

DEVELOPING VITAL SIGNS OF ECOLOGICAL INTEGRITY: A MONITORING PLAN FOR THE NATIONAL PARK SERVICE NORTHEAST TEMPERATE NETWORK

PHASE III: Development of Terrestrial and Related Monitoring Protocols for High Priority Vital Signs

Submitted to the National Park Service by:

James P. Gibbs
Associate Professor
College of Environmental Science and Forestry
State University of New York, Syracuse, New York.
Syracuse, NY 13210
(315)470-6764 (phone)
jpgibbs@mailbox.syr.edu

and

Geraldine Tierney
Post-Doctoral Research Assistant
College of Environmental Science and Forestry
State University of New York, Syracuse, New York.
Syracuse, NY 13210
(315)470-6754 (phone)
gtierney@esf.edu

17 December 2004

INTRODUCTION

National Park managers are directed by federal law to know the status and trends in the condition of natural resources under their stewardship in order to fulfill the National Park Service mission of conserving the scenery, and the natural and historic objects and wildlife in national parks unimpaired. In order to fulfill this mission, it is necessary to identify and understand changes in complex, variable and imperfectly understood natural systems and to provide insight into whether observed changes are within natural levels of variability or indicate excessive human influence. The Northeast Temperate Network (NETN) consists of 10 parks in 7 states. The Appalachian Trail will be handled separately through a State of the Trail Report. The parks are grouped together based on their common ecological resources, northeastern temperate forests and the wetland and aquatic systems that accompany them. Currently, the Parks and Historic Sites in this network do not all have monitoring programs in place that will adequately identify trends in the status of the freshwater resources over the long term.

THE NETN VITAL SIGNS PROGRAM

The National Park Service (NPS) initiated a new "Vital Signs" program in 1998 to develop comprehensive, long-term monitoring of ecological resources within U.S. national parks. Vital signs (VS) are indicators, and are defined as key elements, processes or features of the environment that can be measured or estimated *and* that indicate the ecological integrity of an ecosystem. A core science team is working with the 10 parks of the Northeast Temperate Network (NETN) to identify appropriate regional and park-specific indicators of ecological integrity, and to develop criteria for assessing changes. The team identified VS representing the diversity of ecological systems and anthropogenic stressors within NETN parks at a range of ecological scales. The team is following the 3-phase approach developed by NPS:

Phase 1- define goals and objectives; begin the process of identifying, evaluating and synthesizing existing data; develop draft conceptual models; and complete other background work;

Phase 2- prioritize and select vital signs and develop specific monitoring objectives for each park and the network; and,

Phase 3- develop detailed plans to implement monitoring; including the development of sampling protocols, a statistical sampling design, and a plan for data management and analysis.

Phases 1 and 2 have been completed. In Phase 1, baseline inventories and analysis of threats provided information to build conceptual ecological models for four ecosystem groups – terrestrial, wetland, aquatic, and intertidal systems. In Phase 2, the core science team developed a list of more than 100 potential VS. This preliminary list was peer-reviewed through workshops, from which a final list of 23 high priority VS, with 104 associated potential measures, was developed (Table 1).

In Phase 3, protocols need to be developed for each VS measure and, given the partnerships that exist with the NETN, various agencies and organizations will work with the NETN coordinator to develop those protocols. SUNY ESF and NatureServe will work up protocols for a selected set of vital signs and help with overall coordination. Sampling design, statistical power analysis and cost assessment will be an integral part of Phase 3 in order that the final set of measured VS produce reliable inference within cost constraints of NETN. Standard summaries of statistical trends in VS measures will be compiled. Importantly, each measure will also have a rating scheme tied to specific ecological systems where the VS are measured to allow integration of VS into an overall ecological integrity rank (A-D) for particular occurrences of a system. These ranks, currently used by NatureServe and the Network of Natural Heritage Programs, provide an important communication tool for managers.

OBJECTIVE

The objective of this project is to draft a set of terrestrial monitoring protocols for the 10 parks of the NETN that include Standard Operating Procedures and follow National Park Service Inventory and Monitoring Protocol Development Guidelines for a sub-set of the high priority vital signs, and to oversee the development of all NETN monitoring protocols. NatureServe, in cooperation with SUNY-ESF, will oversee the overall reporting of status & trends and develop ecological integrity scorecards.

METHODS AND APPROACH

The objective, as stated above, will be achieved through the steps outlined below.

1) Write protocol development summaries:

- a. SUNY-ESF will lead with protocol development summaries for the following vital signs and submit them to NETN by 15 December 2004:**

Protocols Development Summaries include;

- 1) Forest Monitoring Protocol
- 2) Reptile and Amphibian Protocol
- 3) High Elevation and Rocky Summit Protocol
- 4) Land Cover / Ecosystem Cover Protocol (landscape context part)
- 5) White-tailed Deer Herbivory
- 6) Air Quality
- 7) Phenology
- 8) Visitor Impacts
- 9) Insects

Protocol development summaries will include the vital sign, the parks where the protocol will be implemented, the justification/issues being addressed, specific monitoring questions and objectives to be addressed by the protocol, the basic approach, principal investigators and NPS lead; and development schedule, budget, and expected interim products.

The protocol development summaries will also highlight interactions among vital signs and measures, because some vital signs and measures can be collected jointly in the field, e.g., those for the Water Quantity VS and for the Wetlands VS. Others may also be system dependent. For example the Water Quantity VS can be measured using the concept of hydroperiod. The sampling needed to measure hydroperiod should either be modified to fit different systems or take into account the expected variation among systems. Further, the values of hydroperiod can be fundamentally changed by measures of beaver activities, which could convert the hydroperiod of a Fen or Bog, Wet Meadow – Shrub Swamp, or Hardwood Swamp into that of a Marsh or Pond, so measures of beaver activity need to be considered as part of the wetlands protocol.

2) Identify and prioritize existing park based projects that would address vital signs monitoring goals.

Meet with park staff where appropriate to identify overlap between current programs and high priority vital signs. Identify possibilities for achieving vital signs monitoring goals through integration with existing programs. This would involve an evaluation of long-term objectives of the existing programs, their site design, protocols, and personnel.

3) Draft Vital Signs monitoring protocols. Lead in writing protocols, including standard operating procedures, for the following groups of vital signs:

- Forest Monitoring Protocol
- Reptile and Amphibian section of Wetland Monitoring Protocol

Land Cover / Ecosystem Cover Protocol (landscape context part)
White-tailed Deer Herbivory Protocol
Air Quality

Note that protocol development for vital signs will be done, in part, through partnerships within and outside of NPS.

In many cases, there are existing standard operating procedures that will be referenced and modified as necessary to make them applicable to the goals of the vital signs program in NETN parks. Integration with existing state and (or) park protocols will be done where appropriate and feasible.

Developed protocols will be comprehensive, applicable to the network, but ready for implementation in individual parks. A Quality Assurance/Quality control SOP will be associated with each protocol as well as SOPs regarding staff qualifications and training, sampling schedules, and equipment. Lab SOPs will be written and (or) referenced as appropriate. SOPs will be written outlining how data will be analyzed, including who is responsible and how often analysis will occur. Initial thresholds will be identified for all vital signs where data are available with the understanding that these levels can be modified as further data collection better defines the range of natural variability. We will also define effect sizes for each measure that can be detected with each sampling design and indicate limitations in detecting changes in condition or trends.

4) Develop a sampling design in each of the following ten parks within the Northeast Temperate Network.

The sampling design will be based around cost / benefit analyses of collecting information on multiple vital signs and measures, the degree to which efficiencies can be introduced through collocating sampling points among measures, the power needed to detect trends, and the ability to detect change in the status of various abiotic, ecological system or species elements. The sampling design will also consider the relative merits of having Tier 1 (remote sensed and rapid field sampling methods) and Tier 2 (detailed monitoring variables) measures.

The sampling protocols will summarize the overall spatial design for each park, will include detailed maps and descriptions of where samples will be taken, and will describe the overall statistical sampling methodology used. Designs will also include justifications for collocating or not collocating sampling for various vital signs and for the attributes used to stratify the park (e.g., cost of access, types of water resources). Sampling design details will include where, when, how large a sample size, and how often selected vital signs will be measured (frequency).

5) Protocol testing and Peer Review. Limited testing of protocols will be done during one field season. Testing will be conducted in a large park (Acadia National Park) and a medium to small -sized park. Testing will be limited to travel time, tests of methods, equipment and time estimates per sample, and will not include tests of staffing scenarios, and or sampling schedules, and assessing the relative merits of having two or more tiers of measures that are monitored. SUNY ESF equipment will be used for testing where available. Budget includes provisions for additional equipment rental if necessary for field tests.

Peer Review will be conducted by submitted protocols testing to partners in the Natural Heritage Network and among agency and academic colleagues in the Northeast. In addition the Vital Signs program will review all proposed protocols.

6) Coordination of protocols among terrestrial, wetland, aquatic and intertidal systems.

As protocols are tested and reviewed for all vital signs, there is a need to coordinate the overall approach to collecting vital signs, including assessing the cost/benefit analysis of all the vital signs, and determine the

overall reporting of status & trends and ecological integrity scorecards. Our (NatureServe and SUNY ESF) approach is to work closely with partners by overseeing the cost/benefit analyses and the sampling design for all NETN vital signs. Ecological integrity report cards will be developed from the final list of measures and vital signs, using an ecological system-based approach. Each selected measure will need to be assessed to determine how well thresholds (ratings) can be assigned, and how it can be incorporated into a point-based or rule-based approach for aggregating the measures into an overall ecological integrity rank. In the first year draft scorecards will be created and sent to system experts (forests, wetlands) for their review.

7) Data reporting, storage, management and QA/QC. Data fields that will be necessary for data storage and management will be identified and will follow I&M standards. A database for reporting, storing and managing data will be identified and (or) developed in collaboration with NETN staff. An SOP that addresses all aspects of data management and long-term storage and accessibility will be provided. Links will be developed between the NPS database design for storing ecological integrity scorecards and that of NatureServe Biotics database. NatureServe's database is also used by Heritage Programs in the Northeast, and it will be the means for Heritage ecologists to use these same ecological integrity scorecards on sites in and around the parks.

8) Develop report cards of ecological integrity that can be used as a communication tool for summarizing vital signs. Thresholds and analyses will be rolled together, where meaningful, to create ecological system report cards and overall VS report cards for each park which would aid in communicating the "state of the parks" natural resources and defining management actions.

9) Prepare a budget. An overall budget that summarizes the start-up, annual and periodic costs of the monitoring program will be developed Forest Vegetation, Wetland Vegetation, Landscape Context, and White-tailed Deer Herbivory Protocols.

10) Address NPS and USGS colleague review comments. SUNY ESF Report approved, printed, and distributed. Electronic version of protocols supplied to NPS.

PERSONNEL

Collaborative Team Members at SUNY include:

James Gibbs, associate professor, SUNY ESF
Geri Tierney, post-doctoral associate, SUNY ESF
Steve Stehman, associate professor, SUNY ESF (statistician)
Field Assistant, SUNY ESF

Collaborative staff in other agencies or organizations include:

Don Faber-Langendoen
Pam Lombard (USGS)
Hilary Neckles (USGS)
Steve Fascio and Dan Lambert (VINS)

NATIONAL PARK SERVICE SUBSTANTIAL INVOLVEMENT

The NPS will be substantially involved in this project by working closely with the cooperator to draft and develop Vital Signs protocols for the Northeast Temperate Network. The NETN staff will act as managing editor the development of the 3-phase monitoring plan and ensure that all national I&M guidelines are followed throughout this project. The NETN staff will provide all

background information related to park legislation, park monitoring programs, and other natural resource information to the cooperator as necessary. The NETN staff will facilitate and document peer review of the final reports generated from this project and integrate the deliverables from this project into the larger NETN monitoring plan. The NETN will provide all spatial and tabular data related to park natural resource and natural resource issues to the cooperator as necessary. The NETN staff will work with the cooperator to draft all final reports associated with this project.

TIMELINES:

Dec 15, 2004	Protocol Development Summaries delivered to NPS
February, 15 2005	Cost/benefit analysis on vital sign measures completed
March 15, 2005	A list of SOPs and 3 example draft SOPs for forest vegetation protocol delivered to NPS
April 15, 2004	Draft SOPs for landscape context protocol delivered to NPS A document summarizing how NETN can incorporate any appropriate existing park monitoring programs into the sampling design for each park for the Forest Vegetation, Wetland Vegetation, Landscape Context, and White-tailed Deer Herbivory protocols .
May 15, 2005	Draft forest vegetation protocol delivered to NPS including ecological integrity scorecards for forested systems to be used as a template for all other protocols. Draft landscape context protocol delivered to NPS(with focus on forest and wetland systems), including its incorporation into ecological integrity scorecard for forested system. draft Standard Operating Procedures following all Inventory and Monitoring Program standards for the reptile and amphibian section of wetland monitoring and White-tailed Deer Herbivory will be delivered to the NETN staff for review.
October 15, 2005	Submit revised forest vegetation, landscape context, and drafts of reptile and amphibian section of wetland monitoring and White-tailed Deer Herbivory protocols based on field testing to NPS
Nov 15, 2005	Final versions of Forest Vegetation, Wetland Vegetation, Landscape Context, and White-tailed Deer Herbivory Protocols following all Inventory and Monitoring Program standards including the final draft of the Ecological Integrity Scorecards for all ecological systems associated with the protocols

DELIVERABLES

Protocol Development Summaries: Dec. 15, 2004

- 1) Forest Monitoring Protocol
- 2) Reptile and Amphibian Protocol
- 3) High Elevation and Rocky Summit Protocol
- 4) Land Cover / Ecosystem Cover Protocol (landscape context part)
- 5) White-tailed Deer Herbivory
- 6) Air Quality
- 7) Phenology
- 8) Visitor Impacts
- 9) Insects

Cost/Benefit/power analyses: Feb. 15, 2005

Determine what vital sign measures for all protocols can be implemented based on NETN budget and sampling logistics.

A list of SOPs and 3 example draft SOPs for forest and landscape context protocols (March 15, 2005).

Draft forest vegetation and landscape context protocols for forest systems, including ecological integrity scorecards and draft of reptile and amphibian section of wetland monitoring and white-tailed deer herbivory SOP's (May 15)

Revised forest vegetation, landscape context, and wetland vegetation and white-tailed deer herbivory based on field tests (Oct. 15, 2005)

Final forest vegetation, landscape context, and amphibian and reptile section of wetland monitoring and white-tailed deer herbivory protocols for all Yr 1 protocols delivered to NPS for inclusion in Monitoring Plan (Nov. 15, 2005)

It is necessary that the Great Lakes-Northern Forest CESU Office at the University of Minnesota receive electronic copies of all related project products upon completion. These products will be posted on the GLNF CESU website or linked to the URL where the project is located (whichever is appropriate). Send electronic copies to the NPS Research Coordinator at <thompson@umn.edu>.

Invoices and Billing

- SUNY-ESF will submit quarterly invoices to the NPS Project Manager for approval and submission for payment. Federal form sf270 will be used for invoicing. Send to:

Greg Shriver, Ph.D.
National Park Service
Inventory and Monitoring Network Coordinator
Marsh-Billings-Rockefeller NHP
54 Elm Street, Woodstock, Vermont 05091

802-457-3368 x37, 802-457-3405 (fax), greg_shriver@nps.gov

- Before invoices will be paid a status report of this project indicating progress made since the last invoice period will be submitted to the NETN staff.

Draft Budget
Submitted to NPS/CESU

**Developing Vital Signs of Ecological Integrity: A Monitoring Plan for the National Park
Service Northeast Temperate Network - Phase III
January 15, 2005 - June 1, 2006**

NPS-CESU-Jgibbs:04q4:v 12/13/04

CATEGORY	Phase III Request
Personnel:	
PI: James Gibbs @ 5% AY	3,056
5 Weeks Summer Salary (carryover)	1,595
CoPI: Steve Stehman 5% AY	3,322
2 Weeks Summer Salary	3,543
2-G. Tierny Postdoctoral Assoc., 100% CY (1.5 years with carryover)	39,915
1-Graduate Students- Field Assistant for 10 weeks@\$8/hr.	0
Total Salaries and Wages	51,431
Benefits @ -40.31% IFR Excl. Students	2,571
35% RF %Non Student	13,970
Summer Salary @ 15.5%	796
Graduate Students @ 10.5%	0
Undergrad Students @ 3%	0
Total Benefits	17,337
Total S, W and B	68,768
Supplies	2,491
Total Direct Costs	71,259
Indirect Costs at 17.5% TDC	12,470
Total Request	83,729