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LTER Education Strategic Plan

Executive Summary

Beginning in 1998, the Long Term Ecological Research (LTER) Network formally expanded its education efforts to include K-12 students and teachers mainly through the Schoolyard (SLTER) program funded by the National Science Foundation (NSF). Each LTER site designed its own program in relation to the ecological research conducted at the site and the particular need and resources of its local school district and community.

Starting in 2000, the LTER leadership engaged in a process of priority setting for the LTER Network and drafted the LTER 2000-2010: A Decade of Synthesis White Paper. This document included Education as one of the ways that LTER can achieve its mission of understanding long-term patterns and processes of ecological systems at multiple spatial scales.

The LTER Network Office initiated a strategic planning process for the Education component of LTER in 2002. LTER Education Representatives including teachers, graduate students and science educators met for two days in the spring of 2002 to provide input for the LTER 2000-2010 White Paper and to discuss issues, objectives and recommendations to include in a Strategic Plan for Education. During this meeting an LTER Education Committee was formed.

The plan presented below written in direct consultation with the LTER Education Committee provides a vision, mission, goals and strategies to advance the teaching and learning of long-term ecological processes at all education levels. This plan intends to serve as a guide to education activities for the LTER Network. Specific goals are:

1. Assess current education efforts (e.g. SLTER).
2. Develop a framework for LTER education that includes all education levels (K-graduate and beyond).
3. Improve the understanding and value of long-term, large-scale ecological processes by students of all levels.
4. Improve the diversity, training, and support of future generations of ecologists.
5. Develop LTER education as a model program to improve science literacy.

To move toward the achievement of these goals, the strategic plan contains a set of strategies and potential outcomes. It also proposes implementation at three levels: 1) At each individual site, 2) at the Network level; and 3) at the Network Office level.

Background

The 10-year review of the Long Term Ecological Research (LTER) program in 1991 recognized that the program not only had established a track record for excellence in research but also it had provided unique and unexpected opportunities for education. The LTER network had succeeded in training many students in ecological research in site-oriented environments with interaction and collaboration among many disciplines.

The committee that reviewed the LTER program was convinced that while the program should continue its research trajectory, there was a far broader and more important role for an LTER program. It was recommended that LTER function as a network of integrated sites and that this new Network must assume a broader role in environmental education:

“ Because the process of ecological science can best be understood by observing and participating in environmental science in action, sites like those in the LTER network have a strong potential to provide unique educational experiences. Thus, the new LTER network must assume a broader role in environmental education”.

The committee report further stated that because of the variety of ecosystems that LTER encompasses, it allows the

network the potential to serve as a test-bed for the development of curricular materials, as a learning environment for students of all levels, and as a classroom in which teachers can learn about science in ways they can transfer the knowledge to the classroom. In addition, the LTER network was the ideal vehicle for demonstrating the necessary interplay between teaching, and research. The committee asked NSF and LTER to play a larger role in K-16 environmental education...

In 1998 the Division of Environmental Biology (DEB) at the National Science Foundation, provided supplements upon request to LTER sites to expand their efforts in education. Supplements were mainly used to involve K-12 students and teachers in the study of long-term ecological processes through the Schoolyard program (SLTER). Each site designed its own program in relation to the ecological research conducted at the site and the particular needs of its local school district and community. Supplements have led to a multifaceted education and outreach program that advances science literacy. Currently, all 24 sites have used supplements to conduct Schoolyard-related education activities. More than 200 teachers and over 6,000 children have participated in the Schoolyard Program.

With a modest amount of funding, SLTER education efforts have stimulated the development of new partnerships with teachers, school districts, organizations, and business/industry. In addition, many sites have used supplements to leverage funds and grow their programs.

Starting in 2000, the LTER leadership through its Executive Committee, Coordinating Committee and Advisory Board reviewed the aims and mission of the LTER Network to establish priorities for the future. They produced a draft of the LTER 2000-2010: A Decade of Synthesis White Paper. The White Paper included Education as one of the ways that LTER can achieve its mission of understanding long-term patterns and processes of ecological systems at multiple spatial scales. The White Paper stated: "The LTER approach to research, coupled with the ability to implement long-term educational initiatives, allows for unique approaches to training of future researchers and to learning and teaching ecological concepts. Evaluating and disseminating this approach through the involvement of graduate and undergraduate students, postdoctoral and international scientists, K-12 educators and students, and the general public will help ensure the success of long-term ecology in the future."

In the spring of 2002, the LTER Network Office initiated a strategic planning process to define the objectives and to make recommendations for the Education component of LTER. The process started with a meeting of LTER education representatives at the Sevilleta LTER in New Mexico in March of 2002. Representatives from 20 of the 24 sites including K-12 teachers, graduate students and Science Education experts attended this event (Appendix A). The purpose of the meeting was to review the goals stated in the LTER White Paper Draft and to respond to these by developing LTER Education goals, specific objectives, and action plans. For two days Education representatives worked in groups to come up with issues, challenges and recommendations to include in a strategic plan for LTER education. They also provided input and comments on the White Paper that are incorporated in this document. LTER Graduate Student Representatives sent their recommendations.

Since the March meeting two related documents came out: 1) the report of the LTER Twenty-Year Review; and 2) A draft of a 10-Year Agenda for Environmental Research and Education at NSF. This document links the recommendations made during the LTER Education Representatives meetings with the relevant LTER and NSF documents to create a broad and visionary Education Plan and develops suggested action items for LTER. This plan will serve as a guide to education activities at LTER sites. Authors of the plan are well aware of the successes of individual sites and value the creative entrepreneurship of the sites, thus the intent is to guide not to prescribe. However, we expect that education activities would start functioning as a network of sites similar to the research activities. As with any strategic plan, activities will evolve. They will be reviewed and revised periodically by the Education Committee to ensure alignment with the overall mission of LTER. The Education Committee might solicit input from people at organizations with similar education-related programs.

At the March 2002 meeting, an LTER Education Committee composed of 7 members and 3 ex-officio members was formed (Appendix B). This document has been written in direct consultation with the LTER Education Committee.

Vision

To become a national model for ecological education that integrates the LTER research and findings with the teaching and learning of ecological principles and processes.

Mission

To use the uniqueness of the LTER programs and network to promote training, teaching, and learning about long-term ecological research and the earth's ecosystems.

Goals

Goal 5B of the LTER White Paper refers to the role of LTER sites in advancing the theory and practice of ecological and science education at all levels and in all areas of LTER expertise. The LTER sites and network are uniquely poised to promote education at the program, institution, state, and national levels. This work builds on, and is linked closely to LTER scientific expertise in its five core research areas and its long term, comparative approach. LTER education addresses some of the most important but vexing objectives for ecological and environmental education; that is, it uses outdoor, inquiry-based teaching and learning to build science literacy; it creates effective strategies for interdisciplinary and collaborative learning about ecology; and it teaches about local ecosystems while fostering an understanding of distant ones as well.

Objectives for the coming decade listed in the White Paper include:

1. Develop a broad vision for LTER education, and acquire the new resources for achieving it.
2. Train, mentor and support the next generation of ecologists who are equipped to conduct long-term, collaborative research to address complex ecological problems.
3. Enhance the understanding of long-term ecological study and concepts among students at the undergraduate and graduate levels.
4. Integrate our core content areas and approaches into education reform at the K-12 levels.
5. Form partnerships with education institutions, programs, and professionals to infuse long-term ecological study, key concepts and research approaches into education activities and initiatives.
6. Develop models and resources for teaching and learning that are well documented and assessed, and then disseminate these broadly.
7. Build our knowledge of how people learn about long-term ecological processes and the earth's ecosystems.
8. Continue to use the important supplemental SLTER funding to support educational activities that build on the unique educational opportunities of the LTER program.

Taking into account the documents mentioned above and the discussion at the Education Representatives meeting, the LTER Education Committee has identified five main goals for Education (in priority order) that will support the LTER Mission:

1. Assess current education efforts (e.g. SLTER, REU).
2. Develop a visionary framework for LTER education that includes all education levels (K-graduate and beyond).
3. Improve the understanding and value of long-term, large-scale ecological processes by students of all levels.
4. Improve the diversity, training, and support of future generations of ecologists.
5. Develop LTER education as a model program to improve science literacy.

Goal 1.

Assess current education efforts (e.g. SLTER, REU)

LTER sites provide unique opportunities to conduct long-term ecological research.

Similarly, sites also provide unique opportunities to develop evaluation strategies and/or instruments to determine how LTER funded education projects have contributed to the understanding of long-term, large-scale ecological processes.

In addition, the ongoing education efforts (e.g. SLTER, REU) would serve as test beds to answer questions related to how people learn best, which long-term ecological processes are the most misunderstood and to create innovative teaching and assessment tools to foster learning and to show that learning has taken place.

Strategies:

- Organize a workshop between LTER education coordinators and selected education evaluators to develop ways to assess LTER education activities (e.g. SLTER, REU).
- Collect, analyze and use assessment data to inform program development.
- Develop Opportunities for collaborative education research activities.

Outcomes:

- Evidence of how and why LTER education activities lead to deeper understanding of ecological processes by students involved.
- Development of LTER education activities that are informed by assessment data
- Published reports and scholarly papers about LTER educational projects
- Establishment of partnerships with cognitive scientists and science educators that capitalize on the uniqueness of the LTER networks

Goal 2.

Develop a framework for LTER education that includes all education levels (K-graduate and beyond).

LTER is uniquely positioned to develop programs that can have a significant impact on students and educators at all levels. LTER involvement in education started with the training of graduate students and participation of undergraduate students in research particularly through the REU program. It has grown to increase awareness of the importance and impact of LTER research at the K-12 level through the Schoolyard program (SLTER). SLTER site-based programs have provided rich professional development opportunities for teachers, exciting enrichment opportunities for K-12 students and the public, while also leveraging considerable resources to create sustained impact on classrooms. To capitalize on the strengths and successes of site-based program and to advance ecological literacy at all levels, LTER must focus its efforts on the creation of a seamless education continuum from K-12 to graduate education and beyond. Through coordinated efforts that involve multiple sites and multiple education levels, LTER education could develop models for inquiry based-learning for all. Education programs at LTER sites could serve to bridge the gaps currently existing in the education pipeline. For example, K-12 students involved in the Schoolyard program could be encouraged to pursue scientific careers in ecology related to LTER research, contributing to the LTER 2000-2010 goal of developing a cadre of new researchers to conduct long-term research. These efforts would also address NSF and national objectives for science education.

Strategies

- Revise draft vision statement and goals based on input from LTER scientists, staff, and students; K-12 teachers, science educators and informal science community to develop a framework for LTER education.
- Create infrastructure to support the vision and mission of LTER education (e.g. education coordinator at the Network Office, Education coordinators at each site, an Education Committee that can work together with the preparation of grants to fund cross-site multilevel education programs).
- Develop an information clearinghouse (through the Network Office) about sources of funding and facilitate the development of cross-site education initiatives.

Outcomes

- Comments and suggestions from the LTER community and the science education community will be incorporated into a comprehensive framework for education.
- LTER Network education activities are supported and coordinated to carefully document and evaluate site-based

activities and to create synergy among sites

Goal 3.

Improve the understanding and value of long-term, large-scale ecological processes by students of all levels.

Long-term ecological research requires a non-traditional approach. In addition to the practical field experience required, scientists and students become part of teams that are committed to long-term measurements and to share data. This approach to research linked with long-term education initiatives allows for unique ways to training ecologists for the 21st century and to teaching and learning ecological concepts. As recommended by LTER review committees, it is important to integrate this approach across the network of sites including international networks.

Strategies

- Develop/disseminate instructional materials using LTER research and data for K-12 students & teachers, undergraduates, and the public.
- Organize annual meetings of education representatives to develop network-wide instructional and outreach materials development projects (e.g. fact sheets, classroom activities)
- Organize workshops at LTER All Scientists Meetings and at Ecological Society of America's meetings to interact with LTER PIs on ways to integrate research with education at LTER sites.
- Develop online ecology courses for undergraduate faculty emphasizing LTER core areas of research. These courses could be linked with the Teaching Issues in Environmental
- Establish a clearinghouse at the Network Office for the dissemination of LTER education and outreach materials.

Outcomes

- LTER materials/activities that can be readily integrated into K-12 science, math and other existing benchmarks; instructional materials available for higher education faculty to incorporate into lab exercises and lecture/discussion materials; and fact sheets available to the public about LTER research and data (e.g. biomes, global change, biocomplexity).

Goal 4.

Improve the diversity, training, and support of future generations of ecologists.

Increased participation in ecology and environmental sciences by members of underrepresented groups is imperative to achieving NSF's environmental research and education agenda. According to documents published by the NSF and the Ecological Society of America, participation by African Americans, Hispanics and Native Americans in Ecological and Environmental careers is extremely low. Yet, some LTER sites are uniquely positioned to bring these groups into the field. For example, LTER sites located on the Southwest and Florida have the potential of attracting Hispanics and Native Americans, Sites in the Southeast can attract African Americans, and sites in Alaska can involve Alaskan Natives.

Attracting and retaining students from underrepresented groups requires long-term and sustained commitment. LTER provides unique environments to bring students to the field to learn about long-term ecological processes. This is especially important for students in urban sites and for those students who haven't had field exposure. LTER can take a lead on promoting Ecology and Long-Term Research as a career option. One way to start is by having underrepresented students participate in the Schoolyard and REU programs and have them linked with mentors early on in their studies.

Strategies:

- Develop a Network wide effort to recruit and prepare students from underrepresented groups for careers in

- ecological research and education. Include faculty and students from Community Colleges.
- Partner with organizations involved in increasing diversity in sciences (e.g. SACNAS, AISES, ESA, NAAEE, Sigma-I) to attract students underrepresented in sciences to the field of ecology.
 - Develop education proposals for network-wide activities that would prepare students for 21st century biology (e.g. IGERT, GK-12).
 - Create mechanisms to prepare graduate students to serve as mentors to undergraduate students and to connect them with K-12 teachers and students to promote the understanding of long-term ecological research and to encourage young students to pursue careers in ecology.

Outcomes:

- Enrichment programs for K-16 students that provide hands-on experiences and opportunities to learn environmental science and conduct ecological research through LTER education.
- Diverse workforce trained to conduct field-oriented, long-term, multidisciplinary research.

Goal 5.

Develop LTER education activities as a model program to improve science literacy. Because of the diverse approaches to education at sites (e.g. instructional materials development, professional development, REU, GK-12, informal science) and the range of constituents (urban, rural, agricultural, etc.), we have a unique opportunity, collectively as a network to construct a very robust education model. We are just beginning to understand the success of educational programs at the site level. By focusing on LTER education as a model program, we will need to document what has worked at the site level, create strategies for dissemination, adaptation, replication, and assessment across the network .

The interaction of at least six components of LTER education enhance student learning:

1. **Use of inquiry-based teaching and learning:** students learn how science is done by actively participating in it. They ask questions, form hypotheses, design studies, collect and analyze data, and communicate their findings to others. This model corresponds with the National Science Education Standards' "Science as Inquiry" components.
2. **Focus on the interdisciplinary nature of the research:** Scientists from many disciplines interact through the LTER program. This interdisciplinary focus is mirrored in the LTER education programs. This allows the programs to simultaneously fulfill the National Science Education Standards and it gives students a better appreciation of the complex, exciting interactions taking place in the Earth's ecosystems.
3. **Incorporation of up-to-date scientific information within instruction:** Much of the scientific information in textbooks is outdated. It takes a long time for the latest discoveries to get from peer-review journals to new textbooks, especially K-12 level textbooks that often go through a lengthy delay before being adopted by the school districts. The LTER program circumvents these delays by bringing the latest scientific information to students.
4. **Emphasis on the value of long-term, large-scale research:** Few ecological education programs emphasize the value of and the results from long-term, large-scale ecological research.
5. **Supplement locally relevant topics with broad-scale connection to other sites:** LTER sites produce information that is relevant to students living in that region. The network of LTER sites can supplement this local information with broad-scale patterns and comparisons between ecosystems.
6. **Build partnerships among students and scientists:** Through LTER education programs, students form relationships with scientists. This often eliminates students' stereotypes of what scientists look like and what scientists do, allowing many students to consider science as a career option.

Strategies:

- Create partnerships with national and international environmental education programs for adaptation and dissemination. For example, partner with organizations that share LTER goals and have education-related programs (e.g. NBII, OBFS, GLOBE, NAAEE)

- Align LTER science activities and materials with National Science Education standards. Organize a workshop to produce a guide.

Outcomes:

- LTER education materials and activities are replicated, adapted, and assessed with partners.

Implementation

The proposed plan requires implementation at three levels: 1) At each individual site, 2) at the Network level; and 3) at the Network Office level.

Site Level:

- Additional funding is necessary to achieve the educational goals of sites.
- Each site should be encouraged to pursue external funding to build existing programs.
- An education liaison at each site is necessary to coordinate activities, to develop common goals between teachers and scientists.

Network Level:

- Pool resources to develop a cost-effective suite of modular “suitcase” education programs that can be implemented by a group of sites across the network.
- Pool resources to develop education assessment strategies.
- Establish and sustain a relationship with the LTER Coordinating Committee

Network Office:

- Hire an education coordinator to coordinate education activities among sites, to develop an approach towards evaluation of current programs, and to work with sites in the development of network wide education programs. This person would have appropriate credentials in science education and should visit sites regularly.
- Sponsor and organize workshops to develop and coordinate successful programs and education activities.
- Provide information to individual sites about funding opportunities for education

Appendix A

Participants at the LTER Education Representatives Meeting

Appendix B

LTER Education Committee Members