

Mid-Atlantic Region Ecological Observatory (MAREO) Organizational Meeting

Held at the Smithsonian Institution's National Zoological Park
Conservation and Research Center, Front Royal, Virginia

January 27-29, 2004

<http://mareo.org>

neon 

Mid-Atlantic
Region
Ecological
Observatory 

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EXECUTIVE SUMMARY

An organizational meeting for the Mid-Atlantic Region Ecological Observatory (MAREO) was convened at the Smithsonian Institution's National Zoological Park Conservation and Research Center in Front Royal, Virginia with the objective of establishing an ecological observatory for the Mid-Atlantic Region, for potential participation in a National Ecological Observatory Network (NEON).

Over 100 researchers from the Mid-Atlantic Region and from other observatory development efforts participated in the meeting. The meeting reviewed efforts in the development of other observatory development efforts and discussed options for developing the institutional infrastructure for MAREO. Working groups at the meeting addressed developing MAREO consortia at the levels of the institution, the field research site or station and individual researchers, development of concepts for comparative NEON-wide studies, and cross-cutting activities and measurements.

Organizational working groups focused on developing the structure of MAREO. Recommendations from the organizational working groups include:

- develop a governance structure for MAREO that includes an advisory committee, a scientific steering committee and a project office;
- continue and expand efforts to gather information on field stations and field research resources;
- develop online resources for identifying scientists interested in participating in MAREO development.

Working groups aimed at initiating definition of concepts for MAREO and for NEON, with a focus on ecological units that could be used for national comparisons.

Recommendations from the concept development groups include:

- hill slopes and associated zero-order watersheds would be desirable comparative study units;
- stream samples represent a spatial integration of everything happening in the watershed and are thus a valuable study system for comparative studies.
- NEON programs should complement, augment, and protect existing data and sampling programs;
- in estuarine and aquatic systems, there are a large number of data sets, some with 25 or more years of observations, that tend to emphasize physical and chemical measurements. Such data sets for larger organisms are rare or missing. We believe that a very substantial IT effort will be needed. The idea would be to provide ready access to these data sets.
- measurements of deposition rates of sediments, nutrients, toxics, etc. should include decadal scale inventories of all depositional field research sites, these should be coupled with higher frequency measurements of variables such as temperature, salinity, algal biomass, pH and dissolved oxygen. New sensor

systems designed to detect HABs and other environmental features could be part of this system as well;

- the zero-order watershed (ZOW) and minimum stream reach (MSR) concepts can readily be applied in urban ecosystems;
- technological needs for urban NEON sites include automated water collection devices (e.g. ISCO samplers), hopefully with real time sensors for key variables (e.g., oxygen, temperature, nitrate, phosphate, DOC, hydrocarbons, metals) and continuous air quality monitoring devices with real-time sensors for key variables (e.g., ozone, particulates);
- landscape-scale models and measurements can tie together site-based measurements based on recurrent aerial and satellite surveys;
- the potential for education and outreach is high in urban ecosystems, e.g. schools and community centers are idea locations for NEON installations;
- if NEON is to achieve its potential to increase human understanding of ecological processes across broad spatial and temporal scales, the NEON network's monitoring protocols implemented on other landscape elements should be established on agricultural and managed forest sites.

Cross-cutting working groups focused on the types of measurement and analysis systems that will be needed by MAREO across all ecological units. Recommendations from those groups include:

- information about structure, function, and diversity of organisms must remain tied to the ancillary data being collected by other groups;
- not all organisms can be sampled and we will have to select focal taxon for monitoring. The selection should be based on ecological and economic importance, as well as feasibility of study;
- hydrologic instrumentation could be conveniently grouped into 3 major categories: the atmosphere, the soil and subsurface, and the stream systems. To achieve success new technologies, such as Doppler radar, eddy-correlation and Bowen Ratio stations and coupled sensing arrays, need to be applied to each of these categories;
- nested systems of measurements can include core (long-term, fixed location), campaign-style (mobile instrumentation) and medium duration (1-2 years of fixed site sampling) measurements;
- the interactions of human activity with ecosystems need to be an explicit part of NEON, especially the Mid-Atlantic Regional Ecological Observatory (MAREO).

INTRODUCTION

An organizational meeting for the Mid-Atlantic Region Ecological Observatory (MAREO) was convened at the Smithsonian Institution's National Zoological Park

Conservation and Research Center in Front Royal, Virginia with the objective of establishing an ecological observatory for the Mid-Atlantic Region, for potential participation in a National Ecological Observatory Network (NEON). The assembled participants included scientists from within the Mid-Atlantic Region and organizers of other ecological observatories in other regions of the U.S. This report focuses primarily on the organization of MAREO and its scientific underpinnings. An agenda for the meeting and list of registrants can be found in Appendices 1 and 2.

On the first evening of the workshop, Bruce Hayden of the University of Virginia charged the participants to “be thinking about what big things you might do by 2015” in preparing for the organization of MAREO and in preparing for participation in a proposed National Ecological Observatory Network (NEON). He called for the development of consortia at the levels of institutions, field research sites and individual scientists during the development of MAREO. He emphasized some of the challenges in developing an observatory that supports diverse groups of researchers operating within different epistemological frameworks.

Following welcoming addresses by Lucy Spelman of the National Zoological Park, and David Evans of the Smithsonian Institution, a series of representatives from other nascent observatories reviewed their progress. Alan Covich (University of Georgia) reviewed the progress on the development of a SouthEast Observatory Network (SEEON), and David Foster (Harvard University) and Jerry Franklin (University of Washington) reviewed efforts in establishing observatories for New England (New England Ecological Observatory Network- NEEON) and Pacific Northwest Ecological Observatory Network (PNEON), respectively. In his presentation and in subsequent discussions, Jerry Franklin emphasized that “NEON is about developing the infrastructural capacity to conduct research.” He also called for the development of mobile measurement platforms to fill in gaps between existing field research sites. James Gosz (University of New Mexico), John Blair (Kansas State University), Knute Nadelhoffer (Great Lakes Region), Art McKee (Flathead Lake Biological Station), Joanne Leong (University of Hawaii), James McMahon (Utah State University) and Michael Allen (University of California, Riverside) reviewed efforts in the South West (SWEON), while Central Plains Grassland (CPGEON), Great Lakes (GLEON), Neotropics (NeoNEON) Great Basin (GBEON), and California (CEON) observatory networks.

Progress in the development of potential NEON observatories was variable, with some developing observatories having set up meetings, web sites and governance systems, while others were still in an informal planning stages. Some developing observatories had intensive development efforts several years ago when NEON was first proposed, but had gone into hiatus as the visions of NEON shifted and evolved. Throughout there was enthusiastic support for the concept of developing a NEON to help address the nation, and world’s, ecological issues.

A successful National Ecological Observatory Network will depend on enabling comparative studies. This is a daunting challenge, since comparable ecological study units must be identified that can be applied to all (or at least most) biomes and ecosystems. Bruce Hayden addressed the development of these comparative study units. NEON would enable the development of synoptic observation networks that would collect common measurements at appropriate temporal and spatial scales. He laid out examples of potential comparative study systems such as “zero-order watersheds,” (small watersheds that contain temporary stream beds), “minimum standard reaches” (sections of first-order streams) and “lentic and estuarine deltas” (systems where deposition of material creates layered time series). Appendix 3 contains brief, informal, narrative statements describing these comparative study systems. He challenged meeting participants with identifying additional comparative study systems that would allow NEON to be a true national program.

To address the challenges in developing the Mid-Atlantic Region Ecological Observatory, working groups were convened. The first set of working groups addressed the organization of MAREO as a consortium at the level of institutions, field research sites and individual scientists. The second set of groups focused on concept development and the comparative sampling systems identified in Bruce Hayden’s talk, along with additional groups proposed by the participants. The final set of working groups focused on cross-cutting activities – developing measurement systems that will allow researchers to address the major questions in ecology. Working groups were charged with identifying researchers who were not present at the meeting, but whose input would be desirable, and to identify potential leaders for future discussions.

Working Groups: MAREO Organization

“Toward a Governance System”

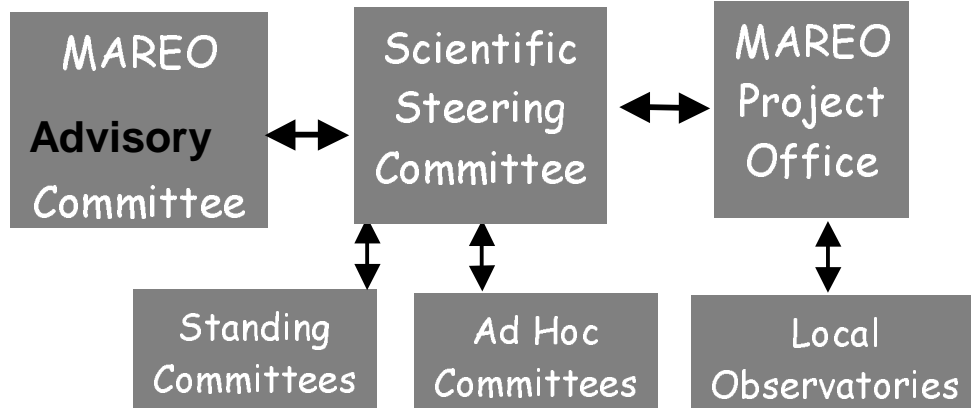
Correspondent: Brent Yarnal. *Group Members:* Donald Boesch, Francisco Dallmeier, Steve Monfort, Marsha Sitnik, Roger Soles, David Smith, and Liz Zimmer

The breakout group concentrated on developing a possible governance structure for MAREO. The diagram below summarizes that structure. Most of the notes presented here describe that structure and thereby capture the group’s discussion. Two other discussion points—by-laws and the basic form of the MAREO consortium—will follow the coverage of structure.

Background. MAREO’s organizational structure and function is designed to fit into the NEON strategy and provide local governance and identify local and regional issues.

Advisory Committee. The MAREO Advisory Committee would provide vision and broad oversight to the Scientific Steering Committee. The Advisory Committee, which would meet once or twice per year, would be relatively large, with two or three dozen committee members. Its membership would consist of a diverse collection of government officials from local to national levels, representatives of non-governmental organizations, businesses and corporations, visionaries concerned with the environment and technology, national and regional NEON representatives, and others who would grasp the “big picture.”

Scientific Steering Committee. The Scientific Steering Committee (SSC) would be the policy-making arm of MAREO, providing critical leadership and decision-making to the enterprise, functioning much like an advisory board. It would consist of 13 members with three-year rotating terms. Selection of the first SSC would be important because its early decision-making would set MAREO on its initial course, which would be difficult to change once started. Many criteria for selection to the SSC would be possible, e.g., by institution, geography, topic, or scientific leadership potential, and it would be desirable to balance all criteria. After the first SSC, a standing Nominating Committee would assemble a slate of subsequent members for election by the MAREO membership. The SSC would meet regularly, e.g., monthly during slow periods and more frequently during active periods.



Project Office. The Project Office will be responsible for the day-to-day workings of MAREO. The SSC would oversee standing committees and ad hoc committees, which it would appoint and from which it would receive reports. There would be a few standing committees from the beginning of MAREO, such as a Nominating Committee, an Infrastructure Committee, an Education and Outreach Committee, and a Field Stations and Observations Network Committee. Ad hoc committees would carry out their business and dissolve as needed.

The MAREO Project Office would carry out the day-to-day business of the enterprise. It would be located at the core observatory site. It would facilitate the SSC and, at the same time, work closely with that committee to ensure that its policies were implemented. The Project Office would also work with the Local (Satellite) Observatories to implement the policies of the SSC.

Local Observatories. Along with the Project Office and core observatory, the Local Observatories would consist of the personnel that make up MAREO. They would be beholden to the policies of the SSC, but they would be the population that the SSC serves.

By-laws. MAREO governing by-laws would be crucial. Nevertheless, many similar organizations have developed by-laws that would be suitable for MAREO's purposes without significant adjustment. Thus, when the time becomes appropriate for developing by-laws for MAREO, it would be wise to survey existing by-laws and to adapt their language for MAREO.

Legal Form. The final form of the MAREO consortium is uncertain. Should it be a legal incorporation? Should there be one lead institution with subordinate institutions? Should MAREO form around the nucleus of an existing consortium, such as the Chesapeake Research Consortium? MAREO membership must answer these

fundamental questions before the enterprise settles on its by-laws and governance structure.

Participants in this breakout expressed interest in future discussions and included:

Donald Boesch <boesch@ca.umces.edu>

Francisco Dallmeier <fdallmeier@ic.si.edu>

Steve Monfort <smonfort@crc.si.edu>

Marsha Sitnik <sitnik.marsha@nmnh.si.edu>

Roger Soles <rsoles@si.edu>

David Smith <des3e@virginia.edu>

Liz Zimmer <zimmer@lab.si.edu>

Brent Yarnal (facilitator) <alibar@essc.psu.edu>

Eric Nagy <enagy@virginia.edu> *could not participate but expressed interest in joining this group in the future.*

Consortium of Field Research Facilities and Field Stations

Correspondent Eric S. Nagy

This “breakout group” was charged with six tasks to serve the formation of the insipient MAREO NEON observatory. Group was joined by another breakout charged to consider aspects of a MAREO Core facility.

Six point charge:

- 1) Identify existing field research infrastructure within proposed MAREO domain.
- 2) Identify federal and other protected landscapes.
- 3) Identify new landscapes that will need some level of infrastructure.
- 4) Identify technology and labs that will be needed.
- 5) Identify facilities that will be needed at core and satellite sites.
- 6) Consider need for a national NEON infrastructure survey.

Breakout opened with a discussion of already existing efforts to identify and inventory existing field facilities, laboratories, technology, landscapes, environments and databases nationwide. It was noted that LTER, OBFS and AIBS are already collaborating in developing inventory databases of the kind needed by MAREO and NEON in general. Bill Michener of the LTER Network Office and OBFS reviewed his efforts to develop such a database and indicated he and the LTER Network office in Albuquerque are willing to cooperate in the MAREO effort. It is known that AIBS is also in the preliminary stages of constructing its own database of field-based research and teaching facilities in support of IBRCS activities. It was agreed that MAREO should at least work from, and not reinvent, LTER, OBFS and AIBS efforts. And ideally should not need to develop its own database at all, but should simply assist, and contribute to, existing inventory efforts. Other organizations (eg. NAML) will be contacted to

determine if their existing databases could also be useful or serve as models. A master national facilities database would be priceless to the construction of other NEON observatories and to that of the entire NEON instrument. The University of Virginia, MAREO, LTER Network Office, OBFS, and AIBS may all be able to contribute resources for database development. A number of subgroup attendants volunteered to assist in the effort:

Eric Nagy (UVA, OBFS)
John Porter (UVA)
Bill Michener (LTER)
Roger Sole (USGS)
Peter Leimgruber (CRC)
William McShea (CRC)
Jim Galloway (UVA)

Immediate plan (2 weeks):

- 1) Fields and categories of existing databases will be summarized for MAREO review.
- 2) All MAREO participants (meeting contacts) will be contacted by email
 - a. to review facilities database structure and,
 - b. to “spread the word” about MAREO and help identify / recruit potentially interested persons and facilities within the newly defined MAREO region. A web-based registration system will be ready to register potential players.
- 3) The group identified above will collect database structure comments, feedback, additions and deletions, and will oversee construction of the final facilities database.

Next (3 months):

- 1) Contact all new potential MAREO participants to feel out interest.
- 2) Develop database in complete compatibility with LTER and OBFS database efforts.
- 3) Populate database with all basic (course-grained) data.
- 4) Determine landscape “holes” in MAREO coverage (USGS maps, database analysis).

Later, but pre-MAREO proposal:

- 1) Populate database with more detailed data from proposed core and satellite sites.

Discussion of Core site - “where?” “what?” and “why?”

Mostly an open and general discussion of value or and need for a MAREO Core site. What is a core? Do we need one? Do we need two? Is it an archaic concept? Might it appear to invest too much power at one site in the network? How can we choose a core before we know what it needs to do? (can we choose the research site before we know the project). Discussion terminated as time ran out. Served to raise issues to participant who have not been part of past NEON planning.

MAREO Scientists Workgroup

Correspondent: Mike Reiter

- 1) At this stage, there is a need for two forms, one informational for a human capital survey (for proposal purposes), and one for project/proposal submission once MAREO is in place
 - a) Both should be available on-line to be filled out
 - b) Combination of fill-in-the-blank (____) and check boxes ()
 - i) Data can be tabulated on the receiving end
 - c) Both forms (informational form in particular) should be available widely: beyond the immediate MAREO community
- 2) On-line informational form, suggested format

NAME _____

INSTITUTION _____

DEPARTMENT _____

CONTACT INFORMATION _____

SPECIALIZATION _____ (could be checklist of broad categories)

E-MAIL _____

DO YOU HAVE ANY OF THE FOLLOWING AVAILABLE FOR THE USE OF OTHER SCIENTISTS: LAB FIELD RESEARCH SITE RESEARCH STATION

IF YES, BRIEFLY DESCRIBE _____

“LEVELS” OF RESEARCH PERFORMED: UNDERGRAD GRADUATE POSTDOC PERSONAL VOLUNTEER

I WOULD LIKE TO BE KEPT INFORMED WITH THE PROGRESS OF THE PROGRAM TO PARTICIPATE IN THE DEVELOPMENT OF THE PROGRAM

- 3) On-line project/proposal form (information to go to a review group), suggested format

NAME _____

AFFILIATION _____

IF STUDENT, FACULTY SPONSOR _____

SITE(S) TO BE UTILIZED _____ (could be checkboxes)

DATES OF PROPOSED PROJECT _____

PROJECT SUMMARY (1-2 pages, including project overview, hypotheses, methods, and expected impacts) _____
(attachment?)

REQUIRED FROM SITE(S) (EXPLAIN ALL CHECKED ITEMS)

DATA

 EQUIPMENT/PERSONNEL

 SITE USE

CONTRIBUTIONS/MODIFICATIONS TO MAREO/SITE

DATA

 EQUIPMENT/PERSONNEL

 SITE USE

- 4) Rights/responsibilities: will require some type of legal arrangement (a standard contract?) involving the following points
- a) MAREO must receive initially a list of the data to be collected, and eventually the data itself
 - b) MAREO must receive copies of all papers, reports, and publications resulting from the project or data request
 - c) Researcher must report all uses of MAREO data to MAREO, and cite MAREO and the source in all reports and publications
 - d) Caveat that data cannot be passed on to a second party: data must come directly from MAREO
 - i) Raises a policing issue
 - ii) Need built-in system reminders (e-mail reminders?)
 - iii) Could block future applications by individuals not following responsibilities
 - iv) Would require a tracking mechanism
 - e) Submit an on-line report annually (format following)
 - f) If the proposer is outside the MAREO network, they should be required to register themselves with MAREO (fill out information and project proposal form) before being considered
- 5) On-line progress report form, suggested format

PROJECT TRACKING NUMBER _____

PROJECT TITLE _____

RESEARCHER _____

AFFILIATION _____

BRIEFLY EXPLAIN ALL CHECKED ITEMS

- NEW DATA _____
- NEW RESULTS _____
- LEVERAGED FUNDING _____
- PUBLICATIONS AND REPORTS _____
- STUDENT INVOLVEMENT _____

PROGRESS (1-2 paragraph summary)

- 6) Review process suggestions
 - a) Should have a review panel for project and data requests
 - i) Consider separate panel for large research institutions and small institutions/public groups
 - b) Panel should involve representation by the site(s) being requested/impacted
 - c) Recommend two processes, one less formal process for data-only or non-manipulative projects, and another for projects involving impacts of modifications to a site
 - i) Impact/modification projects should be subject to site veto

Working Groups: MAREO Concept Development and Leadership Identification

Zero-Order Watersheds

Correspondent: Aaron Mills. Group Members: George Constanza, Chris Duffy, Scott Eaton, Linda Fink, Pat McGonigal, William McShea, Aaron Mills, Steve Seagle, and Don Young.

The concept of a zero-order watershed (ZOW) as defined by Hayden confused several members of the breakout group. Many of the members did not relate well to the idea that these units were intermittent in their hydrological output. Additional concerns were expressed about the replicability of ZOWs such that for many cases N might always be equal to 1.

Overall the group felt that the classical hillslope concept might provide a better basic control volume for ecological study. The hillslope (minus the riparian zone and stream) behaves similar to a ZOW, except that each hillslope might actually contain more than one ZOW. Hillslopes are frequently instrumented throughout the region defined by MAREO, and the concept allows for scaling and regionalization under a variety of circumstances. There is a strong relationship between properties and processes occurring at a position in the hillslope and the actual position (elevation) in the hillslope. (See Fig.) Thus, the ZOW concept offered by Hayden is a reasonable way to deal with small sample units that can be interpreted in the context of scalable units

with which the community is familiar and comfortable. Use of the basic hillslope concept would allow fitting zero-order watersheds into that familiar context.

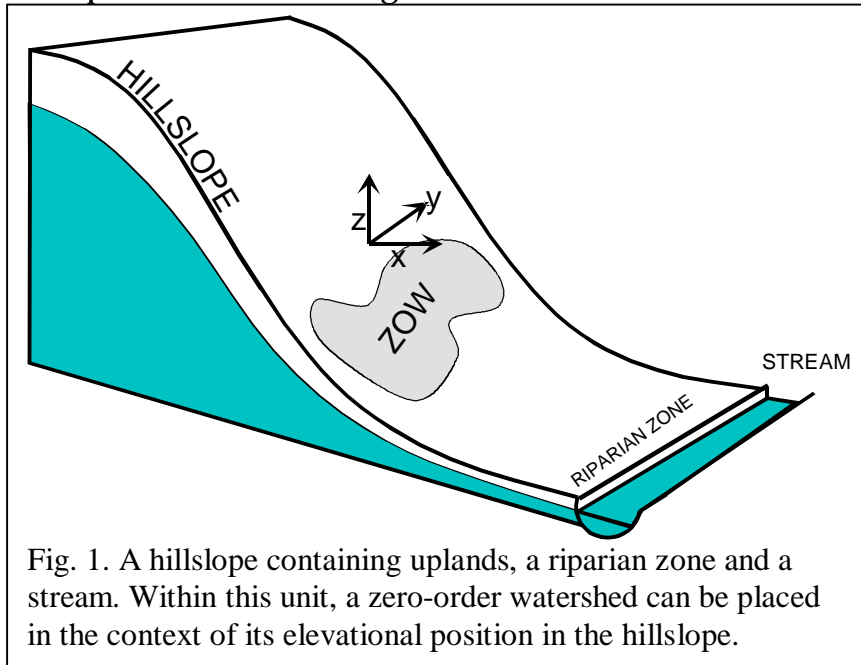


Fig. 1. A hillslope containing uplands, a riparian zone and a stream. Within this unit, a zero-order watershed can be placed in the context of its elevational position in the hillslope.

Minimum Standard Stream Reaches

Correspondent: Jack Webster. Group Members: Alan Covich, Greg Gorham, Mike Bass, Jim Galloway, Mike Reiter, and Mike Paul.

We agreed that a widely accepted standard for sampling streams is that samples should be taken over a reach that is approximately five times as long as the width of the channel. However, we also noted that that length might not be sufficient for measuring many instream processes. From there, our discussion focused on the following three questions:

1. Why sample streams as part of NEON?
2. Where should streams be sampled?
3. What should be sampled?

1. Why sample streams? First, the water in streams is a reflection of both terrestrial and aquatic ecological processes in the entire watershed upstream of that point. Thus stream samples represent a spatial integration of everything happening in the watershed. Second, streams are important landscape features and resources that need to be sampled and monitored.

2. Where sample? Based on our answer to the previous question, we suggest several sampling sites. In order to use streams as an integrator of what is happening in the watershed, it would be best to sample as near the headwaters as possible in order to

isolate terrestrial processes. Sampling should include near-stream wells and lysimeters. Additional sampling downstream, perhaps at the first stream junction or at a landscape change, could make it possible also to determine instream processes. Consideration should also be given to sampling in larger order streams, however, NEON needs to avoid overlap with existing programs (USGS, EPA), which generally target larger streams. NEON programs should complement, augment, and protect existing data and sampling programs.

3. Sample what? NEON should initially consider an extensive sampling program that includes a whole suite of physical, chemical, and biological characteristics. This list can then be shortened based on fiscal reality. We discussed the advantages and disadvantages of chemical versus biological samples. Chemical samples are generally cheaper and more easily standardized, but they represent only the characteristics of the stream at that time. Biological sampling is more costly because it requires much greater expertise, however, animal and plant assemblages are important and useful temporal integrators of stream conditions. Given very limited funding, our recommendation would be to concentrate on automated measures of downstream fluxes. These measurements should be made with a design that allows scaling up to a regional landscape.

The MAREO region includes a wealth of stream scientists with expertise in hydrology, geomorphology, biogeochemistry, and stream organisms. The first step in developing a MAREO-NEON program should be to enlist the help of this community in documenting information that exists now.

Lentic and Estuarine Deltas Working Group Report

Correspondent: Walter Boynton. Group Members: Anthony Overton, Denise Breitbart, Steve Macko, Iris Anderson, and Mike Reiter.

1. Recommended that deltas be changed to systems or estuarine systems and other delta systems.
2. Noted the need, especially in MAREO, for consideration of reservoir ecosystems...we have quite a few. I suspect they act a bit like kidneys (or an appendix) if we can use a medical analog here. In any case, our group did not contain a lake/reservoir person so the lack of comment on these systems reflects ignorance not lack of interest or importance.
3. The general consensus of our group was that it was worth including the N. Carolina estuaries in MAREO, especially for comparative purposes. However, this might well be one of the "fuzzy edges" and in the long run makes little difference what group it is included in.

Group discussions also included the following general statements:

1. In this region there are a large number of data sets, some with 25 or more years of observations, that tend to emphasize physical and chemical measurements. Such data sets for larger organisms are rare or missing.

2. Given the huge but dispersed data sets, we believe that a very substantial IT effort will be needed. The idea would be to provide ready access to these data sets.

3. Much, but not all, of the inputs of materials from uplands to estuaries are well monitored and have been since ~1978. It appears that more effort is needed in some of the Virginia waters.

4. Several classes of NEON-MAREO measurements were discussed but not in great detail. One class could be called decadal scale inventories of all locations. These measurements would involve deposition rates of sediments, nutrients, toxics, etc in depositional areas of estuarine systems. There is a need for these measurements perhaps once a decade but they have not been made in most of these systems. A second class of measurement would involve higher frequency measurements of variables such as temperature, salinity, algal biomass, pH and dissolved oxygen. Such measurements are responsive to variations in river flow and loading rates from terrestrial sources. In addition, new sensor systems designed to detect HABs and other environmental features could be part of this system as well. There is a rich area of evolving sensor technology. We also briefly discussed the possibility of moorings capable of counting anadromous fish returning to spawning areas in the upper tributaries, thus augmenting the assessment of larger animals in this coupled land-seascape.

Here is a list (not complete) of institutions the group identified as possible MAREO players;

- a. North Carolina
 - i. East Carolina University and field station
 - ii. Elizabeth State University
 - iii. Duke University and marine lab
 - iv. UNC Chapel Hill and marine lab
 - v. UNC Wilmington and marine lab
 - vi. NCSU and marine lab
 - vii. NOAA lab at Beaufort, NC

- b. Virginia
 - i. VPI
 - ii. Virginia Commonwealth University
 - iii. Virginia Tech
 - iv. ODU
 - v. VIMS, Wachapreague lab and William and Mary
 - vi. Hampton University
 - vii. George Mason University
 - viii. UVA and LTER Site
 - ix. CRC Smithsonian

- x VA NERR sites

- c. Maryland
 - i. University of Maryland
 - CBL
 - HPL
 - AL
 - ii ANSERC
 - iii SERC
 - iv NOAA Oxford
 - v EPA Chesapeake Bay Program
 - vi NOAA Chesapeake Bay Office
 - vii USGS Chesapeake Bay Program Office
 - viii Chesapeake Bay Foundations and field sites
 - ix MD NERR sites

- d. Delaware
 - i. University of Delaware and Lewes marine lab
 - ii Delaware State University

- e. New Jersey
 - i. Rutgers University and field station
 - ii NOAA Sandy Hook lab
 - iii Haskins lab

- f. Washington, DC
 - i Howard University
 - ii University of DC
 - iii Loads of Govt agencies
 - iv Loads of NGOs

We suggest additional group members might include:
Hans Paerl UNC Marine lab
Mark Leutenback - VIMS
George Luther - University of Delaware marine lab
Ken Able - Rutgers University marine lab
Unknown Individuals to represent reservoir ecosystems

Urban Components for MAREO/NEON

Correspondents: Peter Groffman and Michael Paul.

Urban and suburban ecosystems are an increasingly important land cover type in the U.S., with high rates of biogeochemical fluxes and important impacts on water and air quality. Moreover, there are commonalities among urban and suburban ecosystems such that residential areas in diverse parts of the country have similar patterns of soils, vegetation and streams due to human preferences and needs. Urban areas could be an important component of each regional NEON, e.g., MAREO, or there could be a cross-cutting urban theme-based NEON, with a network of sites monitoring air and water quality, biodiversity and human-environment interactions in widely distributed cities. Any type of urban NEON should have a strong social science component as cities are focal points for human:environment interactions and socio-ecological research.

The zero-order watershed (ZOW) and minimum stream reach (MSR) concepts can readily be applied in urban ecosystems. The simplest ZOW in urban areas would be a storm drain network, where natural drainage patterns have been completely replaced with pipes to collect stormwater. These are true ZOW, but may not be the optimal unit for an urban NEON because some variables may not be amenable to study within these units, e.g. groundwater flow, biodiversity. Concerns about applying the ZOW approach will need to be worked out for all ecosystem types in MAREO. Beyond storm drainage networks, hydrologic changes associated with urbanization, i.e. an increase in flashy stormwater flows associated with impervious surfaces, create characteristic urban headwater watersheds, with highly incised stream channels and low water tables in riparian areas. In many areas, degraded urban headwater areas have been replaced with stormwater detention basins. An urban NEON would thus need to include at least three types of ZOW and/or MSR – storm drainage networks, degraded headwater watersheds and detention basins.

Technological needs for urban NEON sites include automated water collection devices (e.g. ISCO samplers), hopefully with real time sensors for key variables (e.g., oxygen, temperature, nitrate, phosphate, DOC, hydrocarbons, metals) and continuous air quality monitoring devices with real-time sensors for key variables (e.g., ozone, particulates). Biodiversity assessments in urban areas must encompass exotic species that often are a significant component of the species diversity in these ecosystems, with important functional roles. The potential for education and outreach is high in urban ecosystems, e.g. schools and community centers are idea locations for NEON installations.

Some useful references on urban ecology:

Grimm, N.B., J.M. Grove, S.T.A. Pickett, and C.L. Redman. 2000. Integrated approaches to long-term studies of urban ecological systems. *Bioscience* **50**:571-584.

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Agricultural And Managed Forest Subsystems

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Agricultural lands and forests managed for resource production (“cultured landscapes”) major components of the ecological systems that occur across mid-Atlantic landscapes, and should be considered as essential to NEON. The mid-Atlantic landscape of Delaware, Maryland, New Jersey, Pennsylvania, and Virginia is 23% agricultural and 58% non-federal forest (NRCS, 1997). Area-proportionate effects of agricultural systems on aqueous and atmospheric fluxes are high, relative to other land uses occurring over extensive areas. Agricultural and managed forest systems provide food and habitat for numerous non-cultured organisms, and can serve as sources for pest species and toxins; management activities on such areas often alter hydrology. If NEON is to achieve its potential to increase human understanding of ecological processes across broad spatial and temporal scales, the NEON network’s monitoring protocols implemented on other landscape elements should be established on agricultural and managed forest sites.

Energy and material fluxes should be a focus NEON monitoring in cultured landscapes, as such fluxes are integral to ecosystem function at all spatial scales. Essential questions that can be addressed by NEON concern effects of agricultural and silvicultural management on geochemical fluxes through aqueous and atmospheric media; the influence of management-induced fluxes on non-cultured communities and systems; and the development of indicators to gauge the success of management practices intended to limit or control impacts on non-cultured species.

Monitoring protocols on agricultural and forested lands should also address biological change and mobility. Non-crop species’ and communities’ spatial distributions are essential landscape characteristics that are influenced by and influence cultural management; these communities are affected by exogenous variables such as

atmospheric composition, atmospheric deposition, and climate change, which also affect agricultural management. Although specialized monitoring networks targeting economically important pest species are operating today, the NEON network could aid fundamental understanding of bio-landscape processes at the systems level by monitoring larger community segments. The genetic composition of non-managed communities could be a major monitoring focus, given the rapid expansion of transgenic crop usage by US agriculture; the potential for genetic translocation from transgenic crops to create biological novelty in wild species with consequent community and ecosystem effects; and the lack of any national systematic landscape-based strategy for monitoring transgenic agriculture's community and ecosystem effects (NRC, 2002). The emerging field of biosensors may provide an opportunity for NEON to help develop and deploy a cutting-edge technology with potential biosecurity applications while achieving the above goals.

Ecosystem impacts of agricultural and silvicultural practices are also of interest across broad spatial scales, where current capabilities to quantify human-induced change is limited. Even at the fundamental level of land use / land cover, our current capability to quantify past change is limited by the rapid evolution of our landscape characterization technologies and methods, which has had the unfortunate consequence of limiting the comparability of current to past measurements. Even more limited is current capability to characterize over time and across landscapes the use of specific cultural practices, such as agrichemicals and fertilization, that are known to influence ecosystems; an ability to monitor such practices' application will be necessary to understand and predict their landscape-level biological effects. An emerging concern that could be addressed by NEON monitoring is the effect of crop management practices on carbon sequestration by soils. Periodic airborne hyperspectral surveys of agricultural and forested landscapes would be useful in monitoring cultural practices' bio-landscape effects.

Agricultural and forest field stations operated by the region's universities and agencies could provide a network for NEON monitoring in cultured landscapes. Such facilities are located throughout the mid-Atlantic region, and most are staffed. A broad array of agricultural and forest scientists could become involved in a NEON monitoring network, but precisely who those parties should be would be more appropriately addressed after a vision of the NEON network and its goals have been more clearly articulated.

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Landscape-scale Observation Systems within MAREO

Correspondent: John Porter. Group members: Peter Liemgruber (leader), Phil Townsend, Tai Roulston, Chip Bachmann, Jose Fuentes, Norm Bourg, Don Weller and Han-Bin Su.

This was a diverse group, incorporating experts on remote sensing, modeling, land-atmosphere interactions and landscape ecology. We saw an important role for landscape-scale studies within MAREO as a way of linking core and satellite sites both together and to the interstitial landscapes. The group focused on defining the issue of scaling (going from measurements at points to measurements for an entire region), and the data and computational requirements.

Infrastructure needs to support the use of remote sensing in landscape observations were identified as:

- recurrent aerial, satellite and lidar data for specific study sites and the region,
- ground-based measurements, including leaf area and phenological status,
- a library spectrometric signatures for land cover elements throughout the region,
- access to high performance computing, and mass storage,
- a base set of GIS data for core and satellite sites and for the entire region, and
- an advanced data repository supporting data from specific field sites, remote sensing and additional data to support model development.

Additionally, we identified additional scientists within the region who could materially contribute to landscape-scale research within MAREO. These included: Remote sensors, such as Steve Prince, Chris Justice, and Forest Hull, LIDAR experts such as Ray Huff, Geoff Parker, and Belay Demoz, and modelers and landscape ecologists such as Tom Fisher and Bob Gardner. It was also suggested that representatives from organizations that frequently sponsor or conduct aerial surveys, such as NOAA and NASA should be involved.

Activities were identified for future meetings of this group. These activities include:

1. Identify measurements
 - a. ground measurements
 - b. remote measurements
2. Use landscape data and remote sensing data for stratification, determine sample density, identify gaps in NEON site selection
3. Do an analysis of probable MAREO satellite sites to see gaps, redundancies

Working Groups: MAREO Cross-Cutting Activities

Biodiversity Observation System within NEON

Correspondent: William McShea.

These are the preliminary discussions within the committee. Our goal would be to obtain information about structure, function, and diversity of organisms across the landscape. We would base our observations within the sampling system devised for NEON, which is stratified within the geomorphic structures of zero-order watersheds, first-order streams, and estuarine/marshes. We recognize meaningful data for some organisms may involve extending the size of the sample point, but we must remain tied to the ancillary data being collected by other groups. The grand questions addressed by this monitoring are still to be determined, but the metric used to measure biodiversity could include a species list, the ratio of invasive to native species, productivity, the movement and sequestering of nutrients and minerals, and the ability of the location to serve as source or sink for organisms within the landscape. A single biodiversity question might be determining the thresholds for the persistence of ecologically or economically important organisms across our human-dominated landscape.

We recognize that, except in rare cases, not all organisms can be sampled and we will have to select focal taxon for monitoring. The selection will be based on ecological and economic importance, as well as feasibility of study. There will be a need for the training and support of taxonomists for these focal groups. There is extensive work on selection criteria for monitoring programs being conducted by government agencies, such as NPS, USGS, EPA, Smithsonian Institution, and USDA, and these groups must be brought into the discussion. There will most likely be a tiered system where all sites collect data on a suite of organisms and select sites collect more extensive data, either more taxon or more depth on the focal taxon. There will be need for a mobile science team that can be brought to a field station to enhance its database.

Beyond the training of taxonomists, the biodiversity observation system will also serve as a conduit for many public groups to understand the importance of NEON. If focal taxons include charismatic groups, such as migratory birds, the documentation of their role within the system will provide understandable examples of ecological functioning. The biodiversity observation system will be the mechanism by which many groups participate and use NEON, as most small colleges, secondary schools, and community groups do not possess specialists in stream ecology, ecosystems, or hydrology. NEON should be aware of its role to provide the bedrock data upon which other groups can add their interest in distinct organisms.

One function of the biodiversity observation system would be an early warning system for the country through communication between NEON groups to the appearance of

new organisms or loss of important elements within their networks. Communication between regional groups will be essential to the effective functioning of the network.

We are aware that the biodiversity observation system is operating on both a spatial and temporal scale. There is a need to create reference collections at distinct intervals, which would include both genetic and biological samples. We will collect blood and tissue samples to track disease pathogens. We must recognize that technology is improving rapidly and samples taken today and properly archived will continue to produce new data. There is a need for genome resource banking for focal species that are identified through the network. Investment in the technology to rapidly assess, and properly archive, genetic and biological samples is critical.

Biodiversity observation systems would have a critical role in NEON by providing a direct link between geomorphic features and biochemical processes and organisms that are relevant to the public.

Hydrologic Implementation Group

Correspondent: Chris Duffy

We discussed four theme areas pertinent to implementing MAREO Hydrology

Instrumentation The group decided that hydrologic instrumentation could be conveniently grouped into 3 major categories: the atmosphere, the soil and subsurface, and the stream systems, a fourth group might be bio-sensors but we left that to the other group on indicators.

1) *stream*: With respect to stream instrumentation the group decided that new technologies need to be applied to this problem as traditional methods of stream-stage measurements and rating curve development is probably too high a cost especially in the maintenance. All existing USGS/state and federal cooperative sites within the region would of course be included as part of the observing system so we focused on what MAREO needed to do. Two types of doppler radar methods seem to be the most promising. For small streams an up-looking radar would be located on the bottom channel. For large channels the doppler radar would be located on a streamside tower. The technology is state-of-the-art and provides flux directly.

2) *atmosphere*: The basic atmospheric instrumentation is the eddy-correlation or Bowen Ratio weather station/flux tower. These would be designed along the lines of Ameriflux station at selected sites for carbon research but additional sites with a standard package would be deployed synoptically and with full integration with existing federal and state weather stations/mesonets.

3) *Soil & groundwater*: The group discussed the importance of integrating the soil moisture and water table sensor system with the stream and atmospheric sites such that all instrumentation is coherent and probably in real time at core sites. Particulars of the array design is left for future discussions.

4) *Coupled sensing arrays*: A fundamental problem is the separate sensing of transpiration and soil/water table evaporation. The atmosphere/soil/groundwater system described above could easily be designed to directly measure these two fluxes if sapflow sensors were incorporated. The integration of the stream-gaging system with arrays of sediment, dissolved oxygen, nitrogen species and other geochemical observations including possibly isotopes is necessary if a mass balance is desired. Some of our discussion was about the new generation of bio sensors (e.g. tracking fish), thermal imaging, acoustic methods, in situ biochemical devices and colorimetric chemical indicators. Geophysical tools for physical site assessment might also be useful (ground penetrating radar, resistivity, other) especially under the mobile observing capability (below).

Site Selection. The group generally felt that site selection should proceed based on opportunity-driven science, or clearly articulated science hypotheses. The group felt that there were three types of sites necessary to support the diverse nature of NEON science.

- **Core measurement** sites should be chosen to satisfy the synoptic, **long-term and fixed location** water, energy and mass needs of the MAREO science plan.
- **Campaign-style instrumentation measurement** would use a mobile instrumentation package designed for
- **Medium duration instrumentation** (1-2 year fixed site and mobile sampling) will require some of both types of instrumentation. The idea here is that much university research has a 1-3 year window with hypotheses that must be tested in a non-core site location. This allows for intensively sampled experiments which would augment the Synoptic coverage.

The group felt that “nested design” would be the best way to link the Core measurements, the Campaign measurements and the Medium Duration Measurements.

Mobile-Fixed Observing System. The group generally felt that instrumentation/sensors would require both a mobile and fixed type strategy to satisfy the synoptic and campaign style investigations to be carried out. This will likely require an instrumentation facility that may go beyond the capabilities of the MAREO. Infrastructure for instrumentation design a needs consideration and cooperation with existing federal agencies (NCAR, USGS, USDA, etc..

Interface with Existing Federal, State and University Science. This will likely be a critical element to the success of MAREO and NEON in general. The first level of cooperation is to leverage other agencies existing facilities for instrument design and deployment. Examples: NCAR ATD, USGS Stream Gaging and NAQWA activities, USDA National Soil Moisture Network. State Mesonets, State Landuse/Landcover, geology, etc.

Report of Cross-Cutting Working Group on a Coupled Human-Environment Regional Ecological Observatory (CHERO)

Correspondent: Bill Easterling. Group Members: D. Boesch, M. Reiter, P. Leimgruber, M. Paul and B. Yarnal (Penn State),

Land use change and policy, energy and water use, population change, urbanization, and change in the built environment are among the most important drivers of ecological change across the spectrum of spatial and temporal scales. Moreover, ecological changes affect the delivery of ecosystem goods and services that are of value to humans. These processes are fundamental to a comprehensive ecological observatory. *We strongly recommend that the interactions of human activity with ecosystems be an explicit part of NEON, especially the Mid-Atlantic Regional Ecological Observatory (MAREO).* A Coupled Human-Environment Regional Ecological Observatory (CHERO) approach must be incorporated in the construction of the MAREO. This approach requires including social scientists with skills in integrated assessment of environmental change, which effectively meshes ecology with the disciplines of geography, economics, sociology, political science, and anthropology. The goal of CHERO is to build capacity to understand and predict how human activities impact ecological processes at the local (zero-order stream basins) to regional scales (large river basins), and how ecological changes impact ecosystem goods and services of value to humans.

CHERO should monitor human drivers of ecological change such as population change and distribution, land use and land values, energy consumption and transportation patterns, recreational demands, demand for water and other renewable resources, and relevant policies. Creative scalable demographic, economic, policy, and land-use datasets that match with the scales of ecological datasets must be developed from existing and future databases using innovative geoinformatics and visualization technologies. CHERO must also monitor needs and concerns of stakeholders to facilitate the production of policy-relevant ecological information. For example, stakeholders can shed light on the utility of ecological indices and the scales and locations of intense environmental policy interest now and in the future. The disciplined acquisition of such stakeholder-driven data and information will require such innovative mixed-method combinations as simulation modeling, GIS and remote

sensing technologies, and focus group interactions. These data should be archived with all other ecological data being collected in MAREO.

Participants in the CHEREO working group included D. Boesch (University of Maryland), M. Reiter (Delaware State University), P. Leimgruber (Smithsonian-CRC), M. Paul (Howard University), B. Yarnal (Penn State), and W. Easterling (Penn State). An organizational meeting is anticipated for Spring or early Summer 2004.

Report of the Workgroup on Standard Measures

Correspondent: Pat Megonigal Group members: Eric May, Eric Nagy, Steven Seagle, Martha Sitnik and Don Young

Our assignment was to consider the suite of standard measurements that would be made at sites in a mid-Atlantic ecological observatory network. The group recognized that some sites will be studied more intensively than others, and this will determine how many types of standard measurements are required. A decision was made to focus on the basic suite measurements that will be required of every permanent site in the network. Rather than develop an exhaustive list, we discussed a general framework that such a list will need to satisfy.

The subset of standard measurements chosen for every site in the network must be easy to perform, affordable and meaningful. Automated instruments and probes that collect high-intensity temporal data are attractive, but they must be sufficiently inexpensive to install and maintain so that they can be replicated across the network. Because a small subset of all possible measurements can be chosen as standard measures, they must be relevant across a broad array of biological disciplines. We considered four types of standard measurements that meet the above criteria, but vary with respect to measurement frequency:

- **Topographic and Geological Elements** include physical characteristics of a given site that vary slowly, requiring infrequent measurements. This could include measures of topographic relief, the dimensions of water bodies, and soil and sediment characteristics.
- **Fast-Changing Physical Characteristics** include weather variables such as temperature, humidity, wind and precipitation. It would also include variables specific to aquatic systems such as dissolved O₂ and conductivity. Automation allows these measurements to be made at a high frequency.
- **Biological Measurements** present a special challenge because they may need to be made frequently but are difficult to automate. Also, the wide variety of organisms that could be surveyed is potentially overwhelming. Nevertheless, it

seems critical to perform a biotic survey of most of the sites when the network is established, and to repeat the process at intervals that are appropriate for the effort required (e.g. decadal). It was suggested that the minimum criterion for biological data is the information required for a user to select a subset of sites appropriate to address a user-defined question. On land this includes plant community composition, particularly the relative importance of dominant species and invasive plant species. This information will need to be updated at perhaps five year intervals. There are many indexes and indicators that could provide information on biological activity on a short (e.g. annual) recurrence interval. For example, there is the index of biotic integrity, Simpson's index or the ratio of least-to-most sensitive species.

- **Remote Sensing** tools can potentially provide high resolution measurements in both space and time. Biological variables such as NDVI are made routinely. Hyperspectral imagery has the potential to provide a species-specific data relevant to plant productivity. Regular surveys of land use will be valuable to all users of the network platform, and can provide useful landscape information such as patch sizes and connectivity among landscape units. Consideration should be given to choosing ground-based measurements that link easily to remotely-sensed measurements (and vice versa) in order to facilitate scaling.

NEON can build upon the experiences of existing programs with standard measures such as the LTER sites, USGS gauging stations, and the Ameriflux network.

The group used the brief time allowed to discuss baseline measurements that would meet the monitoring goals of NEON. However, NEON is conceived as more than a monitoring network. NEON must be a powerful and flexible tool and experimental instrument – such a ship, particle accelerator, or telescope -- with nascent questions and a full spectrum of scientific tools and capabilities. NEON must also embody an incipient paradigm shift in ecological, evolutionary, and environmental (physical and biological) research. Standard measures that would accomplish the more ambitious goals of NEON were not discussed, but comments on this issue were provided soon after the meeting by Eric Nagy.

The NRC report emphasized the need for long-term physical and biological experiments that would be standardized across observatories. These might include traditional common garden-type experiments designed to address specific questions or perhaps very long-term ecological trends (e.g. global warming, invasions, or disease transmission). Innovative, cooperative, and novel scientific designs and approaches need to be developed as part of the intrinsic core of NEON. In fact many of the scientific questions put forth by both the IBRCS Working Group (white paper #1) and the NRC report can only be addressed using a combination of monitoring and experimentation at landscape, watershed, community, population, and evolutionary

scales. LTERs have done experiments at the local/small regional scale, and very successful monitoring programs are in place as a result of good work by agencies and NGOs. NEON must seek to take both approaches simultaneously at a region-wide and continent-wide scale.

Working Groups: MAREO Enabling Technologies

Correspondent: Jim Galloway.

Archives

On Friday January 30 during the Technology Fair at the MAREO meeting, Dave Carr, Michael Bass, Jack Webster, James Comiskey and Jim Galloway informally discussed what types of samples should be archived. In theory everything should be saved, in reality proper storage is expensive and requires extensive space. We agreed that the top priority for stored materials should be those materials that integrate processes. In that regard, the top three on our list were liver tissue, atmospheric aerosols and water samples. It should be noted that this list is meant to generate discussion as opposed to be set in stone!

We also agreed that the next step should be to determine what materials are already being archived in the MAREO region.

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Appendix 2: Meeting Agenda

Mid-Atlantic Region Ecological Observatory			
Date/Time	NEON MAREO Meeting	National NEON Meeting	
28th 4:00 pm	Arrival Registration and Social at the CRC Training Center		
28th 6:00 pm	Evening Meal at the CRC Training Center		
28th 7:00 pm	Some Introductions CRC Training Center		
28th 7:15 pm	Evening Plenary: A Vision for NEON Regional Implementations Bruce P. Hayden CRC Training Center		
28th 8:15 pm	Resume with the Social Backslapping and Discussion CRC Training Center		
28th 7:30 am	The Morning Meal CRC Training Center		
28th 9:00 am	Welcome -- Bruce P. Hayden University of Virginia		
	Smithsonian Under Secretary for Science David Evans and Director of the National Zoo Lucy Spelman		
28th 9:30 am	Overview of the Meeting of the Mid-Atlantic Regional Ecological Observatory and The First National Convening of Regional NEON Planning Groups		
28th 10:00 am	Comments from NSF and AIBS		
28th 10:30 am	A Vision for a Mid-Atlantic Region Ecological Observatory Bruce Hayden		
28th 11:00 am	Other Organizing Visions for the Observatory (Discussion)		
28th 12:00 pm	Lunch at the Training Center		

Mid-Atlantic Region Ecological Observatory			
Date/Time	NEON MAREO Meeting	National NEON Meeting	
29th 1:00 pm	MAREO Tours of the GRG Facilities Training Center Parking Lot	NEON Regional Representatives Meeting CRC Auditorium Bruce Hayden & Jeff Goldman	
		Introductions & Region NEON Status	
		Agenda Adjusting	
		Discussion of IBRC White Paper	
		RSP Announcement	
		NEON Taskforce	
29th 2:30 pm	Discussions with Leaders of Other NEON Planning Groups		
	The Geography and Region Boundaries Covich, Foster and Hayden		
29th 3:30 pm	MAREO Consortium of Universities Dave Smith (facilitator) Training Center Conference Room	Regional NEON Planning Groups Meeting The CRC Auditorium WHAT HAS TO HAPPEN IN REGIONS to be NEON READY Call Regional Organizational Meetings	
	Field Stations & Research Sites Meeting Eric Nagy (facilitator) North Half of Training Center Main Room	Identify Regional Leadership; Build in Diversity Designate 2 Keps Organize Institutional Support Base Inventory Regional Infrastructure	
	MAREO Consortium of Scientists Mike Reiter (facilitator) South half of Training Center Main Room	Debate NRC v IBRC Models Consider Design Strategy National: Everyone in the Same Regional: Thematic Neighboring NEONS	
29th 5:00 pm	MAREO Core & Satellite Site	Special Site Science Special Opportunities	
29th 5:30 pm	Social Begins Discussion Continues Training Center Main Room		
29th 6:30 pm	The Evening Meal Training Center Main Room		
29th 7:30 pm	Reports from Smith, Nagy and Reiter		
29th 8:00 pm	IBRC Overview of NEON: Past, Present & Future Jeff Goldman		
29th 9:00 pm	Informal Discussions: Social Resumed		
30th 7:30 am	The Morning Meal CRC Training Center		

Mid-Atlantic Region Ecological Observatory			
Date/Time	NEON MAREO Meeting	National NEON Meeting	
30th 8:30 am	First Break Out Sessions	Regional NEON Planning Groups Meeting	
	Concept Development and Leadership Identification	The CRC Auditorium	
		AGENDA Adjustments	
	Zero Order Watersheds (Mills)	Focus on Regional Boundaries	
	Minimum Standard Stream Reaches (Webster)	Focal Research Problems and Issues	
	Lentic & Estuarine Deltas (Boynton)	Contemporary NRC's	
	Toward a Governance System (Yarnell)	The Coming Generations (be prepared)	
	Urban sub-network (Graftman)		
	Agricultural sub-networks (Zipper)	Call for a National NEON Congress	
		Write Proposal to Finance	
30th 9:45 am	Plenary Reporting by Groups	Steering Committee Work	
		Elect Leadership	
		Chair	
	Second Break Out Sessions	Executive Council (Steering Committee)	
	Concept Development and Leadership Identification	Coordinating Committee (Site Reps)	
30th 10:15 am	ZOW, SMR and LED	REGIONAL COORDINATION	
	Cross-cutting		
	Biodiversity Observation Systems ()	Community DISCUSSIONS on	
	Metecological Implementations (Fuentes)	Governance	
	Hydrologic Implementations (Mills)	Single National Design (Reference Design)	
	Standard Measures: Populations, Productivity, etc	NEON Inc. Staffing Plan	
	Information Technology & Communications (Porter)	One of a Kind Facilities	
30th 11:30 am	Technologies Fair	Central Data and Information System	
	Wireless Technology: T-1 to the Field (Williams)	Facilities Construction Team(s)	
	Remote Sensing & GIS (Linsgubler)		
	Stable Isotopes (Garnier)	Work Time Line Development	
	Flux Towers -- atmosphere (Fuentes)	Consult with NSF and IBRC	
	Flux Towers -- water column (Berg)		
	Gas Sequencing (Mills)	Leadership for the Months Ahead	
	Dating: C-14, lead 210 etc. (Macko)	From: Field Stations and Research facilities	
	Lidar ()	From: Planning group rank and file	
	Archival & Curation (Wineall & Galloway)	From: User community	
	Other		
30th 12:00 pm	Lunch at the Training Center		
30th 1:00 pm	Plenary Reporting by Groups	THE WORK AHEAD	
		Agree on next steps -- lay out the work ahead	
30th 2:00 pm	MAREO Leadership: Nomination & Election		
	MAREO National Representatives (2)		
	MAREO Executive Committee (5)		
30th 2:30 pm	The Work Ahead		
		Building the MAREO Consortia	
		Find our Political Muscle	
		Plan for Next MAREO NEON Meeting	
		Prior to a National Congress	
30th 3:00 pm	Adjourn		

Appendix 3: Informal Concept Documents from Bruce Hayden

The Concept of a Distributed, Synoptic and Hierarchical Observatory

Lets start with Ben Franklin. As Postmaster General, Ben took the liberty of making each postmaster an observatory site. Ben had a distributed observatory. Ben then had them collect wind data at the same time each day. The distributed observatory was synoptic in nature [repeated measures in space and time]. As the data arrived Ben mapped the wind directions and found that with winds rotated counter clockwise around storms. He was interested in Nor'easters. Making a new map for each time element he found that the Nor'easter came from the west and southwest not the northeast. They were called Nor'easters because the strongest winds were on the NW side of the storm and these winds came out of the northeast! Thus the postmen were a distributed, synoptic observatory.

Ben's friend Tom Jefferson pestered his best friends (George, James, James and George [Mason]) to take temperature, rainfall, wind and general weather conditions at their plantations on the Virginia Piedmont. This was a mesoscale network! Tom's and Ben's combined network was hierarchical network.

Tom, worried about climate change (See notes on the State of Virginia by Tom) and thought that every county seat should have a weather station. Weather stations that frequent in space did not happen until the 1870. There are more than 10,000 such stations in the US. That distributed, synoptic network continues to serve us. Taken with the less frequent airport stations, that take much more data, the network is Hierarchical! Weather takers with 50 years of continuous data collecting are awarded the Thomas Jefferson Medal!

Tom also worried that if the climate should change – well so should the plants and animals! He suggested periodic biotic inventories in every county. We are still waiting for that one. NEON is a start on the road to a Distributed, Synoptic and Hierarchical Observatory that will meet fundamental needs for the decades to come. It is appropriate that MAREO is rooted in Ben's, Tom's, George's, George's, James' and James' back yards.

--Bruce Hayden, Dec. 11, 2003

MAREO Zero-Order Watersheds

That most distal part of watersheds where no stream course incises the land and where the overland flow of rain water is only seen during storms of significance is what we will call a Zero-Order Watershed (its a ZOW).

ZOWs occur everywhere in the terrestrial world. They are episodic dischargers. More importantly they behave as capacitors of a sort. In the extensive time between discharges biogeochemistry happens, primary and secondary production gets done, litter falls, rot rules, species come and go, and accumulation is the hallmark of the day on a ZOW. Then the rains come in good measure, the capacitor discharges and a stream course becomes evident. Wells and weirs come to life. We would like to know everything about the ZOW's "exudate": chemistry, DIN, DON, DIC, DOC, sediment and large woody debris. Seed and critter export would be nice as well.

We also need to know about the ZOW itself and its dynamics. Each ZOW on the landscape (forests, grasslands, tillage and burbs) is a potential station in a distributed observation system. In MAREO there are ZOWs in the tidewater, the coastal plain, the piedmont and the mountains to the west.

ZOWs are subject to succession and state change, invasions and extinctions by Mother Nature herself as well as by farmers, yuppies, developers and gardeners. Biodiversity rises and falls in ZOWs but how.

ZOWs will permit the normalization of our science in a new and fundamental way. It will permit deserts grasslands, forests and cities to be gauged on a common scale – from the Atlantic to the Pacific and from the high tide to the highlands.

A ZOW as an object of study can be managed, collected from and observed by institutions BIG and small. Some ZOWs may only have biodiversity assessments done, others are like the best bank -- a full service provider by an institution of significant size and intellectual capital. It is the distributed network of ZOWs within MAREO that will increase the power of our analyses. Should other REOs catch ZOW-fever the power base of our science grows multiplicatively.

--Bruce Hayden, Dec. 11, 2003

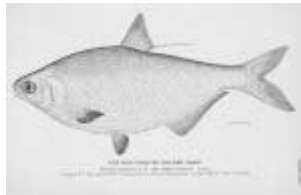
Minimum Standard Reach (MSR)

A Minimum Standard Reach (MSR) is proposed as a core MAREO landscape study element. It is here defined as a 500 m segment of a first-order stream and its associated hyporheic zone and riparian margins.

Like Zero Order Watersheds (ZOWs) MSRs are found in nearly all terrestrial landscapes. Within the MAREO region they are found in the tidewater, coastal plain, piedmont, mountains. All potential NEON sites also have examples of MSRs. Thus it can serve as a normalizing construct that would foster nation-wide comparative science. MSRs will be loved by hydrologists, fluvial geologists and geomorphologists and of course riparian ecologists with and without backbones. Biodiversity workers will find the joy of toiling, in a comparative way, in their MSRs endeavors.

MAREOites will in due course define a full MSR measurement infrastructure to support the wide spectrum of scientists who will dedicate themselves to network-wide MSR research. Wells, sippers, current meters and the like will dot the MSR landscape. Research opportunities will also arise where ZOWs and MSRs are synoptically linked.

Coastal MSR scientists will, of course, be energized by the bi-directional flow (saline and fresh) within their MSRs and will hold it over upland MSR devotees! With some luck a more anadromous graduate student will evolve. Reproductive strategies should then become evident.



Shad - an anadromous fish. George Washington caught 11,000 shad at Mount Vernon in one year.

-- Bruce Hayden, Dec. 12, 2003

Lentic and Estuarine Deltas (LEDs)

From [ZOW](#) through [MSR](#) to LED we have a connected sequence of MAREO landscape elements which may constitute an on-the-land component of a NEON observatory. LED is sort of the inverse of ZOW. Where a ZOW accumulates and then discharges, a LED takes discharge and accumulates it as a delta in a receiving basin. LEDs are often layer-caked records of upland history. LEDs may be found in farm ponds, reservoirs, lakes, slack-waters along stream courses and before leaving the continent in estuaries, sounds, bays and lagoons.

LEDs then are suitable MAREO landscape elements for systematic study, observation and instrumentation. Because they are accumulators they record the past and receive the future. LEDs in the region have been cored and disassembled, measured, counted and classified to chart the coming of Europeans, podzol-busting farms, chestnut extinction and suburbanization. Observatories need to look backward in time as well as recording the yet to happen.

LEDs buffer lentic and estuarine open water environments from the harsher side of upland life. Unfortunately they leak. The dissolved is most easily lost from LEDs and whisked-away on the ebb where there are consequences.

MAREO scientists should consider LEDs as landscape elements for comparative study and as additional landscape instruments in our emerging observatory.

--Bruce Hayden, Dec. 12, 2003

MAREO Archives and Curation

Saving the past (archival) permits knowing in the future. Without proper curation it is just good old American gibberish. Archived blood permitted the following of the trail back the origin of AIDS. Decades after the fact, stomates from desiccated herbarium sheets revealed the connection between plants response and the century-long rise carbon dioxide.

Unfortunately, we don't know all the key scientific questions that will be asked in June of 2023. Thus the wisdom of Solomon is needed in designing MAREO savings accounts. What to save? [ZOW](#) water? [MSR](#) periphyton? [LED](#) clam shells? Blood? Liver snips? Hair? Feathers? Do we focus on disease carrying organisms in order to target the future discovery of role of ecosystems in the dynamics of disease?

Think of a MAREO archive agent having to fill an order for 3 grams of liver from *Peromyscus leucopus* collected each summer since 2009 in 6 ZOWs in the Baltimore area to meet a health crisis or a bioterror attack.

The MAREO community will have to come to grips with the fundamental questions about archival and curation.

--Bruce Hayden, Dec. 12, 2003