5-23-2014

2004 LTER Network Office Annual Report

Long Term Ecological Research Network

A Report from the Network Office of the U.S. Long Term Ecological Research Network
for work accomplished in Year 2 of **DEB-0236154**
December 16, 2004

Section 2. What have you done? What have you learned?

a. Research and education activities

Research and support activities in the LTER Network Office (LNO) are organized into 10 categories, arranged to reflect the organization of the Scope of Work for our Cooperative Agreement with respect to the following 4 subordinates: Service to LTER sites, Service to the Network, Service to NSF, and Service to the broader scientific community. These general categories and specific activities under each category are given below.

Network Office Administration and Service Activities

- Interact with external entities
- Administer funds
- Prepare proposals
- Coordinate meetings
- Report and communicate
- Plan
- Review and evaluate staff
- Perform community service

Computational and Communication Infrastructure

- Maintain 24x7 access to email, web, ftp servers.
- Assure database integrity through daily backup and verification routines.
- Provide for backup and restoration of LNO computer file systems.
- Monitor and maintain Local Area Network.
- Enforce LAN, WAN, and computer security model.
- Upgrade and maintain server operating systems and application software.
- Upgrade and maintain desktop operating systems and application software.
- Provide user support to Network Office Staff.
- Provide ad-hoc technical assistance to LTER sites.
- Plan for and procure hardware, software, and supplies.
- Upgrade and maintain computer and network hardware.
- Monitor and maintain remote sensing archive.
- Communicate knowledge about technical advances computational and communication infrastructure to LTER sites. (LTER)

Information Management and Methods Development

- Promotion of metadata standards
- Curation, maintenance, and expansion of LTER Network Databases
- Data standardization

Network Development, Community Outreach, and Training

- Network Development
- Community Outreach and Network Linkages
- Training

Publications and Public Outreach

- Prepare and print two site brochures per year.
- Revise and print the LTER Network brochure every third year.
- Prepare, edit, print, and distribute two Network Newsletters each year.
- Provide editorial support to LTER sites preparing synthesis volumes for the Oxford University Press series.
- Design, develop content, and supervise maintenance of LTER network web sites.
- Revise and print the LTER Personnel Directory every third year.
- Review and upgrade the LTER traveling exhibit every third year.
- Prepare materials for All Scientists Meetings every third year.
- Provide limited support to LTER Network scientists in producing quality publications that describe the importance of LTER research aimed at general scientific audiences.
- Research and synthesize widely scattered historical documents associated with the development and scientific significance of the LTER program.
- Foster collaborations with organizations such as the Ecological Society of America to produce scientific fact sheets and other material that conveys scientific information to an audience that includes the general public, educators, managers, and policy-makers.
- Prepare and disseminate short descriptions of LTER research results on a regular basis and make these available to funding agencies, policy makers and the general public.
- Disseminate information to organizations involved in encouraging the participation of underrepresented minorities in science to increase the diversity of LTER scientists.

Synthesis

- In coordination with the CC, identify and support at least one major synthesis effort each year
- Lead in developing one value-added database per year in association with the science theme meeting.

- Participate in and organize scientific activities as part of the All Scientists Meetings in 2003, 2006, and 2009, including planning and follow-up working groups.
- In off years (2004, 2005, 2007, 2008), facilitate the organization of joint symposia at annual meetings of associated disciplines and support participation of LTER scientists in these symposia.
- Identify and support 6-8 small research working groups a year, and seek other funds to increase that number to 20-25 following an All Scientists Meeting.
- Organize and lead annual meetings of the Committee on Scientific Initiatives, whose role is to identify and evaluate opportunities for Network-level scientific investigations.
- Facilitate the production of site volumes for the Oxford Synthesis series by providing editing and other technical assistance to sites, so that a complete set of volumes synthesizing research at all sites is available by the end of the decade.
- Participate in research activities designed to achieve the objectives of the LTER Decade of Synthesis.

Network Information System Design and Development

- Establish the distributed data network
- Community collaboration and standardization efforts
- Promote and support synthetic research collaborations

International LTER

- Maintain the ILTER website
- Provide service to the US International Committee of LTER

Education

- Facilitate the activities of the LTER Education Committee in developing a strategic plan for education.
- Maintain the SLTER web site.
- Promote participation of under-represented minorities in LTER-supported education activities.

Strategic Planning for the LTER Network

- Develop a strategic plan focusing on LNO's mission, its role in relation to other organizations, and the most effective structure for managing LNO and its relations with external entities.
- Specifically incorporate into the LNO strategic plan five-year plans and budgets for 1) further development of the information infrastructure and informatics capabilities of the LTER Network and 2) creation of high-level leadership and facilitation of future Network synthesis activities as part of the strategic plan.

- Implement the Center for Research in Ecological Science and Technology (CREST) as a new relationship between UNM and the Network Office as an institute under the Dean of Arts and Sciences.
- Design and complete an evaluation by the LTER community of the activities of the LNO, including: 1) an assessment of the functional requirements of LTER scientists, and 2) the effectiveness of LNO in responding to those requirements.
- Coordinate the results of evaluations of the International LTER program and LTER educational activities into the LNO strategic plan.
- Coordinate LNO strategic planning with the development of a strategic plan for the LTER Network being carried out by the Executive and Coordinating Committees.

b. Major Findings

Executive Summary

The scope and priority of activities conducted by the LTER Network Office (LNO) are closely linked to the overall objectives of the LTER Network and the tasks defined through the Cooperative Agreement between NSF and the University of New Mexico. The Scope of Work described in the Cooperative Agreement comprises ten core task areas. During the last year, the LNO has realized nine major accomplishments related to our core task areas, as well as many achievements in response to specific tasks.

- LNO staff finalized the strategic plan focusing on LNO's mission, its role in relation to other organizations, and the most effective structure for managing LNO and its relations with external entities. Comments on the draft plan were solicited from the LTER Executive Committee and Coordinating Committees, the LTER National Advisory Board, and NSF. A draft version was submitted to the Coordinating Committee for their approval at the April, 2004 meeting. Implementation steps are being crafted for each of the strategies enumerated in the plan. After the implementation plan is reviewed by the National Advisory Board, the final document will be submitted to NSF by February 28, 2005.
- LNO Senior Staff participated in the development of the Network Strategic Plan, including the preparation of a proposal to NSF for a planning grant to define and implement new synthesis activities as part of the LTER Decade of Synthesis. This proposal was funded in August 2004 and activities are well underway for a successful project. LNO staff are facilitating the organization and logistics of working group meetings in association with the planning activity.
- The LNO office moved from the research park at the University of New Mexico (UNM) into new space on the main campus in July 2004. The design of this space will encourage close collaboration among the programs housed in the same building (the Museum of Southwestern Biology, the Sevilleta LTER program, the Department of Media Arts, the SEEK project, and the LTER Planning Grant office). The new facilities are also in close proximity to the Department of Biology and the Dean of Arts & Sciences. All of these entities have direct access

to a new training lab, a state of the art web-based interactive lab for training scientists on latest technology, informatics, and data management.

- UNM formally recognized the Center for Research in Ecological Science and Technology (CREST), which incorporates the LNO, the Science Environment for Ecological Knowledge project (SEEK), the Resource Discovery Initiative for Field Stations, and the Knowledge Network for Biocomplexity under a single umbrella organization in the College of Arts and Sciences. Impetus for the formation of this center came from the 2002 review of the LNO by NSF. The vision of the new center is a scientific enterprise in which national networks of environmental measurements are coupled with advanced informatics technology to provide real-time information for the solution of ecological grand challenges. The new center reports to the Dean of Arts & Sciences and adds a Sr. Program Manager to manage the day to day administration of the projects and to ensure consistency in support of resource coordination, proposal preparation, budgeting, grant accounting, contract negotiations, staffing, meeting coordination, and reporting services.
- LNO established a partnership with the National Biological Information Infrastructure (NBII) to develop a new position in ecological informatics. This position, funded by NBII, will expand the relationship between LTER and NBII informatics programs and provide technical support to LTER sites and information managers. Inigo San Gil was recruited for this position.
- LNO staff participated in the visioning process for the National Ecological Observatory Network (NEON). William Michener, Associate Director of Development for LNO, played a key role in developing the proposal to establish the NEON Design Consortium, under which NEON will be fully planned, designed and budgeted. During the next two years, Michener will be co-director of the NEON Project Office in Washington, which is supported through a Cooperative Agreement between the National Science Foundation and the American Institute of Biological Sciences.
- LNO staff worked with the Network Information System Advisory Committee (NISAC) to continue development of the LTER Network Information System (NIS). Meetings were held with representatives of the National Center for Supercomputing Applications (NCSA) at the University of Illinois and the San Diego Supercomputer Center at the University of California-San Diego. Through its interactions with NISAC, the LNO is contributing to a plan to develop enhanced cyberinfrastructure in the LTER Network in collaboration with the LTER planning effort. Development of the NIS is being carried out by LNO staff and coordinated with advances in the SEEK project.
- LNO provided ongoing support for 86 participants in 17 working groups based on the 2003 All Scientists Meeting as well as a science theme meeting held in conjunction with the fall Coordinating Committee meeting in Fairbanks, Alaska.
- LNO accomplished objectives outlined in the Scope of Work while integrating new staff members into our operations. Mark Servilla joined LTER Network Office as Lead Scientist on the Network Information System (NIS) project in May 2004. McOwiti Thomas joined the LNO as Public Information Officer in Spring 2004. His initial tasks are to develop and implement strategies and tools for

communicating LTER accomplishments to its various constituencies. Marjorie Hudson was recruited in September as the Senior Program Manager to manage day to day administration of the projects under CREST. Additions in administrative and technical support included Andrea Briscoe as Accounting Technician, Katy Perry as Administrative Assistant, and Subhek Garg as a Graduate Student supporting computer needs. Patty Sprott-Bonito relocated to North Carolina but continues to work part-time with LTER to develop site brochures and other projects.

More detailed descriptions of accomplishments are given in the following sections organized according to Service to LTER sites, Service to LTER Network, Service to NSF, and Service to the Broader Community.

Service to LTER sites

Service to LTER sites takes a variety of forms including support for travel, meeting coordination, technical advice, support of communications and database systems, and response to requests from individual investigators. LNO staff members prioritize their time among site and network support activities according to a criteria developed as part of the LNO Strategic Plan. Many activities benefit both sites and the network. The following represents a sampling of activities conducted that primarily benefited sites.

- The 2002 Site Review Report and NSF's response to that report acknowledged communication as critical to the LTER Network mission and have endorsed the infrastructure supported by LNO for computation and electronic communication. Our accomplishments in this area focus on increasing efficiency and accessibility of cross-site and network-wide communication.
    - Sites and individual scientists were surveyed to identify needs for additional support. Results of the individual survey indicated strong support for a centralized data repository, a centralized web entry port, and a web-based collaboration portal.
    - The @LTERnet.edu email reflector and mailing list service continues to be heavily used despite increasing limitations on file attachments and mail lists as seen by the leveling off of email volume. We have installed additional SPAM prevention and virus scanning software to make this service more useful.

- Duane Costa, Network Information System (NIS) Programmer/Analyst, responded within 24 hours to 18 requests about Metacat Harvester from the following LTER sites: AND, CAP, GCE, HBR, KBS, KNZ, NTL, AND SBC. He also responded to a request from FCE with a question about Ecological Metadata Language (EML). At the request of the LTER ARC site, he developed and deployed within three weeks the Arctic Conversion Tool software and documentation.

- Greg Shore, Systems Administrator, managed LNO infrastructure to provide 24/7 access to key services by sites. Among other tasks, he:

    - Assisted HBR LTER twice with DNS resolving/caching problems and virtual web server problem, and assisted HBR and GCE LTER sites with DNS zone file changes.
    - Provided assistance to BNZ LTER and NSF for video teleconferencing session for CC Meeting in Fairbanks in August, 2004. He configured and shipped the LNO Polycom video teleconferencing system to BNZ, and provided tech support and coordination as needed.
    - Assisted SEV LTER, University of New Mexico (UNM) Museum of SW Biology, and UNM Natural Heritage Program in coordinating and negotiating the annual renewal of ERDAS Imagine remote-sensing/image-processing software agreement, and in providing license servers for software usage. He assisted SEV LTER twice in installing/upgrading and configuring ERDAS Imagine remote-sensing/image-processing software, requesting license keycodes, and configuring license server on Unix-based system.
    - Provided assistance twice to SEV LTER in installing/upgrading and configuring ESRI ArcGIS/ArcInfo/ArcView GIS software, requesting license keycodes, and configuring and license server on Unix-based server.
    - Attended numerous meetings with SEV LTER, UNM Museum of SW Biology, UNM Natural Heritage Program, and UNM Computer and Information Resources and Technology (CIRT) from January through August to plan and coordinate the move of LNO and SEV offices, systems, and networks into the new Center for Environmental Research, Informatics & Arts (CERIA) building.

- Jeanine McGann, Web Designer, posted multiple job opportunities for the following LTER sites: LNO, KNZ, HFR, HBR, SBC, SEV, JRN, FCE, KBS. She scanned and posted online site brochures online for Jornada and Santa Barbara Channel LTER. She updated LTER site pages and site maps to include the Moorea and California Coastal (CCE) LTERs and provided direct assistance to both sites with instructions for adding new information to the new site database. At the request of Hugh Ducklow, she made changes to Palmer LTER site www.lternet.edu/sites/pal/ . She assisted SEV with the EML conversion. She also worked on the new design for the SGS web site.

- Marshall White, Senior Web Designer, responded to 55 individual requests from the following sites: HBR (15), JRN (6), LUQ (8), MCR (4), SEV (15), SGS (7). He also responded to 28 requests from sites about the site characteristics database.

- Michelle Murillo, Database Manager, responded to 45 requests for email list modifications, 30 requests for personnel Database (DB) changes, 3 requests to modify security permissions for LTER sites (web), 10 requests regarding web

database errors, 30 requests to fix orphan problems between LTER Database and Light and Directory Access Protocol (LDAP), and 8 requests for mailing list creation. She assisted SEV with a request for poster printouts, a request for assistance DB access issue, and assistance with problem accessing the all-site bibliography. She responded to a request to assist the new Information Manager at SBC with procedures and to answer questions about intranet, four requests (approximate number) to provide users with their password for intranet, a request to provide information about SPAM to SBC, and 3 requests to assist Ellen Denny (HBR) with web page problems.

- Sonia Ortega facilitated the activities of the LTER education committee through regular conference calls, annual meeting and education workshops. She prepared minutes of conference calls and meetings and disseminated information to LTER education representatives. Additionally, Dr. Ortega organized the annual meeting of LTER education representatives at LTER Andrews Field Station. The meeting focused on the role of education representatives in the LTER Planning Grant, re-structuring of the Education Committee, follow up on proposal writing to submit to NSF, completion of Education Handbook and further revision of Education Strategic Plan.

- Ortega participated in education workshop at Wheeling Jesuit University organized by Steve McGee (LUQ-LTER) with the purpose of drafting cross-site education pre-proposals for submission to NSF. The workshop had participation from 10 LTER sites. She represented LTER education community at LTER coordinating committee meetings and she collaborated with the Ecological Society of America's Education Committee to develop programs of common interests such as field trips of minority students to LTER sites.

- Ortega provided information of funding opportunities (e.g. NSF- Environmental Education Fund), courses, fellowships and other education-related activities to LTER education representatives and she posted information on LTER website. She summarized LTER education accomplishments on a regular basis and made information available to NSF and the general public and she provided feedback to LTER education representatives on the preparation of education proposals while encouraging LTER cross-site collaborations. She also updated and maintained LTER education representatives list.

- Bob Waide visited six LTER sites (Baltimore Ecosystem Study, Virginia Coast Reserve, Luquillo, California Current Ecosystem, Central Arizona-Phoenix, and Sevilleta) to assess needs of sites and scientists and provide information on LNO activities.

- Waide worked with scientists from the Luquillo site to develop a book for the Oxford LTER series. He wrote and edited major sections of the volume, which will be submitted to Oxford in 2005.

- Waide collaborated in a NASA-funded project to conduct LIDAR overflights of selected LTER and non-LTER sites. The goal of this project is to develop techniques for surveying biodiversity using forest structure measures derived from radar data. At present, five LTER sites (HBR, HFR, CWT, SEV and AND) are involved in the project.

- Waide coordinated cross-site research activities involving LTER and non-LTER investigators by serving as an intermediary between sites and investigators and by providing letters of support for proposals for work at LTER sites.

- Waide contacted and provided information to the new California Current Ecosystem and Moorea Coral Reef LTER sites. He organized interactions among site personnel and LNO staff and coordinated attendance of site personnel at IM and CC meetings.

- Bill Michener, Associate Director for Development, directed the Science Environment for Ecological Knowledge/Biodiversity and Ecological Analysis Modeling (SEEK/BEAM) activity by collaborating with the LTER Biodiversity and Productivity Synthesis Working Group and their associated information managers to design and develop needed integration and analysis cyber infrastructure. Drs. Deanna Pennington and Bill Michener organized a working group meeting.

- John Vande Castle, Associate Director of Technology, obtained background information related to LIDAR remote sensing research which will be used in conjunction with ongoing NASA LIDAR data acquisition at LTER sites. This work is related to LTER technology and remote sensing efforts and may result in a future LTER workshop regarding the use of this technology for intersite LTER research.

- Vande Castle continued to work with the U.S. Global Fiducial Program related to ongoing acquisition of high-resolution reconnaissance for all LTER sites in the program prior to 2004. This work included providing information for special acquisition of coastal LTER sites to collect additional information during the 2004 hurricane season. Very high spatial resolution data is now required on an on-going basis for all LTER sites. All of these data are now available to researchers with proper security clearance. The data are also archived for future release when the status is determined to be non-classified.

- As Chair of the LTER Technology Committee, Vande Castle provided support for development of technology within the LTER Program. Vande Castle wrote and maintained web pages on LTER Technology (http://lternet.edu/technology/). During 2004, Vande Castle updated all of these web pages and reorganized the information for easier access by LTER researchers. Vande Castle also adjusted the entire LTER Technology Committee membership to reflect changes in

personnel at the sites as well as the addition of new sites. By working with LTER Technology Committee members and LTER site principal investigators, all LTER sites now have representatives on the Committee.

Service to the LTER Network

The LNO facilitates, supports, and implements decisions and policies of the LTER Chair, Executive Committee and Coordinating Committee. As the entity charged with providing resources to support the LTER mission and goals, most of the LNO's efforts address network-level priorities. These priorities are established by LTER governing bodies and are embodied in the LTER bylaws, planning documents, and committee recommendations. Many routine activities in support of LTER priorities are carried out in the background, with schedules set internally by LNO management. However, tasks that occupy large amounts of LNO resources are submitted to appropriate LTER governance bodies for approval, as described in the LNO Strategic Plan. The following describes LNO activities that support the LTER network.

One of the most important activities of LNO is the dissemination of results obtained by LTER scientists. Scientific publications based on LTER research inform the ecological community of our accomplishments. The Network Strategic Plan establishes the goal of expanding the use of LTER knowledge in education, policy-making, management and public understanding of scientific issues. LNO contributes to fulfilling this goal 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. Specifically, in the past year:

- LNO continued to improve the content and design of LTER network web sites. (http://intranet.lternet.edu/, http://www.lternet.edu/)

- LNO produced articles for and edited two LTER Network Newsletters, working closely with writers from other LTER sites to assure broad, balanced coverage of research, outreach, publishing and other site activities. McOwiti Thomas and Patricia Sprott-Bonito worked with the printer to manage production and distribution, and reformatted both issues for presentation and distribution on the Web.

- The LNO has entered into an agreement on behalf of the Network with Earth and Sky, Inc. to collaborate on a radio program titled "*Human World:* What Scientists Say About Humans' Relationship to Earth in the 21st Century." LTER scientists will be interviewed on their research for this program, which is sponsored by NSF and heard by over three million listeners weekly. As part of this arrangement, the Executive Director will serve on the Board of Advisors of Human World.

The LNO has widespread responsibilities in the governance structure of the LTER Network.

- The Executive Director participated in the activities of the Executive Committee, the Coordinating Committee, and the Science Task Force for the Planning Grant.

- The Executive and Associate Directors participated in the activities of the NIS Advisory Committee, the Information Management Committee, and the Information Management Executive Committee.

- LNO staff participated in the activities of the Education, Technology, and International Committees of the LTER Network.

- Bob Waide will serve on the working group on governance for the LTER planning project.

- In October 2004, Gosz, Michener and Hudson attended the week long training program on managing big science projects (Project Science Workshop in Aspen, CO.). Waide, Gosz, Michener, Vande Castle, and Brunt, attended a similar meeting in December that the University of New Mexico Vice President for Research hosted for scientists.

The LNO maintains communication and computational infrastructure and manages Network databases.

- LNO staff continued to integrate LTER Network databases to increase the ease of updates and create the capability for sites to automate update via web services interface. The next phase will expose the database as an EML data source with a consistent API.

- The LTER Network Personnel database now contains over 2000 Scientists. This up just under 200 from last year. There have been no major pushes for getting information updated in the last year so we attribute this to increases in site activity.

- The All-Site Bibliography is now being exposed through a server that is compliant with the international Z39.50 standard used by libraries and bibliographies around the world, and can be browsed by all Z39.50 clients including EndNote.

- The Site characteristics database will be online and searchable in mid-February. A number of changes in the design have been made by the IM committee since it was originally introduced and these have been implemented in this version.

- We have been collaborating with the Canopy Database Project to develop a cross-site study database framework. We have supported several site IMs on this development, and results have been very useful. This provides groundwork for standardized approaches to ANPP.

- The LTER Data Table of Contents (DTOC) continues to be updated weekly from all 24 LTER sites and is searchable from the web.

- Historic LTER data were maintained in the remote sensing archive, and new data acquired as part of the Spatial Data Workbench were added to the archive.

- Databases have been tested on a monthly basis for anomalies and verification.

- Backups of databases were performed on a regular schedule, and shadow databases have been successfully restored from backups on a routine basis.

- LNO prepared or edited reports and minutes from Coordinating Committee, Executive Committee, Information Management (IM) Committee, and IM Executive Committee/Network Information System Advisory Group meetings, teleconferences, and video conferences and posted these reports on the appropriate LTER web page.

A key responsibility of the LNO is to help increase the pace of scientific synthesis in the LTER Network. This task is accomplished through direct and indirect support of site- and network-based research syntheses.

- A call for proposals for follow up activities to the ASM resulted in 27 requests for support. LNO staff organized the call for proposals, distributed the proposals to the Executive Committee, and coordinated the review of the proposals. Sixteen proposals were selected for funding by the Executive Committee. Working groups from these proposals have been supported by funds from the LNO.

- The LNO facilitated the fourth annual LTER mini-symposium at NSF. The them of the mini-symposium was "Application of Long Term Ecological Research to Management."

- We received a successful renewal of the NPACI Spatial Data Workbench project. This is the only NPACI Earth System Science project to be renewed for FY04. This will continue the important collaboration with SDSC and NACSE, especially related to web services and spatial data mapping. This effort will also support the initial steps to merge data of the Spatial Data Workbench and related LTER data into the SEEK processing environment.

The LNO is responsible for facilitating communication among sites and individuals regarding LTER and LNO activities.

- We prepared a survey to sites to determine needs and satisfaction with LNO services. This survey is being administered and evaluated by the LTER Executive Committee.

- James Brunt provided quarterly reports to information managers and monthly reports to IMEXEC on the status of network office activities.

- Sonia Ortega visited four LTER sites and interacted with graduate students, educators, as well as scientists to learn about education activities taking place at the sites and to provide feedback on these activities.

- Brunt developed an article for the Network News entitled, "Informatics Highlights in the LTER Network".

- Brunt developed a white paper on "Collaborate Conferencing Options Available to LTER Network Scientists."

- Brunt attended the IM committee meeting in Portland where he discussed LNO staffing and responsibilities and presented a seminar on data security at an ESA workshop entitled "Ecological Metadata: Software Tools and Approaches for Documenting and Discovering Biological and Environmental Data."

The LNO serves as a point of contact between the LTER Network and other entities and agencies.

- We continued to coordinate interactions between the LTER Network and NSF, the U.S. State Department, the National Biological Information Infrastructure (NBII), other agencies, and other national and international networks. Specific activities included the organization of NSF participation in LTER meetings, conference calls, and videoconferences. We continued negotiations with NBII to supply computational infrastructure for the LTER Network.

- The Executive Director coordinated a series of discussions with Feng Shui Synergies Corporation regarding the possibility of a donation to the LTER Network. The people behind Feng Shui Synergies have given money to a number of charitable organizations in the past.

- We responded to multiple requests for information from individuals and organizations about the LTER Network.

The LNO has responsibility for the development of proposals to support network-level activities and the administration of funds from these proposals. In addition, we are responsible for reporting the activity of the LNO to NSF, the LTER Coordinating Committee, and the University of New Mexico.

- We received funding for 1) a workshop on Environmental Cyber-infrastructure needs for distributed sensor networks (NSF), 2) the Spatial Data Workbench (NPACI), 3) improvement in LTER databases (NSF), and 4) biodiversity and ecological workflow modeling (DARPA). We prepared a supplemental proposal

for the ILTER brochure. We prepared a revised budget to NSF to cover the cost of a funding increment associated with the selection of two new LTER sites.

- We administered funds from the NSF under our Cooperative Agreement as well as funds contributed by the University of New Mexico as cost-sharing for the Cooperative Agreement.

- During the present year, the following separate grant accounts were managed: 1) a workshop on Environmental Cyber-infrastructure needs for distributed sensor networks (NSF), 2) the Knowledge Network for Biocomplexity (NSF), 3) the Spatial Data Workbench (NPACI), 4) the Resource Discovery Initiative for Field Stations (NSF), 5) the Science Environment for Ecological Knowledge (NSF), 6) National Biological Information Infrastructure (USGS), and 7) Predictive Modeling Visualization (DARPA).

- We created and reconciled sub-accounts for 16 LTER cross-site working groups.

- We managed the close out of the previous Cooperative Agreement (DEB-9634135) and provided a final technical report.

- We produced separate annual reports to the LTER Coordinating Committee, and the University of New Mexico.

- We prepared for and were exposed to reviews from the LTER Executive Committee and the University of New Mexico.

- We organized, coordinated logistics, managed finances, and helped prepare reports for the following meetings: Coordinating Committee (2), Information Management Committee (1), IM Executive Committee/Network Information System Advisory Group (3, plus 1 to be held in Feb 2005), International LTER Coordinating Committee (1), SEEK Workshops (7), Research Coordination Network (RCN; 2), RCN OBFS informatics training (1), Post-ASM Workshops (16), EML Implementation Workshop (1), Education Representatives Meeting (1), Planning Grant STF (1) and the Meeting of 100 LTER Planning Grant (1). A total of 504 participants attended these meetings.

- We organized meetings and maintained communications for four significant grants addressing global IT infrastructure (SEEK, RCN, KDI, and NPACI).

The LNO facilitates efforts to improve cyberinfrastructure in the LTER Network and takes the lead in informatics tasks as determined by the LTER Coordinating and Network Information System Advisory Committees.

- James Brunt coordinated meetings for IMEXEC, IM, EML Implementation Standards, and Canopy Database Project, including conference calls and televideo conferences.

- Brunt developed a vision document on Network Information System (NIS) entitled “Facilitating Synthesis in the LTER Network: Approaching the Unanticipated Question.”

- Brunt also contributed as Co-PI to a BDI proposal entitled “Network Information Systems for Ecological Synthesis: An Open Framework for Query, Harvest and Validation of Distributed Datasets.”

- Brunt contributed to a successful memorandum of understanding and developed the subsequent proposal to NBII for funding of a metadata standards initiative that will create a technical support position at LNO.

- Brunt developed a Draft Network Data Policy Revision as tasked by NISAC and in recognition of additional breadth necessary for progress on NIS and he developed Draft LTER Grid Architecture document – an approach to a global IT infrastructure for LTER.

- Brunt developed a prototype all-site bibliography and made it available for testing, revised the Network Information System Strategic Plan, facilitated and contributed to EML best practices workshop at LTER Network Office in May and contributed to EML best practices document.

- Brunt oversaw the completion of the EML harvester by Duane Costa which completed KNB project work and transitioned Duane to NIS in May. This harvester work has received positive feedback and has been recommended for use in developing the network metadata catalog.

- Duane Costa developed and deployed Metacat Harvester software and user documentation. (26 weeks) and assisted with revision of Metacat documentation for Metacat 1.4.0 release. (2 days). He assisted with testing of Metacat SQL scripts for Metacat 1.4.0 release. (3 days), assisted with the review of Morpho documentation for Morpho 1.5 release (1 day), and helped establish CVS source code repository at LNO. (1 week). Costa performed system administration (installation, upgrades, etc.) of LTER Metacat and Tomcat server. (2 weeks), developed and deployed Perl script to update the LDAP database with changes to the LTER database (3 weeks), developed code to test interface between LTER Query Interface prototype and Metacat back-end query engine. (3 weeks) and participated in EML Best Practices working group meeting (2 days; 5/19/04-5/20/04).

- Mark Servilla conducted a survey of current EML implementation level and general data/metadata accessibility for all 24 sites. (4-days, July 2004). He conducted a survey of XMLSpy xml editor applications to provide detailed information for LTER Information Managers. Specifically, the information will be used to determine if an LTER Network-wide license would be feasible. (1-

day; August 2004). Servilla assisted in LTER Network-wide EML Support Tool survey performed during August 2004 LTER Information Managers meeting, Portland, Oregon. Survey results were compiled and analyzed for development of a strategy document (EML2004AugSurveyResponse.pdf), which was delivered to the Network Information System Advisory Committee and Information Manager's Executive Committee, September 2004, and distributed to all Information Managers for prioritizing actions October 2004. (2-weeks; September 2004).

- Servilla developed original specifications for the LTER EML Mentor Program Virtual Help Desk (pending development November 2004). (1-day; September 2004), developed three prototype html-based interface designs that will be used for usability requirements determination for querying and accessing LTER data/metadata. (1-week; October 2004), and developed (in conjunction with others) first draft of the LTER Grid Architecture specification (in progress). The LTER Grid Architecture is based on future needs of the LTER Network, as defined in the LTER Network Information System Strategic Plan. (2-weeks; October 2004). Servilla also supported the development and LTER Network-wide deployment of the FCE LTER EML Support Tool. This tool, developed by the FCE IM and programmers, utilizes Microsoft Excel and PERL as process for creating EML 2.0.1 compliant EML. (2-days; October 2004).

- Jeanine McGann streamlined the main intranet page per the request of Bob Waide. She worked on a design document for the intranet web page, and worked on draft specifications for new LTER site multimedia gallery. She began construction of new LTER site multimedia gallery, began design and construction of new LTER network site. She created a search option interface in LTER Directory Search that allows users to search by core area, discipline, habitat, and organism http://search.lternet.edu/dir.php. She designed a set of tabbed templates for the administrative interfaces to the LTER databases (Personnel Directory, Site Characteristics, Mail Groups). McGann created and distributed a questionnaire to all LNO site personnel to gather information for the new LNO home page. She also researched a new document management system for LNO.

- McGann created site maps for www.lternet.edu, intranet.lternet.edu, schoolyard.lternet.edu, and www.ilternet.edu and redesigned site pages for all sites in LTER network http://www.lternet.edu/sites/ and she created the editable project forum for those working on LTER Education Handbook. McGann created new php-based job posting pages for use on intranet savanna.lternet.edu/jobs. She created a design document for the proposed IM mentoring web page and created the new committee page for US ILTER Committee http://committees.lternet.edu/. She helped create web based interfaces for new sitedb pages, and she created layout and formatted workshop reports for ASM. McGann designed the “Grand Challenges” web site http://www.lternet.edu/grandchallenges/ and she worked with LTER grad students to design a new website for the Graduate Student Committee.

- McGann proofread the Spring and Fall newsletters, posted the spring newsletter online and assisted with the layout. McGann formatted and posted NAB page with bios and member information on LTER intranet pages, and posted new Databits sections for Jonathan Walsh (spring and fall 2004). She participated in EML Best Practices workshop May 2004 and edited notes for inclusion in Best Practices white paper and participated in planning for new sitedb. She edited two articles for Fall 2004 Network Newsletter and added 40 new documents to the Access-based LTER Document Archive and lined these to the appropriate areas on the LTER web site.

- Marshall White responded to the following requests: Graduate Student Committee (3), ILTER committee (5), LTER planning grant committee (8), Schoolyard LTER group (8), LTER National Advisory Board (9), and IM committee web development activities (27).

- Michelle Murillo implemented and configured a new Request Tracking (RT) system for handling LTER Network requests, implemented and configured new CVS (source code control) server for use by LTER Network developers, worked on designing and developing site characteristics database, and worked on modifications to personnel database design. She curated, maintained, and expanded LTER Network Databases, helped maintained 24x7 access to email, web, and ftp servers, assured database integrity and through backup and verification, provided for backup and restoration of file systems and installed and maintained server operating systems and application software. She also responded to 10 requests to setup conference calls for LTER committees,

- Greg Shore performed a variety of system administration tasks in support of the Computational and Communication Infrastructure maintained by the LNO. He maintained 24x7 access to email, web, and ftp servers, and provided for backup and restoration of file systems. He enforced LAN, WAN, computer security. He was responsible for installation and maintenance of server operating systems and application software. He installed and maintained desktop operating systems and application software, and provided user support to network office staff as well as ad-hoc technical assistance to sites. He installed and maintain computer and network hardware and tested and selected new software. He worked with a student assistant and other LNO staff to complete the LTER training Laboratory.

- In the final year of NPACI funding, Vande Castle worked to transition the LTER Spatial Data Workbench project to new activities of the SEEK project and EML/NIS work at LNO. This effort, in collaboration with Mark Servilla has made the entire LTER spatial data collection more accessible and available to LTER researchers. It has involved generating EML metadata files to describe the datasets. The data are also being transferred to the LNO Storage Resource Broker (SRB) for improved access and availability. Vande Castle wrote the final report of this NPACI Earth Systems Science collaboration between LNO, SDSC and

Oregon State University, Northwest Alliance for Computational Science and Engineering (NACSE). This NPACI project has provided a number of follow-on project related to LTER Network Information System development including web services and mapping, as well as International collaborations.

Service to NSF

The Cooperative Agreement between the National Science Foundation and the University of New Mexico details tasks that are to be carried out by the LNO. A limited number of these tasks represent service to the NSF. In addition, NSF occasionally requests the participation of LNO staff in meetings and other activities as representatives of the LTER Network. The following describes some of the services the LNO has provided to the NSF.

- We prepared annual reports to NSF and the U.S. Global Change Research Program (as required by NSF).

- Deana Pennington represented SEEK and LTER as an NSF Invited speaker as the Division of Environmental Biology Distinguished Lecturer, January 26, 2004, "Vision for the 21st Century Information Environment in Ecology."

- Bill Michener participated in a 2-day workshop at NSF on designing cyberinfrastructure for national environmental observatories. He also attended the annual AAAS meeting at the invitation of Margaret Leinen (AD, GEO) where he presented a talk on environmental cyberinfrastructure at a session she organized. He also presented talks on cyberinfrastructure to the BIO and GEO Advisory Committees at NSF.

- Sonia Ortega reviewed and provided input to the NSF Education Strategic Plan developed by NSF's Directorate of Biological Sciences (BIO).

- Bob Waide participated in a workshop in San Jose, CA to discuss the desirability and feasibility of establishing an LTER program in McMurdo Sound, Antarctica.

- John Vande Castle responded a number of times to inquiries from NSF regarding the ILTER Program and LTER technology issues. This included LTER use of Landsat satellite data and use of Commercial Remote Sensing Data Products. This process involved follow-up discussions with experts at the NASA/EROS Data Center to clarify the problem and help improve data reprocessing.

- Vande Castle was also invited by NSF to attend the Sensors for Environmental Observatories Workshop (November 30-December 2), and he has been working with the organizing committee providing requested input related to LTER for the meeting.

- Greg Shore provided assistance to BNZ LTER and NSF for the video teleconferencing session for CC Meeting in Fairbanks in August, 2004. He configured and shipped the LNO Polycom video teleconferencing system to BNZ, and provided tech support and coordination as needed. In July, 2004 he also assisted the LTER Network and NSF at the IM Meeting to use the Polycom video teleconferencing system at LNO as hub for video teleconferencing session. He coordinated, tested, and provided required tech support.

- Michelle Murillo modified, added, and deleted several people from 10 NSF email lists as needed.

- LNO staff facilitated a mini-symposium held at NSF in March 2005. The topic of the meeting was "Long-term marine research and the Grand Challenges in Ecology". LTER scientists made six presentations to an audience comprising NSF program officers, and representatives of other agencies.

- NSF requested that LNO staff prepare a brochure describing the membership and activities of the International LTER Network. Part of this task included the preparation of a supplement proposal to cover the costs of printing.

- LNO staff members frequently respond to requests for information from NSF, including advance notice of significant publications and media releases describing results from LTER research. For example, the Executive Director polled LTER sites to determine the potential impact of a hiatus in the acquisition of LANDSAT data. This information was used by NSF in discussions with other agencies.

- At the suggestion of NSF, we conducted an annual planning and assessment meeting between LNO staff and UNM administrators including the Vice-President for Research, the Dean of Arts and Sciences, the Chair of the Biology Department, the Director of the Museum of Southwestern Biology, and the Director of the State EPSCoR Program. (February 2005)

Service to the broader scientific community

The LTER Network has a responsibility to share publicly-funded information and discoveries with the broader scientific community, policy makers, and the public. Information sharing often takes place through scientific publications, but the LNO facilitates the communication of results in many other forms. The following examples illustrate some of the activities of the LNO in this arena.

- Bill Michener continued extensive interactions with network partners and building community outreach activities. In particular, he organized and participated in workshops and working group meetings with: SEEK (the Science Environment for Ecological Knowledge), PBI (Partnership for Biodiversity Informatics, which includes the National Center for Ecological Analysis and Synthesis, The University of Kansas, University of California-San Diego, and the

LTER Network), NPACI (National Partnership for Advanced Computational Infrastructure), NBII (the National Biological Information Infrastructure, an affiliate of the US Geological Survey), RCN (a Research Coordination Network comprised of multiple LTER and non-LTER universities that are committed to enhancing the discovery of information resources at field stations and marine laboratories), NEON (the proposed National Ecological Observatory Network and related planning activities supported by the American Institute of Biological Sciences), and multiple NSF-sponsored workshops on building cyberinfrastructure for the environmental sciences.

- Bob Waide participated in a workshop sponsored by AIBS to address the scientific framework for biodiversity research to be proposed under NEON. This workshop was held at the Hastings Reserve in California.

- Waide participated in the reorganization of the Long Term Studies Section of ESA and agreed to serve as Secretary of the section.

- LNO staff members communicated results and activities from the LTER Network through two LTER Network Newsletters, working closely with writers from LTER sites to assure broad, balanced coverage of research, outreach, publishing and site activities. Over 2000 copies of these newsletters were distributed to LTER and non-LTER scientists. In addition, the newsletters were made available on the LTER web page for a broader audience.

- John Vande Castle helped to host a visit by Taiwan research scientists to the LTER Network Office. Vande Castle's presentation focused on technology and related research within the LTER program as well as other International LTER programs and activities of the ILTER Network itself.

- An action item of the LTER Information Managers meeting was to develop a symposium related to advance cyberinfrastructure to support ecological research. Vande Castle contacted national and international experts in this field, and then developed and wrote a symposium proposal for the International Association for Ecology (INTECOL) and Ecological Society of America (ESA) meeting next year in Montreal, Canada. The proposal is now in review.

- Bill Michener participated in a 3-day workshop, January 23-25, at Sevilleta Biological Research Station that was funded by NSF and devoted to developing a long-term strategic plan for the Organization of Biological Field Stations.

- Michener organized policy and communications training workshop for the Organization of Biological Field Stations.

- Michener participated (including a plenary talk) in the Biological Societies' Policy Summit in Washington, DC. The Summit resulted in a data sharing policy statement that is currently under review by all major biological societies.

- Michener attended the Congress of Regional NEON Planning Groups in Portland OR and presented a talk on the NEON design process.

- Michener co-organized two SEEK All Hand's Meetings. Members of the UK e-science initiative were invited to share information and tools with LTER and other community representatives.

- Bill Michener and Samantha Romanello organized a series of activities for the community that communicated results of the SEEK project. These included:

    - A 1-day long workshop on ecoinformatics for the community at the annual ESA meeting in Portland (discussed in more detail below).
    - An evening workshop on managing metadata for the community at the annual ESA meeting in Portland (discussed in more detail below).
    - Two week-long training workshops on ecoinformatics and GIS that were held at the University of New Mexico for the Organization of Biological Field Stations (discussed in more detail below).

- Bill Michener and Deanna Pennington collaborated with the ecological niche modeling community to design and develop needed integration and analysis cyberinfrastructure through two working group meetings.

- Deanna Pennington was an invited speaker at the Oregon State University IGERT in Ecosystem Informatics Colloquia, December 3, 2004, "Ecoinformatics and the Research Cycle".

- Pennington was an alternate delegate for the University Consortium for Geographic Information Science (UCGIS), representing the University of New Mexico.

- Marshall White and Mark Stromberg, through a grant obtained by B ill Michener, re-designed the OBFS web site.

- Mark Servilla and Duane Costa were trainers at the Knowledge Network for Biology Data Management Tools workshop held in Santa Barbara, California 28 September 2004 – 1 October 2004. Attending students consisted of both national and international ecologists and biologists. Mr. Costa also delivered a presentation on "Metacat Replication and Harvesting." Mr. Costa also prepared the following Metacat documents: EML Harvesting I: Metacat Harvester Overview and Management, for the Fall 2004 DataBits issue; User documentation: Metacat Harvester User's Guide; and web page: Metacat Harvester at the LTER Network Office.

- Jeanine McGann created the design for the new OBFS web page, participated in Celebra La Ciencia day at the NM State Fair, and participated in Celebra La Ciencia day at UNM.

- Marshall White responded to 52 requests regarding the OBFS web site and database development, 16 requests regarding the RDIFS RCN project, and 50 requests regarding NEON website development.

- Michelle Murillo responded to numerous requests to change course offerings in OBFS database as well as multiple requests to change personnel information in OBFS database and she worked on the design and development of Field Station Module for site characteristics database.

- Sonia Ortega promoted participation of women and under-represented minorities in science through different activities such as:

    - Presentations: Pathways to Careers in Science: Integration of Research, Education and our Life's Interests at the University of California, Irvine. She presented to minority students, post doctoral fellows and faculty.
    - Committee participation: Member of Advisory Committee, Strategies for Ecology Education, Development and Sustainability (SEEDS) Program, Ecological Society of America. She attended two meetings of this Committee. She is a member of the Human Resources Committee, American Institute of Biological Sciences (AIBS) and member of Education and Human Resources Committee- Ecological Society of America.
    - Forum/panel participation: Co-organized and chaired forum for Women in Science at the SACNAS annual conference in Austin, TX. Participated in panel for Ecological Careers at the SACNAS annual conference in Austin, TX
    - Organized workshop (at Sevilleta, LTER) for the Ecological Society of America's (ESA) Education and Human Resources Committee to draft a report on Women and Minorities in Ecology. This document is a 10-year update on a previous report developed by ESA and a major undertaking for this committee.
    - Formed and chaired the committee to select minority students participating in field trip sponsored by ESA/SEEDS program.
    - Continued participating in the SACNAS biography project. Elementary and High School students contact SACNAS members regarding science careers. Responded to messages from students who are doing school projects regarding women and minority scientists and how to become a scientist.
    - Participated in the Conversations with Scientists session during the SACNAS annual meeting.
    - Met with students at the University of New Mexico funded by the NIH/MARC and MBRS program.

Under a sub-contract from Brown University, John Vande Castle served as coordinator of activities of the International LTER Research Network. This work, which serves the broader scientific community, is outlined in the following bullets:

- Vande Castle helped coordinate and conduct a formal meeting of the ILTER Executive Committee in Taipei, Taiwan in April and write a report on the results of the meeting (see[1]). This included preparing a first version of a policy and bylaw document for the committee to edit. These documents were then presented to the full ILTER Coordinating Committee for comment and eventual approval in October (see[2]).

- Vande Castle helped coordinate and provided logistical support for the annual ILTER Coordinating Committee meeting and ILTER Executive Committee meeting which he attended in the first week of July. This involved creation of a web page for the meeting and subsequent meeting proceedings report which he wrote (see [3] and see[4]). This process also involved providing travel support for meeting attendees and working with funding agencies including the World Bank who provided some travel support for the meeting.

- Vande Castle assisted in the coordination and logistical support for the 5th meeting of the East Asia and Pacific Regional Network of ILTER. This included significant help with the meeting proceedings which are posted on the ILTER Web page (see [5]). Vande Castle also provided presentations during the meeting on the activities of the ILTER Network, (see[6]) and Network Information System Development in the U.S. LTER program (see: [7].)

- Vande Castle worked closely with Dr. Hen-biau King on various coordination tasks for the ILTER Network including ILTER meetings, potential funding for ILTER activities, and interactions with other Networks and International programs. This included working with developing ILTER Networks, and posting information regarding their activities (see [8] and see[9]).

---

1 http://www.ilternet.edu/meetings/taiwan_2004_ec/ILTER_Executive_Committee_Meeting_4_2004_Taiwain.html

2 http://www.ilternet.edu/documents/ILTER_bylaws_10_01_2004.html

3 http://www.ilternet.edu/meetings/brazil2004/Brazil_ILTER_symposium_v0.html

4 http://www.ilternet.edu/meetings/brazil2004/ILTER%202004%20Coordinating%20Committee%20Meeting%20Proceedings.html

5 http://www.ilternet.edu/meetings/east_asia_pacific_2004/finalized%20Minutes.html

6 http://www.ilternet.edu/meetings/east_asia_pacific_2004/12-John%20Vande%20Castle_files/frame.htm

7 http://www.ilternet.edu/meetings/east_asia_pacific_2004/Sep7LTER_NIS_JVC_BEIJING_2004_files/frame.html

8 http://www.ilternet.edu/meetings/2005_lter_student_symposium/student_symposium.html

9 http://www.jern.info/jalter/

- The funding activities included working with an ILTER consultant, Michel Gutleman, on a document for potential funding sources, primarily by assisting in document editing to reflect ILTER needs and include input provided by ILTER committee members (see [10]).

- In December 2004, Vande Castle worked with the ILTER Chair and NSF to plan and coordinate a meeting in Washington D.C. to develop a funding proposal for the ILTER Network.

- Vande Castle worked with NSF to develop a new brochure for the ILTER Network. This included working with Patty Sprott-Bonito by providing new text, pictures and comments regarding printing of the final brochure. The brochure will also be available via the ILTER Webpage for Members to download and print locally. The source material will also be able to be easily updated as the information changes in the future.

- Vande Castle helped coordinate ILTER involvement in a planned U.S. LTER student collaborative workshop by disseminating information about the workshop to the ILTER community and working with the ILTER student committee representative, Tiffany Gann with responses and inquiries. This included the creation of a web page for the meeting and subsequent report (see[11]).

- Vande Castle also worked with the IM representative of the U.S ILTER Committee, Kristin Vanderbilt and the ILTER Australia representative, Rodney Keenan to organize a proposal to NSF for an East Asia and Pacific Region Information Management workshop. This activity is still in progress.

- Vande Castle worked with Vera Straskrabova of the Czech Republic Academy of Sciences to develop a survey related to ILTER aquatic research and have posted the survey on the ILTER web page for individuals to fill out and return to Vera (see[12]). This should result in a consensus for collaborative aquatic research. Coordination of this survey is still on-going and will be included in discussions during the 2005 ILTER Coordinating Committee meeting.

- Vande Castle worked with other International programs including FAO, in particular, providing information regarding ILTER to the GTOS program and working with ILTER Members to update information in the GTOS "TEMS" site database. This, in turn, is valuable for the ILTER program as a way to provide and publicize information regarding individual sites of the ILTER Network (see information at the bottom of the ILTER Network page at: (see [13]).

[10] http://www.ilternet.edu/meetings/brazil2004/presentations/Gutelman_proposal.pdf
[11] http://www.ilternet.edu/meetings/2005_lter_student_symposium/student_symposium.html
[12] http://www.ilternet.edu/meetings/brazil2004/Aquaticlter_survey.pdf
[13] http://www.ilternet.edu/networks/

- The largest activity regarding the ILTER program was to update the badly outdated information of the ILTER web pages (see www.ilternet.edu). This included updating or rewriting most of the web pages to reflect the changes that have happened within the ILTER program over the last four years. In addition, Vande Castle worked to separate all of the ILTER web pages from the associated U.S. LTER web pages for portability. This involved working with the U.S. LTER web personnel to help clean up the various linkages. The U.S. web personnel were also able to transfer the entire ILTER web content to a new server.

- Related to the ILTER webpage effort was Vande Castle's work to update the ILTER contact database and group mailing lists which had become almost unusable as a contact resource due to the large change in contact information by individuals of the ILTER Network throughout the years. This work involved verifying valid contact information for representatives of all the ILTER committees, as well as valid contact information for all the ILTER Networks and Regional Networks. Individuals of the entire ILTER Network can be now be viewed or searched via the link: (see[14]). The entire ILTER Network can now be contacted via the email address ilter@ilternet.edu. The ILTER Coordinating Committee (one or more representative of each ILTER Member Network) can be contacted via iltercom@ilternet.edu and members can view the list at: (see [15]). The ILTER Executive Committee can be contacted via ilterexec@ilternet.edu, and members can view the list at: (see [16]). All of this information can be viewed on the updated ILTER "People" web page at: http://www.ilternet.edu/people/ . The mailgroup and database portion of the ILTER work are currently highly dependant on the infrastructure of the U.S. LTER Network Information System. However, Vande Castle worked to separate these individual ILTER databases from the larger LTER system, and they can now be easily exported to other database systems as long as they support the existing database structures.

- Vande Castle also worked with the U.S. ILTER Committee regarding their activities and helped to set up a U.S. ILTER Committee web page for their use: (see [17]).

c. training/development

Individuals and organizations are increasingly recognizing the value of ecological data, particularly long-term, broad-scale and thematically-diverse data for addressing environmental questions of scientific and societal interest. Interest in data- and information- related technologies have further intensified in response to proposed plans for building a National Ecological Observatory Network (NEON). Despite their interest

[14] http://search.lternet.edu/directory.php?site=INT
[15] http://savanna.lternet.edu/groups/members.php?groupid=32
[16] http://savanna.lternet.edu/groups/members.php?groupid=114
[17] http://intranet.lternet.edu/committees/us_ilter/index.html

in relevant technologies, most ecologists have not been able to keep pace with the rapid advances in computing, communications and information management and analysis. LNO provided informatics training for LTER information managers, representatives from field stations and marine laboratories, and scientists from ILTER national networks. Maximum use was made of leverage from the SEEK and RCN projects to develop a diverse set of training workshops to address the needs of scientists at many career stages. These workshops are specifically designed to make ecologists aware of new and appropriate information technologies as they consider equipping or upgrading individual laboratories or expanding field station capabilities to those needed for NEON.

KNB Data Management Tools Workshop: Bill Michener and Samantha Romanello organized the workshop and instructors included: Duane Costa, Mark Servilla, and Samantha J. Romanello. This workshop was designed to provide ecologists, biologists, and data managers hands-on experience with some of the new ecoinformatics tools being created under the Knowledge Network for Biocomplexity Project. The KNB Data Management Tools Workshop was held September 2004 in Santa Barbara CA. The participants included 30 ecologists, biologists, and data managers. During the 3 day intensive workshop, trainees received hands-on experience with Morpho metadata software, the KNB data registry page, and Metacat. Additionally participants provided feedback on the software tools to guide further development

OBFS Resource Discovery Initiative for Field Stations Training Program in Ecoinformatics and GIS: This workshop was designed to provide data and field station managers with hands-on experiences in ecoinformatics and ArcGIS. Participants learned how to design dynamic databases and websites, establish advanced wireless networking technologies, use Morpho to create Ecological Metadata Language (EML), and apply these skills to managing ecological data at field and marine stations across the country. Additionally participants became ESRI certified in ArcGIS. The 2004 Ecoinformatics and GIS OBFS training was held October 17 through October 29 at the LTER network office at the University of New Mexico. Trainers included: James Brunt, William Michener, Michelle Murillo, Deana Pennington, Samantha Romanello, Marshall White, and John Vande Castle.

New Faculty and Postdoctoral Training: Ecoinformatics Training for Ecologists: This workshop was designed to provide early career faculty and postdoctoral associates with hands-on experiences in ecoinformatics. Participants learned how to design dynamic databases and websites and how to use and incorporate advanced research technologies like Morpho, Kepler, Sparrow, Growl and EcoGrid in their research practice and teaching.

The SEEK post-doc symposium and training: The symposium was held January 2005 at the University of New Mexico. The objective of the training was to have early career faculty incorporate ecoinformatics in their teaching portfolio. The participants were 16

early career faculty in biology, ecology and related fields. Seventy-five percent of the participants were from underrepresented groups. The 1 week intensive workshop covered: ecological informatics, metadata management, DBMS, QA/QC, web page authoring, taxonomic and biodiversity data, and an introduction to scientific workflows, ontologies and concept mapping. Trainees received hands-on experience with metadata software, SQL, Access and wireless technologies. LTER Network Office trainers included: William Michener, Michelle Murillo, Deana Pennington, Samantha Romanello, Marshall White, and John Vande Castle.

Ecological Informatics: Managing Data & Information for Projects, Laboratories, & Observatories: The Ecological Informatics: Managing Data & Information for Projects, Laboratories, & Observatories workshop was held September 2004 at ESA Annual Meeting in Portland OR. Primary topics covered in the workshop included: 1) ecoinformatics; 2) metadata; 3) archives and backup; 4) scientific database approaches; 5) QA/QC and 6) web interfaces and data and information portals. Sessions included both hands-on computers activities and lecture with discussion. LTER Network Office trainers included: William Michener, James Brunt, Samantha Romanello and Marshall White.

Ecological Metadata: Software Tools & Approaches for Documenting & Discovering Biological & Environmental Data: Individuals and organizations are increasingly recognizing the value of long-term, broad-scale and thematically diverse ecological data in addressing environmental issues. However for any data set to be used outside the scope of a single project, it must be discoverable, accessible and understandable. Such information about a data set is referred to as metadata. An evening session at the 2004 ESA annual meeting focused on characterizing metadata content that makes a data set useable for different purposes and provided significant hands-on experience with relevant software that facilitates metadata management as well as in-depth discussion on data sharing and archival data issues. Trainers included: William Michener, Kristin Vanderbilt and Samantha Romanello.

OBFS Policy and Communication Training Workshop in Conjunction with the 2004 OBFS Annual Meeting: This hands-on workshop provided participants with the information and training necessary to effectively influence policy. While the examples used during the workshop were based on the U.S. federal government, much of the information is transferable to other government systems (non-U.S., state, local, etc.). Following a brief introduction to the benefits of interacting with lawmakers, participants learned about the who, what, when and where of effectively influencing public policy through four sessions:

- Understanding the Federal Budget Process
- Navigating the maze of Congress and Executive Agencies
- Developing an Effective Message

- Building and Maintaining Relationships with Policy-makers

Each of these sessions began with background and how-to tips. Following the introduction, participants worked in small groups to develop lobbying strategies for hypothetical scenarios. By the end of the workshop, each group developed a complete strategy for addressing their hypothetical scenarios and meeting the needs of their field station community.

The workshop was sponsored by OBFS, ESA, AIBS and NSF (via the Research Coordination Network (RDIFS) project). It was held Sunday September 19th, 11 am - 5 pm at Shoals Marine Laboratory off the Rhode Island coast. The workshop was organized by William Michener. Adrienne Froehlich, (Director of Public Policy, American Institute of Biological Sciences) and Nadine Lymn (Director for Public Affairs, Ecological Society of America) served as instructors and coordinators for this training session.

Along with Jim Gosz and Scott Collins, Bob Waide taught a course titled "Ecosystems of North America" focusing on ecosystems studied by the LTER Network. This graduate course at UNM has potential to be web-taught to a wide to a broader audience.

d. outreach

The LNO was fortunate to have Dr. Sonia Ortega work in our office from 2001-2004. Dr. Ortega is a program office from the Division of Education and Human Resources at NSF who worked to strengthen the education programs of the LTER Network. Her principal activities included facilitating the activities of the LTER education committee through regular conference calls, annual meetings, and education workshops. Among her accomplishments were participation in developing the role of the LTER Education Committee in LTER planning activities, re-structuring of the Education Committee, mentoring LTER education coordinators in proposal development, completion of an Education Handbook, and completion of an Education Strategic Plan. She also performed the following efforts for community service:

- Gave Presentation: Strategies for Meeting Broader Impacts in Proposals. University of Wisconsin, Madison. This talk was part of the Graduate School Spring Seminar Series.
- Gave Presentation: Integration of Research and Education: Funding Issues and examples from LTER Marine Sites. North American Benthological Society, Vancouver, BC. This talk was part of a Special Session on Teaching in the 21st Century: Programs and Funding Opportunities.
- Gave Presentation: Integration of Research and Education at LTER sites. University of Mississippi. This was in conjunction with an outreach activity by another NSF program officer.

- Served on the Board of Directors of the Society for Advancement of Chicano/Latino and Native Americans in Science (SACNAS). Participated in Board Meetings and Annual Conference. Chaired Education Committee of SACNAS.
- Served on Advisory Board of Ecological Society of America (ESA) Strategies for Ecology Education, Development and Sustainability (SEEDS) project. Attended 2 meetings of this board.
- Chaired committee and reviewed applications (more than 40) for the ESA/SEEDS field trip to the National Wetlands Research Center in Louisiana.
- Served as Independent Reviewer/Advisor for Education Projects for the Costa Rica-USA Foundation (CR-USA).

LNO and SEEK staff presented talks describing their accomplishments in a variety of settings.

- Jasso, H., Shin, P., Fountain, T., Pennington, D., Ding, L., Cotofana, N., [submitted], A grid service for automatic land cover classification using hyperspectral images (abstract), *AGU 2004*, December 13-17, 2004, San Francisco, CA.
- Pennington, D., Berkley, C., Bowers, S., Higgins, D., Jones, M.B., Ludaescher, B., Michener, W.K., Rajasekar, A., and Schildhauer, M., 2004. The Science Environment for Ecological Knowledge (SEEK): A Distributed, Ontologically-Driven Environment for Ecological Modeling and Analysis (extended abstract). *Proceedings of GIScience '04*, October 20-23, 2004, University of Maryland.
- Jasso, H., P. Shin, T. Fountain, and D. Pennington, 2004, Using wavelets for the classification of hyperspectral images (abstract). *Fourth European Conference on Ecological Modelling and Fourth International Workshop on Environmental Applications of Machine Learning, ECEM/EAML 2004*, September 27 – October 1, 2004, Bled, Slovenia.
- Pennington, D., Michener, B., Beach, J., Jones, M., Ludaescher, B., Schildhauer, M., 2004, Ecological Niche Modeling with the Science Environment for Ecological Knowledge (SEEK) Infrastructure (abstract). *USIALE 2004 Conference Proceedings*, March 31 – April 2, 2004, Las Vegas, Nevada.
- Romanello, S. J., Pennington, D., Michener, W. K., Beach, J.H., Jones, M. B., Ludaescher, B. and Schildhauer, M. 2004. Science Environment for Ecological Knowledge: providing distributed data and computational resources for ecologists. (poster) Symposium of the US Regional Assoc. International Assoc. for Landscape Ecology, Las Vegas, NV
- Michener, W., J. Beach, M. Jones, B. Ludaescher, A. Rajasekar, M. Schildhauer. 2004. ITR PI Meeting held in Washington, DC (June 9-11). Enabling the Science Environment for Ecological Knowledge (SEEK) (poster).
- Michener, W., J. Beach, M. Jones, B. Ludaescher, A. Rajasekar, M. Schildhauer. 2004. International Symposia on Long-Term Ecological Studies - July 1-11, 2004 Manaus, Brazil. Enabling the Science Environment for Ecological Knowledge (SEEK) (poster).

- Waide, R.B. A Brief Overview of the LTER Network Office. Baltimore Ecosystem Studies Annual Meeting.
- Waide, R.B. An Overview of the Mission and Operations of the LTER Network and Network Office. California Current Ecosystem monthly meeting.
- Waide, R.B. Collaborative Science in the Long Term Ecological Research Network. Meeting of the Network Information System Advisory Committee at NCSA, Urbana, IL.
- Waide, R.B. Network Structure and Future Planning. Annual Meeting of the Luquillo LTER program.

III. Products

a. journal pubs

- Michener, W.K., J.H. Beach, M.B. Jones, B. Ludaescher, D.D. Pennington, R.S. Pereira, A. Rajasekar, and M. Schildhauer, [in press], A knowledge environment for the biodiversity and ecological sciences, Journal of Intelligent Information Systems.
- Pennington, D., H. Jasso, P. Shin, and T. Fountain, 2004, The effect of landscape heterogeneity on classification accuracy: a comparison of classifier prediction in sub-optimal sampling conditions. *Seventh Workshop on Mining Scientific and Engineering Datasets, 2004 SIAM International Conference on Data Mining (SDM 2004)*, April 24, 2004, Orlando, Florida.
- Simkin, S.M. and W.K. Michener. 2004. Mound microclimate, nutrients and seedling survival. *American Midland Naturalist* 152:12-24. .
- Boglioli, M., C. Guyer and W.K. Michener. 2003. Mating opportunities of female gopher tortoises, *Gopherus polyphemus*, in relation to spatial isolation of females and their burrows. *Copeia* 2003:846-850.
- Michener, W.K. 2004. Win-Win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise. *Restoration Ecology* 12:306-307.
- American Institute of Biological Sciences (Franklin, J., R. Gardner, A. Mills, W. Michener, K. Holsinger, K. Nadelhoffer, R. O'Connor, J. Goldman, J. MacMahon, and H. Swain). 2004. IBRCS White Paper: A Plan for Developing and Governing the National Ecological Observatory Network (NEON). Washington, DC: American Institute of Biological Sciences. 23 pp.
- Andelman, S.J., C.M. Bowles, M.R. Willig, and R.B. Waide. 2004. Disentangling biocomplexity through a Distributed Knowledge Network. BioScience 54:240-246.

b. books

- Groffman, P.M., M. Shachak, M. and R. B. Waide. 2004. Unified Framework II: Ecosystem processes: a link between species and landscape diversity. pages in *Dryland Biodiversity* (J. Gosz, S. Pickett, A. Perevelotsky, and M. Shachak, eds). Oxford University Press.

c. internet disseminations

- Databits, An online Newsletter for LTER IT community, Spring and Fall 2004
- LTER Network News, Spring and Fall 2004
- Brunt, James, "Informatics Highlights in the LTER Network", LTER Network News, Fall 2004.
- Costa, Duane, EML Harvesting I: Metacat Harvester Overview and Management, DataBits, Fall 2004(http://intranet.lternet.edu/archives/documents/Newsletters/DataBits/04fall/)
- Costa, Duane, User documentation: Metacat Harvester User's Guide, Metacat 1.4.0 release, Knowledge Network for Biocomplexity (http://knb.ecoinformatics.org)
- Costa, Duane, Web page: Metacat Harvester at the LTER Network Office (http://intranet.lternet.edu/projects/informatics)

Web Sites:
Service to LTER Sites:

- PAL Web Page - http://www.lternet.edu/sites/pal/
- SGS Web Page - http://sgs.lternet.edu
- Webmail - http://mail.lternet.edu/
- Source Code Repository for sites - http://cvs.lternet.edu

Service to LTER Network:

- New Standardized Site Representations -http://www.lternet.edu/sites/
- LTER Intranet - http://intranet.LTERnet.edu
- LTER Public Homepage - http://www.LTERnet.edu
- Schoolyard LTER Program - http://schoolyard.lternet.edu
- International LTER - http://www.ILTERnet.edu
- Improved Personnel Directory - http://search.lternet.edu/dir.php
- Graduate Student Committee Page - http://student.lternet.edu
- Development and Testing Web Site - http://devel.lternet.edu
- New CMS for Committees - http://committees.lternet.edu/
- Request Tracking Interface for LNO - http://rt.lternet.edu
- Source Code Repository for NIS - http://cvs.lternet.edu

Service to NSF:
http://www.lternet.edu/grandchallenges/
Service to the broader scientific community:

- Organization of Biological Field Stations - http://www.obfs.org
- LTER and community jobs board - http://savanna.lternet.edu/jobs

LTER image archive - http://savanna.lternet.edu/gallery

This year the seek.ecoinformatics.org web site was reconstructed to increase the breadth and depth of content and more importantly to open up the development of content to the larger SEEK community. The original site contained a couple of dozen pages developed by one person. The new site is open to all SEEK members to contribute and now has about 350 pages developed by about a dozen authors.

The obfs.org web site has been re-designed by White and Stromberg via a grant obtained by Michener.

d. other specific product (databases, collections, software, instruments)

Managed Datasets

1. LTER Personnel Information – the LTER personnel database serves many functions. It houses web accessible contact information for staff and scientists across the LTER network and other organizations such as the International LTER. It contains information about research expertise, site affiliations and roles, and organizational affiliations of LTER personnel. Demographic information is also housed here. All of this information except the demographics is easily accessible from the web.

2. LTER Electronic Mail lists – the electronic mail lists represent a service provided by the network office that allows sites or specific research groups (e.g. climate) to build custom email lists from the LTER personnel database. These mail lists can be viewed or built from the intranet web interface.

3. LTER Data Catalog – the LTER data catalog contains information that can be searched from the web, about data sets collected by the sites.

4. LTER Bibliography – the LTER bibliography database contains over 15,000 publications from all 24 sites.

5. LTER Site Description – the site description data base is an emerging data base that contains geophysical information about sites such as latitude, longitude, and size as well as administrative information such as contact people, grant numbers and host organizations.

6. LTER Image Archive – the image archive, which is a collection of digital photographs from the LTER network sites, is a repository of web searchable images important to research and education efforts throughout the network.

7. LTER Annual Net Primary Productivity (ANPP) – the ANPP database houses information collected in the cross-site study of annual net primary productivity by Alan Knapp and Melinda D. Smith.

8. LTER Climate[1] – the LTER climate database is a large repository of historical climate data from participating sites around the network. This allows for cross-site comparisons of climate data through time. The web site provides access to the data and production of graphs.

9. ILTER/GTOS NPP Demonstration Project - created to provide policy makers, resource managers, and researchers with access to the data needed to detect, quantify, locate, understand and warn of changes especially reductions in the capacity of terrestrial ecosystems to support sustainable development.

10. LTER Network Remotely Sensed Imagery - various remotely sensed (RS) data sets are warehoused for access and analysis by LTER sites as well as network office staff. The RS image archive includes the following data sets: Landsat TM and ETM+, ADAR, AVHRR, AVIRIS, SPOT, GFL (Global Fiducial Library: historical reconnaissance data).

11. North Inlet LTER Site Datasets – the datasets of the now defunct North Inlet LTER site are archived at the LTER Network office.

[1] The LTER Network Climate database is being revised and expanded to include hydrology data at the Andrews LTER site. It will be returned to LNO for long-term management following these developments.

Other Data Bases

- OBFS (SQLServer) in transition into obfs (MySQL)
- HBR site database- (MySQL)
- OJS (open journaling system for ecoinformatics.net) (MySQL)
- rt3 request tracking database (MySQL)
- SEV site database - (MySQL)
- www_lternet_edu – content management database (MySQL)
- lter_opportunities – jobs board database

Software and standards:

Two of this year's LNO products promise to have an impact on the broader ecoinformatics culture of the community:

1. The development and release of the **Metacat Harvester** software - A java based internet harvesting agent that was publicly released with the metacat XML/EML repository software version 1.4.0 in September. This software has been well-received by the ecoinformatics community and the transfer standard XML harvest document is being tested by NBII for use in their clearing house.

2. The release for review of **Ecological Metadata Language Best Practices** white paper – this groundbreaking work by members of the LTER IM community was organized, facilitated and funded by LNO. The document provides well-grounded pragmatic advice on the implementation of EML along with examples and templates. The utility of this document extends far beyond LTER.

Five products put in place this year will increase our efficiency and productivity relative to the LTER Network and LTER sites:

1. The **LNO Request Tracking System** – this system implements the workflow diagram approved by the LTER Executive committee for the LNO's responsiveness to site requests for technical and logistic support.

2. The **LNO CVS repository system** – the system provides a software source code control system that is usable by the entire LTER community.

3. The **LNO Information Technology Training and Usability Lab –** this laboratory is truly one-of-a-kind – The state-of-the-art furniture, unique layout, computers, and audio-visual equipment were designed from the ground up by LNO to meet the needs of ecoinformatics trainers. And what is even more unique is that the laboratory is entirely under LNO scheduling control – a situation made possible UNM that is virtually unheard of in academic settings.

4. **ARC2EML** – a java tool that converts standard ARC based metadata into EML. One of several tools started under the KNB project that LNO has completed.

5. **ARC2HBR** - a java tool that converts standard HBR based metadata into EML. One of several tools started under the KNB project that LNO has completed.

IV. Contributions

Development of your own discipline

By coordinating cross-site activities of the LTER Network, the Network Office contributes directly to development of partnerships and co laboratories in ecological science. We provide leadership in the field of ecology, especially in critical areas involving the development of knowledge networks. Moreover, we provide expertise and leadership in the development of new kinds of networks (e.g., NEON, CLEANER) and new initiatives for existing networks. By emphasizing interdisciplinary and cross-site research activities, we advance our understanding of complex systems, including human-driven systems. Specifically, we are working with the LTER Executive Committee to develop an approach by which the LTER Network can address grand challenges in ecology. 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 LNO 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.

Development of other disciplines of science and engineering

Our participation in the KDI and SEEK projects 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 these proposals. Both of these projects provide test beds for integrating multidisciplinary, multi-scale data for addressing critical environmental questions. The efficient discovery of new ecological insights from these systems will provide validation of the informatics approaches being tested. Similarly, advances in computer science research involving probabilistic testing of hypotheses will guide ecological research and accelerate progress in understanding complex phenomena in general. The governance and information management models developed under the LTER program have relevance for networks in other disciplines (e.g., CLEANER).

Education and development of human resources

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. In the long-term, the LNO is working with the LTER Executive and Education Committees to define a strategic plan for integrating education and research seamlessly across all educational levels.

Physical, institutional, and information resources for science and technology

The technical and information resources developed and maintained by the LNO are available for use by the 2000+ scientists of the LTER Network as well as the ecological community in general. The Long-Term Ecological Research Network Office occupies a 2,700 square-foot suite comprising seven offices, an 8 person technical workspace, and two 40-person conference rooms in the CERIA building on the main campus of University of New Mexico. This space is ideally positioned to support the activities and research proposed. One of the conference rooms is equipped with a Polycom VU FX – 4-port IP video conferencing hub. This equipment is portable and can be easily relocated in any of the working group conference facilities described above. In addition, we have a Polycom single port VU video conferencing unit that can be easily moved or shipped around as necessary to support this activity.

We are completing a dedicated computer training facility of our own design that will complement the above facilities and will be under complete control of the program – this is unheard of in most institutions where computer classrooms are always shared and usually under control of a centralized scheduling system. Computers and furniture have been installed and the A/V equipment installation should be completed by summer of 2005. The equipment for the facility is being paid for by the SEEK ITR grant and University of New Mexico Cost-Share.

In addition, we are planning for an ACCESS grid node to be completed sometime in 2005. The ACCESS conference room at the UNM High Performance Computing Center is available to us in the interim.

Sevilleta Research Station and Conference Facility

The UNM Department of Biology maintains a unique facility to support research and conferences 55 miles south of the UNM campus in a scenic section of the 200,000 hectare Sevilleta National Wildlife Refuge near the Rio Grande River. This facility can house 48 people and has full conference facilities including two large conference rooms with multi-media projection systems, a library, computer center, computer teaching lab, institutional kitchen, office space, and additionally includes quiet work-enhancing isolation complete with resident wildlife. The station is fully interconnected via fiber optics and has wired and wireless Ethernet in all facilities including bedrooms. The station is connected to the Internet via a point-to-point T-1 that connects directly to the Internet II router and the UNM gigabit backbone. This creates an environment conducive to productivity via the combined effects of solitude and connectivity. Participants can take a hike with their wireless enabled laptop or seek any number of secluded refugia around the compound. This facility is available for scheduling of proposed workgroup activities and is very supportive of this type of research effort.

Computing Facilities to Support Research

The LNO houses computer facilities for the LTER Network Information System Infrastructure: The backbone of the network information system is the network office data center. The climate controlled center has scalable servers and enhanced network bandwidth to better serve the LTER Network and its partners in the ecological community. Two Sun E-450 Enterprise servers (4-300mhz UltraSPARC CPUs, 1gb memory, 20gb local disk, tape backup including Benchmark DLT7 tape robot and DDS3-12/24 gb, redundant power supplies and uninterruptible power) and 4 Dell Poweredge servers (2-2.4Ghz Pentium IV, 4Gb memory, LTO tape backup, a 1 Tb RAID5 disk array, redundant power supplies and UPS) serve the LTERnet.edu domain. The combination of the Sun Solaris operating system on the UltraSparc platform and the Linux and Windows NT operating systems on the Intel platform allows for maximum flexibility in incorporating new developments and technology. MS SQL server, Mysql, and Oracle are used for databases. In addition, the office has a number of large format color output devices and a variety of formats of scanning data input devices.

The UNM campus is wired with a new Gigabit redundant fiber backbone that connects all the zones in which the LNO will operate. Our facilities have both fiber and copper gigabit ethernet connections. Research activities at UNM enjoy a fractional OC-3 fiber connection to the Internet II via Denver that is connected directly to the gigabit backbone

infrastructure. In addition, the University of New Mexico has just become a full member of the National LambdaRail consortium. National LambdaRail (NLR) is a major initiative of U.S. research universities and private sector technology companies to provide a national scale infrastructure for research and experimentation in networking technologies and applications.

Public welfare beyond science and engineering

Three of the objectives of the LTER Network directly address public welfare beyond science and engineering:

- To create a legacy of well-designed and documented long-term observations, experiments, and archives of samples and specimens for future generations.
- To promote training, teaching, and learning about long-term ecological research and the earth's ecosystems, and to educate a new generation of scientists.
- To reach out to the broader scientific community, natural resource managers, policymakers, and the general public by providing decision support, information, recommendations and the knowledge and capability to address complex environmental challenges.

In an effort to go beyond these objectives, members of the LNO staff have participated in the planning for the proposed National Ecological Observatory Network (NEON). NEON will be the first national ecological measurement and observation system designed both to answer regional- to continental-scale scientific questions and to have the interdisciplinary participation necessary to achieve credible ecological forecasting and prediction. As such, NEON will transform the way we perform science by enabling the integration of research and education from natural to human systems, and from genomes to the biosphere. Social scientists and educators will join ecologists and physical scientists in NEON planning and design and participate as observatory users, recognizing that we live on landscapes that are, to varying degrees, human-dominated ecosystems.

Immediate broader impacts to be realized are associated with the diversity that is built into the leadership of the NEON Design Consortium (i.e., inclusion of multiple disciplines, traditionally underrepresented groups and broad geographic representation). We believe that by providing for diversity "at the top," we will help insure appropriate diversity in populating the workforce (committees) that will be critical to the success of the NEON Design Consortium. Furthermore, in designing NEON, we will tap the intellectual capital across the full range of four-year institutions. We will also include the insight of post-doctoral associates—NEON's next generation of leaders—in our design efforts.

The broader impact of our work in designing NEON will also be fundamentally enhanced by a focus on questions recognized by the National Research Council as being fundamentally important to the nation—climate change, invasive species, ecology of

infectious diseases, biodiversity, nutrient cycling, and land use change—plus hydroecology and “emerging issues.”