



A M E R I C A N I N S T I T U T E O F B I O L O G I C A L S C I E N C E S

October 14, 2003

Dear Colleague:

As part of the Infrastructure for Biology at Regional to Continental Scales (IBRCS) project, the American Institute of Biological Sciences (AIBS) seeks your feedback on a draft report on the Coordination and Implementation of the National Ecological Observatory Network (NEON). The report is a synthesis of discussions that took place during a conference at the National Museum of Natural History on September 4-6, 2003 and describes a both an organizational framework and a process for implementation. The report, tentatively titled *Coordination and Implementation of NEON*, is the second white paper about NEON issued in association with the IBRCS project—an effort foster development of next-generation biological research infrastructure. Further information about the conference and access to the report is available at: <http://ibr.cs.aibs.org/NEONCoordConf>.

We seek feedback on the report in one or more of the following ways:

- Submit written comments about the report via an online form accessible at: <http://ibr.cs.aibs.org/NEONCoordConf>.
- Attend the open session of a follow-up conference in Washington, DC (see details below).
- Participate in the open session of the follow-up conference via teleconference.

The follow up conference is scheduled November 10, 2003, during which a subset of conference participants will discuss the report with interested members of the scientific community. The conference will be held in the East Room of the Conference Center in the American Society of Association Executives Building, 1575 I (Eye) Street, NW, Washington, DC. Please visit the conference website (<http://ibr.cs.aibs.org/NEONCoordConf>) for emerging details such as schedule and how to participate via teleconference. Please RSVP to me at jgoldman@aibs.org if you plan to attend the conference in person.

Questions and other correspondence should be directed to me at jgoldman@aibs.org or 202-628-1500 ext. 225.

Sincerely,

Jeffrey Goldman
IBRCS Project Manager

IBRCS White Paper

COORDINATION AND IMPLEMENTATION OF NEON

Report from the

NEON Coordination and Implementation Conference

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September 4–6, 2003

National Museum of Natural History

I. Introduction

Unprecedented changes in the earth's ecosystems are now taking place. Habitat alteration and the introduction and spread of exotic species are affecting the composition of native communities and the productivity of biota that are essential to the health of the nation's natural resources and economy; high rates of soil loss are resulting in declines in agricultural productivity and impacting aquatic flora and fauna negatively; harvest rates of the earth's fisheries and forests are not sustainable and have resulted in fragile systems susceptible to collapse.

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 insufficient for the task. Much of it supports research on individual species and processes at the scale of watersheds and landscapes. Although many research networks exist that are national—even international—in scope, few are set-up and function in a way that allows for the synthetic research required to address the environmental challenges we face as a nation (Smith *et al.* 2003).

Based on the need to address these and other environmental challenges, the National Science Foundation (NSF) has proposed to fund the construction 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, continental-scale experiments on ecological systems and 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 and NSF (NEON 2000a, NEON 2000b, NEON 2000c, NEON 2002a, NEON 2002b, NEON 2002c, Holsinger *et al.* 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 coordinated and cooperative (NEON 2000c, NEON 2002c, Holsinger *et*

5 *al.* 2003). The need for an entity tasked with ensuring network coordination has been recognized since the earliest discussions of NEON and the need for that entity to be in place prior to the establishment of the observatories has been stated clearly in several previous reports concerning the coordination of NEON (NSF workshops). Despite the stated importance of a coordinating entity, neither the structure of such an entity, nor its functional relationships with observatories have been adequately specified (NEON 2000c, Holsinger *et al.* 2003).

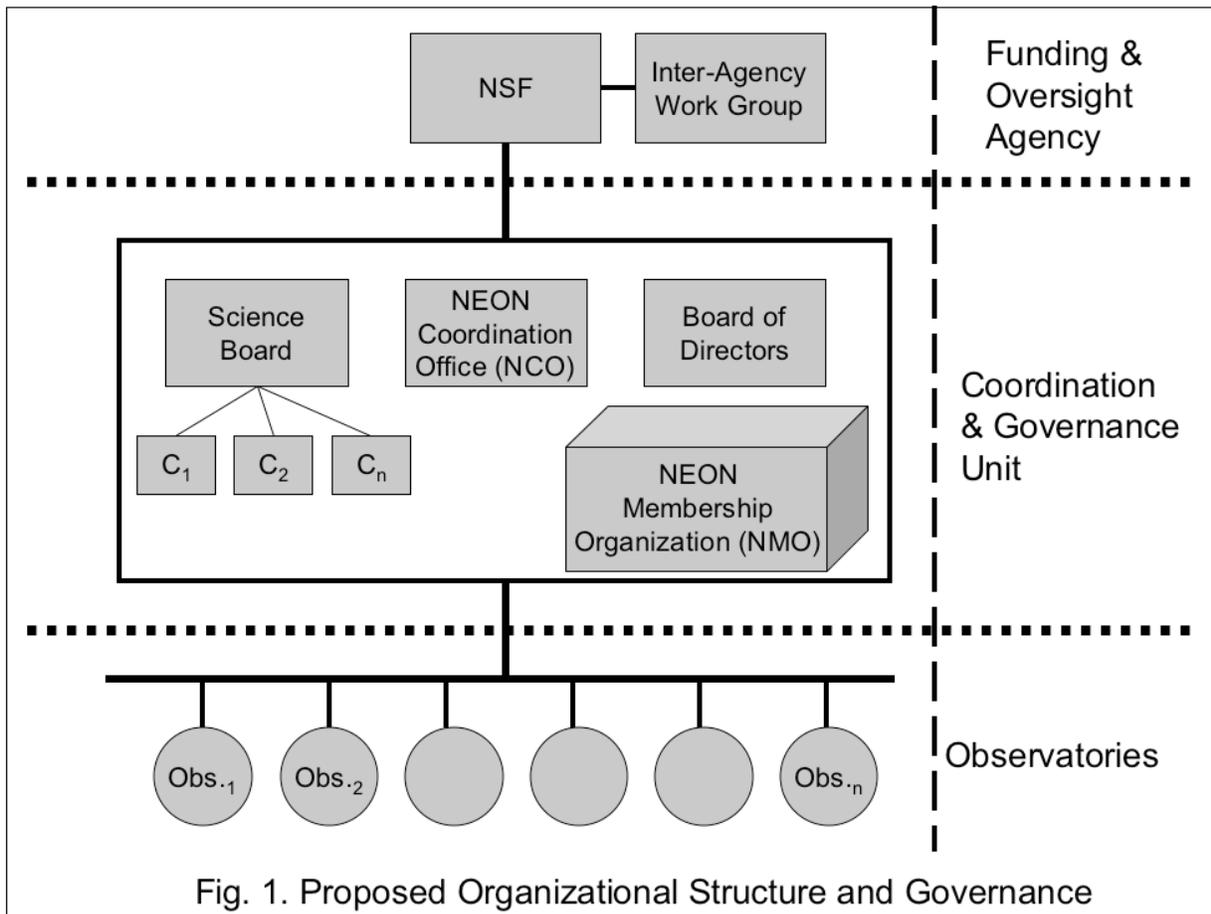
10 On September 4–6, 2003, the American Institute of Biological Sciences (AIBS) convened the NEON Coordination and Implementation Conference at the National Museum of Natural History, Smithsonian Institution to analyze the issue of NEON coordination. Participants included members of the AIBS working group on biological infrastructure; experts in the building and operation of large scientific networks, facilities, and organizations; and other NEON stakeholders. Observers from NSF and the National Research Council also attended (Appendix). The conference took place prior to publication of the results of a study of NEON by an ad hoc committee of the National Research Council (NRC 2003). Thus, conference
15 participant did not have the benefit of any of the findings of that study. This report reflects the discussion that took place during the conference. The final draft of this report will be prepared in the light of the finding and recommendations revealed in the NRC study.

20 Conference participants considered both the ultimate organizational structure of NEON and the process by which that structure might be realized. This report, a synthesis of the discussions that took place during the conference, reflects those considerations and is intended to help both NEON stakeholders and NSF plan the future of NEON. Section II presents a flexible organizational model that identifies several important entities and their respective roles in coordinating and governing NEON but not the formal relationships between them or how precisely they will operate. The participants recognized that over-specification at this stage might
25 stifle other creative approaches that will likely emerge through competitive proposals and other means as NEON continues to evolve. Section III 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, section IV summarizes immediate next steps and recommendations.

II. Organizational Structure and Governance

The organizational structure of NEON must be simple and understandable, ensure full accountability to funding agencies, provide timely data and information to the scientific community and public, and foster an environment for informed decision making to resolve emerging environmental issues. Furthermore, the NEON structure must 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 Coordinating 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 might provide funding to NEON activities. This Working Group, in conjunction with the NEON scientific enterprise (i.e., the observatories and the entities that form the coordination and governance unit), 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 may be measured for the entire biosphere.

Tier 2 comprises national coordination and governance of NEON. Central to this governance is the NEON Coordination Office (NCO), which should be a non-profit corporation with 501(c) 3 status—most likely a Limited Liability Corporation, acting in conjunction with a Board of Directors, Science Board, and NEON Membership Organization (NMO). The conference participants did not define formal structures for the NCO, Science Board or NMO. Nor did they provide rules for their operation, the powers and qualifications of the membership, and the authorities and composition of the Boards, recognizing that many possible alternatives exist. 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 observatory, regional, and national scales. The conference participants did recommend that the network-level coordination and governance unit constrain its responsibilities and activities to those that bear directly on the goal of enabling multi-observatory research and education; other matters should rest with the individual observatories.

The NCO is primarily charged with financial responsibilities (e.g., accounting and 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 and coordinating data products), and supporting an appropriate level of public relations. The NCO should be staffed by an Executive Director, accountants and purchasing representatives, as well as science administrators and staff members dedicated to coordination, communication, data management, public relations activities, and other service functions (e.g., training, web portal support, etc.). A principal function will be

supporting the most effective and efficient flow of funds and common instrumentation to the observatories.

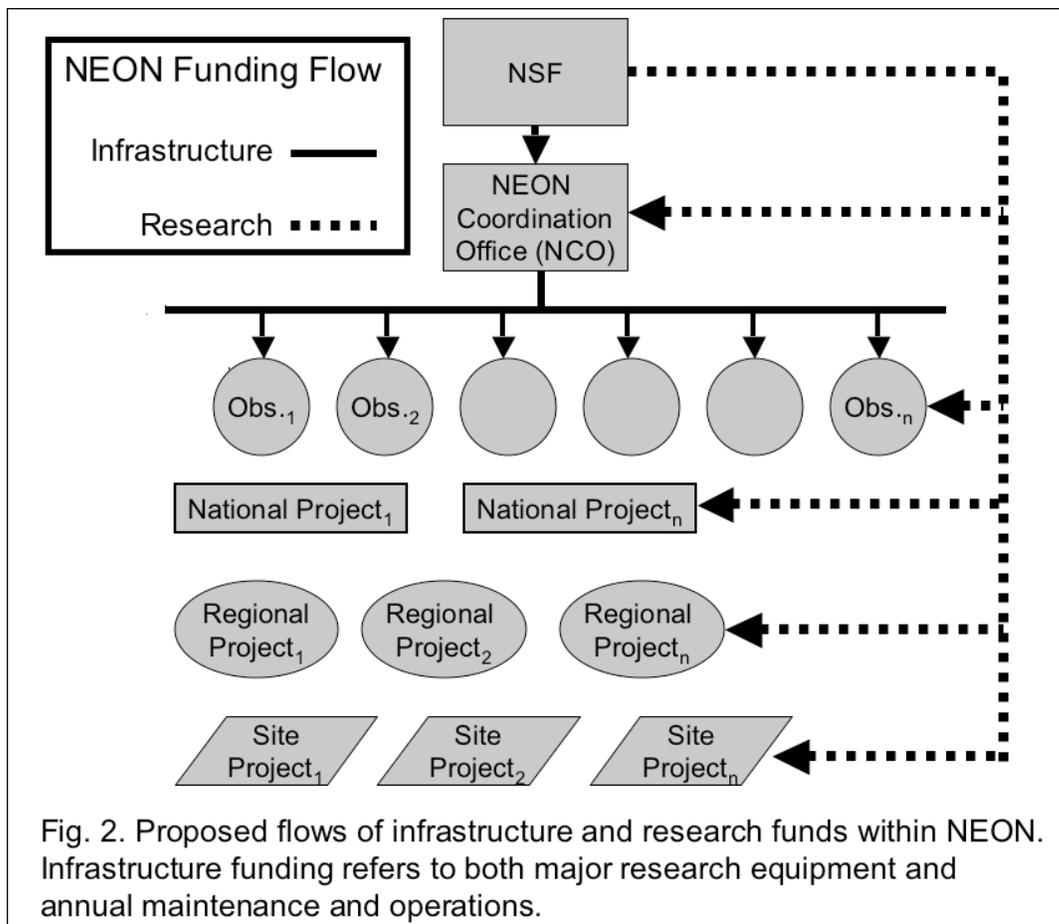
5 A Board of Directors will oversee the NCO, as required for any corporation. This Board could be comprised of well-respected executive level individuals from academic (e.g., Deans, university Presidents) and non-governmental sectors (e.g., Executive Directors of societies and NGOs, and business and financial experts), as well as representatives from the Science Board and NMO. The Board will be empowered, in conjunction with NSF, to hire and, if necessary, fire the NCO Executive Director. It will also initiate annual financial audits and will ensure that management practices and policies of the NCO are sound. The NCO will have a close and direct relationship with two other principal bodies—the Science Board and the NEON Membership Organization (NMO), each of which encompasses multiple entities.

15 The Science Board is composed of scientists, educators, observatory directors, and science administrators from within and outside the NEON enterprise. The Science Board plays a leadership role and crafts short- and long-term science plans for NEON. Thus, the Science Board helps create the vision for how the overall infrastructure can be best utilized to focus on issues of national and global significance. Furthermore, the Science Board identifies and develops the instrumentation, cyber-infrastructure, measurement, data, and education standards for NEON. Ideally, the Science Board will empower standing and *ad hoc* committees to meet the needs of NEON—e.g., education, data and metadata standards, analysis and visualization protocols, coordination, and operations. Some members of the Board of Directors could be elected from the Science Board; alternatively, the Science Board itself could serve as the Board of Directors.

25 The NMO is an open dues-paying body comprised of NEON stakeholders: colleges, universities, scientific organizations, and individuals that may directly benefit from the NEON infrastructure and have the minimum qualifications to be defined later. Membership should be inclusive, drawing in organizations and institutions that may or may not be directly affiliated with one or more observatories. The liability of any member should be limited to the size of the dues payment; i.e., the member organization may also be structured as a Limited Liability Corporation or could be part of the NCO. Some members of the Board of Directors could be nominated and elected from the NEON Membership Organization.

Tier 3 consists of the observatories themselves. As noted earlier, observatories will be represented on the Science Board, which sets policy for the network regarding the network science plan, standards, etc. It is critical that the observatories, individually and collectively, play a major role in network policy making. With respect to internal governance, each observatory, subject to approval by NSF and any other appropriate supporting agencies and as set forth in cooperative agreements, will have its own internal organizational structure and governance that reflects and is responsive to regional and local needs (e.g., regional science plans) and institutional constraints, but must also be able to abide by national rules of governance. Observatories should not necessarily be cast from the same mold—that is, organizational and internal governance structures may vary from one observatory to another. Some observatories may choose to base their organizational structure and governance on some variation of the NEON coordination and governance unit.

In this proposed organizational structure there is a single, unidirectional flow of infrastructure funds from NSF through the NCO 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 this infrastructure funding 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 (not shown here for simplicity). It is envisaged that this flow of infrastructure dollars will be largely pass-through from the NCO 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.

The conference participants also envisioned that research program dollars could flow directly to the scientists and groups of scientists that are working at individual observatories or groups of observatories. Thus, an individual scientist may apply for instrumentation use at a specific observatory rather than going through the NCO. Alternatively, where economies of scale and necessity for coordination dictate, the model could support the infusion of funds into the NCO for regional to continental scale research projects. However, there must be appropriate mechanisms for balancing the allocation of observatory resources among observatory, regional, and national projects.

The proposed organizational structure has many advantages. First, there is a clear channel of accountability, particularly with respect to the flow of funds. Second, the Board of Directors, Science Board, and NMO ensure that decision-making authority fully rests in the hands of 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 community and NSF. For instance, what is the appropriate balance of service and administration versus research and development at the NCO? Could the research required for developing different cyber-infrastructure standards be supported at the NCO, through one of the Science Board committees, or through broader community working group activities?

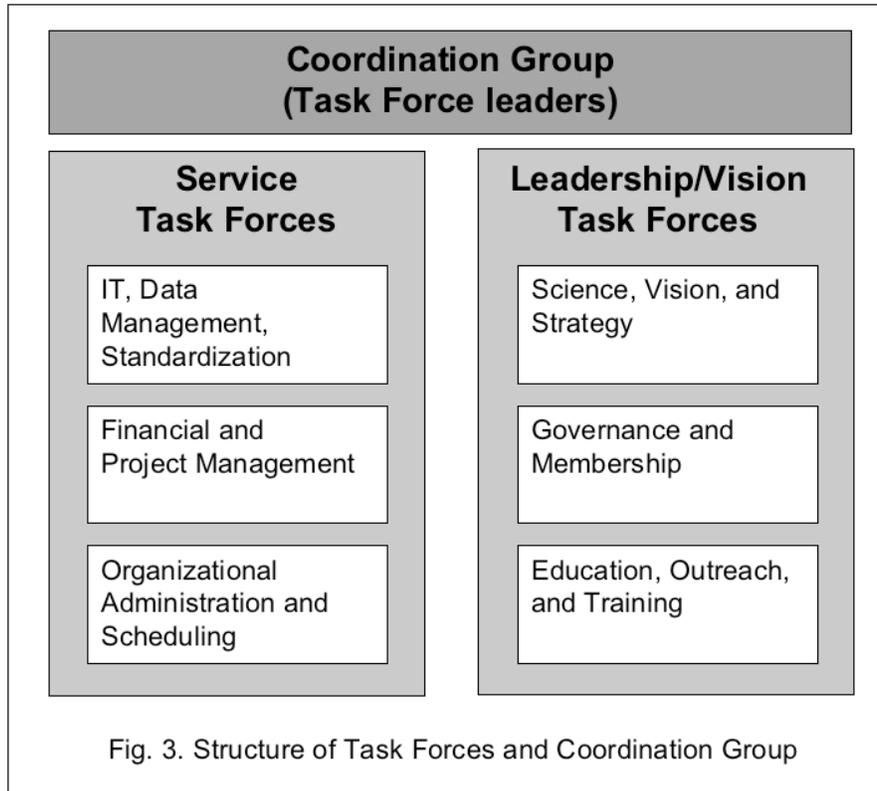
Unresolved issues do not pose any hindrance to developing the NEON infrastructure. As competitive proposals are developed for operation of the NCO, it is expected that the community will further refine models whereby flexibility can be maximized, and power and authority are placed at the lowest possible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

III. Development of Coordination and Governance Unit

The organizational structure and governance of NEON should take form, and begin functioning, at the earliest possible stage of the network's ontogeny. Previous NEON workshops recommended strongly that a nascent governance and coordination structure should be operative
5 prior to establishment of the first observatories. Early formation of the NCO, and associated boards and committees, would provide individual 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, and would also generate community support and credibility. The functions of the NCO and
10 associated boards and committees should evolve rapidly during the first decade of NEON. These will serve as the nexus of an effective governing structure (Figure 1) by (1) promoting the formation of a broad membership organization (the NMO, previous section), (2) providing a focal point for coordination of efforts among observatories, and (3) communicating with and reporting to the NSF, the NMO and the broader public.

15 Conference participants did not define the formal relationships between the NCO, the Board of Directors, the Science Board and the NMO or their rules for operation, recognizing that alternatives exist. Rather, participants recommend 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. Each Task Force would
20 address a series of tasks, divided broadly into two classes: Service Tasks and Leadership/Vision Tasks. One Task Force should be established for each task category (Figure 3), targeted at resolving the issues surrounding these tasks as they pertain to the NCO, Board of Directors, Science Board, and NMO (but not the observatories). These task categories may be incomplete, or need refinement, but they encompass most of the critical issues to be resolved before the
25 governing entities are fully operational.

The Task Forces need to be formed immediately. Recruitment should focus on individuals who represent the broad community (for example by research discipline, geographical area, or institutional type) and who have relevant talents (IT, legal structure, large-scale project management). Membership on Task Forces should have pre-defined term limits.



Each Task Force would appoint a Chairperson, and could appoint new members as needed. As NEON observatories form and join the network, it is envisaged that observatory representatives would be incrementally allocated significant—but not majority—membership on the Task Forces.

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

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 discuss issues of data standards that will feed directly into the work of the IT/Data Task Force.

5 The overall goal of the Task Force process is to define and help establish the NCO, Board of Directors, Science Board, NMO, and associated committees. Task Forces should, therefore, have finite terms and will either terminate (as in the case of the Governance and Membership Task Force) or convert to Standing Committees (e.g. the Science, Vision, and Strategy Task Force might transition into scientific sub committees of the Science Board). Task Forces may
10 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 Board, and NMO.

15 It will be critical to have one central entity to oversee and coordinate Task Force activities; this would be a Coordination Group made up of the leaders of the Task Forces, with an elected Chair (Figure 3). We recommend that Task Forces and the Coordination Group be provided with support staff (see 2a, 2b below). The staff would be responsive to Task Force needs, conduct fact finding and research, coordinate the preparatory work and necessary writing,
20 and integrate activities among Task Forces. Therefore, if deemed appropriate, the Task Forces may also be responsible for the establishment and staffing of an Interim NEON Office, and appointing the Interim Director (see 2a, 2b below).

 The question of which is the appropriate organization to initiate the process for appointing the Task Forces, and guiding the process, is not resolved. AIBS is one possibility as it
25 has credibility and experience with NEON via its Infrastructure for Biology at Regional to Continental Scales (IBRCS) project. However, other entities associated with the biological community could also function in this role. 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. The conference identified two approaches towards implementing the work of the Task Forces:

- 5 1. *Grassroots*. Provide NSF funds for a subset of topics identified above; NSF typically funds workshops and other activities to investigate issues and ideas relevant to ambitious goals. Such an effort would extend the current efforts of the IBRCS effort to recommend NEON organizational structure and governance. Ecologists with specialized interests and expertise could also independently organize workshops on Task Force topics. Either of these approaches would result in progress towards resolving issues in making the NEON facilities into a truly national resource of value to ecological research and education.
- 10 2. *Centralized*. Create an Interim NEON Office to ensure that NEON is shaped into a national asset in a systematic manner. Participants were particularly attracted by this second and more far-reaching alternative. Within two years, more or less, the permanent NCO and associated boards and committees would assume the functions of an Interim NEON office. The permanent NCO, boards, and committees could not be ready in time to
15 function in building the initial NEON framework.
 - 20 a. A limited view of the Interim NEON Office would be solely to house full-time technical staff to service the various Task Forces and workshops. This would accelerate the rate of progress. Staff might be co-located in an existing institution to facilitate integration of NEON planning activities into the larger picture. Once a permanent NCO and associated boards and committees were established, this Interim NEON Office would disband.
 - 25 b. A wider view of the Interim NEON Office involves appointing an Interim Director, to oversee the Interim Office and precede the eventual Director of the NCO. Responsibilities would extend beyond the narrow staffing activities described above (a). The Interim Director would have four strategic goals over the two-year position.
 - i. Promote the NEON concept as a resource for the ecological 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 involved directly in running observatories. The Interim Director will thus serve as a conduit from the broad community to help shape NEON from its earliest materialization.

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- ii. Work with NEON stakeholders at large to determine the role of the NCO and associated boards and committees.
- iii. 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.
- iv. Facilitate and accommodate the needs and roles of observatories joining the network as the result of later competitions.

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15 Participants recommend that the Interim NEON Office and Interim Director should report to an Advisory Board comprised of scientists and others skilled in the management of large and complex projects. Membership might be drawn from, or even be limited to, the Coordination Group of the Task Force Leaders. To be most effective, an Interim NEON Office would need to be in place early in 2004. A critical need, however, is to ensure that the accelerated process does not confer an unfair advantage on any individual, or on any institution hosting the Interim Office in terms of subsequent requests for proposals for the NCO. To this end a majority of the conference were willing to require that the Interim Director (not junior staff) be ineligible for appointment to the permanent NCO. This requires that the Interim Director be a senior person with an established reputation within the NEON and related communities who is either able to obtain leave on these conditions from their current employer or perhaps recently retired and willing to take on this task. However, a significant minority of the conference participants felt that so few candidates qualified to direct even the Interim NEON Office exist that the ineligibility clause might be undesirable.

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IV. Recommended Next Steps

The broad outlines of how NEON will be governed are clear. Resolution of some details must wait until the first observatories are chosen. Other tasks must begin immediately.

By January 2004, the NEON community should form:

- 5 1. An IT, Data Management, and Standardization Task Force to (a) identify standards for core network data (data to be collected by every observatory), including the set of variables to be measured, the techniques to be used in measuring them, and the metadata standards to be followed in recording them and (b) design information technology and data access standards that ensure long-term archival integrity of all
10 NEON data and that provide near real-time access to all NEON data.

2. A Governance and Membership Task Force to develop a flexible rules of governance for NEON that responds to the need for strict facilities and management oversight by the National Science Foundation, to the interests of NEON users in access to NEON observatories and data, and to the interests of observatory administrators in ensuring
15 practical, efficient operation of the facilities.

These two task forces should work with relevant governmental and non-governmental organizations to ensure compatibility and complementarity of NEON with other networks designed for environmental data collection.

20 These two task force reports should be made available by summer 2004 with the understanding that they are preliminary reports subject to revision and that additional reports will be released and new task forces will be formed as needed.

 An interim administrative office for NEON is vital to ensure that the task forces work productively and efficiently once formed and that they communicate effectively among themselves and with the broader community. The administrative office should be responsible for
25 the following:

- Provide staff support to the task forces.

- Facilitate communications among the different task forces and the broader NEON community.
- Oversee operational aspects of NEON until the final organizational structure and governance are determined.

5 An interim NEON office should be established as soon as possible, and the National Science Foundation should provide funds to support the interim office and task force activities by whatever mechanisms are appropriate to the task.

Tasks for 2003–2004

- Fall 2003: Establish an interim NEON office
- 10 January 2004: Form IT, Data Management, and Standardization and Governance and Membership Task Forces
- March 2004: Establish additional task forces on (1) Financial and Project management; (2) Organizational administration and scheduling; (3) Science, vision, and strategy; and (4) Education, outreach, and training
- 15 Summer 2004: Distribute preliminary task force reports for IT, data Management, and standardization and Governance and membership
- Fall 2004: Develop task force work and report plan for 2005–2006

V. References

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VI. Appendix:
NEON Coordination and Implementation Conference Attendees

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