



LTER

LONG TERM ECOLOGICAL RESEARCH

ANNUAL PROGRESS REPORT

Long Term Ecological Research

Network Office

2001 ANNUAL PROGRESS
REPORT

SUMMARIZING ACCOMPLISHMENTS OF THE LTER NETWORK OFFICE DURING THE FIFTH YEAR

OF COOPERATIVE AGREEMENT DEB-9634135

Executive Summary

The LTER Network Office played key roles in four major activities during 2001-2002. The Network Office continued its leadership role in the effort to refresh the intellectual aims of LTER and to prioritize activities over the next 10 years. Staff from the Network Office took the lead in providing information requested by the panel conducting the 20 Year Review of the LTER program and contributed to the written network response to nine issues raised by the panel. The Network Office organized an informational meeting at NSF in February 2002 to provide current information on LTER accomplishments for NSF programs. NET provided support to produce research syntheses and publications for 17 working groups that were formed as a result of interactions at the 2000 All Scientists Meeting.

NET staff took the lead in a variety of other activities designed to support the overall goals of the LTER program. The Network Office, the LTER information management committee, and partners at the National Center for Ecological Analysis and Synthesis developed the very first metadata standard for ecological data. Ecological Metadata Language (EML) version 2.0 is a hallmark development that will greatly facilitate the further development of integrated information systems. Continued progress was made towards the development of a Knowledge Network for Biocomplexity under a grant from the KDI program. The Network Office, in collaboration with LTER information managers, designed an LTER knowledge base that integrates LTER information currently housed in disparate databases. NET staff and colleagues from the San Diego Supercomputer Center and the University of Colorado continued work on the LTER Spatial Data Workbench, developed to provide access to hyperspectral and other data acquired for LTER sites since 1990. An NSF Research Coordination Network grant was awarded to the Network Office to develop the informatics framework that can facilitate storage, discovery, and access to the strategic environmental information resources that are collectively held at

North American biological field stations. The Network Office continued to work with other members of the Partnership for Biodiversity Informatics (San Diego Supercomputer Center [SDSC], the National Center for Ecological Analysis and Synthesis [NCEAS], and the University of Kansas) to advance the field of informatics as it relates to biodiversity and ecology. We reorganized the LTER web pages into a public web page to improve access to information for non-scientists and an intranet page for the use of LTER researchers. NET staff initiated the development of a publication summarizing research accomplishments in the LTER network since its inception. A new national network (Zambia) was added to the International LTER Network at the annual meeting in London. Four other countries (France, Italy, Mexico, and South Africa) made substantial progress in developing their own networks.

The Network Office continued to carry out duties related to facilitating electronic communication, facilitating scientific exchange within the LTER Network and between the LTER Network and other networks, development of International LTER activities, promoting standards on information management, encouraging the use of new technologies, developing linkages with other long-term research programs, and promoting the relevance of long-term ecological research through education, outreach, and training activities.

Project Participants

People

Robert B. Waide, Executive Director, 10 months; responsible for management of LTER Network Office, supervision of employees, development and execution of budgets, coordination of network level research and planning activities, and proposal preparation

James Gosz, Professor, 2 months, Chair of the LTER Coordinating Committee; responsible for planning of network level and international research and educational activities

John Vande Castle, Associate Director for Technology Development, 10 months; responsible for the coordination and implementation of new technologies, including geographic information systems and remote sensing within the LTER and ILTER network

James Brunt, Associate Director for Information Management, 10 months; responsible for the management of LTER network data bases, the supervision of NET and KNB technical staff, and the coordination of information management practices at sites through the Committee on Information Management

William K. Michener, Associate Director for Project Development, 10 months; promote and facilitate LTER collaborations with national (e.g., OBFS) and international (e.g., ILTER) partners; design and implement training and technology transfer activities; coordinate new initiatives; identify and develop new tools and approaches for generating, processing, propagating, and understanding LTER data and

information; facilitate LTER network data synthesis activities

Patricia Sprott, Editor (promoted from Technical Writer in August 2000), 100% time; responsible for the development, editing and production of LTER and ILTER publications and presentations (both print and electronic). Directs World Wide Web site development, Outreach and Education programs

Sonia Ortega, Program Director for Education and International Activities, 100% time (started September 2001); NSF employee on IPA contract with University of New Mexico; responsible for fostering development of educational activities and International LTER Network

Deanna Pennington, post-doctoral associate, 100% time; contributes to Spatial Data Workbench as part of joint project with the National Partnership for Advanced Computational Infrastructure (started September 2001)

David Blankman, Database Administrator, 100% time on KNB project; responsible for database design and application programming for the Knowledge Network for Biocomplexity project

Richard Dahringer, Analyst Programmer III, 100% time; responsible for computer systems and network administration (until June 2001)

Owen Eddins, Programmer/Analyst III, 100% time on KNB project; responsible for software development for the Knowledge Network for Biocomplexity project

Pamela Griego, Administrative Assistant, 100% time; responsible for office management, filing, accounting, and general clerical

Troy Maddux, Database Administrator, 100% time; responsible maintenance and further development of LTER Network databases

Monte Mitzelfelt, Systems Administrator, 50% time (June-October 2001); maintain computer hardware and systems

Marshall White, Graphic Designer, 100% time; responsible for technical implementation of World Wide Web site and assistance with graphics for print publications

Gregory Bonito, Research Assistant, 10% time; compile information on field sensors for Scalable Information Networks for the Environment workshop

Kimberly Benally, Student Assistant, 40%; - general clerical work

April Moreno, Student Assistant, 40%; - general clerical work

Jorge Allen, Student Assistant, 40%; - computer programming

Organization

Collaborators

Within institution

- Bob Parmenter – Biology Department
- Terry Yates – Biology Department
- David Bader – Computer Science Department
- David Lightfoot – Biology Department
- Jim Brown – Biology Department
- Bruce Milne – Biology Department
- Blair Wolf – Biology Department
- Frank Gilfeather – Advanced High Performance Computing Center
- Barbara Kimbell – Arts and Sciences Development
- Greg Shore – Biology Department
- John Soboleski – VP for Computing and Information Research and Technology
- Kristin Vanderbilt – Information Manager for Sevilleta LTER
- Eric Charnov – Biology Department
- Tim Lowrey - – Biology Department

Other institutions

- University of California – Santa Barbara (National Center for Ecological Analysis and Synthesis) – Jim Reichman, Sandy Andelman, Matt Jones, Mark Schildhauer, Rudolph Nottrott, Dan Higgins, Jivka Bojilova, Chad Berkley, Britta Bierwagon, Elizabeth A. Sandlin, Stephen Cox
- University of California – San Diego (National Partnership for Advanced Computational Infrastructure) – Peter Arzberger, John Helly, Tony Fountain, Arcot Rajasekar, David Stockwell, Alison Withey, Chaitin Baru, Bertram Ludäscher
- University of California – San Diego (Scripps Institute) – Karen Baker
- University of Kansas – Leonard Krishtalka, Jim Beach, David Vieglas, Town Peterson, Susan Gauch
- Colorado State University – Roger Pielke, Bill Parton, Susan Stafford, Patrick Bougeron
- Michigan State University – Stuart Gage, Diane Ebert-May
- Brown University – Steve Hamburg

- Oregon State University – Andy Moldenke, Paul Risser, Don Henshaw, Cherri Pancake
- Arizona State University – Peter McCartney, Corrina Gries
- University of Virginia – John Porter
- University of Montana – Jack Stanford
- University of Alaska – Rich Boone
- Sandia National Laboratory – Center for Cooperative Monitoring – Arian Pregoner, David Betsill, Mike Vannoni
- The Nature Conservancy – Bruce Young
- University of Georgia – Frank Golley, Ted Gragson
- University of Washington – Jerry Franklin
- Oak Ridge National Laboratory – Dick Olson, Bob Cook, Kent McCord
- USDA – Forest Service – Doug Ryan, Chuck Liff, Ariel Lugo
- NBII – Anne Frondorf, Mike Frame, Gladys Cotter, Susan Fayad
- Global Terrestrial Observing System – Jeff Tschirley
- Cornell University – William Carlson, Mary Anne Krasney
- University of Northern Colorado – John Moore
- University of Puerto Rico – John Thomlinson, Jorge Gonzalez, Jess Zimmerman, Nick Brokaw, Eda Melendez-Colom
- Texas Tech University – Michael Willig
- Archbold Biological Station – Hilary Swain
- Duke University (Organization for Tropical Studies) - Jorge Jimenez
- University of California – Berkeley – Mark Stromberg, Craig Moritz
- University of California – Riverside – Mike Hamilton
- University of Mississippi – Marjorie Holland
- Organization of Biological Field Stations – Hilary Swain
- Santa Fe Institute – Ellen Goldberg
- University of Maryland – Margaret Palmer, Ferdinando Villa
- Pennsylvania State University – James L. Rosenberger
- Smithsonian Institution – Janet Gomon, David Nicolson

- University of Massachusetts, Boston – Robert Morris
- University of North Carolina, Chapel Hill – Robert Peet
- NASA – Paula Smits
- U. S. Environmental Protection Agency – Stephen Hale, Patricia Bradley, Linda Harwell, Robert King
- NOAA Coastal Services Center – Anne Miglarese
- NJ Department of Environmental Protection, Trenton, NJ – Thomas Belton
- Southern California Coastal Water Research Project, Westminster, CA – Larry Cooper
- Florida Marine Research Institute, St. Petersburg, FL – Christopher Friel
- USGS – Bruce Peterjohn, Michael Frame

Outside US - The Network Office interacts on a regular basis with the nineteen non-US coordinators of the International LTER Network, as well as representatives from several countries where networks are actively under development. This list can be found on the web site at <http://www.ilternet.edu/networks/ILTERtable.htm>

Project Activities/Findings

Major research and education activities

The Long-Term Ecological Research Network Office operates under a Cooperative Agreement with the National Science Foundation that defines our scope of activities. It is understood that the responsibilities of the Network Office may change over time to meet developing needs of the LTER Network and the National Science Foundation. At present, the activities of the Network Office can be classified into seven categories.

Facilitating electronic communication

One of the principal responsibilities of the Network Office is the development and maintenance of effective electronic communication among the 24 LTER sites, among ILTER sites and networks, and between the Network Office and LTER, ILTER, and other networks. The tasks associated with this activity include the maintenance of a personnel directory and e-mail aliases for scientists working at U. S. LTER sites, development and maintenance of LTER and ILTER home pages, and support of the hardware and software required for data bases and electronic communication. This year we provided a new electronic discussion forum for threaded topical communication and revised and updated both the LTER and OBFS personnel directory as well as planning the future of these databases. We are also hosting the OBFS web page after the organization ran into difficulty with providing dynamic content through it's commercial provider.

Facilitating scientific exchange

The ultimate goal of all activities of the Network Office is to help increase the quantity and quality of scientific studies performed by the U.S. LTER Network and its associated national and international partners. The principal mechanism by which the NET achieves this goal is the facilitation of scientific exchange at all levels of LTER activity. To this end, the NET is charged with the development of activities that enhance the capabilities of LTER Networks and their opportunities to interact. During the past year, the Network Office supported a suite of synthesis activities that arose from the 2000 LTER All Scientists Meeting.

Activities associated with the development of ILTER

Paralleling the development of the U.S. LTER network, international networks have sprung up in 22 countries since 1993. The impetus for this explosive growth was a meeting of international scientists held at Estes Park, Colorado, as part of the last LTER All Scientists Meeting. It was at this meeting that the concept of a global network of networks was first presented and embraced by representatives of 16 countries. Since that time, the LTER Network Office has successfully embraced the challenge of transferring the model of long-term ecological research developed in the U.S. to other national scientific communities. Each of the countries now supporting a network of long-term research sites has adopted a version of the model pioneered by the U.S. LTER program. At present, more than 200 international LTER sites have been designated (see <http://www.ilternet.edu>).

Promoting information management protocols

The LTER Network Office provides leadership to the LTER sites and the Committee on Information Management regarding the development of standard protocols for management of data and information. An Associate Director for Information Management (James Brunt) is responsible for encouraging and assisting individual sites to develop state-of-the-art information management capabilities. In addition, NET coordinates information management activities at the network level to provide value added data products to LTER scientists and the ecological community in general. Moreover, NET provides the point of contact between the LTER Network Information Managers and other agencies and networks involved in the development of national standards for data management. This year NET facilitated a workshop to bring together LTER and other scientists to finalize an ecological metadata standard, EML (Ecological Metadata Language). Version 2.0 was released in early 2002 with formal and informal reviews by the community in progress.

Encouraging new technologies

The LTER Network has as a prime objective the dissemination of new technologies among its sites and scientists. The Network Office provides leadership in identifying and developing new technologies through an Associate Director for Technology Development (John Vande Castle), who serves as the chair of the Committee on Technology. The Network Office fulfills its role in encouraging the use of new technologies by actively identifying novel technology and new uses for existing technology that might benefit ecologists. We serve as a test bed for new products and a

clearinghouse for products whose use is facilitated by a centralized repository. The Network Office also works to develop standardized data collection techniques where appropriate.

Developing linkages with other long-term research programs, site networks, and science and technology centers

The Network Office acts as liaison between the 24 sites and 1200 scientists in the LTER Network and other research programs, networks, and science and technology centers. We serve to coordinate activities of the LTER Network with similar efforts being conducted by other agencies or networks. This coordination includes cross-site or cross-network studies, standardization of experiments or data management, and joint proposals for research funding. We actively seek out partnerships that allow us to amplify the effect of research conducted at LTER sites and to address research questions that cannot be investigated successfully in isolation. We conduct focused research on mechanisms to improve linkages among research programs and data repositories.

Promoting the relevance of long-term ecological research

One of the most important activities of the Network Office is the dissemination of results obtained by LTER scientists. Scientific publications based on LTER research inform the ecological community of our accomplishments. The Network Office has the responsibility to insure that LTER research results reach other potential users of the information such as policy makers, ecosystem managers, educators, students, the media, and the general public. We fulfill this responsibility through an outreach program that utilizes print and electronic media, personal presentations, video, the World Wide Web, workshops, symposia, and other means of disseminating information.

Major findings

The fifth year of the Cooperative Agreement establishing the Long Term Ecological Research (LTER) Network Office (NET) at the University of New Mexico began on March 1, 2001. All activities proposed for the fifth year of the Cooperative Agreement are on schedule. A summary of noteworthy accomplishments during the past year is given below followed by descriptions of specific progress made in the seven major areas of responsibility of the Network Office.

- The Network Office continued its leadership role in efforts to review and revise the intellectual aims of the LTER network and to prioritize activities to achieve these intellectual aims. NET participated in the preparation of a document whose goal was to refresh the intellectual underpinnings of LTER and to prioritize activities over the next 10 years. The document sets out a revised set of goals for the LTER Network and discusses specific actions needed to reach those goals. (http://intranet.lternet.edu/archives/documents/reports/priority_setting_wht_paper.html)
- The Network Office took the lead in preparing material for the 20 Year Review of the LTER program. Jim Gosz and Bob Waide made presentations to the committee in Washington in August and in Albuquerque in October. In preparation for the latter meeting, NET staff contributed to and edited the written network response to nine issues raised by the review committee. NET staff

prepared a web page (http://www.lternet.edu/20yr_review/) to inform members of the committee and hosted and handled logistics for the Albuquerque meeting.

- NET staff participated in the organization of an informational meeting at NSF in February 2002. The purpose of the meeting was to provide current information on LTER accomplishments for NSF programs that support LTER.
- The Network Office provided support for 17 synthesis groups that were formed as a result of interactions at the 2000 All Scientists Meeting. These groups focused on a wide variety of themes. Support from the Network Office was used for meetings to produce research syntheses and publications.

Baker, L. (HBR) et al. "Integration of Research on Biogeochemical Cycles at LTER Sites"

1. Benson, B. (NTL) et al. "Advancing the Sharing and Synthesis of Ecological Data: Guidelines for Data Sharing and Integration"
2. Boone, R. (BNZ) et al. "Defining the Schoolyard LTER Program: Priorities, Infrastructure, and Communications"
3. Childers, D. (FCE). "LTER-based Tropical Coastal Research Across the Caribbean Basin"
4. Christian, R. (VCR). "Ecological Network Analysis for Cross Site Comparisons: Developing the Network of Users"
5. Coleman, D. (CWT) and J. Moore (SGS). "A Cross-Site Synthesis of Biotic and Abiotic Agents of Decomposition and SOM Dynamics in LTER Sites"
6. Dyer, L. and P. Robertson (KBS). "Integrating LTER Research Into Ecosystem Management."
7. Harmon, M. (AND). "The Long-term Intersite Decomposition Experiment Team (LIDET)"
8. Huenneke, L. (JOR) et al. Preliminary Synthesis of Species Removal Experiments: Follow-up to the ASM "LTER/GCTE Workshop on Removal Experiments on the Role of Biodiversity in Ecosystem Functioning"
9. Lajtha, K. (AND). "Dynamics of Coarse Woody Debris and Effects on Soils and Ecosystem Fertility"
10. Lathrop, D. (NTL) et al. "Sense-of-Place Attitudes in the World's Temperate Lake Districts"
11. King, H. (TERN). "East Asia-Pacific Organic Matter Decomposition Processes Workshop"
12. Morris, J. (PIE). "Regulation of Organic Matter Preservation in Soils and Sediments"
13. Peters, D. (JRN) et al. "Scaling From Plots To Landscapes and Regions: Relevance of Landscapes to Current Issues in Ecology"
14. Seastedt, T. (NWT) et al. "Causes and Consequences of Invasive Species; Past and Future Contributions of the LTER Network"

15. Turner, D. (AND) et al. “Scaling Carbon Flux to the Site Level in the Context of Validating Products from Earth Observing Satellites”

16. Yeakley, A. (CWT) and S. Wondzell (AND). “Process Controls on Nitrogen Flux in Riparian Zones”

- The Network Office continued to work with other members of the Partnership for Biodiversity Informatics (San Diego Supercomputer Center [SDSC], the National Center for Ecological Analysis and Synthesis [NCEAS], and the University of Kansas) to advance the field of informatics as it relates to biodiversity and ecology. Among other activities, we helped prepare a preproposal to the National Science Foundation’s ITR competition.
- NET staff initiated the development of a publication summarizing research accomplishments in the LTER network since its inception. This document, which will be completed in 2002, will be used to publicize the LTER Network and is available at: (<http://www.lternet.edu/temp/SiteAccomplishments/index.html>).
- A new national network (Zambia) was added to the International LTER Network at the annual meeting in London. Four other countries (France, Italy, Mexico, and South Africa) made substantial progress in developing their own networks.

Facilitating Electronic Communication

- The ecoinformatics homepage, which contains resources for ecologists involved in information management, debuted last year and has received a lot of traffic. This year we have partnered with the NCEAS to expand the content and timeliness of this website to appeal to a wider audience of ecologists. These resources include lists of relevant websites and publications including PDF documents of unavailable publications and now also include information about relevant informatics research projects including the Knowledge Network for Biocomplexity Project (<http://www.ecoinformatics.org>).
- To more effectively facilitate electronic communication, we have implemented a request tracking mechanism that is accessed via the web or email. User requests for information, help, changes, corrections, etc. are logged, assigned a tracking number and responded to immediately. A web interface helps network office personnel manage and respond to these requests in a timely manner. Over 1000 requests have been responded to in 2001.
- We continue to maintain and add new features to the LTERnet mail reflector. New features include the addition of a threaded discussion forum for LTER researchers to host and post topical discussions via the intranet. This system is fully integrated with the LTER email system so that researchers need not have access to the web to participate. New security features are continually being added to protect against malicious activities and mailings.

Facilitating scientific exchange

Facilitating exchange within the U.S. LTER Network:

- Rapid progress was made towards the development of a Knowledge Network for Biocomplexity under a grant from the KDI program. With partners at SDSC, NCEAS, and Texas Tech University, we were involved in a software development and IT research project that includes ecological metadata management software called MORPHO, designed to provide ecologists with improved methods of data and metadata management and access to distributed data sets, and a metadata/data repository network called Metacat, designed to provide discovery and access to broad repositories of ecological data. A training program aimed at graduate students was initiated with seminars conducted at the University of New Mexico, the University of California-Santa Barbara, and Texas Tech University.
- This year the Network Office unveiled the LTER “Intranet” web site. This web site separates LTER research specific content from the information presented about LTER to the general public. Although most sections are still publicly accessible, this gives the LTER researcher a portal to all the content needed in the process of conducting LTER research. Most functions are available via the <http://intranet.lternet.edu> homepage without additional navigation of the site. This facilitates a broader presentation at the <http://www.lternet.edu> homepage for the general public, educators, potential graduate students, legislators, highlighting LTER research and accomplishments.
- The Network Office in collaboration with LTER information managers has designed an LTER knowledge base that integrates LTER information currently housed in disparate databases. When implemented, this system will greatly improve the information content and tracking capability for LTER researchers, projects, and research findings as well as automating previously static web content.
- The Network Office recruited and hired postdoctoral fellow Deana Pennington as a specialist to work with the large array of archived remote sensing data to facilitate access for LTER researchers. The position is funded as part of a collaboration with the San Diego Supercomputer Center (SDSC) and the Earth System Sciences thrust area of the National Partnership for Advanced Computational Infrastructure (NPACI). The focus of the project is continued work on the LTER Spatial Data Workbench, initially developed by John Vande Castle, colleagues from SDSC and collaborators at the University of Colorado (Greg Asner and Carol Wessman) to provide access to hyperspectral data acquired for LTER sites. The project was expanded in late 2001 to include the Landsat, AVHRR and MODIS data acquired for LTER sites by the Network Office since 1990. The project will utilize the advanced computational, mass storage and visualization infrastructure available at SDSC. More information regarding the project can be found at: <http://www.lternet.edu/technology/sdw/>
- James Brunt, Bill Michener, Bob Waide, and John Vande Castle attended a three day workshop on “Synthesis in Ecology: Approaches, Principles, and Procedures” at the Sevilleta Biological Field Station. Results will be compiled in a manuscript for submission in 2002 that should facilitate future synthesis efforts in ecology.
- NET developed a proposal for supplemental funds to plan, and implement EML ecological metadata language throughout the LTER network.
- NET helped organize and fund meetings of the Coordinating Committee at Central Arizona-Phoenix in April and Plum Island Estuary in September (later cancelled).
- NET staff organized Executive Committee meetings in Phoenix, Albuquerque, and Washington, D.C.

Facilitating exchange between the LTER Network and the national scientific community:

- The Network Office, the LTER information management committee, and partners at the National Center for Ecological Analysis and Synthesis developed the very first metadata standard for ecological data. Ecological Metadata Language (EML) version 2.0 is a hallmark development that will greatly facilitate the further development of integrated information systems. The Network Office facilitated the first of three metadata-oriented meetings in January 2002 to develop EML implementation plans for LTER.
- James Brunt represented NET at the Metadiversity II meeting in Charleston, South Carolina, where a broad group of information specialists from government and non-government organizations considered the future of biodiversity informatics.
- Troy Maddux and William Michener represented NET at a meeting of the Organization of Biological Field Stations at the University of Oklahoma Biological Station, where they discussed information management systems at field stations.
- An NSF Research Coordination Network grant was awarded to the LTER network office to develop the informatics framework that can facilitate storage, discovery, and access to the strategic environmental information resources that are collectively held at North American biological field stations. This project will support expansion of ongoing collaborations between LTER and OBFS. Project objectives will be accomplished through two integrated networking activities: (1) a research focus that encompasses five inter-related resource discovery components and (2) an intensive training component that provides field station personnel with a solid foundation in the computational and informatics skills that are critical for developing, archiving, managing, and communicating data and information resources. Research activities include the development of five databases that will support discovery of biological data and information resources at field stations. In particular, the research team will: (1) establish a North American Field Station Data Registry and Repository; (2) initiate a Thesaurus for Field Biology; (3) develop a Site Characteristics Database for North American Field Stations; (4) create a Bibliography of North American Field Station Publications; and (5) develop a WWW-accessible Database of Field Station QA/QC and Standard Methods. The team of investigators will coordinate development of the databases in conjunction with representatives of the Organization of Biological Field Stations, who comprise the project steering committee. In addition, the investigative team will coordinate the development of educational activities for field station personnel. These field station personnel will also contribute to database development activities. Education will principally focus on annual intensive (2-week) training workshops in ecological informatics that are developed around a series of course modules. Where appropriate, training modules will be made available on a web site to broaden the potential audience throughout the community of potential users.

Facilitating exchange between the U.S. LTER Network and the international scientific community:

- The LTER Network Office sponsored participation of LTER Network personnel in efforts that are helping to lay the groundwork for developing international standards for data exchange and

interoperability and provided exchange of information valuable to the developing ILTER networks.

- The Network Office supported the GTOS NPP Demonstration Project 2001 as part of its ILTER coordination efforts. The project was initiated in 1998 to improve current estimates of global terrestrial primary productivity by comparing ground based measurements of land cover (LC), leaf area indices (LAI) and net primary productivity (NPP) with satellite-derived remote sensing products. During 2001, the database developed to support information and data exchange within the NPP Demonstration project has been modified with new and updated site information. MODIS data products have been downloaded from NASA sources for most of the 26 sites participating in the GTOS NPP Project and placed online within the project webpage for sites to access. For sites which participate in the NPP Demo Project, it is planned that regular 11 x 11 km cutouts of selected MODIS products will be provided beginning summer 2001 by the ORNL DAAC with whom the Network Office continues an active collaboration. Primary productivity data products have been produced globally since December of 2000, which will allow a first comparison of global satellite, and ground based annual NPP data by the end of 2001.
- An LTER/GTOS “Carbon Flux Scaling” workshop, co-hosted by John Vande Castle and supported by the Network Office was held in May of 2001 near Corvallis, Oregon. The workshop was a first step to begin collaborative data comparison and validation activities. Twenty people attended the workshop, including participants from Brazil, Hungary and Korea. The workshop was intended to promote data exchange between the remote sensing community, and the field sites where relevant validation data is being produced. A report from the workshop is available at http://www.fsl.orst.edu/larse/bigfoot/gtos_home.html .
- NET recruited a group of U.S. LTER scientists to act as a consultative body regarding interactions with national networks in the Latin American, Central European, and African Regions. We will continue our efforts to develop a cadre of interested US scientists to act as advisors to the countries with active LTER programs or those interested in LTER style research.
- Patricia Sprott edited chapters submitted for publication in a book on biodiversity in drylands for the LTER Oxford series. This book is the result of a workshop held in Israel that included many LTER scientists from the U.S. and other countries.
- Regional networks continued to develop in the Central European, North American, South American, and East Asian regions. NET has contributed to these developments in a number of ways: communication by e-mail, information made available through publications and the increasingly enhanced web site it maintains, but most importantly through consultative visits and attendance at meetings.
- A Meeting of the International Long Term Ecological Research (ILTER) network (http://www.ilternet.edu/meetings/2001_ilter_meeting_report.html) was held in conjunction with the "Detecting Environmental Change" (DEC) Conference at the University of London on July 16, 2001. This meeting included representatives of many of the participating sites of the GTOS NPP Demonstration project. A presentation of the project status, initial data products was made by John

Vande Castle. It is planned that during 2002, there will be focused workshops to specifically compare ground validation measurements with the MODIS data products produced during 2001. Updated information will be provided on the GTOS NPP Project webpage maintained by the Network Office at: <http://www.iltinternet.edu/gtnet/>.

Promoting Information Management Protocols

The LTER Network Office (NET) has contributed to several major advances toward the development and use of standards and standard protocols for managing and accessing LTER Network data.

- The Network Office, the LTER data management committee metadata working group, and partners at the National Center for Ecological Analysis and Synthesis have developed a structural metadata standard for ecological data. This hallmark development will greatly facilitate the further development of integrated information systems. The EML (ecological metadata language) Version 2.0 standard will be made available and reviewed by the community during early 2002 via the <http://www.ecoinformatics.org> website.
- The LTER network climate database “CLIMDB”, an interactive, web-based access system to integrated climate data from all sites, has been expanded to house hydrology data. This effort is being accomplished through support of Don Henshaw, database manager at AND and funds from the US Forest Service – Forest Health Monitoring program. The program has also been expanded to provide sites the capability of prompting a harvest and receiving automated QA/QC information back via the web.
- A prototype site description database has been populated and is available via the LTER intranet page. The relevant features of this database have been revised and integrated with the LTER personnel databases to combine features suggested by PI’s with those needed to do broad-scale analyses and those needed to provide timely information via the web. The knowledge base design features standardized representations of locations and sub-locations at sites including geo-spatial references. (Expected prototype completion date is March 2003).
- The Network Office coordinated and hosted the Information Managers Network Information System (NIS) working group in February 2002 at the San Diego Super Computer Center to further progress on the NIS. The committee focused attention on the use of new technologies like XSP and XSLT to connect heterogeneous databases.
- The Network Office hosted the information manager from Luquillo (Eda Melendez) for discussions about web to database connectivity.
- Representatives from the NBII and USGS Center for Biological Informatics in Denver visited the LTER Network Office February 23, 2002 to discuss further development of the relationship between LTER and NBII previously established by Anne Frondorf, NBII director and James Brunt, ADIM.
- Alison Withey (SDSC/UCSD) and William Michener organized an NSF-funded workshop on

Scalable Information Networks for the Environment (SINE). The SINE workshop was hosted by the Partnership for Biodiversity Informatics (PBI) from October 29-31, 2001 at the San Diego Supercomputer Center. The SINE workshop was attended by a diverse group of research scientists, directors of field stations and marine laboratories, and experts in computational and information sciences who met to discuss the technical requirements for building local, regional, and national-level environmental information networks. LTER NET participants included William Michener, Robert Waide, and John Vande Castle. Workshop presentations and working group sessions focused on three topics: (1) building distributed sensor networks: design and implementation issues; (2) enabling technologies and user requirements for data and information management and delivery; and (3) scaling components of environmental information networks: data, computers, and people. Information about the SINE workshop can be found at www.sdsc.edu/pbi. A complete workshop report will be available later this year, but a subset of preliminary findings and recommendations for infrastructure development, education, and policy has been submitted to NSF.

- Bill Michener participated in an EPA workshop panel (*Managing Troubled Waters: Partnerships Smooth Data Integration*), April 26, 2001, Pensacola Beach, FL, and discussed how partnerships lead to better information management systems. Numerous examples of LTER successes and approaches were highlighted.
- A comprehensive survey of OBFS information technology capabilities and needs was completed. Results of the survey were compiled for presentation at the annual OBFS meeting in October. The survey results will be used in developing and prioritizing informatics training activities and promoting ecoinformatics.

Encouraging new technologies

- As part of the NSF workshop on Scalable Information Networks for the Environment, NET assessed the current state-of-the-art in sensor and sensor array technologies. The Ecological *in situ* Sensor Website is located at <http://www.lternet.edu/technology/sensors/index.html>. Three reports (sensors, sensor arrays, manufacturers) are currently available and others will be added in January. Development of these reports was coordinated by the San Diego Supercomputer Center (Alison Withey -- co-leader) and LTER Network Office (William Michener -- co-leader). Greg Bonito assembled a wealth of information about *in situ* sensor technologies that is available in the reports.
- John Vande Castle organized and held a meeting of a "Technology Task Committee" consisting of a subset of the full LTER Technology Committee. The meeting held at Archbold Biological Station, January 8-9 2001, documented specific technology needs and projects that could be realistically undertaken within the LTER program. The Committee report, available at <http://www.lternet.edu/technology/2001techtask/>, includes information related to wireless data transmission already in use at LTER sites, new remote sensing data and initial information on *in situ* environmental sensors and other new technologies.

- John Vande Castle attended the MODIS LAI Validation Workshop on June 7 and 8, 2001 in Frascati, Italy for the GTOS NPP Demonstration Project. The workshop focused on methods to scale and compare ground LAI measurements with MODIS data products. The workshop provided excellent examples of sampling methods for extrapolating site-based measurements to the course scale, 250m to 1km resolution of the MODIS data products. (http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/CEOS_WGCV/lai_intercomp.html).
- John Vande Castle continued his coordination between LTER site personnel and associates of the Global Fiducial Program for access to historical and declassified reconnaissance imagery. During 2001, John Vande Castle met with contactor staff of Earth Satellite Data Inc, and reviewed potential data for LTER sites using his security clearance. Data was acquired for the Virginia Coast Reserve and the Sevilleta LTER sites as initial test cases. The raw reconnaissance data acquired is historical imagery dating back to 1962 at a spatial resolution of about 1m. These data were read from tape and added to the LTER archives for site access and future use. There will be future coordination with the LTER sites to determine the utility of data needs by these and other sites. Further information can be found at <http://www.lternet.edu/technology/gfl/> and a PowerPoint presentation with background and example imagery can be found at: http://www.lternet.edu/technology/gfl/gfl2001_jvc_lter_files/frame.html

Developing linkages with other long-term research programs, site networks, and science and technology centers

- Staff of the Network Office maintain personnel and site databases for the Organization of Biological Field Stations and host the website for OBFS and the mail list for the Canopy Network.
- The OBFS data registry, a mechanism for registering data sets collected at field stations and marine laboratories with a minimum of metadata, has undergone beta testing through the California Natural Reserve System. The Data Registry will be fully implemented and online in January 2002.
- Michener, Brunt, and Kristin Vanderbilt (SEV) collaborated with Dr. Masato Hori (Laboratory of Forest Botany, Faculty of Forestry, University of Tokyo, Bunkyo-ku, Tokyo, 113-8657 Japan) and co-authored a publication for the *Japanese Journal of Ecology* entitled “Ecological Informatics: a Long-Term Ecological Research Perspective.” The publication summarizes the history, current practices, and future vision for LTER informatics and compares and contrasts LTER informatics efforts in the United States with LTER in Japan.

Promoting the relevance of long-term research

Nearly all of the activities of the Network Office could be viewed as promoting the relevance of long-term research. However, some accomplishments in particular have been directed towards promoting a greater awareness in the scientific community and the public regarding the importance of our mission. These include the following training and development activities shown below.

Project Training/Development

- NET staff members Robert Waide, James Brunt, and William K. Michener are contributing to training modules for a seminar course to be conducted at 15-30 universities in association with the Knowledge Network for Biocomplexity project. This seminar is being designed to instruct graduate students in techniques needed to collect and analyze data on the relationship between biodiversity and ecosystem processes. The seminars will also include guidance on the construction and maintenance of databases and the use of software for data accession to be developed under the KNB project. The seminars will culminate in a meeting at NCEAS to synthesize data from the individual projects.
- The LTER Network Office prepared or provided informatics training to numerous ILTER countries, including Israel, Palestine, Egypt, Jordan, Tunisia, and Mongolia.
- As part of the Network Office's ["LTER Schoolyard Collaboration"](#) John Vande Castle has implemented wireless networking to support Webcam data transmission including wireless data transmission at the LTER Network Office. Further details and documentation can be found in the LTER wireless information document at <http://www.lternet.edu/technology/wireless/>
- Additional satellite imagery was acquired for the Schoolyard LTER project to provide space-based views of LTER sites. The data acquisition was expanded in order to provide at least one good Landsat Thematic Mapper image for all existing LTER sites. The graphical imagery as well as the raw satellite data will be included in the LTER data archive as well as added to the LTER Spatial Data Workbench Project.
- A data management training workshop was organized by the Network Office for a group of ecologists and scientists from five Middle Eastern countries in September, 2001 in Bonn Germany. Trainers came from the Network Office: Bill Michener (NET; data management and metadata), John Vande Castle (NET; GIS and remote sensing), David Blankman (NET; metadata, databases), and the LTER Network: John Porter (VCR; data management), and Kristin Vanderbilt (SEV; data management). The training was organized by James Brunt and funded by Sandia National Labs – Cooperative Monitoring Center and was in progress at the time of the tragedies of September 11.
- A data management training workshop was held in July 2001 in Ulumbatar, Mongolia. Information Managers Kristin Vanderbilt (SEV) and Peter McCartney (CAP) facilitated this training.

Outreach Activities

- NET staff hosted a contingent from Southern Africa in June. This group received a briefing on LTER activities and visited several LTER field sites. NET assisted in the organization of their itinerary
- The Ecological Society of America supported a daylong workshop (organized by William Michener and Art McKee from the Andrews LTER) on the Sunday prior to the annual ESA

meeting that focused on expanding information technology capabilities at field stations, marine laboratories, LTER sites, and related institutions. Ten speakers from a variety of institutions covered a diverse array of topics ranging from wireless communication to metadata to taxonomic databases. Each topic represents an area of active development in the field station community.

- Bob Waide hosted congressional and OMB staff on two visits to the Luquillo LTER site. These visits provided us with an opportunity to inform the staffers about the LTER program in general using research examples from Luquillo.
- An OBFS education (course) database (a central database where courses at field stations and marine laboratories can be listed and advertised) has been designed and implemented. The database is available for community use and was announced at the annual OBFS meeting in October.
- The web page describing activities of the LTER Network was re-designed and enhanced to provide improved access to information about LTER for students and non-scientists (<http://www.lternet.edu>). The re-organization of the Website has created important new avenues for reaching the research community and the public through electronic publishing.
- Patricia Sprott developed a poster presentation on the Schoolyard LTER for the NPACI All Hands Meeting and annual meeting of the Ecological Society of America.
- Patricia Sprott developed an exhibit synthesizing LTER aquatic research for the American Society for Limnology and Oceanography meeting, Albuquerque, NM.
- Net staff produced two brochures: A comprehensive LTER brochure and a brochure for the new Florida Coastal Everglades LTER site.
- Patricia Sprott assisted with the organization of a kick-off meeting for the Shortgrass Steppe LTER G-K12 project.
- Bill Michener attended the SAMBAS-LOICZ (South American Basins -- Land-Ocean Interfaces in the Coastal Zone) in Fortaleza Brazil and promoted the integration of LTER concepts into South American continental coastal monitoring program development.

Publications

Journal publications

- Michener, William K., James W. Brunt, Kristin Vanderbilt. In review. Ecological Informatics: a Long-Term Ecological Research Perspective. *Japanese Journal of Ecology*.
- Hale, S.S., A.H. Miglarese, M.P. Bradley, T. Belton, L. Cooper, M. Frame, C.A. Friel, L. Harwell, R. King, W.K. Michener, D. Nicolson, and B. Peterjohn. *In press*. Managing trouble data: coastal data partnerships smooth data integration. *Environmental Monitoring and Assessment*.
- Michener, W.K., T.J. Baerwald, P. Firth, M.A. Palmer, J. L. Rosenberger, E.A. Sandlin, and H. Zimmerman. 2001. Defining and unraveling biocomplexity. *BioScience* 51: 1018-1023.
- Simkin, S.M., W.K. Michener, and R. Wyatt. 2001. Plant response following soil disturbance in

a longleaf pine ecosystem. *Journal of the Torrey Botanical Society* 128: 208-218.

- Mittelbach, G.G., C. F. Steiner, S.M. Scheiner, K.L.Gross, H.L. Reynolds, R.B.Waide, M.R. Willig, S.I. Dodson, and L.Gough. 2001. What is the observed relationship between species richness and productivity? *Ecology* 82:2381-2396.
- Thompson, J., N. Brokaw, J. K. Zimmerman, R. B. Waide, E. M. Everham, III, D. J. Lodge, C. M. Taylor, D.Garcia-Montiel and M. Fluet. Land use history, environment, and tree composition in a tropical forest. *Ecological Applications* (in press).

Books and other one-time publications

- None

Internet Sites

- The Network Office developed an intranet web site separating LTER research specific content from the information presented about LTER to the general public. A portal to all the content needed in the process of conducting LTER research is available via the <http://intranet.lternet.edu> homepage without additional navigation of the site. This facilitates a broader presentation at the <http://www.lternet.edu> homepage for the general public, educators, potential graduate students, legislators, highlighting LTER research and accomplishments.
- Ecoinformatics homepage –the ‘ecoinformatics’ homepage contains resources for ecologists involved in information management and was further expanded this year to include the Knowledge Network for Biocomplexity research project and software. Other resources include lists of relevant websites and publications including PDF documents of unavailable publications. The very successful OBFS/LTER collaboration data management volume (DIMES) is included on the site in its entirety. <http://www.ecoinformatics.org>
- Databits – an online newsletter about data management in LTER was published in April and November 2001. Open subscription readership continues to grow as does the quality of the publication which is coordinated and hosted by the Network Office and edited by the LTER Information Managers:
 - <http://intranet.lternet.edu/archives/documents/Newsletters/DataBits/01spring/>
 - <http://intranet.lternet.edu/archives/documents/Newsletters/DataBits/01fall/>

Other Products

- Site description database - a prototype site description database has been populated that combines features suggested by PI's with those needed to do broad-scale analyses with those need to provide timely information via the web. The database features standardized representations of locations and sub-locations at sites including geo-spatial references.

Contributions

Principal Disciplines

By coordinating cross-site activities of the LTER Network, the Network Office contributes directly to development of partnerships and collaboratories in ecological science. We provide leadership in the field of ecology, especially in critical areas involving the development of knowledge networks. By emphasizing interdisciplinary and cross-site research activities, we advance our understanding of complex systems, including human-driven systems. The partnership we have formed with SDSC, NCEAS, and the University of Kansas directly promotes the integration of the fields of systematics and ecology. The Network Office has played a key role in defining the importance of informatics in ecology and in disseminating knowledge about informatics throughout the ecological community. We have provided leadership in the important areas of data sharing, connectivity, and the acquisition and implementation of new technologies.

Other Disciplines

Our participation in the KDI project jointly with SDSC and NCEAS contributes to the field of computer science and informatics. Network development, research in computer science, ecological research concerning biocomplexity, and educational activities are purposefully linked in the proposal. The Knowledge Network will provide a test bed for integrating multidisciplinary, multi-scale data for addressing critical environmental questions. The efficient discovery of new ecological insights from this system will provide validation of the Network. Similarly, advances in computer science research involving probabilistic testing of hypotheses will guide ecological research and accelerate progress in understanding complex phenomena in general.

Human Resource Development

The LTER educational activities facilitated by the Network Office include development of web-based information on ecology for use by K-12 students, support of Schoolyard LTER sites at secondary schools, assistance to undergraduates and graduate students in identifying educational and research opportunities, organization of international student exchanges, facilitation of the activities of the LTER Graduate Student Committee, and the development of proposals aimed at the integration of education at all levels into LTER research programs.

Resources for Research and Education

The technical and information resources developed and maintained by the Network Office are available for use by the 1100 scientists of the LTER Network as well as the ecological community in general. The Long Term Ecological Research Network Office occupies seven offices, two computer laboratories and a conference room within 2,700 square feet at the University of New Mexico South Campus Research Park. The Network Office maintains scalable servers linked by 100mb/s Internet connections to the campus vBNS to serve the LTER and general ecological community. A mix of Sun

Solaris/Unix and Microsoft NT servers are used for maximum flexibility in database and Web technology development. Two Sun 450 Ultra Enterprise servers each consisting of quad UltraSPARC cpu's, 1gb memory and over 500gb shared disk, provide Internet web services, Geographic Information System (Erdas,ENVI and Arc/Info) and data archive/file services to Network Office staff and the LTER and world-wide ecological community. Three multi-processor Microsoft NT servers sharing over 150gb of RAID disk storage are used for database development using Microsoft SQL server, BackOffice, and Exchange server technology. The Sun and NT servers run from redundant and uninterruptible power supplies with tape backup on all systems. Five CDROM writers, DVD-RAM and DVD-ROM are also used for data archive and distribution. Desktop and laptop computers systems with extensive and current software support the various needs of the Network Office staff. A video editing system comprised of an Apple G4 with 1gb memory, 100gb disk and dual displays are used for processing video and support Apple software and Internet services. Computer projection systems, wide format printer/plotters and high speed color LaserJet printers are used for presentations, documents and publications. Professional/broadcast quality Canon XL1 and JVC DV1 digital video cameras support new efforts for documenting LTER activities and providing web-based video access and information.

Objectives and scope

No substantive changes in the general activities outlined in the Cooperative Agreement are anticipated during the next year.