

## **Report of the Mid-term Site Review Team for the LTER Network Office**

Steve Carpenter  
Chris Jones  
Deb Peters  
Dwayne Porter  
Brenda Shears  
Wade Sheldon  
Russ Schmitt

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### **Summary**

The Mid-term Site Review Team (SRT) strongly recommends that the National Science Foundation (NSF) invite a renewal proposal from the LTER Network Office (LNO) at the University of New Mexico.

### **Introduction**

The LTER Network Office represents a unique and important partnership among the LNO staff, the LTER Network sites, the National Science Foundation and the University of New Mexico (UNM). The SRT visited the LNO on 10-11 October 2005. The SRT was impressed by the high quality of work being performed by the LNO in support of the Network. We view the LNO as providing leadership in presenting the Network as a cohesive union of 26 individual sites. The SRT was pleased to note the activities and accomplishments presented during the mid-term review and the obvious dedication, enthusiasm, and hard work of the LNO staff.

In this Introduction, we highlight some key accomplishments of the LNO, comment on the synergy between the LNO and associated projects administered through the LNO, and comment on potential future space needs of the LNO. The remaining sections of our report evaluate the LNO in four broad categories: (1) performance in key areas dictated by the Statement of Work, (2) role of the LNO in a changing Network, (3) role of the LNO in information technology and associated fields, and (4) communication among the LNO, site information managers, project managers, staff, and LTER Scientists.

Among the notable strengths of the LNO, we wish to highlight the following accomplishments.

- *Establishment of a highly qualified and motivated technical, outreach, administrative, and management team:* The team presents itself as an energetic, enthusiastic, and coordinated unit, as exemplified by the seemingly smooth and timely transition from the previous South Campus location to the renovated CERIA. The collective LNO and UNM administration are encouraged to continue to support a dynamic and collegial working environment providing for professional growth of the individual team members.

- *Coordination of professional meetings, technical workshops, and training seminars that support Network goals by developing and advancing collaborative and synthetic research activities:* Of particular note is the success and prominence of the All Scientists Meetings (ASMs). Planning for the 2006 meeting is well underway. It is recognized that these efforts demand substantial time and resources. These investments are warranted by the important contributions of the ASMs to the Network and the larger interdisciplinary research and management community.
- *Successful efforts to promote the advancement of information technologies (IT) and information management (IM) techniques via collaboration among the scientific, IT and IM communities:* Among several examples, we note LNO efforts to advance the role of IT and IM within the Organization of Biological Field Stations (OBFS).

The LNO has done a good job in leveraging support for other projects that complement the LNO's primary mission of serving the LTER Network. We are pleased with the present level of synergy evident among the projects. We urge the LNO Executive Director to remain vigilant in selecting parallel projects to ensure that the primary focus on the Network is enhanced and not compromised.

The LNO has recently moved into new offices in a central location at UNM. We observe that this space, while appropriate for their current needs, does not allow any room for growth. Since the LNO has been successful in attracting additional projects complementary to their mission, it is reasonable to expect that additional projects will be awarded within the next few years. The LNO is also involved in planning for expanded LTER Network synthetic activities. We anticipate a need for additional space adjacent to the present facility as the LNO expands. We encourage UNM to be proactive in planning for this possibility and to recognize the need to preserve the synergies of this administrative and research team through co-location of the entire LNO team.

### **Progress in Key Areas**

The SRT is pleased to see substantial progress on each of the six key areas (that correspond to 8 tasks in the Statement of Work). In this section of our report, we highlight a selection of these achievements from a long and impressive list. The section concludes with a recommendation to NSF regarding the metrics used to evaluate whether the LNO has met its contractual obligations.

- **Research and Education Environment.** The LNO enhanced the environment for cross-site and synthetic research of the LTER network by organizing the highly successful All Scientist Meeting (ASM) in 2003. The LNO is committed to continuing to organize and support regular ASMs, and planning for an ASM in 2006 is well underway. The LNO has been actively engaged in seeking the necessary finances for the 2006 meeting. Research Working Groups funded by the LNO are a second example of an effective mechanism the LNO uses to facilitate synthesis and cross-site science, and there are 16 such working groups supported at present. Additionally, the growing library of remote sensed imagery is an excellent resource for the LTER sites and network; expanded use of

this digital library should be encouraged. Finally, the LNO is actively involved in PI-driven synthetic products, such as Trends, and is a key participant in this collaborative effort.

- Outreach to other Research Communities. The SRT was particularly impressed with the level of activity in this regard. For example, LNO generated a Research Coordination Proposal to NSF to gather information on expertise and data available at field stations and provided training to individuals from field and marine stations on IM/IT. With the National Biological Information Infrastructure (NBII), the LNO obtained funding for a metadata initiative to facilitate information flow between LTER sites and the NBII. Partnerships developing with the Canopy Network Database Project, the National Partnership for Advanced Computer Infrastructure (NPACI), and the National Center for Supercomputer Applications promise to enhance LTER Network goals.
- IM Support and Development. The establishment of the LTER Network Information System (NIS) that was facilitated by the LNO is a substantial advance. The LTER NIS seeks to accelerate the development and use of shared informatics products, such as data catalogs and integrated databases, to be achieved by implementing shared standards (e.g. EML), confederating site data repositories, developing software tools, training, and support to integrate and provide compatibility across the Network of sites, institutions, and researchers. The LNO continues to play a key role in the LTER Network Information Systems Advisory Committee (NISAC), a very productive committee that involves LNO staff, LTER PIs, and Information Managers. In addition, the LNO participated in the formation of the Partnership for Biodiversity Informatics (PBI), which derived from the project (Knowledge Network for Biocomplexity) that developed the Ecological Metadata Language (EML) and led to the Science Environment for Ecological Knowledge (SEEK) project.
- Public Information and Outreach. The LNO is in the process of developing a comprehensive communication plan based on a proactive philosophy that strives to be both targeted and strategic. LTER public displays were revitalized and the LTER Network brochure was completely revised.
- Administrative and Logistic Support. The outstanding logistical support provided by the LNO for LTER-related meetings sets a standard for excellence that other entities should emulate. Since 2003, the LNO has organized or facilitated an average of about 40 meetings each year involving more than 2,000 participants. In addition, the LNO was involved in the establishment of the Center for Research in Ecological Science and Technology (CREST) at the UNM, which will provide an umbrella organizational construct that should result in considerable synergy.
- Computational and Communication Infrastructure. The LNO moved from off-campus space to an on-campus building, which remarkably was accomplished with no substantive interruption to the core LNO operations.

While the SRT was deeply impressed by these and other accomplishments, we felt that the reporting focused on details and thereby under-represented the significance of the achievements of LNO on behalf of the LTER Network. It is essential that LNO communicate its progress to the Network at a level that can be assimilated by Network scientists, managers, and staff. This leads to the following recommendation.

Recommendation: The SRT recommends that NSF demand a higher level of evidence for the desired impacts of the LNO on the LTER Network. To accomplish this, new metrics of performance must be developed to focus on the overarching role of the LNO in the Network. This shift in reporting may entail less detailed documentation of fine-grained specific lists of tasks performed. We believe, however, that such a loss of detail is unimportant if the LNO demonstrates accomplishments at the larger and more relevant scale of salutary effects on the Network. Impacts of this broader nature are ultimately more important to the success of the LTER Network as a whole.

### **The LNO in a Changing Network**

The SRT recognizes that the LTER Network is in a time of transition. Because of the role of the LNO in supporting, facilitating, and enhancing activities of the Network, this transition has important implications for the LNO. The Network has grown through time, leading to a large array of sites that represent diverse ecosystems with different conceptual, methodological, and analytical challenges as well as differing constraints on site budgets. As the Network has expanded through time, the Coordinating Committee (CC) has increased in number of members and diversity of interests. The CC will continue to change with turnover of leadership and changes in perspectives of the Principal Investigators. Prompted by the 20 Year Review, the Network is launching a decade of synthesis that will demand substantial intellectual effort and new funding. In addition, the Network is attempting to integrate social and natural sciences, a formidable, but critically important challenge. Thus, the Network is changing in virtually every important dimension, from scientific accomplishments and goals to diversity of disciplines, scale of the CC and ASMs, governance, and social structure.

The SRT encourages the LNO to be proactive in their role within this challenging and exciting environment. The LNO should be looking forward and seeking opportunities to enhance and facilitate Network-level synthetic activities, such as the Trends project. Furthermore, the SRT recognizes the importance of the Governance Committee in addressing the complex issues associated with this changing Network and supports the involvement of LNO senior staff in this committee and implementation of the recommendations that emerge from the Governance Committee.

In this time of rapid change, there is need to articulate a shared vision and to work across the Network to implement the vision. The LNO should play a key role in both emergence and implementation of the shared vision. Proactive broad thinking fostered by the LNO can and should have a beneficial effect on the evolution of the LTER Network.

As a specific example, there is need for broad thinking about how the synthesis goals can be achieved across a range of funding scenarios. The Network Planning process has created

enormous energy and enthusiasm across the Network, leading to a remarkable opportunity to advance Network science. We encourage the LNO to think about how to capitalize intellectually on this opportunity regardless of specific funding scenarios. How can LNO resources be adapted, mobilized, or reallocated to maximize the benefits from the Network's intellectual investment in the planning process? We note that the power of the LTER Network lies in its capacity for self-organization from the bottom up as well as its potential responsiveness to centralized leadership. While the LNO has often focused on centralized approaches, and some degree of centralization will be useful in advancing synthesis, the LNO is in a strong position to encourage and support opportunities for groups of sites to self-organize to build Network science. For example, LNO funding for small meetings or training courses may leverage local resources and the energy of site-based scientists to achieve some of the Network planning objectives. We believe there is much potential in such a mixed strategy.

Recommendation: The LNO should begin developing strategies for meeting synthesis goals across a range of funding scenarios,

The SRT strongly supports the efforts of the LNO to allocate or raise additional funds for synthesis activities, such as (but not limited to) small group meetings. The SRT recommends that the LNO establish a mechanism for assessing the outcome of the small grants that it provides for synthesis. While we suspect that these grants are extremely valuable, it would be useful to have more data about the degree of success (or failure) of these projects. Such information would help guide the process of selecting projects for future small grants. We recognize that the informality of these small grants is a key to the success of the program. The assessment and selection process need not interfere with the capacity of the LNO to provide small grants for creative projects in an informal and rapid way. However, it should allow the LNO to allocate funds more strategically to increase the success rate and payoff of the small projects.

Recommendation: The LNO should establish a mechanism for better assessing the outcome of the small grants that it provides for synthesis.

### **Cyber-Infrastructure, Information Technology, and Information Management**

The effort of the LNO to forge partnerships with other emerging networks, such as OBFS, NBII, and NEON, is commendable. Such relationships are critical to the success of the LTER Network, and the LNO should continue to foster such ties.

In order to promote and facilitate synthetic research within the LTER network, the LNO has focused on the adoption of various technologies through these collaborations in information management, such as the use of structured metadata, field sensing techniques, and the acquisition of remotely sensed data products that are relevant to LTER research locations. These efforts are critical to creating an operational network in which the analysis process is enhanced by more transparent sharing of data, processing algorithms, and metadata. Reports from both the 2000 LNO SRT and the 2004 LNO Executive Committee Review urged the LNO to implement technologies in tight coordination with the defined research needs of the LTER Network, and we believe that additional steps are needed to achieve this goal. For example, there appear to have been long delays between deployments of production technologies and we are not sure why these excessive time lags may have occurred. The LNO may have underinvested in staffing needed to

implement the required technologies, or, more alarmingly, the LNO staff may be poorly matched to the actual needs of the Network. More direct involvement in technical development by the Associate Directors would help to ensure the timely deployment of products and services and would help to match appropriate technologies based on the requirements of the Network community. Likewise, more rapid prototyping, in which milestones are more frequent and feedback from end-users is sought more frequently, could lead to faster development of IM products that are well-suited to needs of Network IM staff and scientists.

Recommendation: The LNO should analyze these problems and take appropriate action to shorten the lag between development and implementation of IM technologies that address priority needs of the sites.

The SRT was impressed by the strong commitment to IT and IM standards in all LNO technology projects. We also recognized that the LNO has played an important role in the development and promotion of metadata standards for the environmental sciences, such as EML, through direct participation in the Knowledge Network for Biocomplexity project and by hosting a series of workshops, working group meetings and training events related to metadata creation and management. LNO staff members have also been instrumental in building support for EML metadata within the LTER Network by assisting sites with legacy metadata conversion and harvesting metadata for inclusion in metadata clearinghouses at LTER, NBII, and the emerging Ecogrid network. More recently, the NIS development team has actively participated in the creation of a prototype unit registry to foster standardization of unit definitions in site metadata documents. These are all important contributions to standards development.

However, we felt that leadership in the area of standards implementation could be improved. For example, LNO should be more proactive in adding support for standards such as EML to the centralized network databases and should explore potential applications or services based on these standards in a shorter time frame. These exercises would inform ongoing development of the standards as well as provide utility for LTER sites implementing these standards. The centralized databases represent a major network resource and sites have invested significant effort into populating and maintaining these databases, so any services targeting these databases could have major impact on network-level IM activities. Likewise, the LTER Network would benefit from having a better understanding of how the various deployed and prototyped projects fit into the Network Information System. It was unclear what comprises the specific components of the NIS. A simple listing, along with the development status and impact of each component, would help communicate the intentions and trajectory of the NIS to the greater LTER Network, as well as partner communities.

### **Improved Communication**

With the growth of the LTER Network, there is ongoing need for better communication across the Network for IT/IM. This expanding need is not surprising, and it will demand more effort from LNO. Effective channels for communication (in both directions) among scientists, project and information managers, site staff, and the LNO need to be expanded. We urge the LNO to consider additional meeting, workshop, or training formats that will improve communication among members of these key groups. We also support ongoing efforts to aid Internet-based

collaborations through portals, Wikis, and videoconferencing. The PolyCom bridge is a valuable addition to LNO communication capabilities, and we encourage the development and use of this technology.

Simply deploying communications infrastructure is not sufficient, though, and LNO should ensure that LTER participants are aware of new services and how to request and use them, and should follow up to ensure services and features meet the needs of the Network. LNO should also improve the visibility of important resources and services, such as spatial data products and collaboration portal services, to the network. Creating a comprehensive list of LNO services and contact points on the Intranet site would be one potential solution, and regular announcements regarding major "releases" of new tools and resources would also be effective. The request tracker services should also be advertised more prominently.

Maintaining good communication channels and coordination between LNO and site information managers is particularly critical in the area of site-to-network information exchange (e.g. network database population and metadata harvesting). Changes to these protocols can significantly impact site IM operations and work load, and should be adequately discussed prior to implementation. Including additional LNO staff members in site visits (e.g. web and software developers) would help build bridges between services provided by LNO and needs of site scientists and IMs as well as help LNO set priorities among development projects and mitigate negative impacts of new network standards and protocols on site activities.

Recommendation: The LNO should develop more effective mechanisms for: (a) promoting the availability of communication services and features, (b) assessing whether those services meet the needs of the Network, (c) making appropriate improvements driven by user needs, and (d) consulting with Sites prior to changes in information exchange and other protocols that have the potential of adding undue burdens on Site personnel.

The SRT is very impressed with the recently established Information Technology Training Lab (ITTL) located in CERIA. The ITTL represents a state-of-the-art teaching and training facility with potential to support a wide range of IT and IM activities. Training could range from basic introductions to GIS and remote sensing / digital image processing to database and metadata management to spatial modeling to ecological modeling to time series analysis to advanced topics in ecoinformatics. Primary focus should be on meeting the training needs of the Network, with consideration to additional training of non-Network personnel as time and resources permit. The SRT encourages the LNO to develop a plan that supports an appropriate level of use and maintenance of the facility. This plan should address funding for personnel, hardware and software maintenance, and IT enhancements. In addition, the plan should address scheduling of the facility and adopt a priority system for scheduling of Network and non-Network training sessions. The LNO should work with the UNM administration to identify potential opportunities to share both the use of the facility and the maintenance of the facility.

## **Conclusion**

The SRT was highly impressed with the activities and progress of the LNO over the past three years. Additional improvements are possible. In particular, it is important to meet the needs of the Network while enhancing Network-level activities and communication in a proactive way. Developing a shared vision between the LNO and the Network is critical to maintaining this balance. This is an exciting time for Network synthesis and IT developments, and we expect the LNO will play a major integrative role in these endeavors.