NSF BIO Advisory Committee Subcommittee on Community Development for the National Ecological Observatory Network

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Subcommittee members: Jeannine Cavender-Bares[1], Paul C. Hanson[2] (Chair), Scott V Ollinger[3], Temuulen Sankey[4], Ethan White[5]

[1]University of Minnesota; [2]University of Wisconsin-Madison; [3]University of New Hampshire; [4]Northern Arizona University; [5]University of Florida

1. Executive summary

A subcommittee of the National Science Foundation Biological Sciences Advisory Committee (hereafter called, "NSF BIO AC") was convened to discuss the formation of an entity to represent the scientific community and its role in coordinating National Ecological Observatory Network (NEON) science, education, and outreach. The subcommittee considered NEON's current functions and identified needs for activities or processes that are either presently absent or would be best conducted independently of NSF or the NEON operator. The subcommittee recommends that the needs identified are best met by the formation of an independent entity that organizes the scientific community in its use of and interactions with NEON and its communication with NSF. The subcommittee also recognizes the commitment and professionalism of current NEON staff and their vital importance to NEON's success. As such, the recommendations herein are made in a spirit of collaboration that strengthens the ties between the scientific community and the staff and leadership of NEON.

The subcommittee envisions an entity that maximizes NEON's potential by leveraging and building the community's sense of excitement for and ownership of the science NEON was designed to foster. The entity's activities would broadly be: ***community development*** to expand the use of NEON data and NEON-enabled collaboration; ***communication*** to enhance dialog between NEON and the community; and ***evaluation and assessment*** to provide NEON and NSF with greater access to the perspectives, feedback, and expertise of the science community. The entity would be one with convening power, and its role as an incubator for NEON-enabled science and education would enable it to provide an independent and more unified voice for the research community than is currently possible. These recommendations serve to empower the research community and strengthen its commitment to a successful NEON future.

2. Motivation for this report

NEON is a national-scale observatory designed to provide essential data to the ecological community to enable fundamental research on biological responses to shifting environmental conditions, land-use changes, and invasive species. The scale of infrastructure and coordination required by NEON is new to ecology. The task of establishing a project as large and ambitious as NEON is enormous. While NEON (hereafter also called "the observatory") is now fully operational, challenges remain to accomplishing its ambitious goals. In particular, meeting these goals requires active collaboration—both between NEON and the scientific community and among members of the scientific community conducting research involving NEON and its resources.

While established precedents of community engagement from other large infrastructure projects are useful as models, they are also insufficient because of the unique challenges and opportunities that emerge in the monitoring of ecological systems.

Active collaboration and trust between the observatory and the research community will ensure that strategic planning and operations of the observatory are aligned with the broader vision and needs of the scientific community and that the community remains invested and committed to NEON's success. A collaborative process is particularly important because a large fraction of the scientific community has yet to become actively engaged with NEON. Developing a broader science community working with NEON will allow inclusive, coordinated and innovative engagement that will both enhance the use of NEON data and improve the management and operation of NEON. NEON-led and grassroots efforts have begun to address these needs, but there has not yet been a coordinated community-led effort to determine the best approaches for community engagement. The subcommittee reached consensus early that an independent entity is necessary to organize and represent the community in its use and interactions with NEON. Thereafter, the goals of the subcommittee were to formulate the vision for that entity, identify its key functions and structural attributes, and define at a high level its relationships with NEON and the NSF.

3. Process of the subcommittee

The subcommittee met through video conference on 13 March 2019, 27 March 2019, 08 April 2019, 17 April 2019, 29 April 2019, 08 May 2019, and 10 May 2019. The subcommittee reviewed examples of various user groups and other coordinating entities that might be similar to the proposed entity. These ranged from those designed for facilities in physics (e.g., LIGO) and geosciences (e.g., Ocean Observing Initiative) to those designed for the biological sciences (e.g., LTER). Drawing upon salient components of these existing models and discussion of desired attributes, the group converged on a shared vision through iterative discussion and collaborative writing.

4. The need for community coordination

The subcommittee identified several ways in which an independent entity is needed to facilitate enhanced coordination among NEON, its science user communities, and NSF. Broadly speaking, the goals identified for the entity are intended to maximize the benefits of NEON as a valued resource for scientific discovery, to create an open and inclusive community that feels a sense of ownership of, and commitment to, NEON, and to help ensure sound decision-making as the future of the observatory unfolds and adapts to the needs of future scientists.

The goal of broad community coordination is best met by a community-run independent entity with the power to convene. This will help ensure that community engagement is not an afterthought and will help proactively address concerns that, in the past, dialog between NEON and the community has been too limited to fully engage the breadth of scientists needed to ensure NEON’s success. Such an approach will also empower the community by giving them a voice and allowing them to retain the sense of pride and investment in NEON. The subcommittee identified the following specific needs that must be met to achieve these goals.

4.A. Organization of the community: While there exists a segment of the scientific community that is engaged with NEON as users, Technical Working Group (TWG) members, or advisory committee members, there are many potential NEON users who are not yet engaged with the observatory. Potential NEON users would benefit from a central forum for interaction and exchange with other community members to discuss ideas, challenges, and potential collaborations. Since NEON is designed to broadly influence the study of ecology, it is essential that we take an active approach to engaging all members of the broader scientific community, with an eye toward diversity and inclusivity. The goal is not merely outreach but to actively engage, organize, and develop a vigorous and collaborative community.

4.B. A two-way conduit for information between NEON and its user communities: An open channel of communication between the scientific community and NEON is needed to inspire ideas, inform users of the details and workings of NEON resources, and foster better understanding of the challenges and limitations of running NEON, as well as to provide NEON with important feedback from the scientific community. Active collaboration between the scientific community and the NEON staff and leadership will enable decisions to be made with a full understanding of both the community needs and the limitations faced by the NEON operator. The communication process should involve open and broad dissemination of resulting decisions so that the community can understand the rationale for why specific decisions are made.

4.C. A "Science Incubator" platform for innovation and idea generation: Given the novelty of open, continental-scale, high volume ecological data streams, the science community will benefit from a platform to support creative thinking and idea sharing that will accelerate discovery. A science incubator could foster ideas that lead to local as well as continental-scale science, promote collaborations across historically disparate communities, and catalyze the integration of data from NEON and other sources. As the community of NEON data users grows, a science incubator will become critical to support working groups for data coordination, analysis, and synthesis.

4.D. Community evaluation and assessment of NEON data and science: Maintaining NEON as a high-quality distributed measurement platform that optimizes costs and maximizes its potential to accomplish its high-level science goals will require evaluation of NEON data, NEON services, and the resulting science in a way that identifies strengths and weaknesses and supports positive and transparent decision making. Although NSF has a process for formal evaluation and review of NEON, we see a need for an additional, community-led mechanism through which the experiences and expertise of the community can be ingested, and feedback can inform NEON operations.

5. Recommendations

5.A. Vision for an entity: The subcommittee recommends the formation of a new entity that represents the interests and views of the user community and organizes the user community to help accomplish NEON's vision. The entity should be independent from NEON and should represent the breadth of the potential scientific user community by engaging multiple dimensions of diversity. The entity should have the power to create change that contributes to the success of NEON. That power should derive from its

credibility within the scientific community, its role in evaluation and assessment, and from the responsibilities and authorities conferred to it by the NSF. The entity should work collaboratively with NEON staff and leadership to ensure that the community recognizes the challenges and constraints inherent in building and maintaining a distributed continental-scale observatory. This collaboration will foster constructive communication between NEON and the scientific community.

5.B. Key functions of the entity: The subcommittee recommends that the entity focus on enabling science by the community, rather than conducting scientific research itself. To build a broad research community that leverages NEON's resources to help accomplish the observatory's scientific mission and to empower the community to play an active role in NEON's future, the subcommittee recommends the following functions:

5.B.1. Research community development: Developing a community among the researchers working with NEON will allow for more inclusive, effective, and coordinated efforts to answer the broad scientific questions the observatory is designed to address. Specifically, community development should strive to engage a breadth of scientists diverse in demography, disciplines, and geographies. Community development should engage researchers and stakeholders around both large-scale research—using multiple NEON regions—and local-scale research, focusing on a single site or domain. One of the core challenges for the NEON research community will be navigating the new kinds of team science enabled by NEON. The subcommittee recommends a working group-based **incubator program** in which groups of diverse scientists are assembled in a forum designed to inform and educate participants about NEON capacity, build trust and collaboration, and to inspire innovative thinking and the formation of impactful science ideas and projects. The incubator approach should be supplemented by or coordinated with regular interactions among the broader NEON research community and NEON staff through events such as conferences connected with national and international scientific societies and in some cases at the NEON sites. The subcommittee also recommends an online platform to facilitate and encourage interactions. Furthermore, the subcommittee recommends these efforts explore new approaches for community building including "unconferences" (meetings that focus less on presenting and more on interaction) similar to the approach being developed as part of the NEON Science Summit. Community engagement efforts should be made accessible to the entire community by establishing remote participation (e.g., streaming/recording of all talks) and codes of conduct as part of the foundation of these efforts.

5.B.2. Communication between the research community and NEON: To maximize the breadth of the community that can provide ideas and feedback on data collection, the subcommittee recommends that—in addition to involving selected members of the community in protocol development—avenues be developed to solicit feedback from the broader community related to those protocols and to the higher-level relationships among them. Such avenues could include the use of the online engagement platform described above to solicit feedback, the development of a broad-scale community peer review process of proposed protocol changes similar to that implemented by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC) or some other mechanism for broad community engagement. The subcommittee also recommends open reporting of the decision making process to provide transparency. Communicating the rationale for specific decisions will help make clear the tradeoffs involved, the

compromises made to address the diversity of questions and perspectives within the community, and the nature of the user community input in the decision-making process.

5.B.3. Community evaluation and assessment: The entity should conduct assessment that serves to evaluate community progress in the use of NEON resources, survey the views, attitudes, and priorities of the community with respect to the quality of NEON data and NEON services, and inform decision-making for the entity, NEON, and the NSF. Formal assessment should be conducted using broadly accepted assessment methods that are designed, used, and interpreted in consultation with assessment professionals. Assessment and dissemination of assessment outcomes should be conducted on a regular basis consistent with evaluation goals. Assessment results should be shared broadly and should be designed to help members of the community understand the breadth of opinions present in the research community and inspire thoughtful discussion around challenging topics.

5.C. Structural and governance attributes of the entity: The subcommittee recommends an entity structure and governance that is representative of the scientific community, inclusive of multiple dimensions of diversity, transparent in its operations and decision-making, and that provides multiple leadership opportunities within the entity. The entity should strive for an organizational structure and operation that encourages a consensus approach to decision-making within the entity. The entity should have a structural component whose responsibilities include active engagement of the NEON operator and the scientific community to inform decision-making within the entity and that supports co-generation of new ideas. Leadership should be drawn largely from the science community, with pro-active efforts made to ensure diversity.

5.D. Relationship with NEON: A collaborative and communicative relationship between the entity and NEON will be critical to the successful engagement of the scientific community and to the use, strategic decision-making, and operation of NEON. To this end, the success of the new entity will depend, in part, on strong science leadership within NEON that has the ability to make meaningful use of community input. The subcommittee envisions communication would happen through both formal and informal mechanisms, including through collaborations between the entity and NEON across multiple levels of scientific staff. Collaboration between the entity and NEON should involve open and broad communication of resulting advice and decisions so that the broader community can understand why specific advice and decisions were made.

5.E. Relationship with NSF: The entity requires a unique relationship with the NSF because of its role in supporting the success of BIO's first and only Major Research Equipment and Facilities Construction project. The subcommittee recommends that NSF identify the entity as the primary organizing mechanism for the NEON community and confer to it a commensurate level of responsibility and authority, including the power to convene the community. Through a formalized relationship between the entity and the NSF BIO AC, the entity should provide feedback to NSF that helps guide the use, operation of, and strategic planning for NEON. Community development of the magnitude envisioned here requires years to build and requires continual evolution with the changing needs of the community and NEON science. Therefore, the entity should persist through time to the extent necessary to carry out its mission.