



Response of the Long Term Ecological Research Network to the Report of the Fourth Decadal Review Committee

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Compiled by the LTER Executive Board on behalf of the
LTER Network

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Introduction

The review of the Long Term Ecological Network completed in 2022 by the Decadal Review Committee (DRC) represents a great commitment of time, effort, and thought on the part of the committee members and their NSF managers. The LTER Science Council—and, indeed, the whole LTER Network—deeply appreciates their work to understand the culture, assets, and scientific contributions of the Network, as well as the recommendations for continued improvement contained in the [decadal review report \(NSF #22200\)](#).

Our dominant response to the DRC report is that we are gratified by the positive outcome of the review. The DRC report states that “After more than 40 years of sustained support from NSF, the Long Term Ecological Research (LTER) program has become one of the most highly regarded and successful programs in Ecology. The value of LTER science, education, and outreach continues to increase and strengthen through time. Numerous metrics reflect the quality of the program and its value to the field of ecology: an accelerating number of high-quality peer-reviewed publications, increasingly leveraged external funding, and an excellent track record of training the next generation of ecologists. The program has risen to become a quintessential resource for ecological research and training.”

The committee also makes two compelling overarching suggestions that we look forward to addressing over the next few months and years: 1) After four decades of site-based observations, experiments and theory development, the LTER Network has a unique opportunity to project and offer solutions to human-driven alterations of ecosystems and their life-supporting functions; 2) Following decades of work the LTER Network has now established trusted and well-developed relationships with local communities – we see these relationships as having matured to the point where the Network can now make demonstrable progress toward advancing DEIJ across the Ecological and Earth Sciences. Both recommendations are consistent with the thinking within the LTER Network and we look forward to continuing to leverage LTER resources to address these challenges.

Programs focused on convergence research, the new Environmental Data Science Innovation & Inclusion Lab (ESIIL), the Dynamics of Integrated Socio-Environmental Systems (DISES) program, and the new Directorate for Technology, Innovation and Partnerships (TIP) are all aligned with promoting development of solutions to human-driven alterations of ecosystems and their life-supporting functions. We look forward to engaging with these programs. We are also excited about NSF opportunities that will help us accelerate progress toward our goals of advancing Diversity, Equity, Inclusion, and Justice (DEIJ) across the Ecological and Earth Sciences. The Decadal Review Committee also made specific insightful recommendations about core areas, synthesis activities, conceptual frameworks, information management and other topics that we look forward to addressing in collaboration with program officers and others at NSF, who have ultimate decision-making authority on these issues.

Given the scope and detail of the DRC report, the LTER Network expects to invest months, even years, in considering and addressing the review in its entirety. Our intention in this initial response is to 1) highlight areas where the LTER Network substantially agrees with the recommendations; and 2) suggest some possible paths forward for recommendations that may be more complicated or for which there may be unintended consequences. We also offer a few important clarifications where the

committee may have been working with out-of-date or incomplete information ([see Appendix 1](#)). The most important clarification is that on page 4, item 1, the DRC lauds the LTER Network's productivity, citing ">800 peer-reviewed publications and numerous graduate student theses, and offering substantial return on investment through leveraged funding." Between 2008 and 2019 (the period covered by the self-study), LTER sites actually produced nearly 8000 peer-reviewed journal articles and theses, reflecting the strong emphasis within the LTER Network on publishing our findings to advance ecological science and its application.

Rather than taking the recommendations in numerical order, we have chosen to group them into four broad categories. The relevant recommendations from the report are identified in bold text within each section.

While each of these areas clearly would benefit from increased resources, we expect LTER budgets to grow only slowly over the coming decade. Increasing effort in one area may need to come at the expense of decreased effort in another. Thus, we focused attention on actions with potentially high impact at modest cost or where tradeoffs are feasible.

Diversity, Equity, Inclusion, and Justice

The DRC appropriately called out the low level of Diversity, Equity, Inclusion, and Justice (DEIJ) in STEM as an area where the LTER Network should and can demonstrate leadership. LTER sites serve an important role in training and mentoring, as well as promotion and advancement at K-12, undergraduate, staff, graduate, postdoctoral, and faculty-equivalent levels. Because of their longevity, LTER sites can cultivate long-term relationships among individuals, with local and regional communities, and with minority-serving institutions. The LTER Network also offers organization, cohesion, and opportunities for leadership. Together, these attributes give the LTER Network the ability to reach broad and diverse audiences, achieve economies of scale, and create lasting partnerships to help advance DEIJ objectives. We agree with the DRC that the LTER Network should show leadership in this realm.

The LTER Network Office made progress on many of the activities recommended by the DRC, even as the review was underway. Prior to the societal upheavals of 2020, the LTER Network (1) elevated the LTER Network DEIJ Committee to be a representative committee (requiring representation from all sites); (2) required Synthesis Working Groups to include DEIJ plans in their proposals; (3) published a LTER Code of Conduct for the Network; (4) funded and mentored REU students to attend the All Scientists' Meeting; (5) conducted mentoring training at the 2018 All Scientists' Meeting; and (6) collected demographic information on Network participants to gauge progress.

The societal upheavals of 2020 required academic and other research institutions to take issues of DEIJ more seriously and actively work to dismantle barriers to overcoming racism and other forms of discrimination in STEM. Most LTER sites have now established internal DEIJ Committees, increased DEIJ training (with help from the LNO and their home institutions), developed codes of conduct, and improved recruitment of underrepresented minority (URM) students and scientists.

Progress toward DEIJ goals has been led and guided by the efforts of the all-volunteer, non-specialist DEIJ Committee, with support by the LTER Network Office. DEIJ Committee working groups include Community Building, Resources, Field Safety, and Fundraising. Addressing the DRC's recommendation to **“facilitate opportunities for virtual or in-person gatherings of URM graduate students, post-docs, and faculty to foster community and develop support systems within and across career stages of LTER scientists,”** the DEIJ Committee developed a Community Building seminar series, led by Professor Cristy Portales-Reyes, a former LTER graduate student. This seminar series provides a forum in which LTER scientists with underrepresented identities can find community, mentors, and other support.

In **Recommendation #9**, the DRC suggests **“adding a DEI plan requirement to the LTER program solicitation, and assessment of progress toward DEI goals as components of mid-term reviews and renewal proposals.”** NSF's draft requirement for a supplemental Field/Vessel/Aircraft Safety Plan with each proposal involving field work moves some distance in that direction. The Field Safety working group of the LTER DEIJ Committee has shared sample Field Code of Conduct plans and suggestions for supporting practices at several sites. The working group is primed to be involved in establishing best practices for the Network with respect to the new solicitation requirement. *There is concern, though, that any new requirements and assessments will require supporting resources including assistance from DEIJ professionals.*

The DRC noted that NSF's current solicitation for the LTER program does not require DEIJ plans and activities, nor do NSF reports explicitly request summaries of DEIJ activities. Understandably, sites prioritize investment of their limited resources into activities that result in products that are emphasized, evaluated, and assessed by NSF. Nevertheless, most sites report DEIJ-related activities in other sections of NSF reports including opportunities for training and professional development, impact on the development of human resources, impact on teaching and educational experiences, impact on society beyond science and technology, and even in the reporting of scientific progress where DEIJ efforts have made an impact.

Reaction to **Recommendation #8**, **“...that LTER conduct a top-to-bottom network review of efforts toward DEI”** was mixed, with many investigators and DEIJ committee members holding the view that more progress might be made more quickly by addressing some already-obvious next steps.

In addition to the actions suggested above, the level of leadership envisioned by the DRC would require additional attention to assessing the climate for inclusion at LTER sites (planned for 2023), developing site and Network-level DEIJ strategies, accessing and employing additional expertise in engaging URM communities, and finding ways to involve (and compensate) senior researchers and PIs with diverse identities. The LTER Network is seeking leveraged funds to accomplish these goals.

Leveraging DEIJ Resources

LTER sites, investigators, and staff members can and do compete for NSF funding to advance DEIJ initiatives, as recommended by the DRC. Opportunities that are particularly well-aligned with LTER strengths include: REU Sites, NSF Postdoctoral Fellowship in Biology, and Research Experience for Post-Baccalaureate Students (REPS) supplements. In addition, the DEIJ Fundraising working group

continues to evaluate several opportunities for NSF funding, including the Research and Mentoring for Post-baccalaureates in Biological Sciences RFP that would develop a cohort of young professionals from URM groups who would receive targeted mentoring and professional development.

Although some sites have successfully included dedicated funding for DEIJ activities and personnel in core site proposals, specific funding and/or guidance from the NSF related to using NSF resources to support DEIJ activities could accelerate progress. Unlike other LTER Network-wide committees, the DEIJ committee is composed entirely of volunteers without specialized training. Dedicated support for professional DEIJ guidance and coordination at the LTER Network Office (LNO) could leverage the committee's energy and commitment to accelerate meaningful progress.

Successes and Challenges with Advancing Diversity at More Senior Levels

We note the DRC's emphasis on advancing diversity at more senior levels ("**Now is the time for expanded efforts to increase representation by these communities at the graduate student, post-doc, staff, and PI levels**"), with specific recommendations such as "recruiting and supporting more early-career scientists through new or existing graduate and postdoctoral fellowships that specifically target URMs". We agree that advancing diversity at these levels is of utmost importance. Concomitantly, we recognize that LTER sites are not departments and do not hire faculty or admit graduate students.

Leadership at LTER sites can (and many do) actively prioritize relationships with investigators from historically excluded groups and recruit new URM scientists to join their teams, with the added benefit that this emphasis on increasing diversity often also increases diversity in scientific expertise at a site. A number of sites have also had success at building relationships with Historically Black Colleges and Universities (HBCUs) and Tribal Colleges, partly through LTER supplemental support for Research Opportunity Awards. However, these are primarily teaching institutions where faculty may have limited latitude to pursue their own research interests, so participation needs to be carefully calibrated so that it can be sustained over time.

Potential Approaches

- The LNO can continue to work closely with the LTER Network DEIJ Committee to align activities with the recommendations of the DRC, by reviewing current activities and identifying priorities that are feasible with available resources. Specifically, the Network can:
 - Consider potential sources of support for external professional assistance at the LNO to evaluate the state of DEIJ in LTER (top-to-bottom review) and to help the Network develop authentic metrics and goals.
 - Facilitate internal and external review of site DEIJ plans and progress to goals, codes of conduct, land acknowledgement statements (where appropriate), integration of DEIJ into site management and research, administrative challenges, and representation across career stages.
 - Communicate and coordinate opportunities for LTER site- or Network-level funding to meet DEIJ goals.

- Amass resources for advertising, recruiting, and mentoring URMs at higher levels, such as UC Presidential Postdocs, URM Postdoc, NSF INCLUDES, NSF ADVANCE, NSF BIO-LEAPS.
- Continue to offer DEIJ trainings at the Network level, dependent on available resources.
- In addition, the LTER Executive Board and site PIs can demonstrate leadership by:
 - Involving themselves more in DEIJ efforts at the Network level. Greater PI involvement would send a strong message regarding the importance of the issue.
 - Considering establishing a Network-wide near-peer mentoring community for early career scientists, including participation in Inclusive Graduate Education Network (IGEN) and the Early Career Mentoring program of the Ecological Society of America.
 - Requesting that NSF work to align DEIJ expectations across solicitation, reporting, and mid-term site reviews commensurate with supporting resources.
 - Strengthening connections with researchers and communities that share interests in the human dimensions of long-term ecological change. This step would not only address the DRC recommendation that LTER increase engagement in solutions-oriented science but may also advance diversity at senior levels by connecting with more diverse communities in the environmental, engineering, and social science disciplines.

Synthesis

Synthesis activities are ideally suited for advancing theory and solving problems in the ecological sciences—and the DRC notes that the LTER Network has distinct potential for synthesis through cross-ecosystem comparisons. Indeed, synthesis has been an important way for the LTER community to openly and fluidly engage with researchers in the broader ecological and Earth science communities, with no institutional boundaries and involving scientists at all career stages and institutional affiliations.

At the same time, we recognize that the path from data to knowledge to sense-making may involve some detours and blind alleys and thus may not be as quick and direct as may be portrayed by some champions of the ‘big data’ often required by synthesis efforts. To make headway, LNO-funded synthesis working groups often rely on uncompensated labor to accomplish their goals, given that sites are funded individually and LNO synthesis funding only covers meeting costs (travel, lodging, per diem) and publication charges. As noted in the clarification section of this report (see Appendix 1), synthesis projects supported through the LNO have gathered momentum and have catalyzed and provided best practices for further synthesis. The LTER Network is especially eager to continue to support for early and mid-career scientists who take on leadership roles in synthesis proposals and activities.

Diversifying Approaches to Synthesis

We support **recommendation #2: “experimenting with new approaches for catalyzing and funding syntheses of LTER data beyond the LNO organized SWGs”** and agree with the logic behind **recommendation #1**, which suggests **extending the length of LTER Network Office funded working groups to three years**. Most working groups currently extend beyond the planned 2-year timeline, as long as they remain within the established budget. In addition to the bottom-up syntheses

from within and beyond the LTER community supported through the LNO RFP process, the LTER Network has led synthesis efforts that are initiated and supported in a variety of ways, including:

- NSF-funded syntheses, such as those incorporated into Coastal SEES, Coupled-Natural and Human Systems, and Research Coordination Network awards
- Place-based syntheses, as represented by the [LTER synthesis book series](#)
- Data harmonization and synthesis efforts led by LTER and EDI information managers such as:
 - The **EcoComDP** project which has generated harmonized versions of over 70 community ecology and diversity datasets from LTER sites and the NEON network. These data are searchable and can be readily aggregated using an open-source R package.
 - The **HyMetDP** project, a revived effort to produce harmonized meteorological and hydrological datasets for LTER sites and collaborators such as the USFS and USGS.
- Issue-focused products such as the [Anthropause paper](#), the [Synthesis of Everglades Research and Ecosystem Services](#) in *Restoration Ecology*, or the [Drylands special issue](#) of *Frontiers in Ecology and the Environment* and resulting from deliberate synthesis efforts of the LTER Network Science Council, such as the [Forecasting Earth's Ecosystems with Long-Term Ecological Research](#) Collection in *Ecosphere* and the [Effects of Climate Change Across Ecosystems](#) special issue in *BioScience* (August 2022).

Coordinated experiments, such as those begun at LTER sites in the 1990s or those at Long Term Agroecosystem Research (LTAR) sites, offer substantial promise for comparing the responses of diverse ecosystems to similar stimuli—yet the model of funding each site entirely independently makes it difficult to build such experiments into base LTER funding and to plan for their long term maintenance. We look forward to working with NSF and other possible funders to expand financial support for the many varieties of multi-site experimentation and synthesis that are already underway.

Synthesis and Core Areas

The LTER Network will seriously consider **Recommendation 4: “We recommend modifying the five core areas framework toward a model that retains the high quality, site-specific research that is the hallmark of LTER science, while also proactively strengthening network-level, cross-site collaborative science.”** As described above, LTER site- and Network-level synthesis has taken many different forms. In all these approaches to synthesis, the LTER core areas and associated data have provided a broad foundation for comparable datasets, measured using similar methods across the LTER Network’s diverse ecosystems.

The LTER core areas (five for all LTER sites plus land cover/land use change and human-environment interactions for urban and agriculture-influenced LTER sites) have a history that emerged from the planning of the original LTER program in the 1970s and the desire for cross-site data comparisons. The LTER core areas themselves are intentionally broad, flexible, and inclusive of fundamental categories of data that ecologists and social scientists consider important when testing questions and conducting long term research at the ecosystem scale.

We appreciate the guidance (**Recommendation 4**) from the **ILTER Decadal Review Committee to approach the LTER core areas/data with flexibility and strategy**, so as to both best serve the science questions of each LTER site and enhance synthesis in an inclusive way at a Network-wide scale. We see tremendous value in maintaining core, yet broad and flexible, categories of data that individual LTER sites contribute to at both the site and Network levels. LTER core areas help ensure consistency and stability to the long-term observations made across the Network. They facilitate integration necessary to address ecosystem-scale questions while also enabling cross-site synthesis. We are concerned that changing the core areas to be somewhat ephemeral relative to the four decades of the LTER program or following a pick-and-choose or thematic approach that changed from one funding cycle to the next could place the long term coherence of the LTER program at risk.

The collection of data in the core areas with methods appropriate to a given site has been foundational for many syntheses—both those that are across LTER sites and also for regional syntheses, for which the LTER datasets may be the longest and the most robust in terms of data quality. Nonetheless, there are a few specific issues with the LTER core areas that merit clarification. The first is that, as the DRC identified, some of the core areas are less applicable, and difficult to incorporate into the research program, at particular sites (such as primary production at urban LTERs). Fortunately, NSF review as currently applied, allows great flexibility for the balance of effort among core areas and we support continuing that approach.

The second issue is that many sites engage in long-term research and data collection activities that do not clearly fall under any of the core areas or that core areas are not yet consistently applied when tagging or categorizing research products. “Disturbance,” in particular, is a potentially very broad and expanding area that could include global climate change or human-mediated consequences of climate change, such as wildfire, flood, drought, heat waves, and sea level rise, all relevant to the human-environment interaction emphasis described below. A better remedy than wholesale revision of the core area concept might be renewed attention to consistent categorization and tagging of research products in the Network.

Following the recommendations of the Third Decadal Review Committee, the LTER Network built a data repository for all environmental data (Environmental Data Initiative, EDI), including long-term datasets from the LTER Network. This decision has been revolutionary for the LTER Network and for the broader environmental and social science communities. The outcomes of such synthesis are difficult to track and quantify largely because citation of datasets is a quite recent phenomenon (e.g., only in 2020 did many journals begin requiring that data be published at the time manuscripts are published). In an early analysis of such formal data citations (~3000) in ~1600 publications we found 250 publications using 3 or more LTER datasets, and 20 publications that use data from more than one LTER site). As data citation improves, tracking the use of LTER core area data will improve. Coupling improved tracking of how LTER core areas are used in synthesis with more consistent tagging of research products, we could begin to truly quantify the impact of LTER core datasets in supporting synthesis within and beyond the LTER Network.

Promoting Synthesis Products

Recommendation #3 is to “**further advance synthesis activities by broadly communicating (e.g., through social media and other outlets) the availability of its synthesis-ready datasets and analytical tools as they are published.**” The Network promotes synthesis-ready datasets and tools on [social media](#), at [scientific meetings](#), via regular webinars, and on [the website](#). Workshops and symposia on using synthesis-ready data (such as EcoComDP) have been held at many scientific meetings in the past few years and formed a major thread at the 2022 ESA and LTER All Scientists’ Meetings. Finding the specific audiences most likely to be interested in using particular tools and datasets can be challenging, so coaching and working with researchers on outreach plans may be the most effective approach.

Clarifying Responsibilities

Synthesis cannot proceed effectively without findable, accessible, interoperable, and reusable data, and **recommendation 11 (“that LTER and EDI continue to work on making synthesized and synthesizable data more FAIR”)** echoes the strong desire of the LTER Network to produce such data. In fact, since the finalization of the DRC report, EDI has released at least two major new tools to support the curation of FAIR data and has engaged in analyzing FAIR compliance in its body of metadata. [ezEML](#) makes the preparation and publishing of machine-readable metadata much simpler and more directly accessible to data producers and the [EDI Data Explorer](#) (DEX) allows online exploration and visualization of datasets without the need for downloads.

In addition, the LTER Network’s 27 site Information Managers (IMs), in coordination with site PIs, could have a larger role in Network synthesis efforts, including LNO SWGs. If contributions to Network-level synthesis efforts were considered a part of Information Managers’ normal roles, LTER could leverage considerable IM expertise and site-based knowledge towards producing synthesized and synthesizable data.

Recommendation 10 suggests “**that as a unified body, the stakeholders of LTER data management (LTER site PIs, IMs, LTER researchers, and EDI) clarify the mission, vision, and roles of stakeholders in data management for the network.**” LTER information management and EDI together have succeeded in making the vast majority of Network data findable and accessible. Aligning LTER data to be interoperable and reusable requires participation of investigators alongside information managers. It requires strategic thinking about how data will interface with other data from the outset, before the first sample is even collected. This is a challenging undertaking in the context of a network where sites are funded and reviewed as independent projects, but establishing the balance between independence and cooperation will contribute to the continued vitality and productivity of the LTER Network.

Recommendation 10 should also include another important stakeholder: The National Science Foundation. The nature of the LTER review process limits the degree to which sites can align data collection efforts at the planning stages and EDI has little latitude to tailor its mission to the LTER Network. EDI endeavors to serve the needs of the LTER Network, while at the same time serving other environmental data producers, and its funding (and therefore its mission) is entirely dependent on the outcome of a panel convened in the Division of Biological Infrastructure. After the DRC report was

published, a member of the NSF LTER Working Group was assigned to help oversee EDI's funding, but the stability of the repository continues to depend on 3-year funding cycles in a different program.

Potential approaches to improving synthesis:

- *Synthesis through Network meetings.* The LTER All Scientists' Meetings have been successful at engaging diverse teams of scholars from different career stages and types of institutions (academic and non-academic) in synthesis. Continuing this model seems both tractable and productive, especially if more support for post-ASM follow-up workshops is available.
- *Synthesis through teaching.* Syntheses could occur through expanded use of LTER data in the classroom (e.g., Macrosystems Project EDDIE, Iterdatasampler R package).
- *Synthesis through data science training.* Training students and postdocs on data science techniques that integrate disparate and complex datasets is critically needed. Students and post-docs are often key generators of long-term datasets and can tie together general ecological concepts and data in novel ways. Providing additional training on big data organization and analysis may require substantial external support but could leverage the knowledge and capacity of the LTER IM community.
- *Synthesis through data-tagging/archiving:* Syntheses often generate secondary combined datasets that can stimulate and facilitate additional analyses. Linking existing datasets with synthesis publications is labor-intensive but can illuminate insights gained through synthesis while establishing a precedent for tracking synthesis products. A recent comprehensive assessment of LTER core areas/data use, based on downloads and available data citations, showed that data use is evenly distributed across core areas, but that long-term observation datasets (>10 years) are used proportionately far more than shorter-term observations.
- *Cross-site experiments:* Coordinated experiments could be proposed to supplement individual site funding as long as it didn't compromise the capacity of individual sites to maintain major manipulative experiments.

Human-environment interactions

This section addresses **Recommendation 5**, calling for “**modifying the LTER program solicitation to ask all sites to explicitly address human-ecological interactions**” and **Recommendation 12** that calls on the LTER Network to “**address the challenge of global change by expecting and supporting research to meet NSF’s stated goals of both understanding past ecosystem changes and anticipating future ecosystem changes and their consequences.**” The Fourth DRC report makes a strong case that LTER sites and the Network should take on the immediate and future challenges of global change, acknowledging that these changes are largely anthropogenic.

The DRC suggests that LTER sites should explicitly address human-environment interactions with the aim of making LTER science more action oriented and societally relevant. There is some history here, dating back to the [Integrated Science for Society and the Environment \(ISSE\)](#) report that was written by the Network Planning Committee 15 years ago. While many sites adopted the ISSE framework in subsequent proposals, several sites had reservations about requiring social-ecological research in LTER science. A lot has changed since then, both in the biosphere and in the LTER Network. Today, it

is far easier to envision most LTER sites including a future-looking strategy in their research portfolios that is based on a solid interdisciplinary understanding of human-environment interactions and feedbacks at many different scales that occur in their system. *The LTER Network supports these recommendations with the caveat that sites be given the flexibility to determine how they study human interactions and feedbacks.*

The LTER Network has the capacity to contribute more substantially to transformative solutions for a more sustainable and resilient future for the entire biosphere—in the NSF parlance this is convergence science. For this to be possible, however, there must be strong leadership by the NSF to encourage interdisciplinary and transdisciplinary research being conducted at LTER sites. This inter- and transdisciplinary push could include an additional approach by the NSF to help LTER science be as societally relevant as possible in the next decade. By way of example, urban ecology has begun to move beyond social-ecological systems (SES) approaches by acknowledging the primacy of technology and the built environment in urban ecosystems. This social-ecological-technological systems (SETS) approach enables a fully integrated, multi-faceted approach to understanding how urban systems function and how they may be better designed, built, and managed for a more resilient and sustainable future. The urban LTER sites could be encouraged to take on such a SETS approach, but a SETS approach may also be both viable and desirable for other sites where human actions and technology play a significant role in system dynamics.

Potential approaches to integrating human-environment interactions

- In response to Recommendation 5, the LTER Network encourages NSF leadership to communicate more directly its support for interdisciplinary and transdisciplinary science. This should happen in internal NSF discussions about the future of LTER, in communications with the Network, and in future solicitations for renewals and new sites.
- In response to Recommendation 12, the LTER Network recommends that the LTER Working Group reach out to the Engineering (ENG) and Technology, Innovation, and Partnerships (TIP) directorates at NSF and invite them to partner with and “buy into” the LTER Program in a manner aligned with their programs. One approach would be for ENG to support 1-2 new LTER sites to address environmental engineering challenges that have a strong basis in ecological processes, such as harmful algal blooms and wildfire impacts. Another complementary approach would be an annual contribution to the LTER budget by ENG and/or TIP to support a funding augmentation competition where sites could propose to expand social-ecological science. The precedent to this is when the NSF increased base support for the Coweeta and North Temperate Lakes sites in the 1990s after a "regionalization" augmentation competition.

Education and Outreach

The DRC emphasized the extraordinary opportunity presented by site and Network longevity in the areas of education, community outreach, and engagement. **Recommendation 6** called for **strengthening the experience of LTER REU students to focus on the student experience, including strengthening cohort and networking opportunities for REU students across sites and mentor training.** The LTER Network is already taking steps in this direction. Working with the LNO, a

small group of REU coordinators organized cross-network REU webinars in the past three summers. The LNO also supported training of 5 individuals as “Entering Mentoring” facilitators, with the goal of sustaining a critical mass of mentoring facilitators.

Education and Outreach Coordinators collaborate extensively at monthly online meetings to great benefit. We are, thus, a bit confused by **recommendation 7**, that “**sites develop opportunities for networking among EO coordinators.**” Perhaps the DRC is referencing individual site-to-site staff exchanges, which have been valuable when they occasionally happen among sites with available resources. The assumption—that all sites could support such exchanges—reflects a common misunderstanding about LTER sites. There is tremendous disparity in the ability of sites to leverage institutional and other external funds. Sites embedded in large field stations and institutions may have considerable infrastructure and resources on which to draw. In contrast, sites based at soft-money institutions or small field stations have little to no “cushion” for activities that don’t immediately contribute to measurable scientific or educational production.

Sites and individual network members continue to pursue resources from outside the LTER program to support cross-site REU, RET, and engagement activities with some marked successes. In 2022 new funding from the NSF BIORET program will support a [cross-site research experience for teachers project](#). A [research-in-service-to-practice project](#) focused on community engagement was also funded by NSF’s Advancing Informal Science Learning program.

Potential approaches to education and outreach recommendations:

- The concept of a coordinated REU program perennially attracts strong interest, ideas, and energy. Opportunities to expand student exchanges would be welcomed by the LTER Network. In addition, the Network would enthusiastically embrace “Entering Mentoring” facilitation training at a larger scale if funding can be identified.

Appendix 1

Major Points of Clarification

In any effort of such broad scope, a few inaccuracies are bound to occur. In general, they do not alter the interpretation or conclusions of the report, but a few seemed substantial enough to warrant correction.

On page 4, item 1, under strengths, the DRC lauds the LTER Network's productivity, citing ">800 peer-reviewed publications and numerous graduate student theses, and offering substantial return on investment through leveraged funding." Between 2008 and 2019 (the period covered by the self-study), LTER sites actually produced **nearly 8000** peer-reviewed journal articles and theses.

On page 16, under the heading "LNO and Synthesis Working Groups (SWGs), the report states: "Products so far include three published journal articles that present cross-site syntheses of ..." To avoid the impression that the SWGs only produced three published journal articles at the time of the review, we note that 15 published works were listed under [synthesis products](#) in December 2020 and that there are now 32 papers resulting from LNO synthesis funding since 2015.

On page 13, the report states: "In 2019, the LNO was relocated to UCSB to be managed as part of the National Center for Ecological Analysis and Synthesis (NCEAS), under the leadership of Dr. Frank Davis and Director Marty Downs." The Network Communications Office and the LTER Network Office, which serve essentially the same function, actually moved to UCSB in 2015 under the directorship of Frank Davis. In 2019 Marty Downs became Director and Frank Davis became Executive Director.

On page 16, the report states: "A search for EcoTrends data via the EDI portal based on the keyword "ecotrends" (or any of the project identifiers that were originally assigned to these datasets by the LNO) only brings up three results, all of which are individual site submissions for the project." However, all [15,403 EcoTrends datasets](#) are available in EDI. Given this large number of individual datasets, the community of EDI users decided they should be excluded from general search as they would overwhelm the search results. Because funding for the EcoTrends project was not sustained, most EcoTrends datasets represent a snapshot in time that is now out of date. The other EDI datasets from which EcoTrends data were derived are now the more current data sources.