Long Term Ecological Research Network Communications Office Mid-Term Project Assessment

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Table of Contents

Introduction

NSF Solicitation 15-535 defined the role of the LTER Network Communications Office (NCO) as follows: "to foster and coordinate research, education, and outreach activities across the Network as well as facilitate Network governance" and "to promote the LTER program both nationally and internationally." The National Center for Ecological Analysis and Synthesis (NCEAS) at the University of California Santa Barbara (UCSB) was funded by NSF to establish and operate the NCO from October 1, 2015 through September 30, 2019. The Network Communications Office is located at NCEAS in downtown Santa Barbara, where it serves as a hub for the scientific synthesis, education, and outreach activities of the LTER Network.

This self-study was requested by the National Science Foundation LTER Working Group in September 2017. The assessment comes at the midpoint of the 4-year grant and summarizes NCO accomplishments and progress to date in the light of goals and objectives articulated in our original NSF proposal ("NCO proposal," hereafter).

The NCO proposal was organized into four areas: Communications and Outreach; Synthesis; Education and Training; and, Governance. We envisioned the first three areas as an integrated set of activities (Figure 1). For each of these areas, plus Governance and NCO Management, we will summarize the original goals and objectives, describe some key accomplishments to date and deviations from the original proposal, discuss any unresolved issues, and highlight possible adjustments or changes in emphasis during the final two years of the grant.
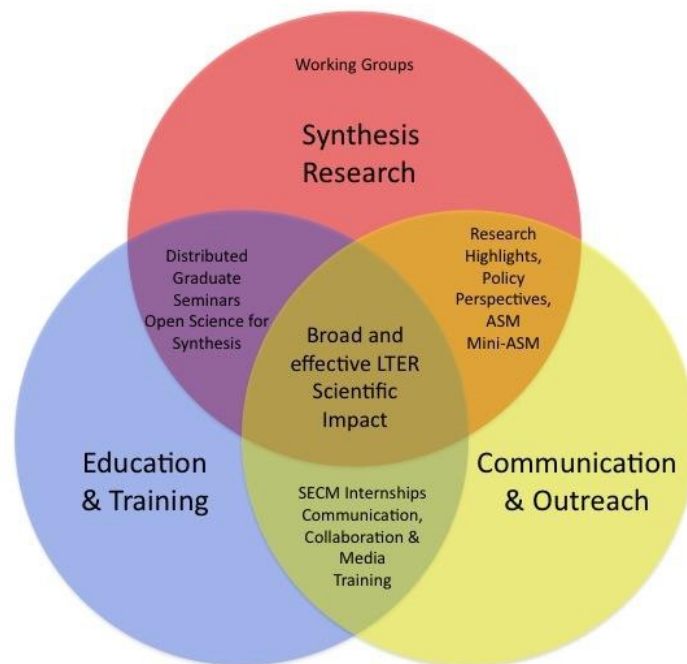

Figure 1. Activities as envisioned in the NCO proposal.

Communications and Outreach

The NCO proposal described a set of activities to establish a brand for the LTER network, highlight LTER research, foster a sense of community, increase public engagement, improve Web-based search

and discovery of LTER resources, expand LTER's social media presence, and incentivize improvements in communication and outreach efforts by individual sites. We recruited nationally for a communications professional and in January 2016 hired Marty Downs to lead this effort. Marty, who is the NCO's sole full time employee, has systematically implemented a communications and outreach program that has made significant progress towards achieving these goals.

Strengthening the LTER Brand

Activities to date that have strengthened the LTER brand include design of a new logo, design and construction of a new website (see below), design and production of a new brochure (Appendix A), and a new catalogue and website for the LTER Schoolyard Book Series.

We re-designed the LTER logo in part because University of New Mexico held a trademark on the existing logo but also because we thought a new logo could better capture the energy and mission of the LTER network. Working with a professional design firm and after extensive consultation with the LTER community, we introduced the new logo in August 2017 (Figure 2).

Figure 2. In August 2017 a new LTER network logo (right) replaced two existing logos

Shining the Spotlight on LTER

The NCO proposal identified the production of "LTER Research Highlights — multi-media productions, similar in concept to 'science spotlights' discussed in the LTER Strategic Communication Plan — that will feature selected LTER research projects and discoveries."

To that end, we created the monthly *LTER Science Update*, which provides short, accessible online articles describing recent news and publications from across the Network. The update also includes outreach to other networks including NEON, CZO, ILTER and OBFS. The first issue of the *LTER Science Update* appeared in September 2016, and as of November 2017 has 2,313 subscribers.

The NCO tracks and shares media activities at all LTER sites. For example, in 2017 alone we have recorded >200 news articles, many of which have been shared in LTER Science Updates. We work with Cheryl Dybas at the NSF Public Affairs Office to call attention to new LTER research products as well as presentations at large national scientific meetings such as ESA, AGU and ASLO.

Community Building

In the NCO proposal we planned to establish web-based research forums to foster interactive community building.

Beginning in January 2018 the NCO will sponsor a webinar series featuring the work of LTER Synthesis Working Groups (described below). These monthly, 1-hour webinars will be aimed primarily at the LTER community but we will also advertise to other audiences such as other synthesis centers and long-term research programs. Seminar speakers and titles have been scheduled through June 2018. We will evaluate the success and reach of this first series and resume after the summer field season, in September 2018.

To foster a greater sense of LTER community, we produce News from the NCO, which includes quarterly updates on LTER Network-related events, meetings, and activities. It is distributed to all LTER-associated personnel, including investigators, staff, and students, about 4 times per year.

Much of our community-building work falls under what was referred to as "governance" in the NSF solicitation. NCO staff maintains email lists and provides logistical and ZOOM videoconferencing support for the Executive Board, Education and Outreach Committee, Communications Committee, Diversity Committee and organizing committees for the annual Science Council meeting, NSF-LTER symposium and All Scientists Meeting. These activities have proven important for maintaining good lines of communication among LTER scientists engaged in different network-level activities.

We have been experimenting with several variations of collaboration tools including Slack, Trello, Github, Google Docs, and Google Sites, that can facilitate the work of committees and working groups. Different groups within the Network favor different approaches and we have not yet settled on a single "best" model. We will continue to track the use of these tools across the various groups within the network both to assist with their use and to potentially coalesce the Network around a single or smaller group of tools.

Policy and management engagement

We originally proposed to assist LTER sites to expand their capacity to utilize a 'public engagement' or 'public participation' approach to outreach and communication. We suggested that NCO staff would collaborate with interested LTER sites to develop a process for capturing stakeholder perspectives on specific resource management issues through semi-structured interviews.

Policy and management engagement activities to date have been limited. At the request of the LTER Executive Board and site PIs we re-initiated the LTER mini-symposium at NSF and hoped to use that event as a springboard to connect LTER researchers to federal stakeholders in the Washington DC area. We are in discussions with NSF program managers and staff about the desirability and feasibility of inviting external guests to the mini-symposium, as well as extending the program to include one or more events at other DC venues.

We engage regularly with the Public Affairs Office at the Ecological Society of America to bring attention to new policy-relevant LTER publications and activities. Historically, the LNO funded the American Institute of Biological Sciences (AIBS) to support LTER policy engagement activities in DC in conjunction with the mini-symposium. We do not have funds in our budget to continue this relationship.

Other policy and management activities are relatively ad hoc, usually in response to a request from the community. Looking forward, we hope to get a clearer sense of NSF's expectations regarding NCO support for LTER public engagement activities, and develop a limited set of targeted efforts in this area, likely relying on partnerships to meet these objectives.

Online Discovery, Search and Browse

A significant amount of time and effort has gone into creating and implementing a new LTER Network website[1]. Creating a website that is current in both look/feel and backend software required a complete site redesign and restructuring. Our first step was to systematically review legacy LTER Network Office (LNO) web domains and websites in terms of intended audiences, design, content, content management system and functionality. The legacy lternet.edu web environment was content-rich but distributed across multiple sites in different content management systems and dependent on several outdated databases (e.g. Personnel.db and Site.db) that proved difficult to maintain under the current

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[1] Please view the new site in progress at https://lter.ndic.com. user login: dev and passwd: ndicdev

organizational structure (NCO + EDI). Importantly, the new website can be maintained and updated without significant scripting and database skills.

Creation of the new website had four primary goals:

- Make content easier to find
- Make content easier to update
- Align content with core LTER audiences
- Increase the website's visual appeal

The new website, which has been designed in consultation with [New Directions in Computing](#) in Santa Barbara, will go live in in early January 2017, after major LTER committees have had an opportunity to review the site and usability testing has been completed.

 Key features of the new website include:

- Front page slider with easily selectable current news items
- Dynamic map of sites
- Event calendar with easy download to common calendar formats
- Blog-style posting of news items - with tagging by LTER site, thematic area, and audience - using controlled vocabularies to allow improved content automation
- Identity management and directory (including ORCIDs) for ~2800 researchers from multiple institutions, searchable by site affiliation, site role, network role, and partial names
- Easy form-based submission of site news, opportunities, and upcoming events
- Integrated image gallery, with user upload capability and associated caption and credit information
- Integrated and reorganized document archive
- Improved social media integration and content sharing
- Adjustable content workflow and queuing, allowing direct access by NCO interns and LTER Site web managers, without putting unrelated content at risk

A possible second phase would include an expanded, controlled-access intranet, allowing committees to better manage private agenda- and document-sharing and a bibliography integrated with modern reference managers.

User feedback and web analytics data (e.g., Figure 3) will allow us to evaluate the impact and effectiveness of the new website through time. Current use statistics for lternet.edu include the following:

- Average monthly visitors in 2017: 5195
- 63% US based
- 54% male; 46% female
- 61% aged 18-34
- 57% of page views last over 1 minute
- How do viewers find us? Search: 63%; Direct:24%; Referral: 11%; Social 1.3%; Email: 0.17%
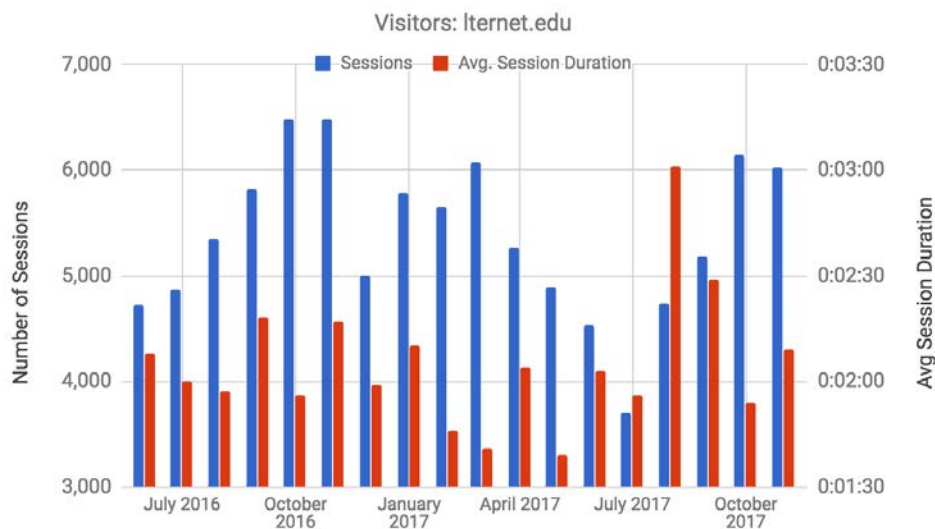
Figure 3. Usage data from the current LTER website (lternet.edu) from July 2016-Dec 2017. Average session duration is measured in minutes.

Social Media Amplification

We proposed to use a variety of social media platforms to "reinforce the LTER brand, raise LTER network visibility, engage with a range of stakeholders, and amplify information dissemination efforts."

The NCO maintains a USLTER Facebook page and recently created private Facebook groups for the Education/Outreach managers and LTER graduate students to share tools, tips, insights, challenges and successes. Activity on the USLTER Facebook page has increased steadily: In 2016, total page likes grew from 342 to 468, and as of November 2017 the number has increased to 595.

We also maintain a twitter account with 2,157 followers as of December 2, 2017. The number of followers has been increasing at an average rate of roughly 50/month; the average post reach is 400.

Rewarding Excellence

We proposed to recognize the value of site-developed communication and education resources through annual awards for excellence in these areas. We intend to create such awards following implementation of the new website and in time for the All Scientists Meeting in October 2018.

Cost-effective Communication

To make the most of NSF funding for Communications and Outreach, we proposed to employ graduate students in the Strategic Environmental Communications and Media (SECM) Program at the Bren School of Environmental Science and Management.

We established the E-Connect Fellowship program in partnership with the Bren School of Environmental Science and Management to provide graduate students in the professional Master's program with the opportunity to gain experience and build communication skills through internships at NCEAS. To date the NCO has employed 13 E-Connect Fellows, typically for 9-15 months (Appendix B). These students receive extensive training in science writing, web design and strategy, and social media while working on NCO science updates, newsletters, website content, and social media.

Changes in Communication and Outreach Approach

The 2015 report of the Next Generation LTER Network Office (NG-LNO) Task Force concluded that "LTER communications to date have been limited and ineffectual, both internally and externally. They recommended several improvements to LTER Network communications including

- Greater focus on the All Scientists Meeting as an opportunity for introducing new collaborators post-doctoral fellows, and students to LTER

- Expanded use of new media, technology, and social networking tools

- Overhaul of the network website

- Increased emphasis on branding of LTER in science communication and outreach efforts

- increased internal communication about the Schoolyard LTER programs

To a large extent the Communications and Outreach section of the NCO proposal was a deliberate attempt to respond to the Task Force recommendations, and we focused a significant fraction of personnel and resources in this area. Although still a work-in-progress, we have pursued most of the activities laid out in our proposal and initial indications are that these efforts are paying off in terms of greater LTER visibility.

Both the NSF solicitation and the NCO proposal placed heavy emphasis on external communications. In retrospect, our proposal underestimated the need for much greater internal communication and coordination of site-level outreach efforts. The LTER Network is a highly distributed, community-driven enterprise. Effective NCO communication and outreach efforts depend first and foremost on building strong lines of communication among sites and between sites and the NCO. Accordingly, our focus has been directed more towards internal communications than we anticipated. Looking forward, we expect to focus more attention on working with sites on improve their outreach activities. Currently, only a few sites allocate much time or resources to building strong outreach programs.

We also underestimated the multiple challenges inherent in rebuilding the network website and are almost a year behind where we to hoped to be at this time. Having screened content, re-designed and streamlined the information architecture, and created a new visual design, we are excited to launch the new site and will continue to modify and adapt based on user feedback and web analytics data.

Synthesis

The NSF Solicitation identified facilitation of communications and outreach, and fostering synthesis, as the two main responsibilities of the NCO. The NCO proposal, building from the NCEAS experience in supporting scientific synthesis activities, emphasized synthesis working groups, distributed graduate seminars, coordination of synthesis and data management activities, and expanded use of virtual interactions. NCO synthesis activities are led by Jenn Caselle and Frank Davis.

Synthesis Working Groups

We followed NCEAS' model of Synthesis Working Groups, in which 6-20 collaborators convene at NCEAS for 3-5 days at a time, 2-3 times per year for 1-2 years. The NCO synthesis groups are relatively well-resourced compared to past LTER synthesis efforts, with budgets of $35-50k per year for up to two years, plus logistical and technical support provided by NCEAS administrative and computing staff.

We issued a first call for working group proposals in March 2016 and a second call for proposals in October 2016. The solicitations were open to non-LTER as well as LTER researchers, and emphasized

research in the five core LTER thematic areas. We held informational webinars in advance of both proposal deadlines and received 23 proposals in response to the first call, as well as 19 in response to the second call. Half of the second-round proposals were re-submittals. Proposals were reviewed by anonymous panels comprised of LTER and non-LTER scientists who followed a structured review process. Highly ranked proposals were discussed with the LTER Executive Board; final funding decisions were made by NCO Executive Director Davis.

Table 1. LTER Synthesis Working Groups funded by the NCO			
PIs	# participants | # meetings to date	Project Title	Start and End Dates
Lauren Hallett, Daniel Reuman, Katharine Suding	18 | 2	Synthesizing population and community synchrony to understand drivers of ecological stability across LTER sites	3/17-3/19
Forest Isbell, Jane M. Cowles, and Laura Dee	20 | 1	Scaling-Up Productivity Responses to Changes in Biodiversity	4/17-3/19
Kate Lajtha and Will Wieder	18 | 0	Advancing soil organic matter research: Synthesizing multi-scale observations, manipulations & models	7/17-8/18
Adam Wymore and Sujay Kaushal	19 | 2	Stream elemental cycling: Global patterns in stream energy and nutrient cycling	9/16-12/17
Eric Sokol, Christopher Swan and Nathan Wisnoski	26 | 3	A synthesis to identify how metacommunity dynamics mediate community responses to disturbance across the ecosystems represented in the LTER network	9/16-9/18
Kimberly La Pierre, Meghan Avolio, and Kevin Wilcox	29 | 2	Integrating plant community and ecosystem responses to chronic global change drivers: Toward an explanation of patterns and improved global predictions	9/16-8/18

We received many excellent proposals - far more than we had funds to support. Ultimately, available funds allowed us to support 6 working groups (Table 1). These working groups engage 115 scientists (some individuals are participating in more than one working group), over half of whom are early-career (<9 years in the workforce). A more complete characterization of working groups is provided in Appendix C, which summarizes survey information that we collect from all working groups to help us better understand and support synthesis activities. It is too early to report on the productivity or impact of the working groups, although all of the first-round groups have multiple manuscripts in preparation.

The NCO has implemented a number of mechanisms to support working groups. Immediately after a proposal is approved, Marty Downs contacts the PIs to develop a project brief for the NCEAS, NCO and LTER websites, and to discuss communications and outreach opportunities. We provide Working Group PIs with a guidance document to help them plan their projects and get started. All logistical

needs of the group (travel planning, scheduling, reimbursement for travel and per diem) are handled by NCEAS administrative staff. The NCO helps schedule virtual meetings of working group members and provides Zoom, Go2Meeting or Webex platforms for meeting participants. We also support virtual participation of meetings at NCEAS for working group members who are unable to attend in person.

As described above, we have developed a new webinar series featuring the progress and results of the LTER synthesis working groups. This first series will kick off in Winter 2018 and continue through June 2018.

Scientific Computing Support of Synthesis Working Groups

Mark Schildhauer and Julien Brun, with the assistance of a small group of NCO data interns, have provided support and advice to the NCO synthesis working groups in several domains:

Setting up a collaborative environment - This collaborative environment aims to facilitate information centralization and sharing among working group participants. For each working group, we set up:

- Online space to share documents and take collaborative notes (Google Drive and Docs);
- A mailing list to facilitate the communication among the participants;
- As needed, a code repository (GitHub) to encourage collaborative scripts development for the analytical part of the project.

Collecting and assembling data - Prior to the first meeting and early in the project, we advise PIs regarding data management and collection through several virtual meetings. As a consequence of these discussions, a template to track the provenance and other essential metadata of the collected data sets has been developed and shared with the working groups. Our scientific computing team, including data science interns, assists working groups with data collection, data cleaning and formatting. For example, we are currently working closely with the Stream Elemental Cycling working group to finalize their harmonized dataset.

Modeling and analysis of data - We assist groups with modeling and data analysis at their request, and promote the use of the [NCEAS analytical server](#) for any analyses or modeling that may challenge the participants' computer capacities. We have not yet received requests for accounts, as most of the working groups have not started their most intensive modeling/analysis phase; however, based on participant feedback we expect to provide additional training on how to best leverage these resources (e.g., working on a remote server and using parallel computing).

Training - During the first meeting of each working group, we introduce participants to the scientific computing support available to them, recommend best practices to conduct collaborative and reproducible synthesis science, and discuss the importance of documenting and preserving data. This introduction is complemented with a 1-hour training on code sharing and collaborative editing with instruction on the use of git and GitHub code versioning solutions. We provide additional training at the request of the working group. For example, we provided the Metacommunity working group with a 2-hour training session on the development and submission of R packages. This group is developing a public R package to enable metacommunity analysis.

The needs of working groups vary considerably as a function of the participants' skills and group objectives. In general, data discovery and integration can be the most challenging and time-consuming activities that working groups face. For this reason, during the rfp phase and prior to the first meeting, working groups are encouraged to include one or more site Information Managers in the group. We coach groups on how to best keep track of information on data sources, and help with the development of scripts to integrate and format heterogeneous datasets.

Following the establishment of the Environmental Data Initiative (EDI) in Summer 2016, we worked with the EDI team to sort out respective roles and responsibilities for technical support of working groups, including extensive discussions and an in-person meeting at NCEAS in April 2017. Figure 4, taken from Corinna Gries' presentation at the 2017 Science Council meeting, shows the approach that we are now pursuing. EDI staff has interacted closely with working groups as they get underway to better understand which LTER data are especially important, as well as the important challenges and solutions to cross-site data integration. We anticipate even closer coordination with EDI moving forward. For example, we are currently working together to support data collection and harmonization efforts of the soil organic matter working group. In the process we are also hoping to develop a common data model for LTER soils information.
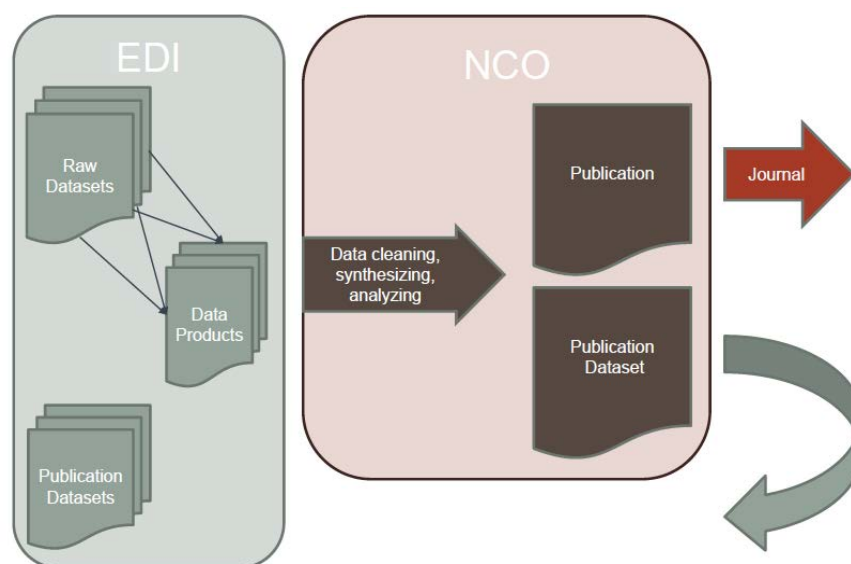
Figure 4. EDI and NCO roles and responsibilities in supporting LTER synthesis working groups (figure created by Corinna Gries).

Distributed Graduate Seminars

The NCO proposal included support of one distributed graduate seminar each year. We envisioned seminars jointly led by co-PIs and held at several campuses, in which graduate students on each campus would assemble, synthesize and analyze LTER and potentially non-LTER data. The NCO's role was to provide virtual meeting and analysis facilities to stimulate remote collaboration. At the end of the seminar, seminar leaders and two students from each site would come to NCEAS to participate in a multi-campus synthesis effort. This model has proven effective with past NCEAS distributed graduate and undergraduate seminars.

To date we have focused exclusively on synthesis working groups and have not supported any distributed seminars. This is partly because of the academic lead time required to plan such seminars and get them onto university calendars, partly because there appeared to be a greater initial appetite in the LTER community for synthesis working groups than distributed seminars, and lastly because we simply did not have the resources to simultaneously launch working groups and seminars. We hope to support at least one distributed graduate seminar in year 4 of the grant.

Changes in Approach to Synthesis

NCO efforts to promote LTER synthesis are largely consistent with the NCO proposal in our focus on synthesis working groups and providing a high level of technical and logistical support for synthesis efforts. While the Synthesis program is well underway, we have not accomplished everything that we had hoped to by this juncture. We have not yet supported a Distributed Graduate Seminar and we have not yet staged our proposed "mini-ASMs" in conjunction with large scientific society meetings. All participant funds that were budgeted for synthesis have been committed to our six working groups, but we will use any unspent participant funds to support at least one distributed graduate seminar.

We proposed mini-ASMs as one-day workshops that could be a cost-effective way to support synthesis work by researchers already attending a scientific conference. One working group (Sokol, Swan, Wisnoski - Metacommunity dynamics) met for a day at the 2017 ESA Annual Meeting in Portland, with mixed success. That meeting took place off site and the facilities proved to be mediocre for remote participants. For the remainder of this grant period, we will watch for opportunities for these types of 'side-meetings' at major conferences and lend support where we can to create a productive work setting. These meetings might originate from the current working groups or other ad hoc groups in the LTER community.

Over NCEAS' 22-year history, providing financial support for postdoctoral researchers has proven one of the most important mechanisms to increase working group productivity and impact. The NCO currently has no funding for postdocs and NCEAS no longer has open calls to support postdoctoral researchers in residence. One NCO synthesis working group is co-led by Meghan Avolio, an LTER Synthesis Postdoctoral Fellow at SESYNC. While we will continue looking for opportunities to be engaged with SESYNC LTER postocs, we believe that procuring additional resources for LTER postdoctoral researchers in residence at NCEAS is a high priority for accelerating LTER synthesis efforts.

Overall, our main concern is that we are not satisfying the desire of the community for synthesis working groups. Based on the response to our first two requests for proposals we could easily double the number of groups from the existing pool of proposals; our key limitation is funding for participant support.

Training and Education

NCO training and education activities were conceived and initially led by Carol Blanchette. In early 2016 Dr. Blanchette assumed the Director's position at the UC Sierra Nevada Aquatic Research Laboratory. Following a national search for a replacement, we hired Sam Norlin to lead NCO education activities. Sam is a certified science and mathematics teacher and has teaching experience at the middle-school, high-school, and community-college levels. The position is 30% time; Sam lives in Fairbanks, Alaska, where he also directs the Raising Educational Achievement through Cultural Heritage (REACH Up) Project at the University of Alaska Fairbanks.

Training Activities

In the area of training, the NCO proposal emphasized training activities in Science Communication and Environmental Media, Collaboration Skills, and Open Science for Synthesis.

As noted above, thirteen E-Connect Fellows have received extensive communications training as NCO interns working with Marty Downs.

Our first training effort for the LTER community at-large was in October 2015, led by consultant and NCEAS Associate Jai Ranganathan through SciFund Challenge. Outreach 101 for Scientists: Getting

[started with engaging the public with your science](#) was a free, 5-week online class that was offered to scientists from graduate students to senior researchers. Six of 173 participants were LTER-affiliated graduate students and early-career researchers.

Since that time we have offered several training courses designed specifically for the LTER community. An online discussion, [Video abstracts: Where, when, why, and how](#), was offered in November 2016. The 8-week online course, [Telling the Right Story, for the Right People, at the Right Time](#), was offered January-March 2017. Twelve LTER scientists enrolled but attendance was uneven. At the ESA 2017 Annual Meeting Marty Downs offered a 1-day workshop, [Video in a Hurry (and on a Shoestring)](#). Fourteen registered for the workshop. Only 5 participants completed evaluations but based on that small sample the workshop was effective (4 of 5 agreed or strongly agreed that the workshop presenter was knowledgeable and the presentation was effective; 5 of 5 described video editing skills as their primary obstacle to creating video before the workshop; afterwards, 4 of 5 said the greatest obstacle was time).

The NCO is building a Communications Resources section of the LTER Network web site. Current offerings include [Twitter for scientists](#) and [Using Video for Science Communications](#). These pages are intended to provide basic guidance, useful tips, and links to other resources in science communication and public engagement.

Up to this point, training in collaboration and open science for synthesis has mainly been provided to synthesis working groups, as described above. We will launch the synthesis webinar in 2018 with a researcher discussing the "science of team science."

Education and Public Participation

The NCO proposal emphasized the office's role as an information exchange hub that would also provide direct support to the LTER Education committee and provide mechanisms to share information between the Education Committee and the broader LTER network. The proposal also described efforts to support site-level fundraising efforts for education and outreach, helping the Education Committee align LTER education efforts with Next Generation Science Standards, support efforts to increase Public Participation in Scientific Research, and seek partners to expand the scope and reach of the LTER Education efforts.

At the ESA 2017 Annual Meeting in Portland, Oregon Sam Norlin (NCO) and Lisa Herman (CAP) offered a workshop titled, *Phenomenal Ecology in the Classroom: Turning Phenomena into Something Phenomenal for K-12 Learning*. The workshop was designed to give faculty and graduate students insight and tools to leverage the Next Generation Science Standards in developing LTER data or the researcher's other data into hands-on and place-based learning materials, and to help build communication between faculty and K-12 educators. The workshop hosted five participants including three faculty and 2 graduate students. Participants completed a survey at the end of the workshop that showed that 5 out of 5 strongly agreed that the workshop was effective. Additionally 5 of the 5 participants agreed strongly that their understanding of K-12 science standards increased after the workshop. Three out of the 5 participants were planning to develop their education resources.

The NCO has facilitated professional development and networking sessions with Education and Outreach Committee members. These monthly, virtual meetings consist of 10-20 LTER Education committee members who are distributed across the country at their individual sites. Potential future projects are often moved from the larger meeting to smaller, focused sub-committees. The NCO Education Lead participates in several of these sub-committees including: EquIP NGSS Lesson Committee and the Digital Education Library Committee. In addition, external speakers and organizations are invited to provided data analysis resources, broaden awareness of national research

and education efforts and methods of collaboration to expand education activities or to address stakeholder needs.

LTER Bookyard Series

The LTER Schoolyard Book Series is a unique sequence of illustrated science children books that engages young readers and their families in learning about ecosystems through stories that reflect the scientific knowledge gained from research conducted at LTER sites.

The NCO has been working to develop a second round of books. After consulting with NSF program officers, we organized and led a virtual meeting of current, past, and potential Schoolyard Book authors. The meeting was an opportunity for authors to share their experiences to inform the NCO on how to develop future books. From this meeting the NCO also identified areas where we could help in the development and dissemination of new books. The NCO subsequently hosted a meeting in Santa Barbara of the current Book Series PI Adrian Howkins with publishers Taylor Trade (TT) and Moonlight Publishing Services (MPS) to develop a more commercially viable children's book series that expands awareness of the LTER to 8-12 year old readers and is more profitable to Taylor Trade. Meeting participants also developed a proposed 20-month project timeline and draft budget.

Changes in Approach to Education and Training

Our efforts in training and education have generally followed the trajectory that we envisioned in the NCO proposal but at a slower pace than we anticipated, partly due to the temporary loss of momentum with Carol Blanchette's departure. Resolving the handling of the LTER Schoolyard Book Series has consumed considerably more time and effort than expected. We would appreciate NSF guidance on prioritizing additional NCO effort on the book series as well as on the proposed business model for future books in the series.

Looking forward, we expect to allocate more time to training in outreach and education and, with the establishment of EDI, reduced focus on training in data management. The NCO still has a role to play in training in data analysis and open science for synthesis, in cooperation with EDI, DataONE, and others. We will also work to improve access to and dissemination of information on external data training opportunities and fellowships.

Promoting Diversity

We proposed to provide networking opportunities that strengthen the connections among mentors and mentees through time, thereby fostering development of 'mentorship ladders' that would provide critical academic support systems for students from groups traditionally underrepresented in the sciences. We also proposed to assist LTER and ILTER sites with coordination of research internships and student exchanges, and with recruitment of underrepresented populations to participate in these programs.

In collaboration with the LTER Diversity Committee, the NCO is developing resources to support sites in becoming more broadly welcoming and inclusive and encouraging every participant to contribute at the highest level. We produced an NCO Diversity Strategy that seeks to engage a broader pool of participants and collaborators across and beyond the LTER network through partnerships with diversity-promoting organizations and institutions. Specific objectives include the following:

- Enable coordinated leadership for diversity work across the LTER network.
- Evaluate success of diversity-focused efforts by examining the involvement of underrepresented participants in leadership and decision making, in addition to counting their numbers. We also aim to examine outcomes for these participants and the groups in which they participate.

- Developing a process for confidentially collecting and aggregating inclusivity indicators for NCO activities. We expect the NCO experience will offer insights into diversity-related success, opportunities, and challenges, and that resources developed at the NCO may be adapted to offer similar capacity at individual LTER sites and eventually across the Network.

- Periodically update the LTER community regarding the NCO's diversity goals, the efforts we are making to achieve those goals, and evaluations of those efforts.

This strategy has been embraced by the LTER Diversity Committee. As a first step we are providing online resources including existing site diversity plans, information on existing programs to broaden K-through-graduate participation in ecology and environmental science, and links to funding sources.

NCO Support of LTER Governance

Approximately 20% of the original NCO budget was to cover participant costs for in-person meetings of the LTER Science Council, Executive Board, National Advisory Board, and committees. We proposed to work with NSF Program Directors and LTER leadership to explore ways to reduce costs, maximize the cost-effectiveness of LTER leadership meetings, and make maximal appropriate use of virtual meetings.

After extensive consultation with LTER leaders, especially the Executive Board and EB Chair Peter Groffman, and with guidance from the NSF LTER Working Group, the NCO has transitioned the LTER Network to a simpler and less costly governance structure with fewer in-person meetings of the Executive Board, fewer committees, a focus on virtual meetings of remaining active committees, and without a National Advisory Board. A complete list of in-person meetings supported by the NCO since October 2015 is provided in Appendix D.

We have worked closely with the Executive Board and Science Council to clarify decision authority, roles and responsibilities. This is reflected in a new representation of network structure approved by the Executive Board in Fall 2017. Where the former LTER governance diagram (Appendix E) emphasized vertical decision structure and identified numerous committees, the new diagram (Figure 5) emphasizes network functions, interactions, roles and responsibilities. The new diagram explicitly identifies the Information Management Committee and Education and Outreach Committee because sites are funded to hire personnel in these areas, and these are active committees with network-wide representation.

The Executive Board now meets in person only once annually in conjunction with the Science Council meeting. The NCO, working closely with Executive Board Chair Peter Groffman, schedules, provides logistical support, and takes minutes of monthly videoconferences of the Executive Board. The Board is deeply and constructively engaged with the NCO in event planning, communications and outreach efforts, and in helping NCO set priorities in the areas of synthesis, education, and training.

NCO participant funds support an annual Science Council meeting and annual mini-symposium at NSF. The latter was not included in our original budget but can be covered using funds intended for an annual meeting of the National Advisory Board. These and other changes to LTER governance have been formalized in revised bylaws that were adopted at the Science Council meeting in May 2017.
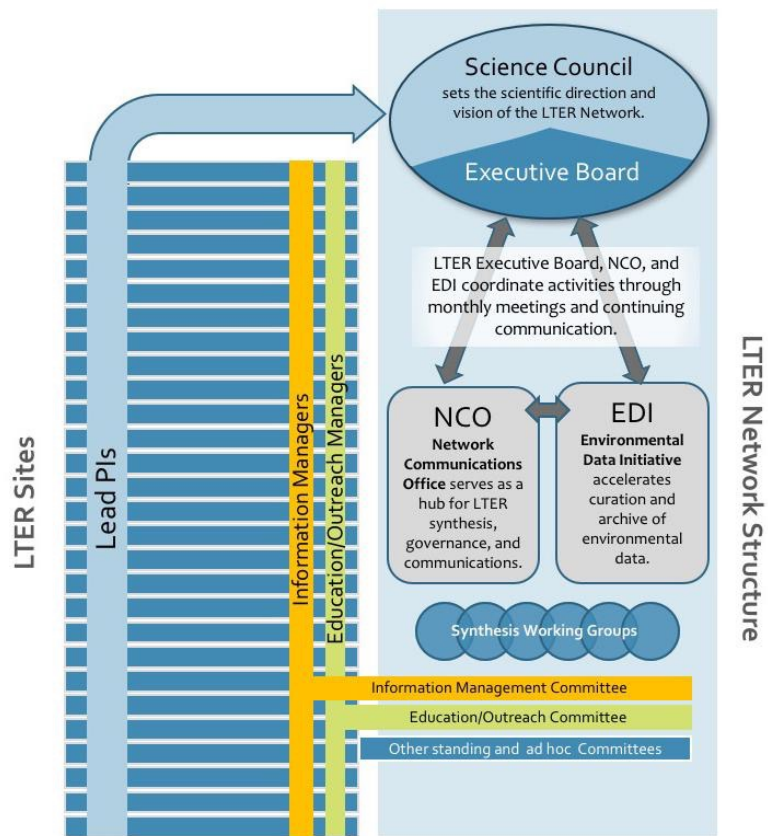
Figure 5. NCO representation of the LTER Network, produced in consulation with the LTER Executive Board

In October 2017 the NCO presented to the Executive Board a funding strategy to support activities of the Information Managers Committee, the Education/Outreach Committee, Diversity Committee and the ILTER Committee. This strategy entails a fixed annual allocation of governance funds ($50,000 total) from the NCO to the committees, which they can use to pay for in-person committee meetings or other costs associated with committee functions. This proposed strategy is now being discussed by the committees.

NCO Management and Budget

Staffing and Staff Coordination

The NCO proposal laid out a management strategy that integrated the Office into the existing NCEAS organization for grant accounting and administration, office and meeting space, and cyberinfrastructure. With the exception of the Communication and Outreach Coordinator, all positions were budgeted as part-time, including the Executive Director. Our strategy was to assemble a team with experience and expertise in administrative leadership (Davis), Communications and Outreach (Marty Downs), Education and Training (Carol Blanchette, replaced by Sam Norlin), Ecological Research and Synthesis (Jenn Caselle, F. Davis), Environmental Informatics (Matt Jones), Evaluation (Stacy Rebich-Hespanha), and Computing and Scientific Programming (Mark Schildhauer, Julien Brun, Nick Outin). NCO operations are supported by an administrative staff led by NCEAS Business Officer Julia Niessen, whose salary is covered by UCSB, and Travel Coordinator (Ana Peters).

We have closely followed the proposed management strategy. We coordinate NCO activities through weekly team meetings and use of a shared Google drive for all NCO documents. The horizontal, team-based management model served us well during the first 2 years as we were transitioning away from the LNO and working on several fronts simultaneously, for example, migrating online content from the LNO to NCO, initiating synthesis working groups, and building relationships and setting priorities with LTER leaders in activities such as Information Management, Communications, Education, Diversity, and Governance.

Over the past several months we have begun to make some changes to NCO staffing to reflect our transition out of a start-up phase (Figure 6). There have been two recent changes in leadership: Mark Schildhauer retired in Summer 2017 and Stacy Rebich-Hespanha departed from UCSB in Fall 2017 to pursue a non-academic career. We do not anticipate replacing Mark Schildhauer but instead will rely on Julien Brun, Nick Outin and Matt Jones for computing, informatics and scientific programming support. Mark will continue to work with the NCO, providing liaison communications between the NCO Scientific Computing Support team and the synergetic activities underway at the Environmental Data Initiative (EDI), particularly with regards to the development of shared data models and controlled vocabularies. In addition Schildhauer will continue to work, in a limited capacity, with Dr. Brun, providing advanced informatics and analytical support and training for the NCO-sponsored Synthesis Working Groups. We have not yet replaced Stacy; for the time being Julien Brun and Marty Downs are continuing to administer the working group survey questionnaire and data, and Jenn Caselle will conduct the analyses of the evaluation data..
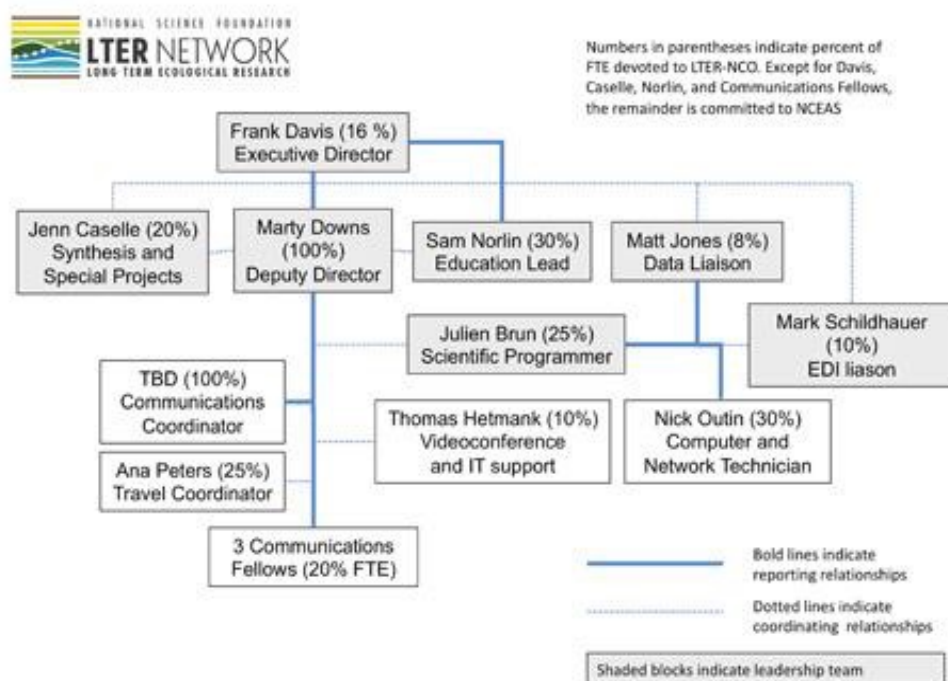
Figure 6. Organization chart for the NCO, version date 12/1/17.

As we have solidified roles and responsibilities for the NCO, Marty Downs has been elevated to Deputy Director of the NCO to reflect her lead role in managing the day-to-day operation of the office. We expect to hire a Communications Coordinator beginning January 2018 to assist Marty in operations including communications and outreach, event planning and logistics. Year 3 will be especially

challenging as we support a mini-symposium, Science Council meeting, All Scientists Meeting and begin planning for the LTER 40th anniversary.

Priority Setting and Budget Allocation

NSF funding for the NCO for the first two years totalled $1,932,628. This includes $1,740,615 in base funding plus $192,013 in supplemental funds to support LTER researcher participation in the ILTER Open Science Meeting in October 2016 and to support transition of data and information management from the LNO to the NCO and EDI. This does not include a supplement of $416,912 for the 2018 All Scientists Meeting.

Actual spending during the first two years closely follows proposed spending in terms of proportional allocation to activities and budget categories. Salaries and Benefits accounted for 48% of budgeted funds and 48% of actual expenditures. Participant Support comprised 32% of budgeted funds and 29% of actual expenditures. Indirect costs accounted for 13% and 14% of proposed and actual expenditures, respectively (Figure 7).
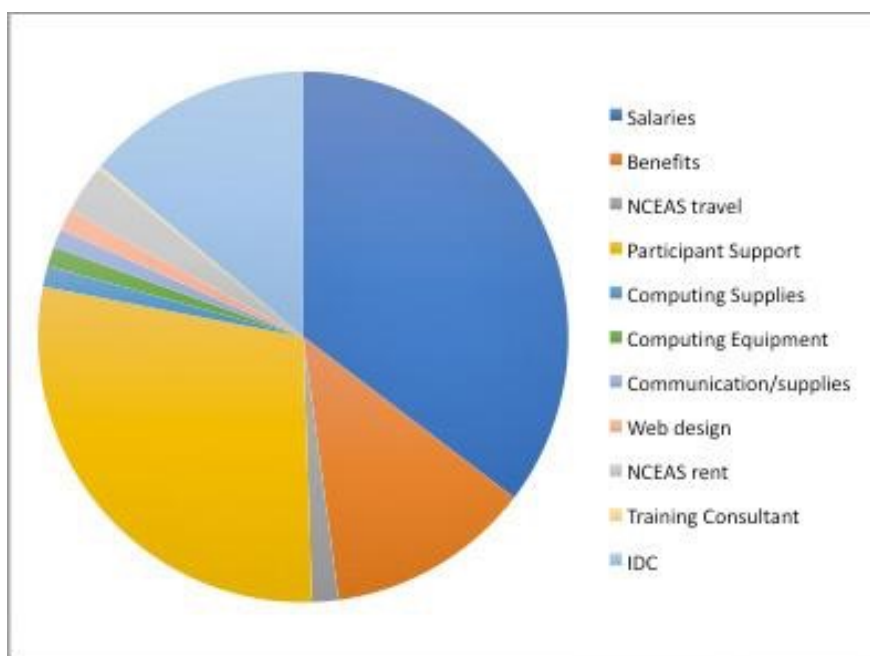
Figure 7. Proportional allocation of NSF funds to NCO budget categories, 10/1/15-9/30/17.

In absolute terms, expenditures to date total 74% of budgeted funds. The lower-than-expected rate of spending is largely due to hiring delays and hiatuses, and to reduced participant costs. Actual meeting costs for Science Council and committee meetings have been slightly lower than projected, and synthesis working groups have not yet spent all of their allocated funding.

In allocating available NCO funds, our highest priorities continue to be communications, outreach, and LTER synthesis research. Our current 4-year budget projections suggest there may be sufficient participant funds to support at least one distributed graduate seminar and, depending on spending for governance and current working groups, possibly one or two additional synthesis working groups. In other words, our highest priority is to support as much community synthesis activity as possible during the next two years.

Evaluation

The NCO proposal included utilization-focused evaluation activities that would assist NCO personnel, NSF program officers, and LTER leadership (Executive Board and Science Council) in judging whether our activities are achieving desired outcomes and serving the needs of the LTER community. These efforts were to be based in large part on longitudinal survey data as well as interviews.

We spent considerable time during our first year of operation in meetings, conference calls and one-on-one conversations with LTER leaders, community members and NSF Program Officers. These discussions, although not formally structured for the purpose of evaluation, were critical in helping us set realistic near-term goals, objectives and priorities. We also learned early on that the community had little appetite for surveys, so we have used surveys sparingly in order to establish a baseline for future evaluation, including:

- An interactive (cell phone-based) survey with attendees at the 2016 Science Council Meeting to better understand their priorities for the NCO;
- A longitudinal survey instrument that has been implemented with all synthesis working groups (Appendic C) to establish working group diversity and evaluate the relationship between group diversity and productivity;
- A survey of all sites to understand how they have implemented and use their current websites, and to better understand site-based skills and interest in science communication and outreach. Site responses showing how they currently rank different audiences for their websites are shown in Appendix F;
- A survey of all sites to establish a baseline of their current education programs and their efforts to promote and broaden diversity of participants in site activities;
- A survey of all LTER committees for information on current leadership, membership, activities and needs of LTER committees. The information was used to better organize and coordinate network-level activities;
- Polling of the entire LTER mailing list to gauge community preferences for different logo designs.

At the 2017 Science Council meeting the issue of review and evaluation of the NCO was discussed. The decision at that time was that the Science Council, organized by the Executive Board, would provide an annual evaluation of the NCO. Formal evaluation of the NCO was recognized as the purview of NSF; this annual evaluation by the Science Council was viewed as a mechanism for the community to provide regular feedback to the NCO to ensure that the office was aware of and responding to community needs and priorities. With NSF approval, we plan to share this self-assessment with the LTER Executive Board to initiate the first annual Science Council review of the NCO in 2018.

Summary and conclusions

Our goals and objectives remain fundamentally unchanged from those articulated in the NCO proposal, but after extensive consultation with NSF and LTER leaders we have greater clarity regarding NSF expectations for the LTER Network, the NCO and EDI, and better understanding of community needs and expectations in the areas of communication, synthesis, training and education. We have also resolved important issues related to network governance roles and responsibilities.

In retrospect, the NCO proposal underestimated the level of effort needed to transition operations from the LNO to the NCO and EDI. Over the past 26 months, thanks in part to supplemental funding from NSF, we have accomplished that transition and can now focus fully on operating the office.

In the area of communications, we have pursued most of the activities laid out in our proposal and indications are that these efforts are paying off in terms of greater LTER visibility. With the launch of the new website in December 2017, we have reached a significant milestone in modernizing and amplifying LTER network communication and outreach activities. Strengthening internal network communications has been our highest priority in order to facilitate dialogue and interaction among LTER researchers. We have also expended significant effort on communicating with external constituencies, especially other research networks such as ILTER, CZO and NEON. We expect greater emphasis on external communications during years 3 and 4 of the grant.

Six LTER synthesis working groups appear to be making good progress on large, important questions in ecosystem and community ecology. We do not yet know whether our strategy of funding fewer, well-resourced working groups will yield greater research impact than funding more groups with lower funding and support per group. But it is clear that we are not satisfying the demand from both LTER and non-LTER researchers interested in synthesis research using LTER data. We believe LTER synthesis efforts could be significantly accelerated by funding LTER postdoctoral researchers in residence at NCEAS.

Our efforts in Training and Education have fallen short of expectations. On the positive side, the training efforts to date have been well received, and synthesis working groups are being provided high-level training in open science for synthesis. We are supporting and working closely with the Committee on Education and Outreach to support information sharing and to facilitate external partnerships. We have organized and updated information regarding site-level activities, and the new website provides easy access to network-level and site-level information and resources. During the next two years we expect to ramp up training efforts, including a monthly webinar on synthesis research and a Distributed Graduate Seminar. Realistically, however, with only one partial FTE allocated, we need to temper expectations regarding how much support the LTER can provide in this area.

We are excited to be working with the Diversity Committee to implement the NCO Diversity Strategy. In the past, LTER network attention to diversity has been focused on educational activities. Our goal over the next 2 years is to develop resources to support sites in becoming more broadly welcoming and inclusive and encouraging every participant to contribute at the highest level.

We have worked closely with NSF and the LTER Executive Board to contain meeting costs while still providing high quality support for virtual and in-person meetings. The Executive Board in general, and Peter Groffman in particular, have been extremely thoughtful, constructive and generous of their time in helping the NCO get up to speed in this area. We are looking forward to a memorable All Scientists Meeting in October 2018, and to working with the NSF LTER Working Group to prepare for the network's 40-year review.

Appendix B. Former and current E-Connect Fellows who have been employed by the NCO.

Name	Employment dates	Degree Year*	Current Employer
Devin Spencer	6/15-8/16	MESM 2016	Communication Specialist, Santa Barbara Channel Marine Biodiversity Observation Network
Melissa Maggass	6/15 - 6/16	MESM 2016	Weyerhauser
Tova Handelman	10/15 - 9/16	MESM 2016	OPC Marine Protected Areas Sea Grant Fellow
Terra Alpaugh	2/16 - 9/16	MESM 2016	Associate, Kearns & West
Alex Uribe	2/16 - 5/17	MESM 2017	Pearl Healthcare Technologies, Inc.
Nicole Poletto	6/16 - 9/16	MESM 2017	Associate, Kearns & West
Alina Werth	9/16 - 3/17	MESM 2018	Bren School MESM student
Madison Harris	9/16 - present	MESM 2018	Bren School MESM student
Erin O'Reilly	9/16 - present	MESM 2017	NCEAS Science Communications Fellow
Tia Kordell	6/17 - 9/17	MESM 2018	Bren School MESM student
Amanda Kelley	4/17 - 6/17	MESM 2018	Bren School MESM student
Alex Jamis	6/17 - present	MESM 2018	Bren School MESM student
Erika Carlos	6/178 - 9/17	BA 2017	Multimedia Design and Tech Support, UCSB Writing Program

* MESM - Masters of Environmental Science and Management, UCSB Bren School.

Appendix C. Initial survey results for selected questions from the first three NCO Synthesis Working Groups.

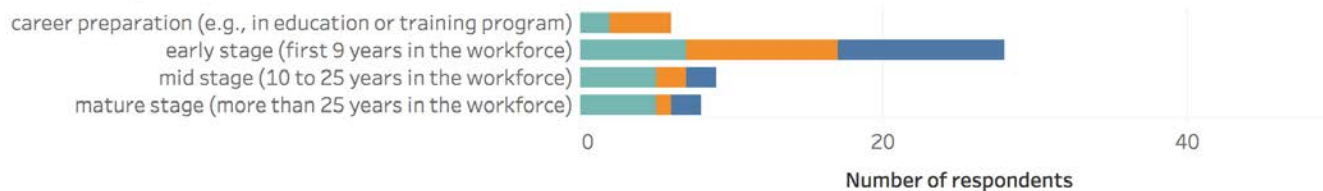Responses from each working group are represented by a different color.

Professional Role/Identity and Career Stage

Which of these best describes your primary professional role or identity?
(If you identify equally with more than one of these categories, please use the "Other" category to identify your roles or identities.)
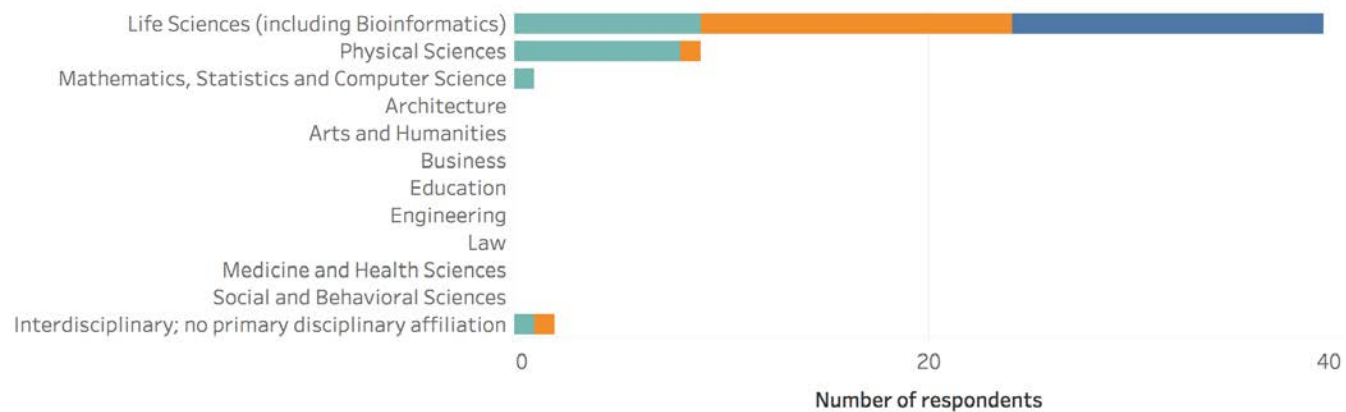

CareerStage

Number of respondents

Scientific research and disciplinary area

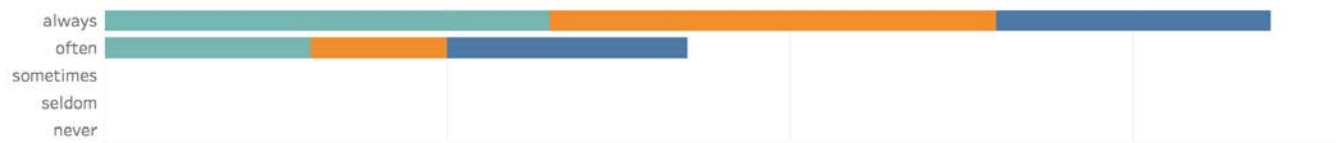## Does your work involve scientific research?

Which of the following would you consider your primary research area?

How often do you use the following approaches in your research?
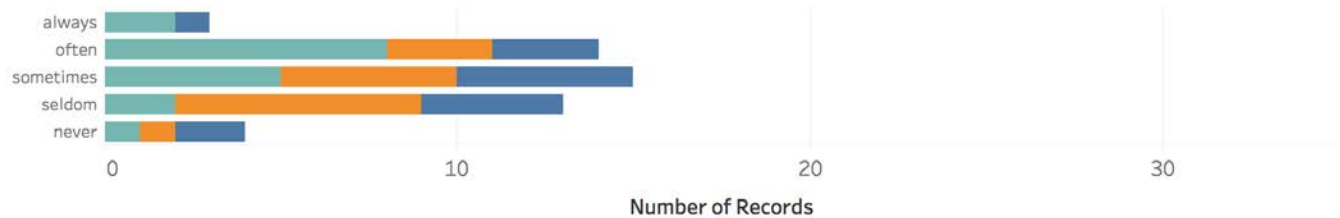
Quantitative research approach

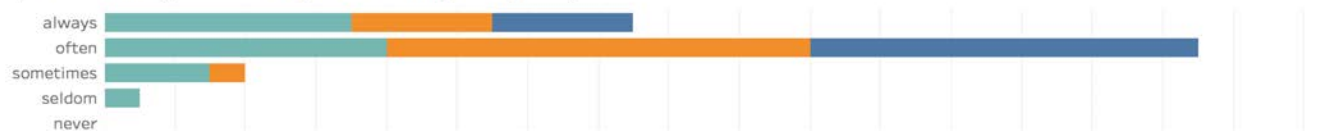## Qualitative research approach

Mixed methods research approach
integrating quantitative and qualitative data collection and analysis in a single study or program of study

Number of Records

How often do you use the following approaches in your research?

Deductive approach
experimental and hypothesis-driven; aimed at testing existing theory
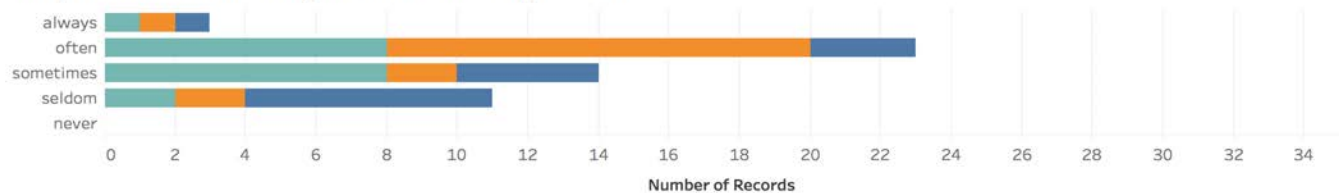

Inductive approach
observational and exploratory; aimed at generating theory based on emergent properties of data

Computational modeling or simulation approach

Number of Records

# How often do you use the following approaches in your research?

Participatory research approach
co-planning and co-conducting research with non-academic partners and/or those who are being studied

- always
- often
- sometimes
- seldom
- never
- Null

Action research approach
involving participating in action to address a problem or effect change followed by critical reflection on the outcomes of those actions

- always
- often
- sometimes
- seldom
- never
- Null

Number of Records
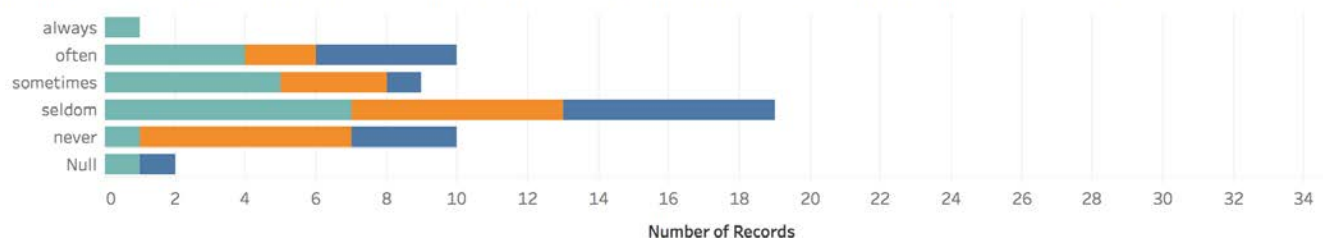
Gender and sexual identity

Do you think of yourself as _____? (check all that apply)
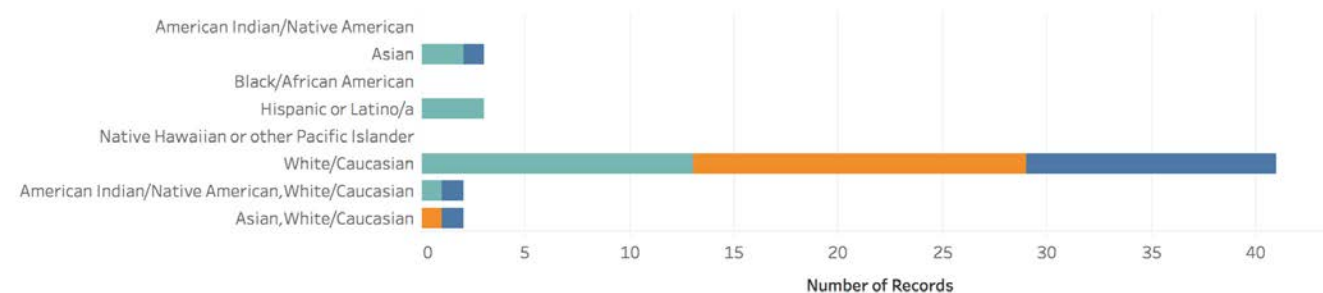

- female
- gender non-conforming
- male
- other

Number of Records

Do you think of yourself as gay or lesbian, bisexual, transgender, transsexual and/or belonging to the LGBTQI community?
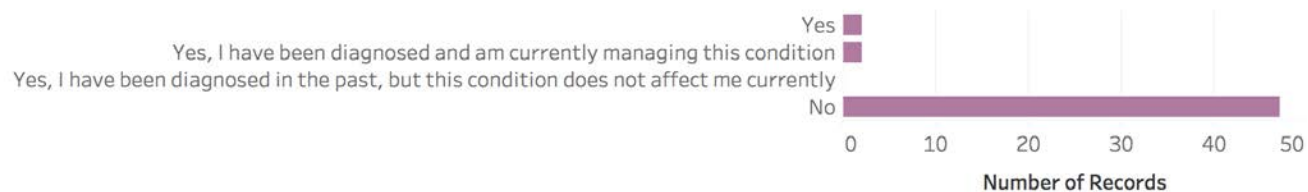

- Yes
- No

Number of Records

Race and ethnicity

Do you think of yourself as _____? (please select one or more)

- American Indian/Native American
- Asian
- Black/African American
- Hispanic or Latino/a
- Native Hawaiian or other Pacific Islander
- White/Caucasian
- American Indian/Native American, White/Caucasian
- Asian, White/Caucasian

Number of Records

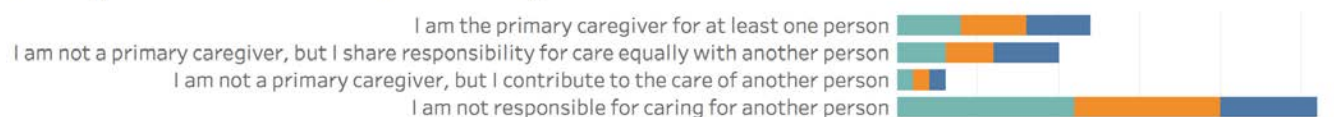# Disability or impairment and caregiving status

Disability
Have you been diagnosed with a sensory impairment, mobility impairment, learning disability, mental health disorder, or other physical or mental disability?

Yes
Yes, I have been diagnosed and am currently managing this condition
Yes, I have been diagnosed in the past, but this condition does not affect me currently
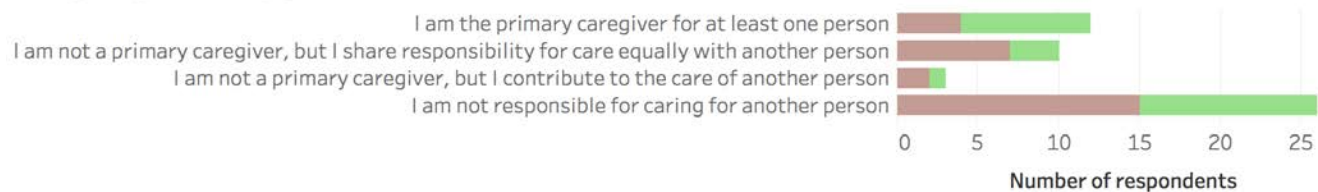No

0   10   20   30   40   50

Number of Records

Caregiving status
Are you regularly responsible for the care of one or more people who are not able to fully care for themselves (e.g., child, elderly relative, persona with health condition or disability)?

I am the primary caregiver for at least one person
I am not a primary caregiver, but I share responsibility for care equally with another person
I am not a primary caregiver, but I contribute to the care of another person
I am not responsible for caring for another person

Caregiving status by gender

I am the primary caregiver for at least one person
I am not a primary caregiver, but I share responsibility for care equally with another person
I am not a primary caregiver, but I contribute to the care of another person
I am not responsible for caring for another person

0   5   10   15   20   25

Number of respondents

Family socio-economic status and educational attainment

Family socio-economic status

Think of a scale representing the socio-economic status of the people in the United States. At the top of the scale (10) are the people who are best off -- those who have the most money, the most education, and the most respected jobs. At the bottom of the scale (1) are the people who are the worst off -- those who have the least money, least education, and/or the least respected jobs or no job. **At the time you finished high school, where on this scale would you place your parent(s) or primary caregiver(s)?**
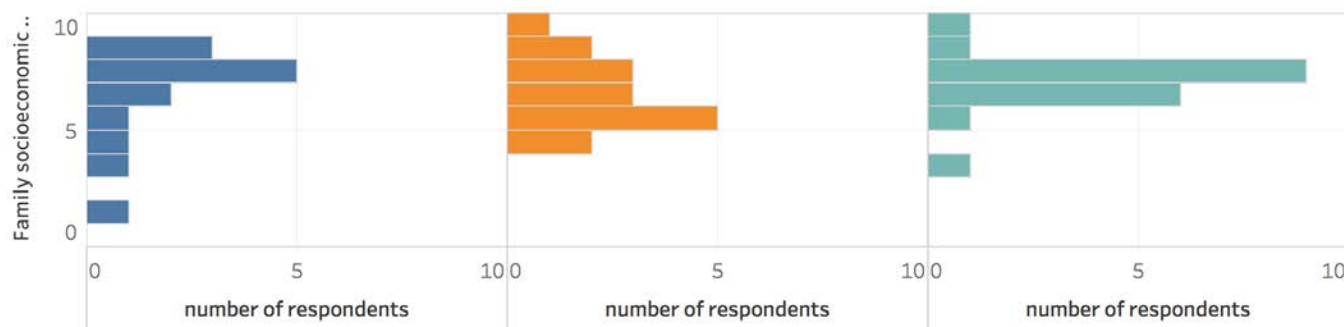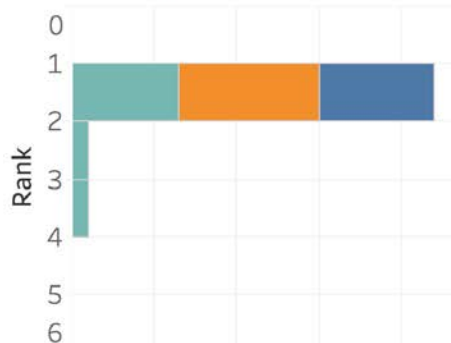

Family educational attainment

At the time you finished high school, what was the highest level of education completed by any of your parent(s) and/or primary caregiver(s)?
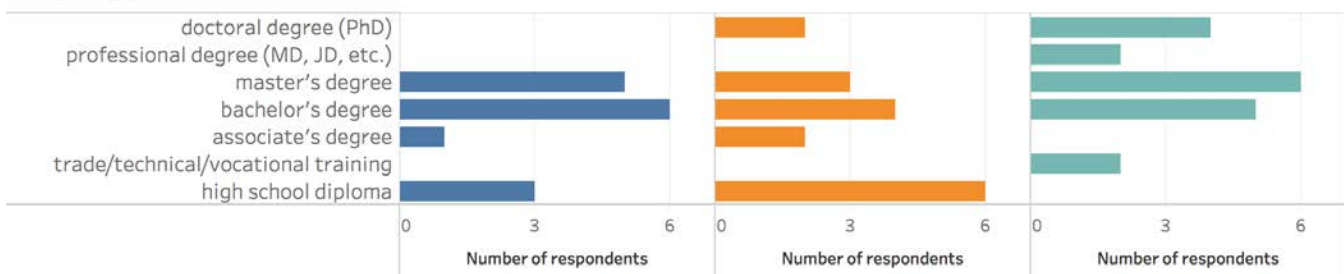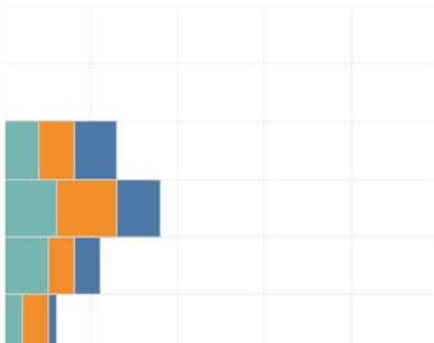
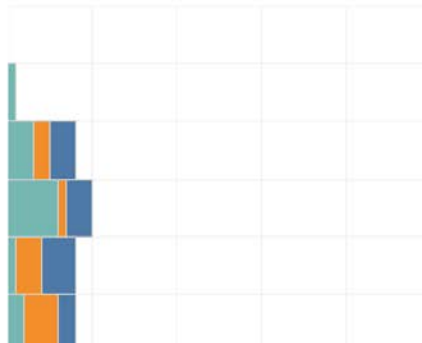# Please rank the importance of the following when you begin work on a group project.
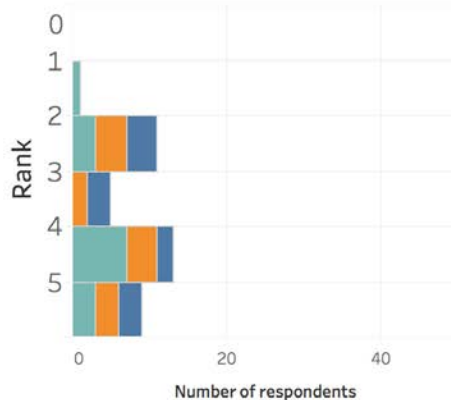
Understanding the purpose and value of the project

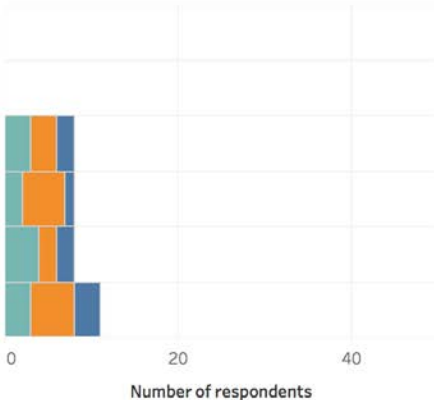### Determining how we are going to go about doing the project

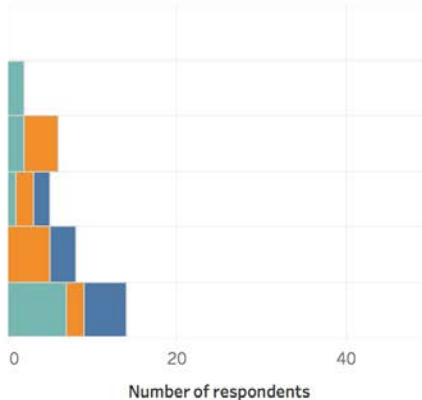### Getting the project organized and underway

Discovering the goals and values of individuals in the group

Understanding how the project can be of benefit to the group

### Understanding how the project can be of benefit to me

Appendix D. In-person meetings supported by NCO between October 1, 2015 and October 31, 2017.

(participant support provided by NCO unless otherwise noted). SWG - Synthesis Working Group.

Date	Meeting	Location	# participants
May 6, 2016	Synthesis Proposal review panel	NCEAS	12
May 17-20, 2016	Science Council	NCEAS	75
Sep 16-19, 2016	Meta-communities SWG	NCEAS	24
Oct 9-13, 2016	ILTER Open Science (NSF supplemental funds to NCO)	Kruger NP South Africa	23
Nov 18, 2016	Synthesis Proposal review panel	NCEAS	12 (7 remote)
Nov 28- Dec 2, 2016	Communities to Ecosystems SWG	NCEAS	17
Dec 6-9, 2016	Stream Elemental Cycling SWG	NCEAS	19
Feb 7-9, 2017	Schoolyard Book Series	NCEAS	5
Mar 6-10, 2017	Meta-communities SWG	NCEAS	12
Mar 21, 2017	NSF mini-symposium	NSF, Arlington	8
Mar 29-31, 2017	NEON-LTER synergies (funded by NSF grant to Peter Groffman and Julia Jones)	NCEAS	30
Apr 11-13, 2017	LTER, NCO, EDI, DataONE Collaboration	NCEAS	28
May 8-11, 2017	Ecosystem synchrony SWG	NCEAS	18
May 16-19, 2017	Science Council	Hubbard Brook	76
Jun 12-15, 2017	Biodiversity and productivity SWG	NCEAS	20
Jul 27-28, 2017	Information Managers at ESIP annual meeting	Bloomington, IN	12
Aug 11, 2017	Meta-communities SWG	Portland, OR	10
Oct 2-5, 2017	Ecosystem synchrony SWG	NCEAS	18
Oct 23-27, 2017	Communities to Ecosystems SWG	FT. Collins, CO	28
Oct 24-27,2017	Stream Elemental Cycling SWG	NCEAS	17
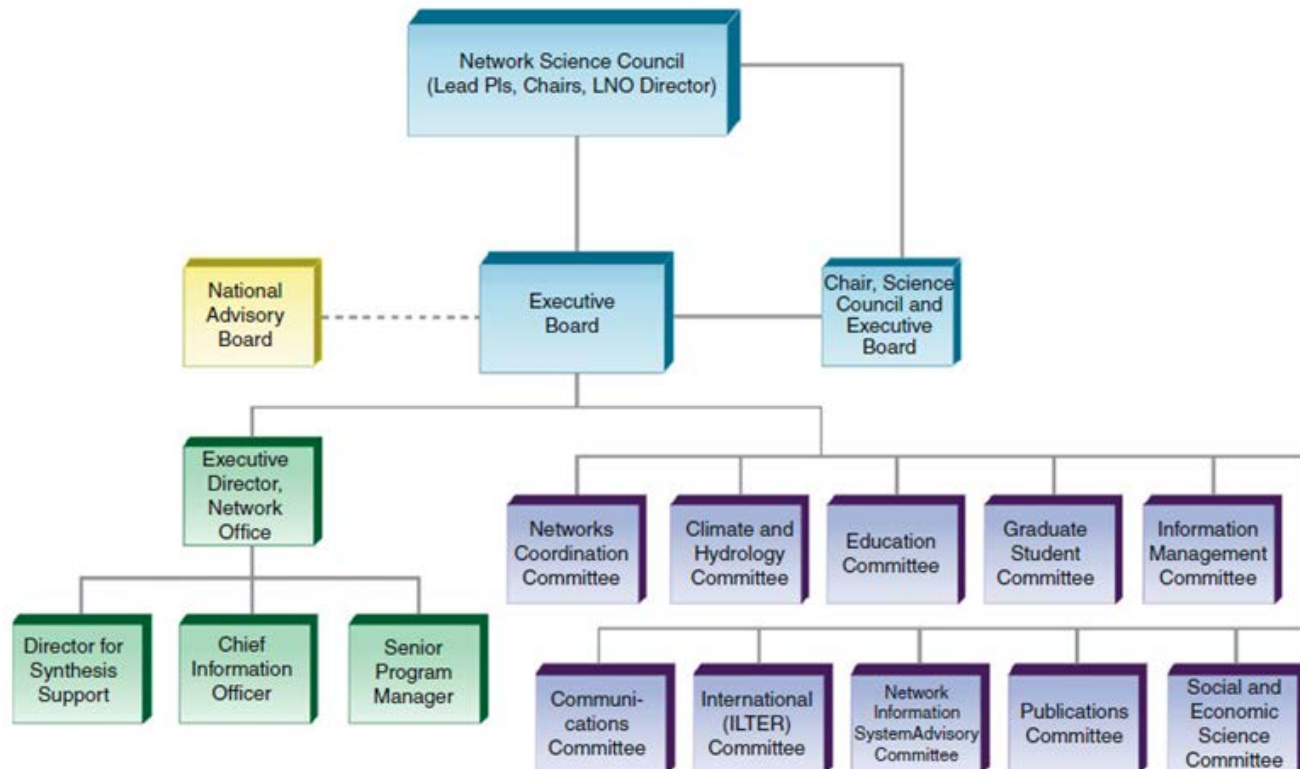
Appendix F. How LTER sites currently rank potential audiences for their websites.

The size of the circle is proportional to the number of sites (out of 24 that responded) that ranked an audience as highest (Rank 1) to lowest (Rank 10) importance. For example, the large majority of sites identified LTER scientists as their highest-ranked audience and non-LTER scientists as their 2nd-highest.