Protocol Development Summary (*last updated – July 29, 2008*)

Eastern Rivers and Mountains Network Protocol:
Aquatic benthic macroinvertebrates (short name: benthic macroinvertebrates)

Parks where protocol will be implemented:
All parks: DEWA, UPDE, ALPO, JOFL, FONE, FRHI, NERI, GARI, and BLUE

Justification/Issues being addressed:

There are approximately 211 miles of river and more than 425 miles of stream throughout the Eastern Rivers and Mountains Network (ERMN). The importance of water resources throughout the ERMN is reflected by the network's ranking of benthic macroinvertebrates (BMI), river and stream hydrology, and chemical/physical water quality as 3 of the top 4 vital signs prioritized by the network. Benthic macroinvertebrates are aquatic invertebrate animals larger than microscopic size that live on or within the stream bottom (benthos), and because they are a vital component of all functioning stream ecosystems, they are often used as indicators of ecosystem integrity. In addition to being instrumental to nutrient and carbon dynamics, BMI are an important link between basal resources (e.g., algae and detritus) and higher trophic levels (e.g., fish and birds) in stream food webs. Because BMI have been by far the most commonly used group for biological monitoring of aquatic ecosystems (Carter and Resh 2001), many metrics have been evaluated with respect to natural variation and responses to various sources of human-induced degradation. Given the proven ability to derive ecosystem integrity based on measures of BMI assemblage structure and composition, combined with the relatively low cost to sample, BMI are almost certainly the single best biological group to assess and monitor the ecological integrity of small and mid-sized streams.

Specific Monitoring Objectives Addressed by the Protocol:

The primary objectives of the ERMN BMI monitoring protocol are to:

1. Determine the status and trends of BMI assemblages throughout ERMN streams by way of diversity, abundance, and community metrics.

2. Determine the status and trends of stream habitat condition (both instream and streamside) and water quality by way of habitat assessments and point-in-time measurement of core water quality parameters (i.e., dissolved oxygen, temperature, pH, conductivity).

3. Relate condition of BMI communities in ERMN streams to site condition (water quality and habitat) and landscape attributes by using regionally developed multi-metric indices.

Secondary objectives of the ERMN BMI monitoring program are under development and differ among NPS parks due to the diverse characteristics of the parks (e.g. size, shape, historical condition, management objectives).

Basic approach:

The sampling design for the BMI program includes 81 proposed sites that will be sampled annually throughout the ERMN. Sites are located on different streams and their method of selection varied depending on the park. Effort is expended at the parks in proportion to the quantity (number and length) of flowing waters within each park; consequently, less effort is expended at the western Pennsylvania parks due to their small size relative to the large parks in WV and surrounding the Delaware River. Sites at large parks (i.e., DEWA, GARI, and NERI) were collocated with another vital sign (Louisiana Waterthrush, LOWA) because: (1) the LOWA sites were randomly located using a stratified design to represent medium-sized streams (generally 2nd and 3rd order) throughout those parks and (2) collocation between vital signs will allow for potential corroboration of observed trends in condition. This sampling design is not applicable at the other ERMN parks given their small, disjointed, and/or linear nature. Sampling sites at these remaining six parks were chosen in consultation with park resource managers and the ERMN coordinator based primarily on NPS ownership, historical condition, ecological value, accessibility, and human value.

Because physical, chemical, biological, and most other ecological characteristics vary with stream size, sampling reaches (i.e., sites) will be proportional to (40 X) stream width, but will be a minimum or maximum of 150 m and 500 m respectively. Field methods will be based on established and widely used protocols for collecting BMI (Moulton et al. 2000), assessing reach-scale habitat condition (Barbour et al. 1999), and quantifying instream habitat condition (Moulton et al. 2000). At each site, a rapid, reach-scale habitat assessment will be conducted and core water quality data will be recorded prior to collecting BMI and assessing instream habitat condition at five 0.25 m^2 replicate riffle habitat areas throughout the sampling reach. Samples will be collected by disturbance sampling and a 500 µm mesh net, and then composited into one sample and volumetrically subsampled ($\leq$ 750 mL per sample).

Laboratory sample processing will be based on the U.S. Geological Survey Water Quality Laboratory protocol (Moulton et al. 2002). Macroinvertebrates will typically be identified to the genus level based on a fixed-count of 300 organisms. If samples contain more than 300 organisms, they will be subsampled using gridded subsampling trays. Digital image vouchers will be taken of all distinct taxa and stored at the ERMN office. Data will be analyzed and reported on annually using regionally-developed and accepted multi-metric indices (e.g., Klemm et al. 2003).

Principal investigators and NPS lead:
Protocol development is being done through a cooperative agreement with the Pennsylvania State University (University Park, PA 16802) during 2008-2009. Drs. Caleb Tzilkowski and Paola Ferreri are Co-P.I.'s of the project. Additionally, Drs. Craig Snyder and Dave Smith, USGS Leetown Science Center, received funding from the NPS USGS Status and Trends Program for a project entitled: "Ecological Thresholds and Structured Decision Analysis Using Aquatic Macroinvertebrate as Indicators of Stream Health in the Mid-Atlantic and Eastern Rivers and Mountains Vital Signs Networks". This project includes the ERMN and will inform several important components of this protocol including the sampling design, number of samples needed to detect levels of change, and ecological and management thresholds. The NPS contact person

is Matt Marshall (ERMN Coordinator).

Development Schedule, Budget, and Expected Interim Products:
The P.I.'s have produced and delivered a draft protocol, will conduct a pilot field season during fall 2008, and deliver a second draft final protocol before June 15, 2009. It is anticipated that the protocol will be implemented during fall 2009. A budget of $161,664 was allocated for the 24 month protocol development and testing period (October 1, 2007 – September 30, 2009).

References:

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