

Engaging the Social Sciences to LTER Network-Level Science & Synthesis

Ted L. Gragson (CWT), J. Morgan Grove (BES) & Dan Childers (FCE)

Introduction

Recognizing that pristine systems are rare or non-existent and that the human footprint is global and pervasive (Vitousek et al. 1997, Grimm et al. 2000) has enormous implications for the practice of science as usual. One of the most significant is the fact that Earth systems are now changing faster than research can advance knowledge about their total functioning. That research *should* view human activities as integral to ecosystems is widely acknowledged as is the *importance* of forward-looking research on simultaneously maintaining Earth life support systems and meeting human needs (Palmer et al. 2004). Society faces numerous Grand Challenges (<http://lternet.edu/grandchallenges>), but contemporary research communities are challenged in how to organize interdisciplinary partnerships, coordinate research networks, and make information available. It is generally true that most research continues to be disciplinary in nature or integrated only in the narrow sense across closely related fields in the biophysical, social, behavioral or engineering sciences (Kinzig 2001).

The LTER Network has initiated an ambitious planning effort to address the practical challenges of confronting the Grand Challenges (Gosz et al. 2004). While the planning effort is not yet complete, it is nevertheless clear that a broad array of social sciences is critical to the future success of any plan to emerge from the process: **Without ready and open access to these social areas of expertise and practice, ecologists may not exploit the most cogent or important connections of their research** (Boynton et al. 2005). In a 2½-day workshop in Athens, GA (3-5 August, 2005) social science representatives from nearly every LTER site in the Network met to examine the current status and role of the social sciences in the LTER Network. The goal: to make recommendations for how sophisticated social science concepts and approaches can help fulfill the goal of moving LTER science to a higher level of research collaboration, synthesis and integration. Although independent from the LTER Planning Process, the Athens Workshop did take place in the context of various attempts to transform the role of humans from *drivers* to *agents*.

There are three intended audiences for this report. First and foremost are the participants in the workshop and the lead principal investigators of their sites so that they may continue to build on these results in the near future, e.g., at the 2006 All Scientists meeting. Second, the LTER Planning Process members so they have an overview of social science issues across the Network as well as a list of potential resource people to assist in developing the human dimension of the press-pulse research framework. Finally, Tom Baerwald (NSF-SBE) who funded the workshop and Henry Gholz (NSF-DEB) who directs the LTER program to provide a concrete set of recommendations and associated costs for advancing the social sciences in the LTER Network to which they can respond. The social sciences are already recognized and encouraged in the LTER Network, but long-term support is needed in order to connect biophysical patterns and processes to human agency. As ecologists discovered 25 years ago when the LTER was established, short-term funding does not yield long-term results.

Background

The first gathering of social scientists working within the LTER took place in 1998 at Madison, WI. On that occasion, it became clear that common themes and core areas existed among sites that had already begun to include social science. A social science committee was formed from this group and plans were made for a follow-up meeting. From the meeting at Madison also emerged the need to have a Social Science Committee within the structure of the LTER Network that could serve as a voice for social scientists at LTER Coordinating Committee meetings. Such a committee was formed, and since 1998 there has been at least one individual to provide a voice at CC meetings for a poorly known and highly diverse community of researchers. (A graduate student representative was added to this committee in 2004.)

In 2000, social scientists from the LTER and HERO networks met in Phoenix, AZ to develop social science core areas that would parallel and link to the LTER Network's existing biophysical core areas and to articulate a framework and strategies for interdisciplinary research. Redman et al. drafted a statement on how social sciences could be explicitly incorporated to site-based research at LTER sites. These views were later published (Redman et al. 2004) and are used to varying degrees in site-based LTER science by those individuals who originally sat at the table in Madison. Also, several successful NSF Biocomplexity grants were submitted based on the Madison and Phoenix meetings.

There have been numerous changes in the LTER Network over the last eight years that make it appropriate to reassess the role and status of the social sciences in LTER research and their contribution to the continued relevance of LTER research in the future.

- Some of the researchers who gathered at Madison in 1998 remain active, but others are no longer associated with LTER and many new researchers have since joined. However, the absence of a means to facilitate open communication and exchange information and resources between social scientists currently active in LTER research means individuals are isolated, cooperation is virtually non-existent, and research efforts are often duplicated.
- DEB and to a much lesser extent SBE now directly support social science research at several LTER sites, and increasing numbers of researchers including site principal investigators are declaring their intent to incorporate a human-dimension to their site-based research. However, ensuring the articulated potential of Network-level science and synthesis is actually realized demands the kind of sophisticated social science research that only long-term funding can provide. It cannot be achieved by the current piece-meal and ad hoc incorporation of conveniently available social science perspectives that currently prevails.
- The LTER *Decade of Synthesis* was inaugurated and premised on increased interdisciplinary research that includes social scientists, and the application of LTER knowledge to participatory and forward-looking decision-making relevant to the present and future environmental challenges faced by humanity. For the LTER Network to remain relevant in this arena results must resonate with the concerns of experts and clients. This will require developing true cause-and-effect explanations by active participation of social scientists in the design of research rather than the reliance on correlation and post-hoc explanation as is currently the norm.

The Athens workshop sought to complement the LTER Planning effort by taking a bottom-up, community-driven approach toward moving the social science dimension in the LTER from a mere committee to a true community of researchers. The objectives of the workshop were to: 1) Characterize the present state of the social sciences in the LTER Network; 2) Identify the data, methods, procedures

and knowledge necessary for Network-level interdisciplinary collaboration; and, 3) Determine strategic objectives for enabling social scientists to carry out the science and synthesis demanded and expected of them in the LTER Network.

Site Representation

The Athens workshop was first announced at the LTER Alaska CC meeting in August 2004; the formal invitation was sent to lead principal investigators at each LTER site in November 2004. LPIs were provided information on workshop objectives and logistics, and informed that funds were available for each site to send one representative of their choice. The selection of site representative was left entirely up to the site LPI and the workshop proceeded on the premise that the selected individual faithfully represented the social science interests of their site.

There were a total of 28 individuals at the Athens workshop, with 23 out of 26 LTER sites represented. The sites not represented for different reasons were Cedar Creek (CDR), Harvard Forest (HRF) and Moorea Coral Reef (MCR). In addition to site representation, there was a representative from the LTER Network office, a graduate student representative from the LTER Network Social Science Committee, and three additional LTER graduate students who participated and also transcribed the proceedings of the workshop (Appendix, Participant List).

Site Assessment

In order to provide common ground for discussion over the course of the workshop, the morning of the first day was dedicated to a) a brief history of the social sciences in LTER research, b) a summary of NEON planning efforts, and c) a summary of LTER Planning Grant efforts. This led to an initial open discussion by the participants about social science activities across the LTER Network in response to preliminary results from a 10-question survey that site representatives were asked to complete prior to their arrival in Athens (Appendix, LTER Social Science Survey). It has previously been noted (Gosz et al. 2004), although not specifically in reference to the social sciences, that disciplinary breadth and technical expertise are unevenly distributed across the LTER Network. The results of the survey reveal that the situation is even more pronounced with respect to the social sciences thus presenting a real challenge to realizing the goals envisioned in the Planning Process for the LTER of the future. The results of the survey in brief, with 19 out of 26 sites responding, reveal the following about the current situation of the social sciences across the LTER Network.

There are approximately 51 social scientists of diverse disciplinary backgrounds including urban design, environmental law, public health, geography, sociology, anthropology and economics presently distributed across the LTER Network. Eight out of 19 sites have at least one social scientist directly involved in site-level research (eight have none), and the maximum number of social scientists at any one site is 20. The current biophysical-to-social scientist ratio at sites spans from 6:1 at one site, to the more typical 20:1, to the colorfully explicit “social scientists are completely outnumbered.” These ratios belie the fact that eight sites state their site research has an explicit social science dimension, while five do not and three were uncertain.

The identified funding sources for social science research at LTER sites other than direct or supplemental LTER funds include NSF, EPA, USDA, NASA, USGS, Park Service, and USAID. The research at eleven sites has led to the compilation or actual production of core social science datasets although only five sites state these datasets are documented and publicly available. More importantly, only three sites indicated there was mutual reliance by biophysical scientists on core social science

datasets or by social scientists on core biophysical science datasets; eleven sites said there was no reliance. It is not surprising then that only three sites indicated that social scientists had a significant role in site research orientation, organization or activities; five said that social scientists had a minimal role; and seven sites said social scientists had no role at all.

Nevertheless, seven sites plan to continue their current social science research, expand it, or incorporate an explicit human dimension in their next renewal. These plans and intents are premised on a high perceived value to the reciprocal benefits of site-level integration – 10 sites articulated the ways in which ecological science improves social science and the ways in which social science improves ecological science. When asked what the ideal biophysical-to-social scientist ratio should be, it was between 5 and 10:1. The greatest perceived barriers to the entry of social scientists in LTER research were funding, cross-disciplinary communication and understanding, time, and the absence of knowledge among social scientists about LTER. The identified means for overcoming these barriers included funding, leadership, workshops and research exchange meetings, better community, and informing social scientists about the LTER.

After an open and candid discussion among workshop participants that generated numerous interesting questions, attendees were divided into three break-out groups. During the afternoon of Day 1 these groups developed matrices of site-level strengths and weaknesses or things their sites currently do well and things their sites need in order to succeed in the future. The point was to characterize the present state of social science in the LTER Network in order to discuss the establishment of future collaborations in the manner being discussed in the LTER Planning Process. Break-out groups were thus asked to assess their sites by going beyond their current needs and consider how they might design an LTER Network that met the needs and expectations of their graduate students' graduate students.

Based on this self-assessment, real social science capacity exists in the LTER today, but there are significant barriers to mobilizing this capacity to realize its potential. Most social science research is *not* carried out in the context of the current LTER structure – it is carried out through *ad hoc* informal channels of communication, in the absence of an information or data safety network, and dependent on serendipity and luck for reaching an objective. Funding that is absent or nominal, by comparison to the long-term funding for biophysical science research, is a significant barrier to social science research in the LTER. That LTER sites are in some cases directly funded or supplemented to carry out social science research is acknowledged. The point, however, is that the social sciences have not been institutionalized at any level within the LTER Network. This reflects a variety of issues including the culture of research at certain sites, the lack of participation by social scientists in site research design, the incentives and disincentives to participating in interdisciplinary research, and the general absence of core social science datasets.

Social science research, for example, is frequently conducted at sites by non-specialists. In effect, individuals carry out social science research that requires theoretical and methodological expertise that they do not have yet these same individuals would never tolerate an individual carrying out ecological research that lacked the appropriate level of expertise in biophysical theory and methods. Social science is also not monolithic, but comprises a diverse array of disciplines that have historically specialized in examining distinct aspects of the human condition. As such, there are several social science disciplines currently under-represented within the LTER Network that have obvious value to

both present and anticipated objectives. The most notably absent are psychology, sociology, and history.

Much attention has been given over the years to the compilation, consolidation and documentation of core biophysical datasets. It is now possible to unequivocally state that long-term, biophysical datasets of enormous value not only to site-level but also cross-site and Network-level science are both available and actively used. The same is not true of social science data since social science datasets significant to site-level science are largely absent. This is true regardless of whether discussing data subset by site researchers from Federal datasets or actually collected in support of site research activities. The absence of core social science datasets at the site level obviously makes impossible either cross-site or Network-level collaborations. The absence is more glaring because participants at the Athens workshop identified several social factors that required long-term monitoring in ways comparable to the monitoring of ecological factors that served as the rationale for establishing the LTER program in 1980 (Callahan 1984).

Without long-term, explicitly monitored social factors parallel to the monitoring of ecological factors it will never be possible to go beyond mere correlation to the establishment of cause-and-effect relationships. It will also not be possible to develop models to forecast future conditions in ways that substantively address commonly identified issues about the interaction between humans and biophysical systems. While LTER sites were traditionally viewed as isolated from the effects of human activities on-site or in the surrounding areas, LTER research increasingly dissolves this conceptual boundary to examine the reality of a world influenced pervasively and at so many levels by humans.

Some LTER sites now explicitly examine ecosystems that encompass both human and biophysical systems (e.g., CAP, BES, CWT, NTL, KBS), while others are interested in expanding beyond the traditional boundary because of the incongruence between understanding on-site processes by ignoring external human influences (e.g., FCE, LUQ). The purpose in all these cases is to address the numerous fundamental questions of both methodological and theoretical import implied by the LTER Grand Challenges. Some of the questions identified at the Athens workshop are:

- Is there a common resolution at which land cover is or can be described across landscapes or is it always site specific?
- Although the complex interaction between human and biophysical systems is often effectively reduced to an **IPAT** model (i.e., where Impact = Population x Affluence x Technology, Ehrlich and Holdren 1971), data typically indicate that a small fraction of events disproportionately account for the largest fraction of system response – how do we avoid letting the tail of a log-normal distribution wag the whole distribution?
- There is a large corpus of literature on the contribution of science, values and behavior to decision-making, yet measuring the effectiveness of environmental decisions is still largely based on politics rather than a combined evaluation of relevant evidence. How do we get to ‘yes’ in reaching decisions about land management? Can land managers make durable decisions? Is there a role for both social and ecological science in the decision-making process?
- The Arctic region is a sink for the combined effects of climate, industrial and land use change in the lower latitudes. What are the equity and justice issues associated with the transfer of outcomes from low to high latitude areas? On what basis can the adaptive capacity of institutions to learn and create durable agreements to compensate, mitigate, or redirect the process be evaluated or understood? Over the next 50 years, what will be the similarities and differences in

how villages around the Bonanza Creek study area in Alaska and neighborhoods in Baltimore experience global climate change? What social factors will help them be resilient to environmental change?

- The interest in ecosystem services continues to grow, but within the LTER Network, it has not yet been matched with a parallel research to address such questions as: For which ecosystem services might markets be feasible? How would such markets be designed? What policies would be needed to permit them to function? For which ecosystem services will market solutions not be feasible? What approaches other than markets can be employed in order to get more of the ecosystem services that human want? What is required to develop a socio-political consensus sufficient to change the rules and develop the incentives to meet broad societal wants for better and more sustainable ecosystem performance?

Collaborative Foundations

Based on the outcomes of the assessment of social science research, workshop participants were again divided into break-out groups for the first three quarters of Day 2. Their charge was to identify one or more questions with an explicit human dimension that might be asked either at a site-level, a cross-site level or a Network level. Once such questions had been outlined, groups were to then identify the data requirements along with standard methods and procedures to both answer the questions and ensure comparability of practice and results. The point was for break-out groups to uncover the foundational elements necessary and sufficient for interdisciplinary collaboration across the LTER Network in light of existing or anticipated disciplinary strengths and technical expertise.

Working in break-out groups meant that individuals had a limited sense of how and if there were common grounds for interdisciplinary collaboration. However, the report-out and group discussion that followed in the final quarter of Day 2 revealed a high level of consensus not only in specific objectives, but also in the means for realizing the objectives and their overall significance to both disciplinary and interdisciplinary goals. The groups identified four fundamental, cross-cutting questions:

- 1) What are the human dimensions of an LTER site?
 - What are the effects of land-use legacies on landscape patterns and processes – past, present, future?
 - How do adjacent and regional land uses influence an LTER site?
- 2) How do people and organizations influence the spatial and temporal scale of environmental conditions?
 - Which conditions do they influence?
 - Why do they influence these conditions?
 - What are the consequences of their influence?
 - How do social components contribute to the resilience of the system?
- 3) What affects the distribution of ecological goods and services across spatial and temporal scales?
 - In what quantities?
 - How are they distributed?
 - With what consequences?

4) What role does science have in environmental decision-making?

- How is community knowledge represented in LTER data?
- What happens when site-level data is applied more widely or hierarchically?
- What factors affect the development and longevity of natural resource decisions, agreements, and policy?
- What should the decision-making process be?

The exercise by individual break-out groups to identify the data required to answer these questions led to a set of 24 items (Table 1). Recognizing that there are now more than 1,000 biophysical datasets available across the LTER Network that satisfy a wide range of research needs, groups noted there was no need to list the “under control” datasets. They instead proceeded to identify (missing) core social science datasets suitable for addressing cross-cutting questions and complement existing biophysical datasets. This is obviously an important step in advancing the reciprocal benefits of site-level integration of social and biophysical science research.

Establishing these core social science datasets so they can complement existing core biophysical datasets has distinct implications from the standpoint of investments in the practice of research. Some items (e.g., house starts) already exist in the public domain in defined digital data sets, although they would need to be sub-set and organized before they were useful. Other items (e.g., deeds) exist within defined public datasets that are still seldom available in digital form; these would require substantially more effort to bring them into a useful format. Still other items exist in principle in the public domain (e.g., recreation and visitor use records), but would require negotiating with agencies such as the US Park Service or the US Forest Service responsible for amassing this information on how this information could benefit a larger community of users. Additional items (e.g., prices) can often be purchased from organizations such as Claritas, while other items (e.g., land cover) must be compiled *de novo*.

Table 1. Minimum core social science datasets required to answer cross-cutting questions.

Atlases	Infrastructure	Prices
Census/Demographics	Land Cover/Land Use	Recreation/Visitor Use
Consumption	Literature	Tax Assessments
Deeds	Management Practices	Technology
Expenditures	Maps	Values
Hazards	Open Space	Water
House Starts	Parcels/Land Owners	Zoning
Incentives/Disincentives	Policies	Ecosystem Services

With questions and data identified break-out groups then proceeded to identify distinct measures or indices (Table 2). It is not appropriate in this context to go into the theoretical underpinnings for the difference between “beliefs,” “attitudes” and “perceptions” or discuss why it is important to distinguish between “scarcity,” “sustainability” and “welfare.” However, it is important to note that this suite of measures and indices is both brief and draws on the full conceptual sophistication of the social sciences. While humans are a biological species that under certain circumstances can be analytically treated like any other organism, the imperative of understanding coupled human-natural systems requires different kinds of research.

Table 2. Measures and indices that draw from the conceptual sophistication of the social sciences.

Adaptive capacity for...	Inequality...	Subsistence of...
Attitudes toward...	Legacy of...	Sustainability of...
Beliefs about...	Movement of ...	Value of ...
Change of...	Perception of ...	Velocity of...
Culture of ...	Quantity/Quality of...	Vulnerability of
Distribution of	Relation to ...	Welfare of...
Exposure to...	Resilience/Capacity of ...	Wellbeing of...
Health of...	Scale of...	
Impact of...	Scarcity of...	
Indicators of Resilience of ...	Sensitivity to...	

It is ever more the case that environmental decision-making depends on integrating scientific understanding to a deliberative processes that ensures the science is judged both relevant to the decision and credible to the interested or affected parties (Brewer and Stern 2005). It is also the case that the information needed to influence public choices and the policy process is often inconsistent with the information provided by research and monitoring, and this may require a trade off between timeliness and certainty (Boynton et al. 2005).

The last step was for break-out groups to identify the methodological and procedural standards that would ensure comparability of practice and results in interdisciplinary collaborations (Table 3). While the need to ensure comparability may seem obvious, current practice across the LTER particularly in the social sciences makes clear that knowing better does not lead automatically to the appropriate response. As with the measures and indices identified previously, there is a wealth of social science knowledge embodied within each item listed in Table 3 that will not be discussed in this context. However, the significance of the Athens workshop was moving beyond the identification of questions to the means of answering them.

To paraphrase I. Kant, percepts without concepts are blind while concepts without percepts are empty. Any science that seeks to be relevant to decision-makers or other parties must successfully translate between concepts and percepts, and methods and procedures are central to the translation process. Confronting the practical challenges of addressing the Grand Challenges means a level of sophistication in social science concepts and approaches at least equal to the sophistication in biophysical science concepts and approaches that is simply taken for granted at this point in LTER. There is no reason to believe that all LTER sites currently need, want or are prepared to include a human dimension to their site research. It is also neither important nor viable to convince all biophysical scientists about the inherent value of social science research to the fulfillment of the LTER Network-level Science and Synthesis objectives. However, improving social science research in the LTER Network is premised on the existence and necessity of *disciplinary diversity*.

Table 3. Methods and procedures to ensure comparability of practice and results.

Methods	Procedures
Administrative Document Analysis	Classification/Typology
Community Profiling	Data Resolution
Content Analysis	Ground Truthing
Interviewing	Normalizing Measures
Literature Review	Perception
LU Impact Assessment	Quasi-Experimental Design
Observation Research	Scale Congruence
Policy Analysis	Standardized Census/Demographics
Scenario Analysis	Temporal Scaling
Survey Research	Valuation
Time Series	

Sociologists, anthropologists, political scientists, etc. do not need to know how to be better disciplinarians; they need to know what data, methods and procedures are relevant once they step away from the core of their disciplines. Improving social science research in the LTER Network is about ensuring individuals can address issues at the margins of disciplinary traditional ways of examining the world. Identifying questions is merely a step in the process of, rather than the solution to, improving social science research in the LTER Network. There is also the need to identify or formulate the tools best-suited to examining issues at the margin of tradition as well as facilitating the means for sharing widely the methods and data required for interdisciplinary collaboration.

Incubating Success

The workshop closed the morning of Day 3 with a discussion of how the social sciences can move from being a committee to being a community of researchers with common goals and accepted ways of examining the interaction of human and biophysical systems. It is important to recall that a critical observation from the site assessment was that much social science research in the LTER is *ad hoc*. The issue is how to move the social sciences from outside the sphere of explicit recognition and long-term funding where they currently reside to a position where they are full-partners with biophysical scientists and contributing their expertise to the Grand Challenges faced by humanity (Palmer et al. 2004, Boynton et al. 2005). One of the most valuable outcomes identified by participants at the Athens workshop was the opportunity to learn about what other LTER researchers at other LTER sites are doing.

While this may appear trivial this reflects that lack of institutionalization of social science research in the LTER – there is no practical nor official means by which social scientists at any LTER site can determine who is active at other sites or what the object of their research is. The lack of such means occurs at a time when the social sciences are poised to make meaningful contributions to the salient human dimensions of LTER. For example, the LTER Network could easily emerge over the next 10 years as the platform for assessing environmental justice and ecological services of urban and rural populations. To do so will necessitate moving from *recognition of* to *working with* a diversity of social scientists as well as direct investments to overcome a diverse set of barriers to their full participation in the LTER Network.

The results of the LTER Site Survey as well as the discussions at the workshop make it clear that individual researchers and groups of collaborators have been successful over the years in their requests for short-term (i.e., 3-year) funding from a variety of agencies and programs. While short-term funding is important, long-term social science questions will never be successfully addressed with short-term funding. Such research will also not satisfy the requirements of either the *Decade of Synthesis* or the Grand Challenges. Social scientists have also demonstrated that there are reciprocal benefits to site-level integration through the publications that resulted from the Madison meeting in 1998 (e.g., *Society and Natural Resources* 2006) and from other initiatives (e.g., Freudenburg 2005).

However, institutionalizing the social sciences within the LTER Network cannot be addressed by researchers simply following the traditional path to success: obtaining short-term funding to support individual research and publishing their results in disciplinary journals. Establishing a community of social science researchers entails communal resources that it is not possible to establish under the current support scenario. For example, if a group of biological investigators wished to establish a community they could draw on NSF's Research Coordination Network program for assistance with communication and coordination of research across disciplinary, organizational, institutional and geographical boundaries. There is nothing comparable for social scientists with similar ambitions.

Social scientists have made significant contributions to LTER science as professional outsiders, but moving to the level required for meeting the Grand Challenges will require direct investments that facilitate open communication and exchange of information, minimize isolation, and maximize cooperation by eliminating duplication of effort. Following are four concrete suggestions that emerged from the Athens workshop on how to begin the process.

- 1) **Establish and maintain a threaded listserv.** Enhancing communication and extending relevant expertise will go a long way to overcoming the present isolation of individual researchers and their site-based efforts. At a minimum, it will be the basis for continuing to build the social networks established at the Athens workshop. Interdisciplinary research depends on trust, and trust results from knowledge about individuals and the ideas they hold. A threaded listserv would provide the backbone for virtual meetings including a workroom for developing and making progress on common projects.
- 2) **Create a digital archive of information and data that can be queried.** There is presently no archive of well-documented, publicly-accessible, peer-reviewed core social science datasets. There is also no repository for proven survey instruments, white papers on methods and procedures, existing land-use data and models, or syllabi for courses using LTER data or relevant to training the next generation of researchers. Long-term, explicitly-collected and fully described social science data obtained by accepted methods and procedures is the only way to develop true cause-and-effect explanations for any of the various issues with a human dimension that have already been identified by both those currently active in the LTER Network or in other existing or proposed networks.

- 3) **Hold an interdisciplinary, thematic social science meeting.** While the 2006 All Scientists meeting will provide a venue for social scientists to meet again and advance the discussions of the Athens workshop, there is also the need to plan a meeting to present specific research accomplishments on topics already identified as relevant to LTER research. For example, land use/land-use change, ecosystem services, or coupled human-natural systems. Several such projects germinated at the Athens workshop and with a time-frame of 24-36 months should come to maturity. A meeting at that point would not only provide proof of the accomplishments of the Athens workshop, it would also serve to validate and refine the means to institutionalize social science research in the LTER Network to meet the Grand Challenges facing society today and into the future.

- 4) **Long-term funding opportunities for interdisciplinary science.** While social scientists active in LTER research must continue to pursue competitive, short-term funding opportunities as they have been successfully doing to date, it is imperative that long-term funding mechanisms be established to carry out interdisciplinary social science research. The prospects currently available for long-term ecological research should be available for social science research – research by design regardless of the fundamental paradigm has resource requirements that cannot be met by an *ad hoc* approach to research. It is also clear that without social expertise and practice, ecologists may never exploit the most important connections of their research (Boynton et al. 2005).

The fundamental issue standing in the way of connecting biophysical patterns and process to human agency is the lack of long-term social science funding. While different in kind and requiring distinct levels of investment, all four recommendations ultimately contribute to moving the social sciences within the LTER Network from a committee to a community. The establishment and maintenance of a threaded listserv (1) is within the purview of the LTER Network Office and could be accomplished within their current scope of work at insignificant expense or allocation of effort.

Creating a digital archive (2) is logically within the purview of the LTER Network Office as it would centralize resources for use by all sites. However, the establishment and maintenance costs of a digital archive should not be assumed without first obtaining adequate funding. A first-order estimate including personnel, data purchase costs and database establishment is \$300,000. After forwarding further details on the content and scope of this digital archive to the LTER Network Office they will be able to develop a detailed cost accounting for this project.

Holding a thematic social science meeting (3) is a concrete undertaking for which a locale and money are required. The Luquillo LTER has volunteered to host such a meeting and given the experience of similar events in the recent past \$65,000 should be sufficient to cover expenses. The All Scientists meeting in September 2006 will provide a convenient and low-cost opportunity to reconvene the participants from the Athens workshop to advance the present discussion and plan for a future meeting. As soon as a call for this meeting is issued by the

LTER Network Office then Athens workshop participants can develop a plan to attend the All Scientists meeting.

Finally, establishing long-term funding opportunities for interdisciplinary science (4) will require structural changes at various levels in the current funding mechanisms for research. Individuals must continue to take advantage of available short-term funding opportunities that often leverage LTER resources. However, it must also be recognized that until long-term base funding to specifically address the human dimensions of LTER site-based research is provided there is little hope for linking biophysical research to human agency. Base funding to support site-level social science observational and experimental research needs means an investment of \$300,000 per annum per site. Workshop participants and other LTER site personnel are ready to assist in various ways to overcome the current impediments to long-term social science funding in order to take the social sciences from recognition and encouragement to active support.

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Appendix

Participant List at the Athens Workshop August 3-5, 2005

Alber, Merryl	Georgia Coastal Ecosystems LTER (GCE)
Baker, Karen	Palmer Station LTER (PAL) & California Current Ecosystem LTER (CCE)
Boone, Christopher	Baltimore Ecosystem Study LTER (BES)
Bourgeron, Patrick	Niwot Ridge LTER (NWT)
Brokaw, Nick	Luquillo LTER (LUQ)
Childers, Dan	Florida Coastal Everglades LTER (FCE)
Cioppa, Thomas	McMurdo Dry Valleys LTER (MCM)
Devine, Meredith	Coweeta LTER (CWT), graduate student aid
Freudenburg, Bill	Santa Barbara Coastal LTER (SBC)
Gragson, Ted	Coweeta LTER (CWT), Co-Chair Social Science Committee
Grove, Morgan	Baltimore Ecosystem Study LTER (BES), Co-Chair Social Science Committee, LTER Executive Committee
Harlan, Sharon	Central Arizona Phoenix LTER (CAP)
Harrington, John	Konza LTER (KNZ)

Hudson, Marjorie	LTER Network Office (LNO)
Kofinas, Gary	Bonanza Creek LTER (BNZ) & Arctic LTER (ARC)
Kominoski, John	Coweeta LTER (CWT), graduate student aid
Newman, Peter	Shortgrass Steppe LTER (SGS)
Nowak, Peter	Northern Temperate Lakes LTER (NTL)
Ogden, Laura	Florida Coastal Everglades LTER (FCE)
Parker, John	Central Arizona Phoenix LTER (CAP)
Pennington, Deana	Sevilleta LTER (SEV)
Pontius, Gil	Plum Island Ecosystem LTER (PIE)
Schneider, Laura	Hubbard Brook LTER (HBR)
Schwartzchild, Art	Virginia Coastal Reserve LTER (VCR)
Shindler, Bruce	Andrews LTER (AND)
Skaggs, Rhonda	Jornada Basin LTER (JRN)
Swinton, Scott	Kellogg Biological Station LTER (KBS)
Witter, Rebecca	Coweeta LTER (CWT) graduate student aid

LTET Social Science Survey

1. What is the complement of social scientists and students at your site?
 - a. How many
 - b. What kind (in terms of discipline)
 - c. Are there undergraduate/graduate social science courses based on your LTER site
2. Is there an explicit social science dimension to the LTER research at your site?
 - a. Describe what it is
 - b. List representative products of this effort
3. What core social science data sets are available or have been produced at your site?
 - a. Describe these sets
 - b. Are these publicly available and documented
4. Is there mutual reliance on core data sets at your site?
 - a. What core social science data sets are used by your biophysical scientists
 - b. What core biophysical data sets are used by your social scientists
5. What is the role of social scientists at your site?
 - a. Site research orientation
 - b. Site research organization
 - c. Site research activities
6. Does your site plan to continue/expand/incorporate an explicit SS dimension in its next renewal?
 - a. Describe what this might be
 - b. What is required to succeed
7. Are there reciprocal benefits to site-level integration?
 - a. How does ecological science improve social science
 - b. How does social science improve ecological science
 - c. What is the current ratio of biophysical-to-social scientists at your site
 - d. What is the ideal ratio of biophysical-to-social scientists at an LTER site
8. Do you perceive particular barriers to the entry of social scientists:
 - a. At your LTER site
 - b. To LTER research in general
9. What would help overcome these barriers (common services and products, structural changes, etc.) to advance the current/anticipated SS dimension:
 - a. At your site
 - b. Across the network
10. What are the financial sources of funding for your social science research?