IBRCS White Paper

A Plan for Developing and Governing the National Ecological Observatory Network (NEON)

Report from the NEON Coordination and Implementation Conference

September 4–6, 2003
National Museum of Natural History

November 10–11, 2003
American Institute of Biological Sciences

neon
National Ecological Observatory Network

American Institute of Biological Sciences

IBRCS
Infrastructure for Biology at Regional to Continental Scales
A community resource by AIBS

The IBRCS Program

The IBRCS Program, an effort by the American Institute of Biological Sciences (AIBS), launched in August 2002 with support from the National Science Foundation. The following are the program's goals:

- Help the biological and the larger scientific community—within and beyond the AIBS membership—to determine the needs and means for increased physical infrastructure and connectivity in observational platforms, data collection and analysis, and database networking in both field biology and other more general areas of biology and science.
- Provide for communications within this community and with NSF regarding the development and focus of relevant infrastructure and data-networking projects.
- Facilitate the synergistic connection of diverse researchers and research organizations that can exploit the power of a large-scale biological observatory program.
- Disseminate information about biological observatory programs and other relevant infrastructure and data-networking projects to the scientific community, the public policy community, the media, and the general public.

The program is led by a working group comprising biologists elected from the AIBS membership of scientific societies and organizations and appointed from the scientific community at-large. It is assisted by a variety of technical advisors.

The program has a special focus on the National Ecological Observatory Network (NEON), which is a major NSF initiative to establish a national platform for integrated studies and monitoring of natural processes at all spatial scales, time scales, and levels of biological organization.

Jeffrey Goldman, PhD, is the Director of the IBRCS program. He and Richard O'Grady, PhD, AIBS executive director, are co-principal investigators under the grant. Additional information is available at *http://ibrcs.aibs.org.*

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About the American Institute of Biological Sciences

The American Institute of Biological Sciences is a non-profit(c)(3) scientific organization of more than 6,000 individuals and 86 professional societies. AIBS performs a variety of public and membership services, which include publishing the science magazine, BioScience, convening meetings, and conducing scientific peer review and advisory services for government agencies and other clients.

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Preface

On September 4–6, 2003, the American Institute of Biological Sciences (AIBS) convened the NEON Coordination and Implementation Conference at the National Museum of Natural History, Smithsonian Institution, to consider how best to coordinate and implement NEON at the national level. Participants included members of the AIBS working group on biological infrastructure; experts in the building and operation of large scientific networks, facilities, and organizations; and other NEON stakeholders (see Appendix for list of attendees). Observers from NSF and the National Research Council also attended (also listed in Appendix). Following the solicitation of public comments on a draft conference report, AIBS convened a follow-up meeting of the report authors on November 10–11, 2003, to discuss the feedback and revise the report. A portion of that follow-up meeting was open to the public, and interested individuals were invited to participate in the session by appearing either in person or via a teleconference or webcast. This report reflects these discussions, written feedback, and an independent National Research Council report on NEON released after this activity was initiated (NRC 2003). While these sources provided invaluable guidance, the views expressed herein are those of the authors.

The plan outlined in this document highlights the need for a National Ecological Observatory Network to study biological processes on national and regional scales. NEON would provide the capacity to address biological themes currently of national concern, as well as novel themes, both regional and national, that are likely to emerge within specific regions experiencing rapid change or unusual environmental conditions. To achieve national coverage quickly, initial development of NEON should focus on a subset of themes of broad interest that can be addressed at all observatories. As more resources become available, the observatories can be enhanced to broaden the scope and capabilities of the national network.

As a fully developed network of regional observatories addressing common themes, NEON can address ecological issues at national and regional scales simultaneously. It should provide high levels of regional research capacity to accommodate differentiation of data gathering and research activities that address core national themes. Therefore, focusing resources at regional scales while coordinating efforts across the national network is critical. This will facilitate planning and coordination among themes and will ensure that NEON activities operate across all levels of biological organization.

To function effectively, NEON should be self-governing and should be accountable to and consider the needs of constituents. It can leverage the expertise and resources provided by legions of interacting scientists, government agencies, nongovernmental organizations, and the private sector to provide our nation with high-quality and accessible information concerning critical changes in the biological processes that sustain our quality of life.

1. Introduction

Dramatic changes now unfolding everywhere on Earth are altering the structure and function of ecological systems at broad spatial scales, ranging from microhabitats to entire biomes and continents. Habitat alteration, redistributions of species at unprecedented levels, major changes in the cycling of nutrients important to life, accumulations of heat-trapping gases in the atmosphere, and other factors are changing the composition of natural ecological communities and are influencing productivity and quality of ecosystems that are essential to the maintenance of our nation's natural resources and the health of its economy.

Pressing environmental challenges such as these are national in their extent. Their solution requires "multiscale research that combines experimentation and observation replicated at numerous sites across the nation" (NRC 2003). The current infrastructure available for research on these issues is inadequate for the task. Much of it supports research on individual species and processes at scales much smaller than individual watersheds and landscapes. Although many research networks exist that are national—even international—in scope, few are set up to function in a way that allows for the synthesis required to address the environmental challenges we face as a nation (Smith *et al*. n.d.).

Based on the need to address these and other environmental challenges, the National Science Foundation (NSF) has proposed to fund the creation of a network of spatially distributed and highly integrated observatories—the National Ecological Observatory Network (NEON). NEON is meant to be a virtual laboratory for comprehensive, synthetic research on biological systems and capable of dealing with phenomena that operate at multiple spatial scales (from microns to continents) and levels of biological organization (from molecules to landscapes). The goal of NEON is to help scientists develop a predictive understanding of the nature and pace of biological change. NEON is further described in several documents generated by the scientific community (NEON 2000a, NEON 2000b, NEON 2000c, NEON 2002a, NEON 2002b, NEON 2002c, AIBS 2003, NRC 2003).

Developing and operating NEON is an enormous endeavor that will require coordination in a variety of areas, including scientific vision and strategy; financial and project management; governance and membership; informatics and measurement standardization; education, outreach, and training; and administration and scheduling. The success of NEON hinges on whether the observatories are truly collaborative (NEON 2000c, NEON 2002c, AIBS 2003). The need for an entity that ensures network coordination has been recognized since the earliest discussions of NEON, as has the need for that entity to be in place prior to the establishment of the observatories (NEON 2000c, NEON 2002c, AIBS 2003). However, neither the structure of such an entity nor its functional relationships with observatories have been adequately specified (NEON 2000c, AIBS 2003).

This report considers both the ultimate organizational structure of NEON and the process by which that structure might be realized. NEON should exist as a national network of regional observatories addressing common themes. Such a hierarchical arrangement will provide the capacity to do the following:

- Combine in-depth regional studies to address nationally important scientific questions
- Identify and respond to new questions
- Promote synergy across themes
- Integrate studies across levels of organization from molecules to ecosystems

Additionally, this structure will reduce unnecessary duplication of infrastructure otherwise necessitated through pursuit of separate national themes and will engage a broad variety of biological, physical, and social scientists.

The complete set of regional observatories needs to be brought to operational status simultaneously to achieve a functional network at the national level. The requirement for a simultaneous national start to NEON implies that the initial scientific scope will be restricted to a subset of research themes envisaged for the mature network. The capacity of the observatories and the network would then be built incrementally. Multiple regional observatories will therefore grow in terms of both research scope and the number of participating individuals and institutions as additional resources become available. In addition to the increased scope of questions addressed, this maturation will also necessitate increased integration across themes and levels of biological organization.

Critical to the ultimate success of NEON are the cadres of scientists and educators who will build their careers while using NEON. They must be drawn into the discussion immediately to ensure that NEON reflects their scientific needs and ideas. This should be done by fostering partnerships at the national level to develop and address national research themes and also at regional levels to develop and address regionally relevant themes and develop capacity to integrate research across the emergent national themes and levels of biological organization.

This report is intended to help plot a course for moving NEON forward. The next section, "Organizational Structure and Governance," presents a flexible organizational model that identifies the relevant entities and their respective roles in coordinating and governing NEON. To avoid stifling other creative approaches that may emerge through competitive proposals and other means as NEON evolves, this report does not define the formal relationships between the various entities or precisely how they will operate. The following section, "Development of NEON, Inc.," presents a process for moving forward immediately on the important business of implementing and coordinating NEON and describes how that process can develop the final organizational structure for NEON. Finally, the last section summarizes recommended next steps.

2. Organizational Structure and Governance

The organizational structure of NEON should be simple and understandable, ensure full accountability to funding agencies, provide timely data and information to the scientific community and the public, and foster an environment for informed decision making to resolve emerging environmental issues. Furthermore, the NEON structure should serve to maximize engagement and participation by the diverse community of stakeholders.

Conference participants examined various organizational structures and arrived at a model (Figure 1) that is consistent with the needs for coordinated governance and network flexibility. This structure is composed of three tiers: (1) the funding and oversight agency; (2) the coordination and governance unit, including the NEON Coordination Office (NCO) and associated boards and committees; and (3) the NEON observatories and sites that comprise them.

Tier 1 includes the National Science Foundation, which is providing initial financial support. An Inter-Agency Working Group should also be formed to extend support and interactions with other federal agencies, some of which may supplement funding for NEON activities. This working group, in conjunction with the NEON scientific enterprise, should also explore opportunities for international NEON-like activities. Advanced planning to facilitate coordination at the international scale will enable NEON scientists to expand observations so that patterns and processes of change can be measured for the entire biosphere.

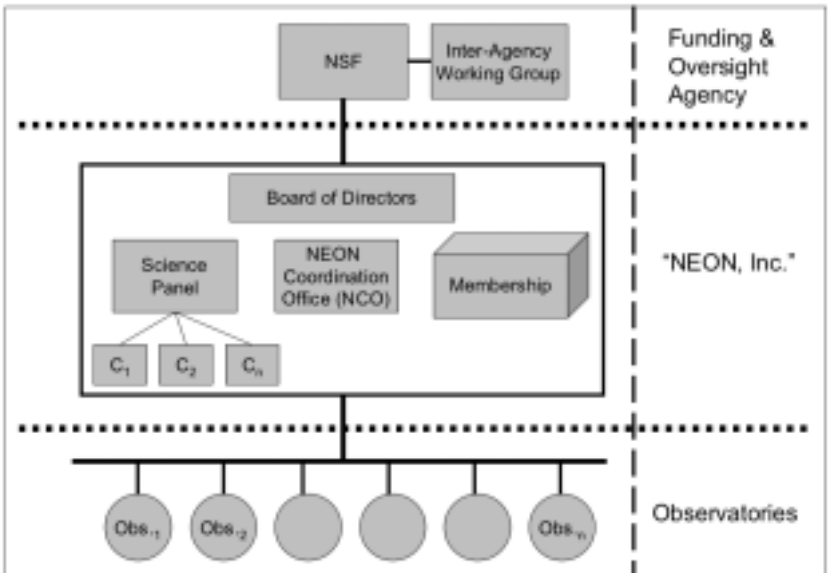

Fig. 1. Proposed Organizational Structure and Governance

"NEON, Inc."

The nonprofit corporation needed to provided network-wide integration and cost-effective support services for the observatories, called "NEON, Inc.," here for convenience, will be:

- Responsible to the NEON community, the core of which is identified as the Membership in NEON, Inc.
- Governed by its Board of Directors
- Administered by its NEON Coordination Office (NCO)
- Advised in matter of science and education by its Science Panel

NEON, Inc., distributes infrastructure funding to the observatories. It does not provide research funding for investigations carried out at the observatories.

Tier 2 comprises national coordination and governance of NEON. Central to this governance is the NEON corporate entity, called "NEON, Inc.," as a placeholder here, which should be a nonprofit corporation with 501(c)(3) status. Its organization as a corporation provides a logical and efficient structure for the task of NEON coordination, and it is similar to the organizational structure successfully used in comparable initiatives funded by NSF. Limitation of liability is another advantage. This nonprofit corporation would be a membership organization governed by a Board of Directors that is elected by the members. A Science Panel, with committees as needed, reports to the board to provide guidance on all scientific functions of the network. The executive and business functions of the organization are carried out by the NEON Coordination Office (NCO). This report does not define formal structures for the NCO or the Science Panel. Nor does it provide rules for their operation, the powers and qualifications of the membership, and the authorities and composition of the board, recognizing that many possible alternatives exist and that certain legal requirements follow from the 501(c)(3) status of NEON, Inc. It is anticipated that the final resolution of the relationships among these bodies will evolve to (1) produce a system of checks and balances among the various stakeholders and (2) support the highest quality science at the observatory, regional, and national scales.

The Membership forms the democratic basis for running the nonprofit corporation in a legal sense. In addition, it forms the operational definition of the NEON community. A clear definition of the community to be served, or at least its core, is

a prerequisite for sound strategic planning and organizational design. The Membership is conceived of as a dues-paying set of stakeholders: colleges, universities, scientific organizations, and individuals who may directly benefit from the NEON infrastructure and who have the minimum qualifications as defined by the NEON, Inc., bylaws. Membership should be inclusive, drawing in organizations and institutions that may or may not be directly affiliated with one or more observatories.

The Board of Directors will oversee the NCO and form the top level of decision making as required for any corporation, subject to the rights reserved to the Membership. It may comprise well-respected, executive-level individuals from academic institutions (e.g., deans, university presidents) and nongovernmental sectors (e.g., executive directors of societies and NGOs, business and financial experts), as well as representatives from the Science Panel and the Membership. The board will be empowered to hire and, if necessary, fire the NCO executive director and staff. It will also be responsible for oversight of the financial and management practices and policies of the NCO.

The NCO is primarily charged with financial responsibilities (e.g., accounting, acting as a purchasing agent for the entire organization where economies of scale justify such), operational responsibilities (e.g., coordinating and scheduling major equipment usage for national and multi-observatory research projects, coordinating data products), and supporting an appropriate level of public relations. The NCO should be staffed by an executive director, science administrators, and others dedicated to accounts and purchasing, coordination, communication, data management, public relations activities, and other service functions such as training and web portal support. Principal functions will be supporting the most effective and efficient flow of funds and common instrumentation to the observatories and facilitating the integration and synthesis of research, education, and outreach across the scientific themes that NEON will address.

The Science Panel is composed of scientists, educators, regional observatory leadership, and science administrators from within and outside the NEON enterprise. Some members of the Board of Directors may be elected from the Science Panel; alternatively, the Science Panel itself may serve as the Board of Directors. The Science Panel plays a leadership role by crafting short- and long-term science plans for NEON and helping to create the integrated vision for how the overall infrastructure can be best utilized to focus on issues of national and global significance. The Science Panel will empower standing and ad hoc committees to address, for example, each of the national-level issues that NEON will address, education, data and metadata standards, and analysis and visualization protocols.

The governance of the observatories (tier 3, Figure 1) will be designed to ensure that critical local and regional issues are identified, data collection protocols are designed and implemented, regional studies are performed and results integrated, and national NEON objectives satisfied. Each observatory will be represented on

the Science Panel to assist in the development of policy and plans for the entire NEON network. The final observatory governance structure is subject to approval by NSF and other supporting agencies.

In this proposed organizational structure there is a single, unidirectional flow of infrastructure funds from NSF through NEON, Inc., to the observatories (Figure 2). This extends to both the Major Research Equipment and Facilities Construction (MREFC) developmental phase and the operational phase. Note that this infrastructure funding enables the observatories to be ready for use in research, but it stops short of research project support. Research funding is shown as a separate set of "pipelines" from NSF to the observatories, with various NSF research awards provided to investigators through its proposal peer review process. This flow of infrastructure dollars should be largely pass-through from NEON, Inc., to the observatories, as reflected in individual cooperative agreements. Nevertheless, this flow of funds through a central entity will enable centralized accounting, economies of scale in purchasing, and enforcement of network-wide standards. Such an approach is critical for providing the coordination and governance unit with the leverage for enabling national-scale research. Although the Board of Directors will have overall authority for NEON, Inc., the NCO will carry out day-to-day activities.

For NEON to reach its potential, it is essential that NSF make a commitment to research funding that is commensurate with the scope of NEON. Research program dollars can flow directly to the scientists and groups of scientists who wish to work at individual observatories or groups of observatories. Thus, an individual

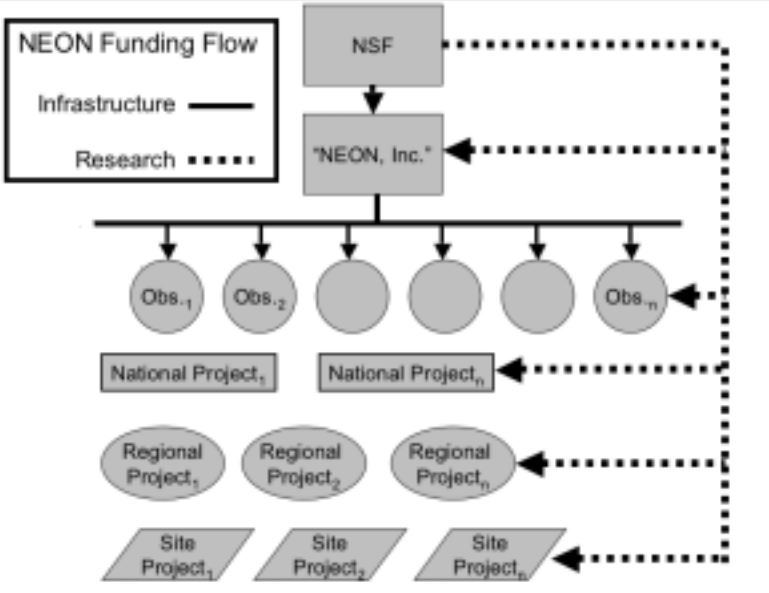

Fig. 2. Proposed flows of infrastructure and research funds within NEON. Infrastructure funding refers to both major research equipment and annual maintenance and operations.

scientist may apply for instrumentation use at a specific observatory rather than going through the NCO (provided such a request is coordinated with network activities). Alternatively, where economies of scale and necessity for coordination dictate, the structure can support the infusion of funds into the NCO for regional- to continental-scale research projects.

The proposed organizational structure has many advantages. First, there is a clear channel of accountability, particularly with respect to the flow of funds. The provision of infrastructure funds to the observatories would be tied to community-defined and centrally regulated network-wide standards, as relate to data quality assurance, for example, or to define which support services are budgeted in the infrastructure category and which in research. NEON, Inc., is the glue that holds together the distributed set of facilities and the diversity of scientific themes inherent in the network of ecosystem observatories, enabling the NSF investment to function as a network in both the information technology (IT) and community senses of the word. Second, governance by the representative Board of Directors and Science Panel, along with participation of a broadly defined Membership, ensures that decision-making authority fully resides with the NEON stakeholders. Thus, accountability is clear, yet responsibility is diffuse and decision-making authority is placed at the lowest possible level in the organization. Third, the structure is simple, easy to understand, flexible, and scalable. For instance, committees can be chartered on an as-needed basis, and the number of observatories can be increased (i.e., what works for two observatories will scale up to a larger number of observatories). Such flexibility can provide the basis for a dynamic organization that can evolve for efficiency and responsiveness to community needs.

Many aspects of the NCO were not detailed by the conference participants and require additional consideration by the scientific community and NSF. For instance, what is the appropriate balance of service and administration versus research and development at the NCO? Would the research required for developing different cyber-infrastructure standards be better supported at the NCO, through one of the Science Panel committees, or through broader community working group activities?

Unresolved issues do not pose any hindrance to developing the NEON infrastructure. As competitive proposals are developed for operation of the NCO, it is expected that the community will further refine the structure such that flexibility can be maximized, and power and authority are placed at the lowest possible level in the scientific enterprise.

3. Development of NEON, Inc.

The organizational structure and governance of NEON should take form and begin functioning at the earliest possible stage of the network's ontogeny. Early formation of the NCO, as well as associated boards and committees, would provide observatories with a point of contact to the NSF, to a wide community of stakeholders, and to one another. It would foster a culture of collaboration, shared decision making, transparency, and accountability for the network; it would also generate community support and credibility. The functions of the NCO, Board of Directors, Science Panel, and associated committees should evolve rapidly during the first decade of NEON. These will serve as the nexus of an effective governing structure by (1) promoting the formation of a broad membership organization, (2) providing a focal point for coordination of efforts among observatories, and (3) communicating with and reporting to the NSF, the Membership, and the broader public (see Figure 1).

Rather than define the formal relationships between the NCO, Board of Directors, Science Panel, and Membership and their rules for operation, this report recommends the immediate formation of several task forces, and the organization of related workshops, to define the structural relationships among these four bodies and their respective composition and responsibilities. Task forces should be established to address two broad classes of tasks: leadership and vision tasks and service tasks. Task forces should be established according to the list presented in Figure 3

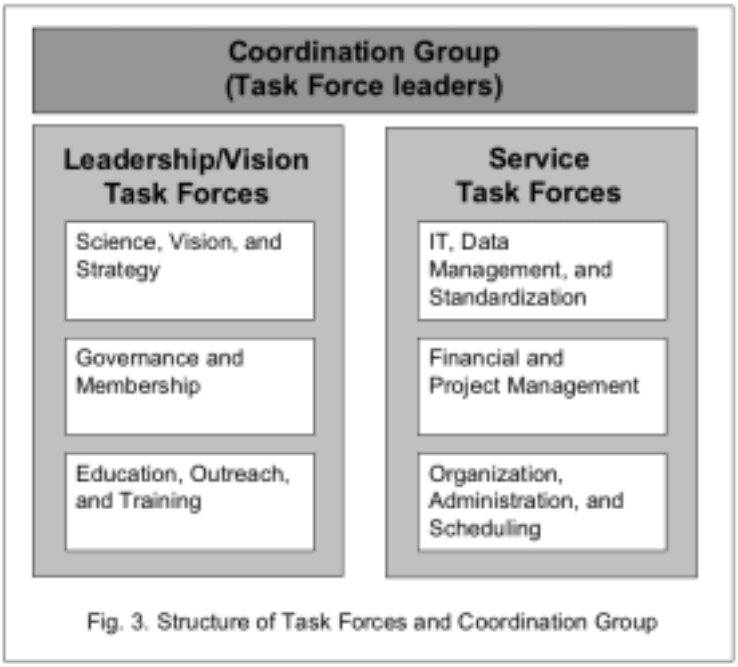

Fig. 3. Structure of Task Forces and Coordination Group

and should be targeted at resolving the issues surrounding these tasks as they pertain to the NCO, Board of Directors, Science Panel, and Membership (but not the observatories). The list of task forces may be incomplete or need refinement, but it encompasses most of the critical issues to be resolved before the governing entities are fully operational.

The task forces need to be formed immediately. Recruitment of members should focus on individuals who represent the broad community (for example, according to research discipline, geographical area, or institutional type) and who have relevant talents (IT, legal or organizational expertise, large-scale project management). Membership on task forces should have predefined term limits. Each task force would appoint a chairperson and could appoint new members as needed. Task force members should be drawn from observatories, once identified, and from the broader community.

Each task force should immediately identify key questions in its area of responsibility. For example, the IT, Data Management, and Standardization Task Force may consider questions such as these: What data and methods need to be standardized and how? What is the data access policy? How is scalability created? What kind of IT standards will be used? How will standards be revisited and evolve over time? What IT services need to be provided centrally (or via outsourced capabilities) to facilitate network-wide collaboration, and which should be provided at the level of each observatory? Questions for the Governance and Membership Task Force will likely include these: What authority and leverage will the NCO have? What is the composition of the Board of Directors and the Science Panel? What are the voting procedures, articles, and bylaws? What is the nature of membership in NEON, Inc.?

Task forces should seek advice, explore issues, and poll constituents. They should be prepared to organize and receive input from associated workshops and other activities. For example, a separate workshop might be convened to discuss issues of data standards that will feed directly into the work of the IT, Data Management, and Standardization Task Force.

The overall goal of the task force process is to define and help establish the NCO, Board of Directors, Membership, Science Panel, and associated committees. Task forces should, therefore, have finite terms and either terminate (e.g., the Governance and Membership Task Force terminates once the governing bodies are established and incorporate) or convert to standing committees (e.g., the Science, Vision, and Strategy Task Force becomes scientific subcommittees of the Science Panel). Task forces may work on different schedules. Some task force responsibilities are more urgent (e.g., setting data standards) and should be attended to quickly to resolve key issues before the NCO and any observatories are established. Others, particularly task forces of a more strategic nature, may evolve slowly and could overlap with initial activities of the NCO, Board of Directors, Science Panel, and Membership.

There is an important role for an interim NEON office to oversee and coordinate the work of the task forces and ensure that NEON is shaped into a national asset in a systematic manner. This office should be staffed with professionals who can respond to task force needs, conduct fact-finding and research, coordinate preparatory work and necessary writing, and integrate the work of the task forces. Within approximately two years, the permanent NCO and associated boards and committees would assume the functions of an interim NEON office. But the interim NEON office is needed because any permanent NCO, Board of Directors, and committees cannot be established in time to build the initial NEON framework.

One view of the interim NEON office is that it would solely house full-time technical staff to service the various task forces and workshops. This would accelerate the rate of progress. Staff can be collocated in an existing institution to facilitate integration of NEON planning activities into the larger picture.

Another view of the interim NEON office involves appointing an interim executive director to oversee the interim office and precede the eventual director of the NCO. Responsibilities would extend beyond the narrow staffing activities described above. The interim executive director could have three strategic goals over the two-year position:

1. Promote the NEON concept as a resource for the scientific community at large, including those not expressly affiliated with an observatory. As the broader stakeholders come to realize the potential of NEON, they will articulate their interests as distinct from the consortia directly involved in running observatories. The interim director will thus serve as a conduit for the broad community to help shape NEON from its earliest materialization.
2. Work with NEON stakeholders at large to determine the role of the NCO and associated boards and committees.
3. Set priorities for the task forces and workshops identified above. This will require integrating task force activities and working closely with task force chairs and coordination groups. By virtue of the extensive contacts that the interim director will develop, this person is likely to widen participation in these workshops and task forces.

If an interim NEON office is established with an interim executive director, that person can report to an advisory board comprising scientists and others skilled in the management of large and complex projects. Membership may be drawn from, or even be limited to, the task force leaders. To be most effective, an interim NEON office needs to be in place early in 2004. A critical need, however, is to ensure that the accelerated process does not confer an unfair advantage or disadvantage on any individual or any institution hosting the interim office in terms of subsequent requests for proposals for the NCO. To this end the interim executive

director (not junior staff) may be ineligible for appointment to the permanent NCO. This suggests that the interim executive director be a senior person with an established reputation within the biological research and related communities who can obtain leave on these conditions from his or her current employer or who is recently retired and willing to take on this task. Alternatively, so few candidates may be qualified to direct even the interim NEON office that the ineligibility clause may be undesirable.

The question of which is the appropriate organization to initiate and guide the task force process has not yet been resolved. Adequate funding for this process, including expenses for staff and task force functions, is critical; this is an important role for NSF as it continues to nurture the development of the NEON process.

An additional benefit of the approach described here is scalability. A series of task forces organized under an interim NEON office can be expanded to address issues beyond the coordination and governance of NEON. For example, additional task forces can be charged to deal with the issues, such as identification of the scientific questions that NEON will address, needing refinement before NEON can be fully implemented.

An interim office could also specify a Reference Design for NEON, that is, a plan that describes the scientific accomplishments sought by undertaking the building of a facility. It defines scientific questions and scientific requirements, describes the network design, and identifies technological options and necessary R&D. The Reference Design would serve as the working plan for NEON and would be subject to change only through a formal mechanism. Furthermore, the Reference Design would ultimately be used as the basis for developing components of a Project Execution Plan as required by NSF for large facility projects such as NEON.

This report primarily addresses the development of the organizational structure and governance for NEON at the national level. Conceptual and organizational development of regional observatories is equally important and should proceed simultaneously. Development of observatories should be stimulated by NSF in the form of planning grants to fund regional efforts to identify and bring together the highly motivated and productive individuals and institutions that will ultimately constitute NEON. Regional efforts should set the stage for new research themes that develop out of intensive regional work and that can be expanded to the national level. They should also explore how various national themes can be integrated within regions (e.g., distribution of infrastructure that balances the need for broad coverage with the need for dense assemblages of data-gathering equipment that permit integration from genes to ecosystems within an observatory). Products of regional efforts should feed into the national discussion, and an interim NEON office should serve as the mechanism to coordinate such activities.

4. Recommended Next Steps

To build on the considerable momentum driving the NEON community, an interim NEON office should be established immediately and should operate until a permanent NEON, Inc., can be established through responses to an open solicitation. This office should be appropriately staffed to coordinate and service task forces, convene requisite workshops and meetings, and deliver a reference design for NEON. The key tasks that need to be completed are as follows:

1. Establish task forces to provide additional input for the Reference Design and to begin implementation of NEON activity, including
   a. Science, Vision, and Strategy
   b. Governance and Membership
   c. IT, Data Management, and Standardization
   d. Education, Outreach, and Training
   e. Financial and Project Management
   f. Organization, Administration, and Scheduling
2. Convene a series of workshops comprising representatives from appropriate task forces, tentative regional assemblages, and additional scientific experts to
   a. Identify critical national questions
   b. Identify common infrastructure needs to address those questions
   c. Provide detailed input to the interim office for completion of the Reference Design
3. Provide planning grants to support the formations and activities of broadly representative regional scientific groups (nascent observatories), which will
   a. Identify and prioritize important national and regional scientific questions for NEON foci that are regionally specific and relate to broad scientific themes, including those identified by the NRC (NRC 2003)
   b. Identify research sites, data sets, and other capacities and infrastructure relevant to addressing such questions, to identify major gaps in infrastructure and data
   c. Develop an organizational and prototype scientific plan for each regional observatory
   d. Develop linkages among relevant governmental agencies, academic institutions, NGOs, and private groups
   e. Identify IT needs (as input to the IT task force)

These three suites of activities, coordinated by an interim NCO, will provide the additional level of detail about NEON and its structure necessary if the ecological community is to have a clear and unitary vision around which to coalesce.

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