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2000 LTER Network Office Annual Progress Report

Long Term Ecological Research Network

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LONG TERM ECOLOGICAL RESEARCH
NETWORK OFFICE

2000 ANNUAL PROGRESS
REPORT

SUMMARIZING ACCOMPLISHMENTS OF THE
LTER NETWORK OFFICE DURING THE
FOURTH YEAR
OF COOPERATIVE AGREEMENT
DEB-9634135

Executive Summary

The Network Office played key roles in three major LTER activities during 2000-2001. Preparations for a mid-term site review in May provided an opportunity to review and revise NET goals and led to an intensive effort to prioritize activities in support of these goals. NET staff took the lead in organizing the All Scientists Meeting in August, including the development of the agenda, preparation for plenary speakers, organization of workshops, management of the meeting budget, and general logistics. The Network Office worked with the Executive and Coordinating Committees to prepare for the twenty-year review of the LTER program. Preparations for this review included the review of LTER aims, activities and priorities, which was accomplished through meetings of the Executive, Coordinating, and Scientific Initiatives Committees, the lead principal investigators of the LTER sites, and the LTER National Advisory Board, all coordinated by the Network Office.

NET staff took part in a variety of other activities designed to support the overall goals of the LTER program. NET supported 18 groups of scientists conducting synthesis activities stemming from interactions at the All Scientists Meeting. A proposal for supplemental funds to create a new position in information management resulted in the strengthening of the relationship between the LTER network and the Organization of Biological Field Stations through the joint development of OBFS databases, metadata protocols, and communications infrastructure. NET staff continued to pursue initiatives in ecological informatics, including the development of a structural metadata standard for ecological data, the creation of a knowledge network for biocomplexity, the development of a web-based course on new informatics technologies, planning for a scalable communication and information network for the biological sciences, creation of a Spatial Data Workbench, and continued development of the LTER Network Information System. Partnerships with the LTER Committee on Information Management, the National Partnership for Advanced Computational Infrastructure at the San Diego Supercomputer Center, the National Center for Ecological Analysis and Synthesis, and University of Kansas contributed to these important activities.

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, Senior Research Scientist, 9 months (started 9/2000); responsible for development of Organization of Biological Field Stations science, data management, and communication capabilities

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

Christine French, Ecological Research Network Consultant, 100% time; NSF employee on IPA contract with University of New Mexico; responsible for fostering development of International LTER Network (returned to NSF 9/30/2000)

Joe Eastman, post-doctoral associate, 100% time; contributes to Biological Scale Process Modeling as part of joint project with the National Partnership for Advanced Computational Infrastructure (until December 2000)

David Blankman, Database Administrator, 100% KNB project (started 5/2000); responsible for database design and application programming for the Knowledge Network for Biocomplexity project

Richard Dahringer, Analyst Programmer III, promoted from User-Support Analyst in July 2000; responsible for computer systems and network administration

Owen Eddins, Programmer/Analyst III, 100% KNB project (started 7/2000); 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 (started 6/2000); responsible maintenance and further development of LTER Network databases

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

Kevin Sanders, Student Assistant, 40%; - general clerical work

Saioa de Urquiza, Student Assistant, 40%; - general clerical work (until May 2000)

Organization

Collaborators

Within institution

- Bob Parmenter – Biology Department
- Terry Yates – Biology Department
- David Bader – Computer Science Department
- Joyce Francis – Biology Department
- Margaret Werner-Washburn – Biology Department
- Jim Brown – Biology Department
- Bruce Milne – Biology Department
- Howard Snell
- Frank Gilfeather – Advanced High Performance Computing Center
- Barbara Kimbell – Arts and Sciences Development
- Greg Shore – 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
- University of California – San Diego (National Partnership for Advanced Computational Infrastructure) – Peter Arzberger, John Helly, Tony Fountain, Arcot Rajasekar, David Stockwell, Alison Withey

- University of California – San Diego (Scripps Institute) – Karen Baker
- University of Kansas – Leonard Krishtalka, Jim Beach, David Viegles, Town Peterson
- Colorado State University – Roger Pielke, Bill Parton, Susan Stafford
- Michigan State University – Stuart Gage, Diane Ebert-May
- Brown University – Steve Hamburg
- Oregon State University – Andy Moldenke, Paul Risser, Don Henshaw
- 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 Prenger, David Betsill, Mike Vannoni
- The Nature Conservancy – Bruce Young
- University of Georgia – Frank Golley
- University of Washington – Jerry Franklin
- Oak Ridge National Laboratory – Dick Olson, Bob Cook, Kent McCord
- USDA – Forest Service – Doug Ryan, Chuck Liff
- NBII – Anne Frondorf
- 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
- Texas Tech University – Michael Willig
- Archbold Biological Station – Hilary Swain
- Duke University (Organization for Tropical Studies) - Jorge Jimenez
- University of California – Berkeley – Mark Stromberg
- University of California – Riverside – Mike Hamilton
- University of Mississippi – Marjorie Holland
- Organization of Biological Field Stations – Art McKee
- Santa Fe Institute – Ellen Goldberg

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 revised and updated both LTER and ILTER personnel directories.

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 planned and organized the fourth LTER All Scientists Meeting, bringing together nearly 800 US and foreign scientists interested in long-term research.

Activities associated with the development of ILTER

Paralleling the development of the U.S. LTER network, international networks have sprung up in 20 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.

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. For example, in September 2000, the Network Office added a specialist in information management (Bill Michener) to strengthen the relationship between the LTER Network and member institutions of the Organization of Biological Field Stations. 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 fourth 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, 2000. All activities proposed for the fourth 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 took the lead in efforts to review and revise the intellectual aims of the LTER network and to prioritize activities to achieve these intellectual aims. NET organized and participated in a joint meeting of the Executive Committee and the Committee on Scientific Initiatives whose goal was to refresh the intellectual underpinnings of LTER in preparation for the 20-year review. Subsequent meetings of the lead LTER principal investigators and the National Advisory Board were organized by NET to continue this process.
- Planning for the 2000 LTER All Scientists Meeting was the major focus of the office this year. This very successful meeting was held at Snowbird Lodge, Utah, in conjunction with the annual meeting of the Ecological Society of America. Nearly 800 LTER and non-LTER scientists participated in over 60 workshops. A highlight of the meeting was the attendance of over 100 foreign scientists from 31 countries.
- NET and the Executive Committee reviewed and decided to provide support for 18 groups of scientists working to synthesize information and ideas across LTER and other sites. Interchange of ideas at the All Scientists Meeting led to the formation of these groups.
- The relationship between LTER and the Organization for Biological Field Stations was strengthened by the recruitment of a senior information manager (Bill Michener) to work with OBFS institutions to increase expertise and capabilities in the management of field data. By strengthening this partnership, we hope to stimulate the development of regional networks of LTER and OBFS sites working with common goals.
- The Network Office, the LTER data management committee, and partners at the National Center for Ecological Analysis and Synthesis developed the very first draft structural metadata standard for ecological data. This hallmark development will greatly facilitate the further development of integrated information systems.
- 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 proposal to the National Science Foundation to conduct a workshop on the

development of a scalable communication and information network for the biological sciences.

- The Network Office continued to develop the collaborative relationship with the San Diego Supercomputer Center and the National Partnership for Advanced Computational Infrastructure (NPACI). A post-doctoral associate (Joe Eastman) worked with Tony Fountain at the San Diego Supercomputer Center to port a parallel version of the Regional Atmospheric Modeling System (RAMS) developed at Colorado State University. Runs of this model using the advanced computational power available at SDSC have already led to increased insights into the importance of canopy structure and land use on regional weather patterns.
- 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 the development of a software package called MORPHO designed to allow ecologists improved methods of data and metadata management and access to distributed data sets. 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.
- Bob Waide participated in the preparation of a successful proposal to the NSF Biocomplexity competition.
- NET continued support of the Schoolyard LTER program. Supplemental funds were obtained to provide integration of the diverse schoolyard program through the development of a web page where students and teachers can share ideas and data.
- As part of the Earth System Sciences thrust area of NPACI, John Vande Castle from NET and colleagues from SDSC developed a joint project to create a Spatial Data Workbench, which will provide access to hyperspectral data from all LTER sites using technology developed at SDSC. Bill Michener also proposed the transfer of technology (Species Analyst and GARP) developed at the University of Kansas under the NPACI program to member institutions of the Organization for Biological Field Stations.
- The International LTER program continued to grow and now comprises a total of 20 national networks. The Network Office facilitated the initiation and development of many of these networks. The ILTER annual meeting was held in conjunction with the All Scientists Meeting.
- John Vande Castle continued to support activities associated with the Global Terrestrial Observing System (GTOS) including development of web-based information and data access and exchange (www.ilternet.edu/gtos/). The goals of this project are to link data sharing/validation between ILTER sites and NASA programs.

Facilitating Electronic Communication

Specific accomplishments during the third year of the Cooperative Agreement included:

- 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. <http://www.ecoinformatics.org>.

- Recruitment of a new database administrator for NET and an analyst/programmer and database administrator for KNB were completed.
- Database status information is now being posted to the web and emailed to LTER information managers and PI's monthly as the 'state-of-the-database report'. NET staff continue to update databases describing LTER climate, hydrology, site, personnel and publications. Statistics on LTER activities were also updated on the web site.
- We continue to maintain and add new features to the LTERnet mail reflector. It is now possible for individuals to create their own temporary '@LTERnet.edu' mailing lists via the functions of the Intranet. Key mail lists are being archived in hypermail and new security features are continually being added to protect against malicious activities and mailings.
- NET Staff continued to develop and upgrade the LTER Web site—the nexus for LTER Network science communication. For example, this year we have revised the form and function of the LTERnet web site – providing differential content for researchers, general public, and schoolyard.
- The Network Office sponsors the participation of individual information managers to develop special projects related to the NIS. Karen Baker, UCSD (PAL) and John Porter, UVA (VCR) both spent time at the Network office this year developing key components of the NIS – the data table of contents (DIOC) and the site description database (SITEDB).
- NET staff designed and created a web site to integrate activities of the Schoolyard LTER program. NET sponsored a meeting of participants from Schoolyard LTER sites to seek input on the development of the web page, which will have information about research at SLTER sites, access to satellite data showing SLTER sites, remote video feeds from LTER field sites, and education modules designed to address specific topics using LTER data.
- We made a concerted effort to expand representation of graduate students and foreign scientists in the LTER personnel database. This was accomplished in part through the provision of data entry stations and technical assistance at the All Scientists Meeting.
- Coordination between LTER site personnel and associates of the Global Fiducial Program continued for access to historical and declassified reconnaissance imagery. This coordination included contacts with staff of the MITRE Corporation and Earth Satellite Corporation. Two initial test cases (VCR and SEV) were selected for search and order of historical imagery dating back to 1962. These data will be included in the LTER archives (http://www.lternet.edu/research/technology/background/global_fiducial_program.html) and there will be future coordination with the LTER sites to determine the utility of data needs by these and other sites.
- NET facilitated the preparation of videos by John Dennis Productions which have been used extensively by LTER chair Jim Gosz in presentations at LTER, ILTER and other meetings.

Facilitating scientific exchange

Some of the activities carried out during the third year of the Cooperative Agreement are described below.

Facilitating exchange within the U.S. LTER Network:

- The fourth LTER All Scientists Meeting was held from August 2-4, 2000 in Snowbird, Utah. The theme of the meeting was “Long-Term Ecological Research: Unifying Principles and Global Applications”. In addition to a keynote address by Dr. Rosina Bierbaum of the Office of Science and technology Policy, the program for the meeting included six plenary lectures by invited speakers, over sixty workshops, poster sessions, student seminars, and the debut of videos on the U.S. and International LTER programs. In addition, the meeting provided time for ad hoc meetings of investigators to follow up on ideas arising from the workshops and invited presentations. NET staff organized the meeting and were responsible for program, travel, and on-site arrangements.
- The Executive Director and the LTER Executive Committee received and evaluated 21 requests for assistance to conduct synthesis activities stemming from the All Scientists Meeting. The Network Office will coordinate and support travel for 18 groups of researchers to these synthesis meetings.
- Reports from ASM workshops were compiled and placed on the LTER web page.
- The Network Office underwent a site review by a panel of experts convened by the National Science Foundation. In preparation for this meeting, NET documents, web pages, and databases were updated.
- NET helped organize and fund meetings of the Coordinating Committee at Snowbird in August and the lead LTER Principal Investigators at the Sevilleta LTER site in January.
- NET staff organized Executive Committee meetings at Snowbird, Utah, and Washington, D.C.
- NET organized a meeting of the LTER National Advisory Board in Washinton, DC, in February.
- Net staff regularly acquires and posts minutes from Coordinating Committee and other meetings on the LTER web page.

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

- NET developed a proposal for supplemental funds to continue outreach activities in data management and communications with OBFS sites. These funds were used to recruit William K. Michener, a scientist resident at NET to organize these activities. The goal of this activity is to prepare OBFS sites for participation in the National Ecological Observing Network (NEON).
- James Brunt, Troy Maddux, and William Michener represented NET at a meeting of the Organization of Biological Field Stations at H. J. Andrews Forest, Oregon, where they discussed methods of developing information management systems at field stations.
- John Vande Castle will host a meeting of the NASA Oak Ridge Distributed Archive Advisory Group to be held at the Sevilleta research site in January of 2001.
- Patricia Sprott presented an LTER Aquatic Science exhibit at the American Society of Limnology and Oceanography Meeting Feb 12-16, 2001 Albuquerque NM.
- NET continued to facilitate the development of two videos by John Dennis Productions. The first is an informational video directed towards research at LTER sites. The second video will describe the formation of international LTER networks.

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

- We have continued to enjoy success in pursuing the international objectives laid out in the Network Office grant and in implementing the mission of the ILTER network. NET recruited a group of U.S. LTER scientists to act as a consultative body regarding interactions with national networks in the East Asia-Pacific Region. A similar effort for the Central and South American Region is well advanced. We will continue our efforts to develop a cadre of interested US scientists to act as advisors to the growing list of countries with active or interested in LTER style research.
- 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.
- NET staff hosted a contingent from the Chinese Academy of Sciences in September. This group received a briefing on LTER activities and visited several LTER field sites. NET assisted in the organization of their itinerary.
- NET staff assisted with the production of an ILTER video.
- Bob Waide attended a joint Chilean-Argentine trip to the Southern Ice Fields and made a presentation on the U.S. LTER program.
- Patricia Sprott, Chris French, and Marshall White maintained a web site dedicated to the ILTER program.
- John Vande Castle assisted with the development of an information exchange workshop at the LTER All Scientists meeting between members of the ILTER Network Global Terrestrial Observing System and NASA researchers. This workshop has resulted in a

follow-on meeting for initial validation and data exchange of new NASA/MODIS technology and measurements from scientists within the ILTER Network.

- During the past year, national networks were formally established in Australia and Slovakia. Promising discussions continue with key scientists in Argentina, France, Austria, Romania and South Africa, and inquiries have been received from scientists and government officials in several other countries.
- The Network Office acted as a clearinghouse for chapters submitted for publication in a book on biodiversity in drylands. This book is the result of a workshop held in Israel that included many LTER scientists from the U.S. and other countries.
- NET staff organized the annual meeting of the ILTER network, which was held in Snowbird, Utah on August 5, 2000, in association with LTER All Scientists Meeting.

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 the very first draft structural metadata standard for ecological data. This hallmark development will greatly facilitate the further development of integrated information systems. The draft standard will be made available and reviewed by the community during early 2001.
- The LTER network climate database “CLIMDB”, an interactive, web-based access system to integrated climate data from all sites, is being 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.
- A prototype site description database has 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 database features standardized representations of locations and sub-locations at sites including geo-spatial references. (expected prototype completion date March, 2001).
- The network Information Management Committee, coordinated by the Network Office, sponsored four workshops at the 2000 All Scientists Meeting. All of the 24 sites were represented with additional guests Dick Olson, Oak Ridge National Laboratory, DAAC project and numerous representatives of OBFS sites.
- 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:
 - A data management training workshop was hosted by the Network Office for a joint Palestinian/Israeli delegation of ecologists and scientists. Trainers came from LTER Network James Brunt (NET), John Vande Castle (NET), Troy Maddux

(NET), Kristin Vanderbilt (SEV), John Porter (VCR), John Thomlinson (LUQ), William K. Michener (NET) and its partners, Kent McCord (ORNL). The training was organized and led by James Brunt and John Vande Castle, and funded by Sandia National Labs – Cooperative Monitoring Center.

- A data management training workshop was held in November 2000 in Vacratot, Hungary. This training was facilitated by Information Managers Kristin Vanderbilt (SEV), Peter McCartney (CAP), and John Porter (VCR).
- William Michener and James Brunt visited the Organization of Tropical Studies Field Stations in Costa Rica (December, 2000) to promote developing standards and provide input on developing data management and communication capabilities. These stations, including the heavily used La Selva station, are funded by NSF and are part of the Costa Rica ILTER network – this presents unique opportunities for collaboration and development in Latin America.
- The Network Office coordinated and hosted the Information Managers Network Information System (NIS) / Metadata working group in February, 2001 to further progress on the NIS and metadata standards for ecological data. The committee focused attention on the draft ecological metadata standard and developing a plan for its implementation at LTER sites.
- The Network Office hosted new information managers from Florida Coastal Ecosystems (Linda Powell) and Sevilleta (Kristin Vanderbilt) to familiarize them with strategies for site information management and network-wide information management efforts. In addition, we also 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 January 8, 2001 to discuss further development of the relationship between LTER and NBII previously established by Anne Frondorf, NBII director and James Brunt, ADIM.

Encouraging new technologies

- Patricia Sprott acquired and implemented a Searchable Digital Image Library for the LTER Network.
- A supplemental proposal was funded to include new technologies for Schoolyard LTER activities. John Vande Castle, the lead person on this effort, has reviewed and implemented portable and wireless WEBCAM technologies as well as new satellite imagery for LTER and Schoolyard sites. These technologies will be useful for both the Schoolyard LTER effort as well as the LTER sites themselves.
- The Network Office continued to provide 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 encourages the use of new technologies by coordinating activities to identify important technology that can be implemented by individual sites or the entire LTER Network. The Network Office serves as test bed for new products and a clearinghouse of information for new technologies.

- The Network Office continued to provide support for better utilization of advanced hyperspectral imagery within its collaborative relationship with the San Diego Supercomputer Center (SDSC) and the National Partnership for Advanced Computational Infrastructure (NPACI). The Associate Director for Technology Development (John Vande Castle and LTER research associate at SDSC (Tony Fountain) worked with LTER researcher Gregory Asner, to develop an initial data distribution system for future research involving advance remote sensing capabilities. The prototype for data access and analysis has been implemented in the last year (<http://srb.npaci.edu/hyperlterdemo1.html>) . Plans are in place to incorporate more datasets such as space-based Hyperion sensor and GTOS/MODIS data, as well as improve operability of the system in the next year.
- The Network Office hosted a number of scientific exchanges to make LTER scientists aware of technology available at SDSC. In particular, we have focused on high-speed computing, mass storage, and visualization capabilities.
- We have implemented the use of professional digital video to enhance communication by providing video on demand via the World Wide Web and CD Rom. The edited clips include examples of site science, field and laboratory procedures, and searchable interviews with prominent ecologists discussing relevant ecological issues.
- NET staff developed Virtual Tours technology—using the digital still camera, a wide-angle lens and graphics software. NET staff assisted several LTER sites with the acquisition and production of panoramic images for their websites. The Network Office has transformed photos into 360° images, which are now available on the LTER Web site, for example: <http://sevilleta.unm.edu/places/refuge/interactive/panoramas/index.html>.
- The same virtual image technology used for the panoramic photography has been modified for display of examples of satellite imagery within the Schoolyard LTER project. This technology will continue to be applied to other LTER visual databases where appropriate.
- John Vande Castle assisted with the development of a technology and communications workshop for the LTER All Scientists Meeting, presenting current high speed network and wireless technologies important to communications across the LTER Network.
- A focused “Technology Task” subcommittee was formed to act as an executive body of the full LTER Technology committee and will meet in January of 2001 to work on technology issues and recommendations from previous full committees, and products of the LTER All Scientists Meeting.
- NET developed a testbed for applications of currently classified remote sensing data within the Global Fiducial Program. NET worked with staff associated with the Global Fiducial Program to search for representative datasets and acquire initial high resolution datasets for sites of the LTER program.
- NET is currently implementing point to point and general wireless technologies for Webcam and data transmission. NET has investigated several wireless Internet technologies for use by LTER sites including CDPD (cellular digital packet data) and implemented an operational prototype CDPD system. The technology allows WWW users to actively view LTER field sites with remotely controlled cameras.

- A joint project was initiated between the LTER Network Office and the Visualization Lab at SDSC to provide access to advanced visualization techniques to LTER scientists. A number of LTER scientists including John Vande Castle worked with the visualization group of SDSC for specialized data visualization training. These results are available at: <http://srb.npaci.edu/hyperlterdemo1.html>.

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

- William Michener gave a presentation on “New technologies for understanding biocomplexity in the environment” as part of the United States-China Policy Forum on Biotechnology and Biomedicine that was sponsored by the National Institutes of Health and the National Science Foundation.
- NET represents the LTER Network in interactions with the National Partnership for Advanced Computational Infrastructure based at the University of California at San Diego. The Network Office has a sub-contract from UCSD to promote the use of the facilities of the San Diego Supercomputer Center (SDSC) by LTER scientists.
- Staff of the Network Office maintain personnel and site databases for the Organization of Biological Field Stations and the Canopy Network.
- NET staff interacts with members of the Oak Ridge NASA DAAC facility to encourage information exchange and coordinate information management efforts between LTER and related NASA facilities. Richard Olsen of the NASA DAAC is included in LTER data management meetings and John Vande Castle is a member of the ORNL DAAC advisory group. John Vande Castle hosted a meeting of the ORNL DAAC advisory group at the Sevilleta research station in January of 2001.
- John Vande Castle and James Brunt led a two-week information management and GIS data training session in October of 2000. The session included experts within the Network Office, LTER sites and other Centers. The workshop resulted from collaborations with the Cooperative Monitoring Center at Sandia National Laboratory to establish a Middle Eastern LTER Network. The goal of this initiative is to develop joint Israeli-Palestinian trust and cooperation through a common environmental research program. NET identified several LTER scientists to represent the LTER Network in future interactions.
- The Network Office is involved in the development of a joint project between LTER modelers, SDSC, and the Kansas University KDI program. The purpose of this initiative is to use meso-scale climate models to examine the indirect effect of land use change on biodiversity. Predictions on the effects of land use change on regional climate at several LTER sites will be correlated with changes in biodiversity obtained through the KDI program’s interface with museum collections.
- A modified version of the Terrestrial Ecosystem Monitoring Sites (TEMS) Database was updated for continued to enhance information exchange within the GT-NET/NPP project.
- NET staff participated in the annual All Hands Meeting of the National Partnership for Advanced Computational Infrastructure at the University of California-San Diego.

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 research and educational activities:

- Patricia Sprott disseminated information about the LTER Network at meetings in Washington DC (AAAS) and Snowbird (ASM and ESA).
- 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://lternet.edu>). The re-organization of the Website has created important new avenues for reaching the research community and the public through electronic publishing.
- NET staff have developed a Schoolyard LTER web page that will include information about each of the SLTER sites, satellite images covering the sites, video interviews with LTER scientists, real-time video feeds of LTER experiments, and video cameras at selected LTER sites.
- The Network Office has formed a partnership with the Ecological Society of America to develop a video history of ecological research in the United States. NET staff will interview prominent ecologists and record the interviews using state-of-the-art digital video techniques. NET will develop an archive of the interviews and develop products targeted for use on the web page and in presentations.
- While electronic publishing adds a new dimension to communications, the LTER Network Office continues to recognize the importance of print publishing. During the last year, NET staff continued to expand the Site Brochure series and revised the LTER brochure and the International LTER book. Together with large-format posters (available on demand to specification), and the Website, these publications create a complete picture of LTER for the greater ecological research community.

Project Training/Development

- Patricia Sprott worked with Dan Childers of the Florida Coastal Everglades LTER site to develop their Website, acquire slides for the Digital Image Library, and develop an outline for their Site Brochure.
- Patricia Sprott visited the Andrews LTER site to acquire slides for the Digital Image Library and develop an outline for their Site Brochure.
- Patricia Sprott visited the Georgia Coastal Ecosystems LTER site to acquire slides and video for the Digital Image Library.
- Patricia Sprott organized Schoolyard LTER Committee meetings at ASM-2000 and at SDSC (meeting – Dec 1-2, 2000).
- NET staff 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.

- NET continues to enhance the LTER World Wide Web site—the primary interface between LTER science and school children, teachers, policy makers, the general public, and other scientists. Recent developments include improving the interface for general science communication and the addition of interactive visualization tools such as virtual reality tours and digital video clips.

Outreach Activities

- NET continued support of the Schoolyard LTER program through participation at the December, 2000, meeting at SDSC. John Vande Castle presented new WEBCAM, wireless, real-time video presentation and satellite technologies at a LTER funded workshop for the Schoolyard LTER project.
- Web information regarding Network Office support to the Global Terrestrial Observing System (GTOS), specifically for the first Net Primary Productivity Demonstration Project (GT-NET/NPP) has been compiled at <http://www.ilternet.edu/gtnet/>. This site includes access to databases developed at the Network Office to support enhanced information exchange between International Long Term Ecological Research sites and verification projects of NASA.

Publications

Journal publications

- 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. (in press). What is the observed relationship between species richness and productivity? (*Ecology*).

Books and other one-time publications

- Completed Site Brochure for Palmer.
- Began site brochures for Andrews and Florida Coastal Everglades sites.
- Produced new LTER Brochure.
- Produced new ILTER Brochure (book).
- Produced two LTER Newsletters—April and October (print and electronic).
- Brunt, James W. 1999. The LTER Network Information System: A Framework for Ecological Information Management . In: Aguirre-Bravo, Celedonio; Franco, Carlos Rodriguez, eds. North American science symposium: toward a unified framework for

inventorying and monitoring forest ecosystem resources; 1998 November 2-6; Guadalajara, Mexico. Proceedings RMRS-P-12. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 435-440.

- Ecological Data: Design, Management, and Processing. 2000. William K. Michener and James W. Brunt, editors. Methods in Ecology series. Blackwell Scientific, Ltd, London. 180 pp.
- A new hardcopy of the personnel database was produced in March 2001. This publication included revisions of the personnel database made in 2000.

Internet Sites

- Ecoinformatics homepage –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. 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.
<http://www.lternet.edu/documents/Newsletters/DataBits/00spring.html>

Other Products

- Site description database - a prototype site description database has been revised and integrated with the LTER personnel databases such 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. (expected prototype completion date March, 2001).

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 testbed 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.