24 June 2024

Battelle Response to NEON STEAC Spring Meeting 2024 Advisory Report

According to its Bylaws, the STEAC is "primarily an advisory body to the NEON Project and will provide strategic advice to Battelle, the NEON Principal Investigator (PI), and NEON Project staff on the planning, construction, and operation of the NEON Project and other relevant programs." This response to the STEAC report from May 11th and 12th 2024 also combines the input of several members of the program team responsible for the execution of the NEON project. Battelle is grateful for the time and expertise these members of the community have provided and appreciates their input.

The focus of the 2024 Spring STEAC Advisory Board meeting was a review of an early draft of the NEON 5 year Strategic Plan (referred to below as the Plan). The thoughtful, rich, and lively discussion yield many ideas and specific recommendations to this draft. As they state in their report "Given the specificity of our recommendations pertaining to the draft of the strategic plan, we have not provided a summary of key recommendations. Instead, we have tried to capture the nuance of the conversations with italicized recommendations for each objective to aid in revising the draft moving forward." The NEON responses below reflect how they relate to each Plan objective. Further the STEAC includes its notes on meetings with our external partner, the NSF ESIIL and with the NSF.

Taken together, the STEAC suggestions have several broad themes that relate to the evolution of NEON:

- Name: With respect to the Plan, the STEAC stressed a narrative that is less technical to make it more accessible

STEAC Recommendations re: NEON's 5 year Strategic Plan

Add Executive Summary to the outset of the Plan; Add context statement to each Goal and potentially specific Objectives.

Response: We appreciate these suggestions, including a suggested organization for the Executive Summary, and have added this to the Plan.

The STEAC notes that "one key takeaway is that NEON needs to lower the 'activation energy barrier'" for entry by community members to use or expand NEON data.

Response: This is consistent with many user comments. Provided concurrence and use of funds from NSF, we plan to accelerate development of critical features of the NEON Data Portal during the 5-year Plan period.

NEON Leadership convened to consider each of the suggestions to the Strategic Plan below. We revised the language of Goals and Objectives, and we moved them to reflect suggestions of the STEAC and our own assessment of their placement in relation to them. The table below (Table 1) reflects the alignment between the Goals and Objectives in the Plan version that the STEAC reviewed (v.02-April-2024) and the current and new revised plan (v.03-June-2024).

STEAC Review Version (v2 April)	New Version (v3 June)
Objective 1.1	Objective 2.6
Objective 1.2	Objective 2.1
Objective 1.3	Objective 2.2
Objective 1.4	Objective 2.3
Objective 1.5	Objective 2.4
Objective 1.6	Objective 2.5
Objective 2.1	Objective 1.2
Objective 2.2	Objective 1.1
Objective 2.3	Objective 4.3
Objective 2.3	Objective 4.3
Objective 2.4	Objective 1.3
Objective 2.5	Objective 4.4
Objective 2.5	Objective 4.4
Objective 3.1	Objective 3.1
Objective 3.2	Objective 3.2
Objective 3.3	Objective 3.3
Objective 4.1	Objective 4.1
Objective 4.2	Objective 4.5
Objective 4.3	Objective 1.4
Objective 5.1	Objective 5.1
Objective 5.2	Objective 5.2
Objective 5.2	Objective 5.3
Objective 5.3	Objective 4.2
GOAL 1: Operational Excellence	GOAL 2: Operational Excellence
GOAL 2: Enabling Science	GOAL 1: Enabling Science
GOAL 3: Evolving Platform	GOAL 3: Evolving Platform
GOAL 4: Empowering Users	GOAL 4: Enhancing Discoverability, Accessibili
GOAL 5: Inclusive Community	GOAL 5: Engaged and Inclusive Workforce

Strategic Plan: Goal 1 - Operational Excellence

This first goal of the strategic plan, Operational Excellence, had six objectives, each focused on distinct aspects of data collection and NEON operations. The overarching points of this goal were to minimize data gaps and improve quality of the data, but that was not immediately clear.

The STEAC suggests providing an overall summary emphasizing the aspects of minimizing data gaps and improving data quality. The STEAC also recommended renaming the objectives as

follows : 1.1: Enhance resilience of observation platform; 1.2. Improve data flows and security; 1.3 Explore new tools for data management; 1.4 Expand interacting communities on data needs and flows; 1.6 Improve assessment of data collection, standardization, and quality.

OBJECTIVE 1.1: EARLY IDENTIFICATION AND RESOLUTION OF PROBLEM == MINIMIZE DATA GAPS.

In this objective, the strategic plans emphasized improved data collection and minimizing data gaps. This objective captured much of the day to day troubleshooting that NEON works on to deliver quality data.

The STEAC recommends reordering the objectives, so that the plan does not start with the challenges (e.g., start with Obj. 1.2 and have Obj. 1.1 later).

Response: Objectives reordered accordingly (see Table 1)

OBJECTIVE 1.2: IMPROVE EFFICIENCY, FLEXIBILITY, AND SECURITY OF DATA PIPELINE.

Objective 1.2 described having a system to evaluate the data pipeline and determining how that system could be improved.

The STEAC recommends that NEON consider using the language 'robust' and 'production level' to signal to the community what the observatory aspires to achieve in terms of data provided.

Response: Language adopted

OBJECTIVE 1.3: DEVELOP AND OPTIMIZE PREVENTATIVE, CORRECTIVE AND PREDICTIVE MAINTENANCE.

This objective focused on exploring new tools for data management and adjusting inventory levels for efficiency.

In this objective and elsewhere through the document, the STEAC recommends keeping the audience in mind. To that end, the STEAC urges NEON to avoid jargon (e.g., asset, life cycle management) and to reduce overly specific parenthetical examples.

Response: We appreciate this suggestion and revised to balance the need for subject matter specific language and publicly facing language.

OBJECTIVE 1.4: SEEK OUT AND RESPOND TO COMMUNITY INPUT AND FEEDBACK.

This objective described how to expand interactions with communities on data needs and flows.

Here the STEAC feels that it was important to highlight how important interactions among NEON staff and community users are to advocate for continued support for such interactions.

Response: We clarified title to focus on data needs and added bullet 4 'Increase communication transparency...' to highlight addressing feedback from community

OBJECTIVE 1.5: ENHANCE PERFORMANCE ASSESSMENT ACROSS THE PROGRAM.

Assessment in the observatory ranges from hiring program evaluators to provide external evaluations to considering risk management and determining how infrastructure (e.g., bricks and mortar, tower) are holding up.

Overall, the STEAC feels this objective was well written. Bullet two could be written for more of an external audience because as written the STEAC feels that the language was specific to internal jargon used by NEON staff.

Response: We qualified bullet two by adding 'physical infrastructure' ('facility condition assessment' is NSF's language for a requirement involving assessment of physical infrastructure.

OBJECTIVE 1.6: MATURE OUR INTERNAL TRAINING MODEL TO DELIVER EFFECTIVE TRAINING MORE EFFICIENTLY.

This objective described improvement of assessment of data collection standardization and quality.

The STEAC recommends more general language, such as removing details about specific software (e.g., LMS365).

Response: Some language made more general, though striving to be similar levels between science, where there is more familiarity from the ecological community and instrumentation and cyberinfrastructure, where there is less.

Strategic Plan Goal 2 - Enabling Science

The second goal of the strategic plan, Enabling Science, placed a strong emphasis on outreach and engagement with their broader scientific community. NEON's proposed thrusts and approaches to enable this engagement include increasing awareness, expanding federal agency partnerships, continued use and refinement of Findable, Accessible, Interoperable, and Reproducible (FAIR) and open datasets and code together with detailed metadata and issue-logging that is open and accessible, fostering a tighter connection with other National and International ecological research networks to share knowledge, experiences, and lessons-learned, and importantly supporting Principal investigator (PI) driven research leveraging the NEON network via the renamed NEON Research Support Services (RSS), formerly Assignable Assets.

The STEAC recommends that this goal (Goal 2) be moved to the beginning of the new plan after the intro/preamble to head off any criticism that could come from the plan starting with a focus on data integrity.

Response: Goal 2 is now Goal 1 in the new version (v3 June) – see accompanying Table 1 above.

OBJECTIVE 2.1: TRANSDISCIPLINARY AWARENESS OF THE NEON PROGRAM.

NEON informed the STEAC about its mandate to increase the "awareness of NEON" via more "use-inspired" connections with the research community and updated branding. This is highlighted in the draft text within Objective 2.1 and reflects NEON's charge from NSF to serve the community. This objective provided direct guidance to NEON on how to make changes, modifications, and adjustments to better serve evolving research and ecological monitoring requirements.

The STEAC provided input that presently much of the ecological community is not fully aware of the value of NEON in that NEON can support enhancement to PI-driven science and can place research in a much broader context (e.g., site to regional-scale studies).

Response: This is a great suggestion, and we have incorporated it in the revised Plan.

The STEAC suggests that the new Strategic Plan needs to be as much a sales pitch as a roadmap to highlight how the community can engage and inform the direction and use of NEON's resources. This includes improving the communication about the ability to apply for larger research assets including PI-driven Airborne Observation Platform (AOP) or mobile facility deployments, which, as raised by the STEAC, are not easily navigated by individual PIs given the complexity and additional costs associated with them.

Response: Noted – we addressed this comment in Objective 2.5 (original numbering).

The STEAC raised questions during the discussion about NEON data stewardship and the ability to support existing data while also expanding into new data and measurements that facilitates the long-term needs from NEON but does not interrupt existing structures.

Response: Expanding into new data involves an increase in the scope of what NEON is supported by NSF to collect. NEON will provide feedback and support to PIs in their requests and proposals to NSF for potential new data and we will relay these requests to the NSF. This topic is a challenge as we want the Strategic Plan to inspire, while also managing expectations of the community. As this is early in NEON's lifetime, we think that focusing on realizing the potential of the data and samples we are already collecting should be a higher priority than expanding scope, although some attention will be reserved for the latter.

In addition, the STEAC suggests NEON consider how to improve messaging around pilot programs that can be used to test out new measurement technologies. Currently it is not clear what that process is, if there are specific sites NEON would encourage / prefer to host these pilots or specific measurements at and/or modalities that are of highest priority by NEON to

increase efficiencies. The STEAC also raised a question about how NEON could be engaging with use-inspired commercial activities, or those within the NSF or other agencies. The STEAC suggests language that avoids too much specificity but does express a mechanism for piloting new activities or evaluating specific high-priority targets. For example, there are a host of directorates within NSF that could be good targets for partnerships with NEON, including those in Math and Computer Science that could leverage NEON data to work on new and challenging problems associated with Artificial Intelligence / Machine Learning (AI/ML) and biological, multi-scale datasets.

Response: We appreciate this suggestion and have implemented it in the revised Plan with modified language in both Objectives 2.1 and 2.5 (original numbering).

OBJECTIVE 2.2: EXPAND KEY PARTNERSHIPS ACROSS THE FEDERAL GOVERNMENT

In this objective, NEON identified various linkages to potential partners across the federal government. In discussion about this objective, NEON noted a few existing partnerships such as with the Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA) that could be expanded and that have already been useful to NEON. NEON also noted that other obvious areas of partnership, e.g., within human health, have been harder to develop. A discussion about other agencies associated with natural resource management and weather, including the National Oceanic and Atmospheric Administration (NOAA), the United States Department of Agriculture (USDA) with regards to water resources, identified potentially easier targets to address first.

The STEAC supports engagement across the broader Federal government, but notes that because of the breadth of NEON activities, the full list of relevant government partners could be impractical. It was agreed that to be effective, NEON would need to narrow this list and prioritize based on user needs.

Response: We appreciate this comment and have attempted to implement it in the revised Plan.

The STEAC also suggests exploring partnerships with the National Institute of Standards and Technology (NIST) around instrument R&D, cal/val, and other instrument testing and characterization.

Response: We appreciate this suggestion and have implemented it in the revised Plan.

The STEAC notes that it is not clear in the current goal how NEON will aid the community to connect NEON and other datasets and ensure interoperability. Such data interoperability should be highlighted, but it is currently missing in this section.

Response: We appreciate this suggestion and have added interoperability as a key component of Objective 2.3 (original numbering)

It was also suggested that NEON focus on USDA's Long Term Agroecosystem Research Network (LTAR), NASA, and DOE over the next five years and to reduce the number of bullets in the draft in this section into a single partner bullet.

Response: We appreciate this suggested prioritization and agree with it. That said, we prefer to keep some additional context associated with these partners which reads better in separate bullets. We continue to wrestle with the appropriate number of partners beyond this list and plan to continue the discussion with the NSF-convened review panel.

The STEAC suggests that NEON consider how to better leverage their biodiversity monitoring in and around agricultural systems and consider a focus on supporting regenerative agriculture as a use-case. In this vein, the STEAC notes that land use characterization at NEON sites is missing and needs to be provided to users.

Response: We appreciate this suggestion and have added language in the revised Plan. We would argue that land use characterization at NEON sites is not 'missing' but is admittedly not as accessible, comprehensive, and usable as it needs to be. Consequently, we added language to Objective 2.3 (original numbering) regarding these data.

OBJECTIVE 2.3: ENHANCE OPENNESS AND FAIRNESS OF NEON DATA

This objective focused on the accessibility and provenance of NEON data.

The STEAC notes that this objective is critical for NEON and warrants careful planning and consideration for what to include and highlight in the strategic plan. The STEAC also suggests NEON should consider enhancing the language around data integrity, sovereignty, and improving data discovery and include samples alongside data in this section.

Response: We appreciate this suggestion and have reorganized the objectives to bring the CARE principles under the same goal (new Goal 4) as the FAIR (see new v3 Objectives 4.2 and 4.3)

The STEAC notes that the increased focus on "analysis- and AI-ready" datasets is a great goal to have within this objective as its been noted that preparing NEON data to be used in workflows may still be or often is still a barrier to entry for many end-users. For example, this includes providing much lower latency access to ecosystem flux data partitioned, gap filled, and ready to be analyzed. For context, at present many ecological users are not easily able to convert the QA/QC'd flux data to variables of interest (e.g., gross primary productivity, evapotranspiration). In addition, improvements in the time it takes to correct and provide guidance for use of critical datasets (e.g., soil moisture) is warranted, so that users spend less time in data preparation and more time in the discovery and analysis phase. The STEAC feels that working towards this

objective has the potential to be a great mechanism to increase trust in data and use of NEON by the research community.

Response: We appreciate this suggestion and have modified language in the revised Plan to emphasis this need, while also emphasizing the need for partnerships to realize those aspects that are not currently within scope.

The STEAC also notes a number of ways in which NEON could better communicate and improve the curation of genomics data, including being seen as a leader in data collection. But the STEAC notes genomics data discovery is still lagging with NEON data products.

Response: We appreciate this suggestion and have modified language for this strategic goal in the revised Plan (new v3 Objective 4.3, bullet 5) accordingly.

In addition, the STEAC suggests increased effort focused on broader, rapid data visualization tools to aid the user community in identifying, screening, and curating data before download for their local analyses.

Response: We appreciate this suggestion and have modified language in the revised Plan accordingly (new v3 Objectives 4.3 and 4.5).

OBJECTIVE 2.4: INSPIRE AND SUPPORT THE EXPANSION OF THE GLOBAL SCIENTIFIC LANDSCAPE OF ENVIRONMENTAL MONITORING INFRASTRUCTURE.

With respect to Obj. 2.4 the discussion between NEON and the STEAC focused time on what should be included given the scope of NEON. NEON informed the STEAC that the NSF is looking to build on their leadership within the US to be seen as a leader in research infrastructure and be involved in discussion with other government agencies and international partners.

The STEAC appreciates that NEON has been actively fostering connections with other global monitoring networks. This includes the Korean Ecological Network, South African Ecological Observatory network and Australia's Terrestrial Ecosystem Research Network. The STEAC recommended continuing to grow ties with these networks specifically around international standards for biodiversity monitoring data, where NEON could gain insights that would help them grow into a National leader. NEON should also be participating in the IPBES biodiversity monitoring network to the extent that time permits.

Response: We appreciate this suggestion. We did not include a list of all the networks included in the Global Ecosystem Research Infrastructure network currently supported by a NSF AccelNet award in the Plan, but SAEON and TERN are active members of this network. GBIF is a strong leader in aggregating biodiversity monitoring data, and we are working closely with them to realize the goal of contributing interoperable data to their repository. The IPBES is an

excellent global program; however significantly supporting this global effort is outside of the scope of NEON operations.

In addition, the STEAC asked NEON to better define scope and whether they are more of an ecological monitoring network, a data science organization, or both.

Response: First and foremost, NEON collects and delivers high quality ecological data and samples. This process does require a strong foundation in data science and systems architecture, and the users generally require data science skills to leverage NEON. However, from a global standpoint, we are part of an environmental monitoring network.

OBJECTIVE 2.5: EXPAND AND ENHANCE NEON'S RESEARCH SUPPORT SERVICES.

At the regular, virtual STEAC meeting prior to this in-person meeting, the STEAC recommended that the Assignable Assets Program be rebranded as Research Support Services (RSS). The goal of this name change was to increase the awareness and use NEON's technical and support capabilities to optimize the use of NEON assets and provide value-added results for PI driven research programs.

The STEAC appreciates NEON's vision for the RSS program, but also has several recommendations to improve the messaging and therefore uptake of the RSS moving forward. The STEAC recommends identifying which services are most valued by the community and gearing the RSS toward those services while ensuring potential end-users understand how to engage and apply for those services. The STEAC also sought clarity from NEON on what the primary focus of the RSS is - whether it is more for physical hardware support, research support (e.g., providing technicians to assist in sample collection) or both?

Response: The purpose of RSS is to enable the community to maximize the utility of NEON for science. We have not defined a primary focus. Users to date have opted for both use of our tower infrastructure and staff to collect additional data and samples, so we could not justify selection of either.

The STEAC also wonders whether the RSS is a good mechanism for commercial space engagement. The STEAC suggests NEON consider how it can better leverage computational resources including CyVerse to provide cloud-computing resources to researchers via the RSS program. In addition, regarding commercial space engagement, the STEAC raised a concern about potential mixing of priorities between the research community needs and commercial requirements - this was highlighted as a potential risk that needs careful consideration.

Response: We appreciate these comments. We acknowledge the challenges that commercial use entail and will continue to work with the NSF to refine priorities and resolve conflicts, if they arise. Currently research and educational uses are given higher priority over commercial use of assets. It is our understanding that CyVerse leverages Jetstream2 for its cloud resources and can no longer offer additional cloud resources. We are considering the potential for

provisioning a limited amount of resources via a data workbench; however existing cloud services are already set up to provide resources in exchange for payment, so it is not clear how NEON would benefit from setting up a similar environment.

Strategic Plan Goal 3 - Evolving Platform

Strategic goal three, Evolving Platform, sought to strike a balance between advancing technology used in the observatory while recognizing that NEON is a large observatory and therefore it takes time to alter course. NEON recognized a need to both provide reliable data streams while making room for optimizations and technological advancements such that it can catalyze research and innovation and continue to enable innovative science throughout the multidecadal lifetime of the Observatory.

OBJECTIVE 3.1: ADAPT TO MEET THE CHANGING NEEDS OF OUR USER COMMUNITY.

This objective seeks to set a process for evaluating NEON scope to identify undersubscribed resources.

The STEAC agrees with the need to develop a formal process for evaluating if data products should continue but stressed that such a process needs to be aware that such a wide range of data products involves fundamentally different data needs and usage patterns. For example, some products in the data catalog may require a decade of observations to draw strong conclusions. The STEAC also advises that additional clarity in this objective about what will be led by NEON vs. by the user community would be helpful. In addition, the STEAC advises that NEON conduct a comprehensive analysis when determining why resources are underutilized. A specific example that was discussed were the mobile deployment platforms, which are underutilized as the current cost model makes these platforms inaccessible to most users.

Response: NEON appreciates the guidance provided by the STEAC and making NEON aware of some of the potential constraints and considerations when conducting the data and resource usage analysis. Careful attention will be made to understand the temporal requirements of data product usage and not react to current usage statistics alone. Rewording in bullet 2 reflects our plan to work with NSF to establish a process and frequency for community review. NEON will also continue to evaluate the use of TWGs in providing additional guidance versus the leadership role NEON plays.

OBJECTIVE 3.2: DEVELOP FORWARD LOOKING VISION THROUGH EMERGING TECHNOLOGIES.

This objective sought to formalize a strategy for innovation and considered the potential use of AI/ML to optimize Observatory operations.

The STEAC suggests that NEON continue to engage with the Technical Working Groups (TWGs) to determine relevant data products to innovate, but also recommended that NEON should

continue to build connections and exchange knowledge with other observational networks for ideas. The STEAC also recommends using the expected lifetimes of instruments to guide replacement and to revisit technology selections. The STEAC supports exploration of using AI/ML to search for operational efficiencies but stressed the need for a formal mechanism to evaluate these potential changes, ideally involving a TWG or other portions of the community with relevant expertise.

Response: NEON appreciates the guidance that the STEAC has provided in moving forward with the use of AI/ML to explore operational efficiencies and understands the need to broaden and leverage existing expertise through TWGs and to leverage our existing formal process to evaluate potential changes.

OBJECTIVE 3.3: SUPPORT COMMUNITY-DRIVEN INITIATIVES TO EXPAND NEON CAPABILITIES.

This objective considered how to create a framework for augmenting NEON with community-led products and initiatives.

The STEAC acknowledges a challenge facing NEON where there is confusion between NEON and its user community about roles and responsibilities with respect to derived data products. NEON would like to support community development efforts, but they are often out of NEON scope. The STEAC suggests exploring the potential of NSF workshop funding to explore data product development, but also stressed that there needs to be improved methods of translating developments to sustained funding or to industry partnerships.

Response: NEON appreciated the guidance that the STEAC has provided in framing the balance between working within NEON scope and exploring user community driven derived data product development. NEON will continue to explore opportunities with the NSF to navigate a path forward for potential product identification, development and sustainment.

NEON-ESIIL Partnership

Broaden the many profitable avenues of collaboration with ESIIL

Response: We agree that there are many amazing opportunities at the intersection of NEON and ESIIL.

- We will continue to build these and seek collaboration through common partners as noted by the STEAC and consider how with new funding to ESIIL and NEON, build a program that provides retention through professional skills development for NEON seasonal staff.
- We will also seek to develop a partnership with ESIIL that is focused as suggested, on tools, techniques and resources focused on growing the usage of AI/ML for biological data.
- We will continue to look to ESIIL in handling issues of tribal data sovereignty.

It was also noted that NEON could learn how to better incorporate external data through the examples already being developed by ESIIL. The STEAC made recommendations on new types / sources of data that would be of particular interest to the ecological community, including packaging bundles of multi-instrument remote sensing data from the International Space Station (e.g., ECOSTRESS, EMIT, and GEDI) which would be synergistic with NEON data, including the AOP.

Response: It is out of scope for NEON to serve external data.

The STEAC also suggests that NEON could learn from ESIIL regarding tracking data usage statistics.

Response: ESIIL does not yet have a tracking system in place; NEON is much further along in this regard. We intend to work closely with them to monitor the use of NEON data.

Strategic Plan: Goal 4 - Empowering Users

Strategic goal four, Empowering Users, describes how NEON is attempting to serve users by providing tutorials and workshops that help users understand how to best leverage NEON data and samples housed in the Biorepository in their research.

OBJECTIVE 4.1: LEVERAGE PARTNERSHIPS TO EXPAND AND EVOLVE DATA SKILLS AND TRAINING RESOURCES IN RESPONSE TO USER NEED.

This objective focused on strengthening and expanding collaborations to provide users with educational resources related to the skills they need for engaging with NEON data and samples.

The STEAC suggests finding and supporting proposals from academic partners that can develop new curricula, data packages, and teaching materials. NEON could work as a mentor for early career researchers by advising them on efficient use of NEON data and to develop ideas and support their proposals. The STEAC also suggests that NEON should participate in workshops on proposal writing to find partners that could include teaching modules, Environmental Data Initiative (EDI) workshops, and tutorials as part of the broader impact of their proposal.

Response: We appreciate the thoughtful comments related to engaging with partners and users on funding proposals and will continue to find ways to support such conversations around the ways in which NEON data and samples can support research interests of the scientific community; however, we are not able to lead proposal writing efforts or training on proposal writing efforts. We have revised the Plan to include ways in which the Ambassadors and Post-Doctoral Programs and Convergence Summits may support the convening and mentoring of early career scientists and research interests with available NEON data and samples.

OBJECTIVE 4.2: BUILD THE NEON OWNERSHIP OF USERS - YOUR OBSERVATORY (BUILT FOR AND BY YOU, YOU CAN ENABLE CHANGE)

This objective described a community needs assessment to be performed every five years and highlighted outreach activities (e.g., NEON Ambassadors Program, Postdoctoral Fellows, Domain activities, and a new biennial NEON Convergence Summit).

The STEAC suggests that the NEON Convergence Summit could be an effective way to engage with the community of PIs from the sunsetted Macrosystems Biology and NEON Enabled Science Program.

Response: We will take this recommendation into consideration during planning efforts for the Convergence Summit.

OBJECTIVE 4.3: INCREASE NEON ENGAGEMENT WITH BROADER SOCIETAL PARTNERS.

This objective highlighted how NEON could support Domain staff to engage in local community science and considered broadening engagement for translational applications.

The STEAC also suggests NEON consider engaging with the tribal communities, K-12, and Minority Serving Institution (MSI). The discussion highlighted the need to create some mechanism to allow faculty from MSIs to work on curriculum development using NEON data in exchange for teaching relief.

Response: We appreciate the thoughtful comments related to broadening reach provided by the STEAC, particularly with underserved communities. Unfortunately, K-12 STEM activities are currently outside the scope of the NEON program and a successful focus of many other programs; instead, NEON's focus of engagement is with end users in higher education and the research community. NEON recognizes the challenges of resources for MSIs and we will continue to work with NSF to explore ways to lower the barrier to entry with them and tribal colleges to participate in training and/or write proposals to utilize NEON data.

Strategic Plan: Goal 5 - Inclusive Community

OBJECTIVE 5.1: DEVELOP AND RETAIN INTERNAL TALENT (PROFESSIONAL DEVELOPMENT)

Battelle has a variety of plans that enhance the welfare and well-being of its staff. NEON planned to continue to encourage all of its staff, both permanent and temporary, to take advantage of these programs, which includes programs on professional development and rotational assignments. NEON also planned to continue to publicize opportunities for career development especially for new and seasonal staff.

The STEAC suggests that in addition to these efforts, the strategic plan should find a way to support a grant mentor to assist NEON staff scientists, as well as external scientists, with grant writing to facilitate using the data portal. To assist with grants targeting appropriate NSF and

foundation sponsored programs, the strategic plan should create an 'idea marketplace' to support new NEON data users and to encourage the expansion of new ideas on data needs as well as on data collecting technologies and data analytics from established and new scientists. For instance, NASA has an internal "Talent Marketplace" https://blogs.nasa.gov/futureofwork/tag/talent-marketplace/ that could serve as a guide.

Response: In relation to internal staff development (the focus of this goal), we will continue to involve staff in proposal writing. In relation to external members of the community, we will pass along this input to NSF, as it relates to existing funding opportunities with NSF related to NEON. While we do support NSF in promoting their related funding opportunities (e.g., Macrosystems Biology), NSF owns the responsibility for their own sponsored programs. Pursuant to available funds, NEON could extend NEON Connect to be externally facing, enabling data users and interested parties to share ideas and connect with each other in relation to developing proposals for additional funding related to NEON.

OBJECTIVE 5.2: BUILD AN INCLUSIVE CULTURE THAT WORKS TOWARDS INCREASED DIVERSITY OF WORKFORCE

Currently, Battelle and NEON promote culture training so that all staff, especially new and temporary staff, know the core values and mission of NEON to foster group cohesion. This is especially important for reinforcing conduct standards.

The STEAC feels the plan should also continue to emphasize the need for inclusive and ethnically diverse hirings by visiting a wide range of universities and career fairs. The STEAC recommends that the plan should also continue to ensure that culturally appropriate language is used in NEON programs, tools, and distributed materials. Going forward, the STEAC recommends that the plan develop ways to build closer relationships to academic institutions of underrepresented minorities to free up time for faculty at these institutions to develop grants to use NEON data. In addition, the strategic plan should develop ways of building stronger links to the Ecological Society of America (ESA) by placing a NEON staff member on ESA's boards of certification for diversity practitioners and media.

Response: Agree with all points, in most cases Battelle has already either started or has in place something that addresses the suggestion. We will need to do better and translate those efforts into results in the NEON workforce. For example, Battelle does participate in visits and career fairs at a wide range of academic institutions and works with a HBCU consortium. While we already work with ESA on ecology certification, expanding that to work they are doing on diversity would be a natural extension.

OBJECTIVE 5.3: IMPROVE ACCESSIBILITY AND INCLUSIVITY OF DIGITAL RESOURCES

NEON provided clarification about what was meant by accessibility in this objective. This objective focuses on accessibility regarding the Americans with Disabilities Act (ADA) Standards for accessible design. Section 508 is part of a 1998 amendment to the Rehabilitation Act of 1973 that requires all federal electronic content to be accessible.

The STEAC recommends that to ensure that all scientific communities have access to NEON data, the plan should find ways for ADA users to access the data portal; money exists in the budget to do so. The STEAC also feels that the plan should develop a regular review process to assess how easily digital resources can be accessed by outside groups. This process should start with translating tools and resources into foreign languages. Such a process should ensure that data is used ethically, that data sovereignty is acknowledged, and that traditional ecological knowledge is noted when appropriate. Applying the Collective benefit, Authority to control, Responsibility, and Ethics (CARE) standards and leveraging a partnership with ESIL to guide plan development would be good ways to begin. Another good next step would be for NEON to form an external advisory group consisting of members experienced with these issues to review plan development.

Response: Agreed. NEON is already planning to increase accessibility to the data portal and is working through a contingency funding opportunity that includes this. We are working on translating NEON outreach materials into the Spanish to assist in reaching a wider group of users. CARE (particularly related to data sovereignty) is another area we are planning to work on. ESIIL is already a partner, and we will continue to work with them to improve, particularly in the implementation of CARE principles. We will look at what mechanisms are needed to help draft, review, and implement these ideas, including using external resources as needed.

Innovation Advisory Council

NEON discussed how in addition to the NEON STEAC and TWGs believe it would be helpful to establish an AI Operations for Data Advisory Sub Committee. This would be a council of 4-5 members that would play a complementary role to STEAC. Establishment of the council should not change the scope of the STEAC. The council would not play a decision making role, and NEON would still rely on the STEAC for this. A strategic focus would be needed to implement the council, with expertise from big tech companies. Ideally, the council would not impact membership of the STEAC, which would retain ten members. The council would be separate and auxiliary to the STEAC, ad hoc, and formed/chartered as needed then dissolved.

The STEAC feels that there would need to be awareness of potential conflicts of interest, For example, it would be problematic if someone from Google proposed something in the company's interest when Google is already under contract to provide services to NEON. NEON would have to pay attention to who is on the council. It would be ok to have Google Earth Engine on the council, but not Google Cloud services. It would also be important to have neutral brokers from the Academic community serve on the council.

The STEAC also notes that early career scientists who want to get involved with AI model training could make a career out of involvement in the council, e.g., training models to recognize traits for the estimated two million species on Planet Earth. The STEAC notes that it would also be good to have expertise on the council from different domains of science. NEON should consider having experts serve on the council for a short period of time to figure out the best approach for longer term service. It would be good to have people who are outside of ecology/biology (e.g., NASA) on the council. The kinds of studies the council could advise on could include large, robust datasets, such as genomic data or dark data that biologists have been collecting for long periods of time, but with gaps of analytical capability, which might require AI expertise.

Overall, the STEAC feels that It would be good to examine bodies like this with other organizations (e.g., NSF Science centers to see what can be learned from NSF Science and technology Centers and synthesis centers) to determine how such a group could benefit NEON.

Response: We appreciate your input here and will take care to consider conflicts of interest as per above. We will take your ideas for membership in such a committee under advisement as we develop the charter and call for the committee.

24 June 2024

Day Two

Reflections on Day One

NSF NEON Cognizant Program Director Visit: Dr. Charlotte Roehm

The STEAC and NEON Staff met with Dr. Charlotte Roehm, NSF NEON Cognizant Program Director for one hour on the second day of the meeting. Following STEAC introductions, Dr. Roehm expressed NSF gratitude for STEAC engagement and noted that the STEAC represents an important, holistic perspective. STEAC Chair, Sydne Record took the lead in asking a series of questions identified by the Committee, aimed at exploring opportunities to raise and generate awareness of NEON data potential across NSF Directorates and funding opportunities.

This first question concerned the sunsetting of the NSF Macrosystems Biology (MSB) Program, and NSF's intent to track subsequent changes in awards leveraging NEON data or NEON-enabled science more broadly. Dr. Roehm responded that the agency has used publication metrics to identify strong community engagement with NEON. She noted that current NEON-enabled science is primarily happening in the ecology community, but that other disciplines are increasingly using NEON. While the MSB program was primarily funding the ecology community, Dr. Roehm was hopeful that core programs across directorates will receive proposals that include NEON resources and data. She noted that there is an internal NSF effort to make sure a range of core programs make their communities NEON-aware. Regarding assessment following the loss of the MSB Program, Dr. Roehm reminded the STEAC that her role is in the DBI directorate, and MSB was a DEB program, while noting that assessment is continuous across NSF. She encouraged STEAC members to reach out to DEB for more information about MSB impacts.

STEAC members noted that there may be a need for increased NSF-led efforts to help current and potential NEON users to understand what being in DBI means for NEON funding support and what the possible connections and synergies are across the BIO Program (and beyond). Along these lines, STEAC posed a number of questions and suggestions related to opportunities for growing awareness and opportunities for NEON-enabled science. Several suggestions were related to ensuring that NEON is flagged on future RFPs and other funding announcements, including future Synthesis Centers, special programs to support undergraduate teaching and research, and in core programs located across Divisions (e.g., BIO, CISE and TIP mentioned). Flagging NEON in more early career award RFPs could also help raise awareness and support a culture of NEON use (e.g., GRFPs, postdoctoral programs, considering a targeted dissertation improvement mechanism).

A third topic raised by STEAC was the perceived need to better support faculty at Minority Serving Institutions to engage with NEON. Members noted that a critical limitation is often the burden of higher teaching loads and that while this is a broader issue, NEON represents a unique opportunity. Dr. Roehm confirmed that while there are a number of NSF funding opportunities in BIO aimed at different career stages ; a few include opportunities for reducing teaching loads such as the cross-NSF GRANTED program.

The STEAC noted that RCN funding often does not include buyout time to reduce teaching loads. Reducing teaching loads to open time is critical for faculty to develop skills, new curriculum, field labs, etc. The STEAC felt that funding to support developing field labs at schools near NEON sites would provide a powerful learning experience and potentially value-added data products for NEON. The STEAC also noted that funded training opportunities in computer science or instrumentation engineering could broaden engagement at MSIs and across NSF Divisions.

The STEAC was particularly interested in potential NSF mechanisms that could support partnerships between NEON and computer scientists to explore ML/AI algorithm development. Dr. Roehm reminded the STEAC that NEON was not built to be at the forefront of technological development, but the Observatory could be leveraged to push technological development that may also potentially benefit Observatory efficiency. She pointed to the Computer and Information Science and Engineering Program (CISE) National Artificial Intelligence Research Resource (NAIRR) pilot program at NSF, aimed at developing infrastructure and data readiness. This pilot may be relevant for NEON data opportunities as it represents a suite of collaborating agencies and partnerships beyond NSF.

The STEAC suggested ideas for inter-agency partnerships that could benefit NEON included NEON partnerships with NASA on ARID or PANGEA field campaigns, and with DOE ARM/ASR, Coastal/TAI, NGEEs (2.0), or E3SM.

The STEAC followed up with questions about NSF help facilitating such partnerships. Dr. Roehm noted that the ongoing partnerships with DOE were strong and reflected a good protocol. She is the NSF point person for representing NEON in internal and cross-agency discussions but noted that these conversations are really motivated by community demand. Such community need is often identified through workshops, where a community member reaches out to NSF Program Officers with an idea and 1-page proposal. The STEAC asked specifically about seed money and funding to facilitate pilot studies and technology development (e.g., a marketplace of ideas approach). Dr. Roehm pointed towards DBI innovation grants, which include three tracks (i.e., innovation, capacity, sustainability) to support new cyberinfrastructure. She indicated that algorithms might be included in innovation funding, and she advised contacting the relevant POs for that program. The STEAC pointed out that this DBI mechanism was still a full proposal process with all the time demands and lengthy decision processing. RAPID awards were suggested as a faster response mechanism, as appropriate. Dr. Roehm recommended the TIP Directorate as a place to look for technology and innovation opportunities. Technology and Innovation support through TIP is looking to partner scientific needs with industry partners. The program is supposed to help identify the relevant industry partners and the program has specific aims for development and scaling out.

The STEAC reflected that many NSF Centers, such as ESIIL, have capacity to regrant NSF money, a much faster mechanism for supporting pilot and exploratory work. This was not part of the NEON mandate but does often create a mismatch in NEON capacity and community expectations. The STEAC noted that NEON needs guidance to craft a clear statement about where to redirect community members looking for support for pilot/exploratory work directly aimed at improving NEON capacity and use.

24 June 2024

New member application reviews

The STEAC considered seven nominations for STEAC membership for 2-3 positions. Per our Bylaws, each nominee was first discussed individually and the STEAC voted on whether each individual was suitable. Suitability was determined based on conflicts of interest and the topical needs of the STEAC. After this the STEAC deliberated keeping in mind the following focal areas where there are recruiting needs in terms of expertise: eddy covariance, aquatic sciences, and instrumentation and software development. Candidates were identified to invite and this list was sent to Paula Mabee and Mike Kuhlman. There was also discussion that we will have a large number of STEAC members cycling off in the coming year, so some candidates could be considered later.

STEAC Business and Report Planning

In planning the report, the STEAC identified some additional areas for NEON to consider regarding community engagement. The STEAC wants to emphasize that NEON should inform the community of NEON researchers and potential researchers to explore NSF funding mechanisms (EAGER, RAPID, Workshops/symposia/conferences, planning grants etc.). These applications are easy to write (not full 15-page proposals), are reviewed internally, are great sources of seed funding and often produce ideas or preliminary data for bigger proposals in the future. A member of NEON staff could research and inform the community of the basic mechanisms for preparing these applications, the instructions for which are not described in solicitations. Most of these funding mechanisms are known only by program officers or described in the grant proposal guide.

Response: Currently NSF bears responsibility for making the community aware of their funding mechanisms. NSF assigns a cognizant Program Director to each of their solicitations, and this needs to be the primary contact for the community. NEON staff are not NSF staff and do not have the internal knowledge to guide the community through NSF's opportunities

The STEAC also notes that there is a need for a bigger community of ecologists to pursue research with NEON data. Some of the hesitancy may be related to data latency requiring more attention to reporting to the community on the stages of data processing and readiness (e.g., the AOP data). The STEAC also notes that the microbial data gathered by NEON seems underutilized.

Response: The previously mentioned issue of microbial data is addressed in v3 (new) Objective 4.3. We are pursuing multiple avenues of increasing awareness of NEON microbial data, facilitated primarily by the ongoing NMDC collaboration. AOP data latency in recent years has been increased due to unplanned issues with calibration; we are optimistic to be able to return to the planned latency of approx. 60 days in 2025. We are open to suggestions on how to benchmark the usage statistics for NEON data to inform 'underuse', as well as ideas for increasing use. We believe that the data portal development work we hope to get funded represents a key prong of this strategy.

Another issue is NEON's underutilized mobile platforms, which are too expensive to deploy and therefore too difficult for individual PIs to utilize. Use of the mobile platforms must be planned and coordinated by multi-PI collaborations. NEON needs to inform researchers about the availability of the platforms, the cost of using them, means of finding support for this (based on uses by others), and how to go about finding this support. It may be necessary for the STEAC to give NEON guidance on how to better promote research with NEON data and to assign this responsibility at NEON to a dedicated liaison.

Response: At our follow-up discussion with the STEAC (15 May 2024), we discussed every avenue previously suggested by the STEAC, NSF, and others to encourage use of the mobile deployment platforms. The primary issue seems to be the cost of the MDPs, i.e., that it seems prohibitive to PIs to propose, even though NSF review criteria do not include reviewer assessment of the proposed budget. Thus, and as per the outcome of this previous discussion, we will request that the NSF consider alternative mechanisms by which assignable assets are funded. For example, it was suggested that NSF set aside a dedicated pool of funds from which NEON Assignable Assets are funded vs. through individually requested PI funding.