

## Coweeta Long Term Ecological Research Program

### Mid-term Review

#### Site Review Team Members:

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The panel met on June 28-29 with PIs, collaborators, and graduate students at the Coweeta Hydrologic Laboratory in Otto, North Carolina. The site is part of the USDA Forest Service Southern Research Station and the central location for the Coweeta LTER. The charge for the team was to visit the site, review accomplishments and plans in five review categories (listed below), and write a report to NSF containing an evaluation and recommendations. The five review criteria were:

#### Intellectual Merit

- 1) Research: site-level, including synthesis
- 2) Research: cross-site, network, and international research and synthesis

#### Broader Impacts

- 3) Outreach, Education, and Training
- 4) Information management/Information technology
- 5) Site and Project Management

The review team was provided with a document containing a brief overview of the research program, the site review schedule, the field trip overview, and abstracts of talks and student posters. The review team requested and received a copy of the funded proposal with addenda, lists of cross site and outreach activities, and access to the data management system. Below we provide a summary of our findings and recommendations for improvement during the remaining grant period.

**Intellectual Merit – Site Level:** The Coweeta LTER has a long and rich research history and has made many important contributions to our understanding of watershed-scale ecological, hydrologic, and geo-physical science. The long-term datasets from Coweeta have been an invaluable resource for long-term ecological research. The collaboration with the US Forest Service has been immensely valuable in generating and maintaining these datasets, and will hopefully continue to play an integral role in the future. The Coweeta LTER program has

benefitted from over a decade of research focused on regionalization that integrates social and natural sciences in innovative ways, and serves as a model for other LTER sites. The quality of the collaborative research taking place between social and natural scientists at Coweeta is exemplary. The review committee recognized the visionary leadership of the lead PI in bringing together a diverse group of scientists and helping to provide a collegial and productive environment for this work. The Coweeta team is at the leading edge of LTER network efforts to incorporate concepts from the Integrated Science for Society and the Environment model into LTER research.

The review team identified several specific strengths of the current research program.

- The incorporation of social science methods – both quantitative and qualitative – into the research agenda is innovative and strengthens the overall research program.
- The use of long-term historical image data is laying the groundwork for understanding trends in land use and land cover change (LULCC) in the study area, and projecting future trends. We were impressed with the new parcel-based approach to land use change analysis. Coweeta researchers appear to be leading LTER network research on how to mine parcel data for useful insights into the drivers and implications of LULCC, and are working collaboratively with other LTER sites to advance the potential for new cross-site projects such as the Maps and Locals Project (MALs). It will be important for the CWT team to design methods that are easily transferable to further network goals of cross-site collaboration.
- The coupling of a state-based vegetation model with the RHESSys hill slope hydrology model is likely to lead to important advances to our ability to predict the potential effects of climate change. The approach makes good use of the long-term datasets. Timely progress on the SLIP model will be critical for successful model integration and scaling.
- The biodiversity research was well integrated and articulated. Collectively it will make an important contribution. It was refreshing to see an emphasis on organismal ecology emerge from this site, as well as the strong linkages with ecosystem research for which the site has traditional strengths.
- The panel was impressed with the eddy covariance system and related science in the complex topography of CWT. This is high-risk research and has the potential to inform the fields of biometeorology and biogeochemistry. This research is being conducted in the true spirit of LTER.

The team also identified several areas of concern and made suggestions for improvement.

- It was unclear how the research being conducted is driven by and linked together through the conceptual framework. We believe that there is merit in keeping the conceptual framework “front and center” to maintain the focus and integration needed of a project of this magnitude and complexity.

- Better documentation of patterns, trends, and *drivers* (vs. ecological implications) of exurbanization in the region are needed. Recruiting a demographer to the team could be beneficial. Also, given its central role in the conceptual framework, we suggest expanding the analysis of landowner behavior and conservation decision-making to include the effects of different forms of environmental governance (e.g. federal, state, and local laws and regulations) and a wider variety of protection mechanisms.
- Modeling efforts to date have been focused on the watershed and county scale even though the regionalization component has been funded for more than a decade. It is unclear if these approaches will be appropriate at the regional scale, and a plan for modeling at the regional scale needs to be clarified.

**Cross-Site, Network, and International Research and Synthesis:** Coweeta investigators are clearly active in a number of network activities, and the lead PI is widely recognized as a leader on socio-economic initiatives within the LTER network. There was no formal mention of these efforts during the presentations, however, and this raised concerns within the review committee about the priority given to this component of the research. The review committee was subsequently sent a synopsis of 23 collaborative research efforts involving CWT investigators. One significant contribution has been the collaboration with the Central Arizona-Phoenix LTER to produce the Socioeconomic Catalog for the EcoTrends Project. This compilation of human population and economic data from 1790 – 2000 for regions around each of the LTER sites should be a valuable resource for future cross-site comparisons and analyses.

The RHESSys model is being used at a number of other LTER sites, and in principle has wide applicability (subject to appropriate parameterization). The linkage of the various modeling efforts underway as part of the Coweeta-LTER site-specific research has the potential for important synthesis within the site, but there was little direct evidence that those efforts would lead to meaningful synthesis outside of the immediate study region, or across other LTER sites. While Coweeta is undoubtedly a leader within the network in the subject of linkages between social and ecological sciences, that research would have even more impact if there was a conscious effort to make the methods and models developed there more broadly applicable.

**Project Management:** The review team was impressed by the collegiality, cooperativeness, openness, and the general tone of interactions between PIs from diverse institutions and areas of expertise. It was also noted that the logistics on site appear to be very effectively managed. Participants at all levels expressed appreciation for and satisfaction with site manager Jason Love in providing logistical support, including access to and the quality of on-site housing, access and quality of meeting and lab space, use of vehicles, and the online reservations system for reserving these facilities. The collaboration with the US Forest Service is clearly an integral part of the overall program and NSF should work to help ensure continued Forest Service support for the LTER, particularly with regard to the long-term monitoring program, high risk research such as the eddy covariance project, and outreach and education.

Several aspects of the project management appear to be unclear or problematic and are outlined below:

- The team was concerned that the leadership of the Coweeta LTER by a single PI may be suboptimal for this large and diverse project. This has led to a relatively informal decision making structure with the concentration of power to make decisions in the hands of a single individual. It also puts a tremendous administrative load on the lead PI. While the approach seems to be working well thus far it is unclear how well it would work if conflicts arise. The panel suggests that the executive committee actively seek to recruit a leadership team that more broadly represents the key areas of expertise covered by the research program.
- Related to the issues above, the Coweeta LTER would benefit from a more transparent and formalized decision-making process, as well as formal guidelines for membership and length of term on the executive committee. The leadership needs to develop mechanisms for bringing younger people into positions of leadership. There did not appear to be a long-term project management plan, giving rise to concerns about how new leadership will be brought into the project and how funding priorities will be decided.
- The Coweeta LTER fosters a diverse community of graduate students, but the gender and ethnic diversity of the senior personnel is much more limited. We recommend that the PIs be proactive about addressing the lack of diversity at upper levels, including active mentoring and recruitment of women and minorities into leadership positions.
- Graduate students from institutions other than the University of Georgia noted a lack of communication and inclusion in management, as illustrated by their ignorance of student representation on the advisory council and of LTER-wide activities. The review team suggests that the leadership help identify and mentor a graduate student representative. The graduate students requested that student symposia be held twice a year, during the PI meeting and during the summer annual meeting, and that web-based activities (e.g., webinars) be developed to supplement activities such as LTER seminars that are traditionally held at the University of Georgia.

**Education and Outreach:** The review team was generally impressed with the breadth of education and outreach activities that is supported by the Coweeta LTER, which clearly benefits from enthusiastic leadership. The School Yard LTER appears to be especially successful in targeting an important age group. The program might benefit from more direct interaction with similar programs sponsored or run by EPA watershed programs, state water quality agencies, and UGA extension. The Citizen Science program is less mature, but shows considerable promise in reaching a broader set of stakeholders. The REU program is active and successful in exposing undergraduate students to a broad range of LTER related topics. It would be useful to track the number of REU students that enter graduate programs. Graduate students were very satisfied with the support and mentoring they receive. The panel felt that the graduate students would benefit from more frequent opportunities for cross-institutional sharing of ideas and results.

Overall, the education and outreach program has developed a set of diverse and interesting approaches for interacting with students and the public. At some point the education and outreach program would benefit from formal assessment, although we recognize that the budget does not provide sufficient support for such an activity at this time.

**Information Management:** The Coweeta LTER (CWT) information management system is currently being modernized from one composed mainly of legacy hardware, a small database and a static HTML-based website to one built on new or upgraded hardware which is fully database-driven with forms for data entry, and with cross references between major website sections. An information manager oversees the system with input from the lead PI. The information manager is also responsible for system administration, which can represent an additional burden, although he has assistance from several student workers in various specialized roles. In general, the site complies with the Network's guidelines for LTER site IM systems and websites. The site chose to adopt most of the new components from a system in use at another LTER site (GCE), a choice that has benefited CWT immensely, and also provides a model for other sites needing to upgrade their systems. The system is now considerably more complex, and as it develops, the site should compile an "Information Management Plan" to ensure continuity. The upgrades were about 85% complete at the time of the review.

*Website:* The website was redesigned in 2010 using a content management system (Drupal) for static content, and adapted templates for dynamic content (personnel, data and bibliographic catalogs). There is already an extensive collection of documents in an "IM Guide" designed to make the current system easy to use by data submitters. Some reviewers had problems finding some basic information pertaining to the sampling program and research projects. As they add content, the site should consider reviewing their design with user groups that include LTER-outsiders. Important links should be highlighted in lists rather than in paragraphs. There should be more prominent links to LTER Network resources and databases.

*Support of science by information management:* As part of its adoption of the GCE system, CWT also has access to a large suite of Matlab tools that it has just begun to make use of. Along with their experience adopting the GCE relational database, adoption of these Matlab tools can be a model for similar work in the rest of the network.

*Data Policies and Availability:* CWT's policies for data submission, access and sharing are well established, published, and appear to be respected. Policies are compatible with those of the network as a whole. LTER sites are required to produce datasets for a central repository in the network-adopted specification (Ecological Metadata Language, EML). Currently, CWT's contributions to Network catalogs are not synchronized with data available at the site. A critical task still to be completed is the migration of the corpus of EML-structured data into the new database, which will be followed by the re-generation of datasets for the network. The developing system is expected to automate the process of creating new datasets in the future.

It is clear that the USFS data plays an important role in supporting the LTER intellectually, and the USFS Coweeta Hydrologic Lab web site directs users to the CWT-LTER for data. However, LTER datasets appear to be co-mingled with data from the USFS, and the source of data is not clearly delineated. The reviewers felt that the catalog and data descriptions should make clearer which data products came from the LTER site, and which from the US Forest Service. Also, it is not clear which USFS data are generally and openly available, and the reviewers recommend that a policy for sharing some datasets openly be developed between the two groups.

The reviewers found it difficult to associate datasets with research activities. Given the 30 years of data collection and a large group of collaborators both current and historical, it is important to link data through the descriptions of scientific research projects and sampling. The infrastructure exists in the new database system to do this, and implementation of that part of the system should be a high priority. The incorporation of other legacy data into the system will be a major effort, and as these data are discovered and incorporated, priorities based on scientific research questions (both local or network) will need to be set to maximize the return on investment.

*Contributions to Network Activities:* Information-related contributions to the network are mainly from the information manager, who joined the Coweeta project about two years ago. His involvement to date has been as editor of the Information Management Committee Newsletter, Databits. The recent adoption of the GCE metadata system means that the Coweeta site will be well placed to participate in network-level collaborations in the future.

**Summary:** The Coweeta LTER is making good progress on research and related activities. The PIs, collaborators and students are providing strong leadership for the LTER network on the integration of social and natural sciences. There are also several areas where the program can improve. We particularly recommend that the Coweeta LTER:

- Establish stronger research linkages with the core questions and conceptual framework of the project.
- Clarify the approach for regional-scale modeling.
- Establish a leadership team that better represents the scientific scope of the project. Improve the gender diversity of the senior leadership and mentor younger scientists to facilitate smooth leadership transitions in the future.
- Establish some general structures and guidelines for decision making and membership on the executive committee.
- Foster more interaction and intellectual exchange among the graduate students from all the institutions participating in the Coweeta LTER.
- Clarify the data policies for USFS data and more clearly associate data with research activities and products.