. Gibson. 1992. Disturbances in tallgrass prairie: local versus regional effects on community heterogeneity. *Landscape Ecology* 7:243-252.

Gorham, E. 1991. Northern peatlands: role in the carbon cycle and probable responses to climatic warming. *Ecological Applications* 1:182-195.

Golladay, S. W., J. R. Webster, E. F. Benfield, and W. T. Swank. 1992. Changes in stream stability following forest clearing as indicated by storm nutrient budgets. *Archiv fur Hydrobiologie* 90:1-33.

Gosz, J. R. 1991. Ecotone Hierarchies. *Ecological Applications*. 99:33-34.

Gosz, J. R., R. R. Parmenter and D. Marshall. 1992. Ecological Indicators in a Desert/Grassland Transistion. Pages 739-763 *in:* Ecological Indicators, Volume 1. D.H. McKenzie, D. E. Hyatt and V. J. McDonald (eds.). Elsevier Applied Science, London and NY.

Greenland, D. E., and A.V. Drozdov. 1991. Monitoring environmental change 2. Surface measurements and field studies. Pages 199-217 *in*: Mather, J. R., and G. V. Sdasyuk (eds.). *Global Change: Geographical Approaches*. Univ. of Arizona Press, Tucson. 289 pp.

Hairston, A. B. and D. F. Grigal. 1991. Topographic influences on soils and trees within single mapping units on a sandy outwash landscape. *Forest Ecology and Management* 43:35-45.

Hanson, P. J., G. E. Taylor, Jr., and J. Vose. 1992. Experimental laboratory measurements of reactive N gas deposition to forest landscape surfaces: biological and environmental controls. Pages 166-177 *in:* D. W. Johnson and S. E. Lindberg (eds.). Atmospheric deposition and forest nutrient cycling: a synthesis of the Integrated Forest Study. *Ecological Studies: Analysis and Synthesis*. Springer-Verlag, New York. 91 pp.

Hetrick, B. A. D., G. W. T. Wilson, and T. C. Todd. 1992. Relationships of mycorrhizal symbiosis, rooting strategy and phenology among tallgrass prairie forbs. *Canadian Journal of Botany* 70:1521-1528.

Holland, E. A., W. J. Parton, J. K. Detling, and D. L. Coppock. 1992. Physiological responses of plant populations to herbivory and their consequences for ecosystem nutrient flow. *American Naturalist* 140:685-706.

Holtmeier, F. K., and G. Broll. 1992. The influence of tree islands and microtopography on pedoecological conditions in the forest-alpine tundra ecotone on Niwot Ridge, CO Front Range, U. S. A. *Arctic and Alpine Research* 24:216-228.

Hornbeck, J. W. and W. T. Swank. 1992. Watershed ecosystem analysis as a basis for multiple-use management of eastern forests. *Ecological Applications* 2(3):238-247.

Huntly, N. J. 1991. Herbivores and the dynamics of communities and ecosystems. *Ann. Rev. Ecol. Syst.* 22:477-503.

Jaeger, C. H., and R. K. Monson. 1992. Adaptive significance of nitrogen storage in *Bistorta bistortoides*, an alpine herb. *Oecologia* 92:578-585.

Jayachandran, K., A. P. Schwab, and B. A. D. Hetrick. 1992. Miner-alization of organic phosphorus by vesicular-arbiscular mycorrhizal fungi. *Soil Bio. Biochemistry* 24:97-94.

Jayachandran, K., A.P. Schwab, and B.A.D.Hetrick. 1992. Separation of dissolved inorganic phosphorus using acidified molyb-date and isobutanol. *Soil Sci. Soc. Am. J.* 56: 762-765.

Johnson, A. R., B. T. Milne, and J. A. Wiens. 1992. Diffusion in fractal landscapes: simulations and experimental studies of Tenebrionid beetle movements. *Ecology* 73:1968-1983.

Johnson, N. C., D. Tilman and D. Wedin. 1992. Plant and soil controls of mycorrhizal fungal communities. Ecology 73:2034-2042.

Johnson, N. C., D. R. Zak, G. D. Tilman and F. L. Pfleger. 1991. The dynamics of vesicular-arbuscular mycorrhizae during old field succession. Oecologia 86:349-358.

RECENT PUBLICATIONS

Kaufman, D. M. and D. W. Kaufman. 1992. Geographic variation in tail length of white-footed mice (*Peromyscus leucopus*) in Kansas. *Journal of Mammalogy* 73:789-793.

Keeler, K. H. 1992. Local polyploid variation in the native prairie grass *Andropogon gerardii*. *Amer. Journal of Botany* 79(11):1229-1232.

Knapp, A.K. 1992. Leaf gas exchange in *Quercus macrocarpa* (Fagaceae): rapid stomatal responses to variability in sunlight in a tree growth form.*American Journal of Botany* 79:599-604

Litaor, M. I., and R. Keigley. 1991. Geochemical equilibria of iron in sediments of the Roaring River alluvial fan, Rocky Mountain National Park, Colorado. *Earth Surface Processes and Landforms* 16:533-546.

Milne, B. 1992. Indications of landscape condition at many scales. Pages 893-895 *in:* D. H. McKenzie, D. E. Hyatt and V. J. McDonald (eds.), *Ecological Indicators, Volume 2*. Elsevier Applied Science, London and New York.

Nellis, M. D., and J. M. Briggs. 1992. Transformed vegetation index for measuring spatial variation in drought impacted biomass on Konza Prairie, Kansas. *Transactions of the Kansas Academy of Science* 95:93-99.

Nellis, M. D., J. M. Briggs and H. L. Seyler. 1992. Growth and transition: Remote sensing and geographic information systems at Kansas State University. *Photogrammetric Engineering and Remote Sensing* 58:1159-1161.

Parmenter, R. R. and V. A. Lamarra. 1991. Nutrient cycling processes in a freshwater marsh:the decomposition of fish and waterfowl carrion. *Limnology and Oceanography*. 36:976-7.

Parmenter, R. R., J. A. MacMahon. 1991. Faunal Community Development of Disturbed Lands: An Indicator of Reclamation Success. Pages 73-89 *in:* J. C. Chambers and G. L. Wade (eds.). *Evaluating Reclamation Success: The Ecological Consideration*—Proceedings of a Symposium. USDA Forest Service.

Ramundo, R. A., C. M. Tate, and T. R. Seastedt. 1992. Effects of tallgrass prairie vegetation on the concentration and seasonality of nitrate-nitrogen in soil water and streams. Pp. 9-12 *in*: D.D. Smith and C.A. Jacobs (eds.). Proceedings of the 12th Midwest Prairie Conference, *Recapturing a Vanishing Heritage*. University of North Iowa.

Ritchie, M. E. and D. Tilman. 1992. Interspecific competition among grasshoppers and their effect on plant abundance in experimental field environments. *Oecologia* 89:524-532.

Schmidt, S. K. 1992. A substrate-induced growth-response method for estimating the biomass of microbial functional groups in soil and aquatic systems. *FEMS Microbiology Ecology* 101:197-206.

Schmidt, S. K. 1992. Models for studying the population ecology of microorganisms in natural systems. Pages 31-59 *in*: Hurst, C. J. (ed.). *Modeling the Metabolic and Physiologic Activities of Microorganisms*. John Wiley and Sons, New York.

Schowalter, T. D. 1992. Heterogeneity of decomposition and nutrient dynamics of oak (*Quercus*) logs during the first two years of decomposition. *Canadian Journal of Forest Research* 22:161-166.

Seastedt, T. R., W. J. Parton, and D. S. Ojima. 1992. Mass loss and nitrogen dynamics of decaying litter of grasslands: the apparent low nitrogen immobilization potential of root detritus. *Canadian Journal of Botany* 70:384-391.

Shuman, T. W., R. J. Robel, K. E. Kemp, and J. L. Zimmerman. 1992. Time budgets of confined northern cardinals and Harris' sparrows in flocks and differences in observer data. *Journal of Field Ornithology* 63:129-137.

Sievering, H., D. Burton, and N. Caine. 1992. Atmospheric loading of nitrogen to alpine tundra in the Colorado Front Range. *Global Biogeochemical Cycles* 6:339-346.

Stanko-Golden, K. M., J. W. Fitzgerald, W. T. Swank. 1992. Sulfur processing in soil from high- and low-elevation forests in the southern Appalachians of the United States. *Soil Biology and Biochemistry* 24(7):693-702.

Strauss, S. Y. 1991. Direct, indirect, and cumulative effects of three native herbivores on a shared host plant. *Ecology* 72:543-558.

Strebel, D. E., D. R. Landis, J. A. Newcomer, D. van Elburg-Obler, B. W. Meeson and P. A. Agbu. 1992. *Collected data of the first ISLSCP field experiment:Volume 2: Satellite Imagery 1987-1989*. Published on CD-ROM by NASA.

Swank, W. T. and D. H. Van Lear. 1992. Multiple-use management: ecosystem perspectives of multiple-use management. *Ecological Applications* 2(3):219-220.

Tilman, D. and A. El Haddi. 1992. Drought and biodiversity in grasslands. *Oecologia* 89:257-264.

Tilman, D. and D. Wedin. 1991. Plant traits and resource reduction for five grasses growing on a nitrogen gradient. *Ecology* 72:685-700.

Tilman, D. and D. Wedin. 1991. Dynamics of nitrogen competition between successional grasses. *Ecology* 72:1038-1049.

Toetz, D. 1992. Use of mass spectroscopy to investigate the diet of brook trout *Salvelinus fontinalis* in an alpine lake. *Journal of Freshwater Ecology* 7: 251-256.

Turner, C. L., T. R. Seastedt and M. I. Dyer.1993. Maximization of above-ground grassland production: the role of defoliation frequency, intensity and history. *Ecological Applications* 3:175-186.

Turner, C. L., T. R. Seastedt, M. I. Dyer, T. G. F. Kittel and D. S. Schimel. 1992. Effects of management and topography on the radiometric response of tallgrass prairie. *Journal of Geophysical Research* 97:18,855-18,666.

Wedin, D. and D. Tilman. 1992. Nitrogen cycling, plant competition and the stability of tallgrass prairie. Pages 5-8 *in* D. D. Smith & C. A. Jacobs (eds.). Proceedings of the 12th North American Prairie Conference. University of Northern Iowa Press, Cedar Falls, IA.

Vinton, M. A., and D. C. Hartnett. 1992. Effects of bison grazing on *Andropogon gerardii* and *Panicum virgatum* in burned and unburned tallgrass prairie. *Oecologia* 90:374-382.

Vinton, M. A., D. C. Hartnett, E. J. Finck and J. M. Briggs. 1993. The interactive effects of fire, bison (*Bison bison*) grazing and plant community composition in tallgrass prairie. *American Midland Naturalist* 129:10-18.

Webster, J. R., S. W. Golladay, E. F. Benfield, J. L. Meyer, W. T. Swank, and J. B. Wallace. 1992. Catchment disturbance and stream response: an overview of stream research at Coweeta Hydrologic Laboratory. Pages 231-253 *in:* P. J. Boon, P. Calow, and G. E. Petts (eds.). *The Conservation and Management of Rivers*. John Wiley & Sons, NY.

Wilson, S. D. and D. Tilman. 1991. Interactive effects of fertilization and disturbance on community structure and resource availability in an old field plant community. *Oecologia* 88:61-71.

Wilson, S.D. and D. Tilman. 1991. Components of plant competition along an experimental gradient of nitrogen availability.*Ecology* 72:1050-1065.

Yeakley, J. A., W. T. Swank, G. M. Hornberger, H. H. Shugart. 1992. A method of modeling source area response to climate variability. Pages 211-219 *in:* R. Herrmann (ed.), AWRA 28th Annual Conference and Symposium: Managing Water Resources During Global Change, November 1992, Reno, NV. American Water Resources Association, Bethesda, MD.

Zak, D. R. and D. F. Grigal. 1991. Nitrogen mineralization, nitrification and denitrification in upland and wetland ecosystems. *Oecologia* 88:189-196.

Zak, D. R., A. B. Hanston, and D. F. Grigal. 1991. Topographic influences on nitrogen cycling within an upland pin oak ecosystem. *Forest Science* 37:45-53.

Zimmerman, J. L. 1992. Density-independent factors affecting the avian diversity of the tallgrass prairie community. *Wilson Bulletin* 104:85-94.

C A L E N D A R

MAY - JUNE

MAY 1 NSF Deadline: Cooperative Sciences (202-653-5789, 653-5862, 653-5437). ***Ethics & Values Studies*** (Rachelle Hollander, 357-9894). ***Networking & Communications Research*** (Aubrey Bush, 202-357-9717). ***Geosciences: Biological Oceanography, Chemical Oceanography, Marine Geology & Geophysics, Physical Oceanography*** (M. Reeve, 357-7924).

MAY 3 Conference: Soil Biodiversity. Kellogg Conference Center, East Lansing, MI (Harold Collins, 616-571-2212, *Collins@MSUKGBS.bitnet*)

MAY 20 - 22 Symposium: Environmental Information Management. & Analysis. Albuquerque, New Mexico (*eim@sevilleta.unm.edu*).

JUNE 1 NSF Target Date, Biological Sciences: Animal Developmental Mechanisms (Sarah Bruce, 202-357-7989), ***Biochemistry, 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, 357-7989). ***Polar Programs: Terrestrial & Limnetic Ecosystems in Antarctica, U. S. Antarctic Research*** (Polly Penhale, 357-7894). ***Geosciences: Continental Dynamics*** (Leonard Johnson, 357-7721), ***Continental Hydrologic Processes*** (357-7866), ***Geologic Record of Global Change*** (John Maccini, 357-7866), ***Geology & Paleontology*** (John Maccini, 357-7866), ***Geophysics*** (Michael Mayhew, 357-7355), ***Hydrologic Sciences*** (Douglas James, 357-7916), ***Instrumentation & Facilities*** (Daniel Weill, 357-7807), ***Petrology & Geochemistry*** (Jonathan Fink, 357-7498), ***Tectonics*** (Thomas Wright, 357-7355).

JUNE - JULY

JUNE 7 Deadline: Summaries, Second Thematic Conference on Remote Sensing for Marine and Coastal Environments, January 31 - February 2 1994. New Orleans, Louisiana. (313-994-1200, x3234.)

JUNE 15 NSF Program Deadline: Instrumentation & Instrument Development (Michael Lamvik, 202-357-7652). ***Animal Behavior*** (Fred Stollnitz, 357-7949). ***Animal Systems Physiology*** (Barbara Zain, 357-7975). ***Ecological Studies, Ecosystems*** (Tim Schowalter, 357-9734). ***Ecology*** (Laurel Fox or Scott Collins, 357-9734). ***Endocrinology*** (Elvira Doman, 357-7975). ***Functional & Physiological Ecology*** (Vince Gutschick, 357-7975). ***Integrated Plant Biology*** (Machi Dilworth, 357-7652). **Systematics & Population Biology, Systematics** (James Rodman, 357-9588). ***Population Biology*** (Conrad Istock, 357-9728).

JULY 1 LTER All Scientists Meeting Workshop Abstracts due (via e-mail to *cBledsoe@LTERnet.edu*).

JULY 15 NSF Deadline: U. S. - Taiwan Cooperative Science Program (202-653-5789).

JULY 16 LTER Network News Deadline: Fall - Winter '93 contributions due (*sMartin@LTERnet.edu*, 206-543-6764).

JULY 28 - 30 LTER Meeting: Data Managers. Madison, Wisconsin. (Rudolf Nottrott, 206-543-8492, *rNottrott@LTERnet.edu*).

JULY 31 - AUG 4 Annual Meeting: Ecological Society of America. Madison, WI (D. Whigham, 410-798-4424).

AUGUST - SEPT

AUG 1 LTER All Scientists Meeting Poster Abstracts due (via e-mail to *cBledsoe@LTERnet.edu*).

AUG 1 - 5 Annual Meeting: AIBS. Ames, Iowa. (Louise Salmon, 202-685-1500).

AUG 2 - 6 Gordon Conference: Hydrologic, Geochemical & Biological Interactions. (Charles Driscoll, 315-443-2311).

AUG 21 - 26 International Conference: Global Change & Arctic Terrestrial Ecosystems. Oppdal, Norway. (Jarle I. Holten, 47 7 58 05 00, *JARLE.HOLTEN@NINA.NO*).

SEPT 1 NSF Deadline: Dissertation Research in Environmental Biology (Elizabeth Behrens, 202-357-9596).

SEPT 18 - 24 LTER Meetings: All Scientists, Executive & Coordinating Committees, & International Summit. Estes Park, Colorado. (John Vande Castle, 206-543-4853, *jvc@LTERnet.edu* or Caroline Bledsoe, *cBledsoe@LTERnet.edu*, 916-752-0388). International Summit 9/23 - 9/24 by invitation following All Scientists sessions.

SEPT 29 NSF Program Deadline: Conservation & Restoration Biology (Joann Roskoski, 202-357-9734).

1994

JAN 31 - FEB 2 Conference: ERIM/ Marine Environment. 2nd Thematic Conference, Remote Sensing for Marine and Coastal Environments. New Orleans, LA. ERIM/Marine Environment Conference, P.O. Box 134001, Ann Arbor, MI 48113-4001, 313-994-1200, ext. 3234.

LTER Network Office
University of Washington
College of Forest Resources, AR-10
Seattle, Washington 98195

Nonprofit
Organization
U.S. POSTAGE
PAID
Seattle, WA
Permit No. 62