

National Park Service Inventory & Monitoring Project

Through a cooperative agreement, the Central Plains Center for BioAssessment (Kansas Biological Survey, Lawrence, KS) and the National Park Service are developing the aquatic resources component of the Servicewide Inventory and Monitoring Program for the Heartland Inventory and Monitoring Network of the National Park Service. The Heartland Network is comprised of 15 NPS units spanning the Central Plains region from Ohio to Kansas and from Minnesota to Arkansas.

This effort has three primary goals:

- 1) to establish a baseline inventory for existing aquatic resources within the Heartland Network,
- 2) to summarize and synthesize the water quality standards and monitoring protocols (local, state, federal, etc.) currently in place, and
- 3) to recommend specific monitoring program designs for chemical and biological criteria based on the information gathered.

Background Information

As part of its ongoing mission “to conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations”, the National Park Service (NPS) has created a Natural Resource Inventory and Monitoring Program “to acquire the information and expertise needed by park managers in their efforts to maintain ecosystem integrity in the approximately 270 National park System units that contain significant natural resources” (NPS Organic Act of 1916, <http://www.nature.nps.gov/>). Aquatic resources are among the most significant of these. Through a cooperative work agreement, the Central Plains Center of BioAssessment is functioning as an integral part of the Inventory and Monitoring program for the Heartland Network (HTLN) of parks within the NPS.

CPCB’s role in the Inventory and Monitoring Program is to collect all water quality data available for the aquatic resources of the HTLN and develop a seamless searchable database linked to a geographic information system (GIS). The GIS will function as a management tool for NPS allowing resource managers a point and click interactive map of monitoring stations within their parks where statistical information regarding water quality can be obtained, updated, and disseminated. Prior to this ongoing work, CPCB collected, reviewed, and summarized state water quality standards applicable to every water body in HTLN. With this information integrated into the GIS, resource managers will be able to readily identify any stream segments that may fall out of compliance with the state rules and develop plans to address the problem.

The NPS Inventory and Monitoring program also has the goal of developing long term ecological monitoring protocols that will be used to assess the ecological conditions of its parks and to monitor changes in these conditions in the future. CPCB is also working to expedite this process for the Heartland Network by first collecting, reviewing, and summarizing all biological and habitat assessment protocols used by federal monitoring programs and state monitoring agencies in states where HTLN parks are located. This information will then be used to determine appropriate protocols for the long term ecological monitoring of the aquatic resources of HTLN. In addition, CPCB will also work to develop a macroinvertebrate monitoring protocol for use in all HTLN parks.

Specific CPCB Project Tasks:

Baseline Water Quality Inventory:

State, national, and park service records and databases were searched for water quality data collected at stations identified in NPS Water Resources Division (WRD) reports from the most recent date of record through December 31, 2001. The methods of data retrieval and filtering used by WRD were followed. Recent data for all stations identified in the WRD reports were integrated with existing data. Since the existing data were contained in a wide range of files and formats, considerable attention has been given to the internal structure design for the relational database itself. The [EPA's STORET database](#), the [USGS's National Water Information System \(NWIS\)](#), the National Park Service (NPS)'s [National Database Resource Template \(NRDT\)](#), and various related water quality database files, were examined as relevant examples.

Based on these examples, a prototype relational database architecture was developed using Microsoft Access, and was subsequently modified per NPS recommendations to promote standardization with existing databases. Due to the extremely diverse nature of the existing data files' organization, a standardized method for converting existing files to the recommended format was developed using VBA and macros for MS Access. The conversion files will be included with the final product in order to facilitate future format conversions.

Trial conversions for water quality data from WRD and NPS data have been finished for 13 of the 15 HTLN service units. Additional development and data file conversion continues.

Water Quality Data Analysis:

After all base line data from have been combined, filtered, and quality assured according to WRD standards, detailed analyses are required. The following analysis protocol has been proposed:

1. Select a subset of sites for which the most long-term data exist.
2. Select a subset of constituents that are deemed informative, useful, and relevant and that have sufficient spatio-temporal coverage for reasonably defensible conclusions.
3. Some sites (and constituents) may need to be combined due to redundancy of monitoring efforts (or inconsistent methods through time).
4. Check that variation in constituent values does not correspond to potential changes in sampling methods.
5. Check for flow-dependency for all constituents, and transform (conduct regression and use residuals as new data) if needed
6. Stratify data by “hydrologic season,” as defined in the WRD report
7. For each site selected in step 1:
 - summarize the seasonal and annual extent of data for each selected constituent
 - provide summary statistics (n, min, max, mean, median, SD, Var, quartiles) for each constituent *by season*
 - produce box-plots of each constituent, by season, where data are sufficient*
 - conduct ANOVA/Kruskall-wallace or other appropriate test to determine statistical significance of season variation for each constituent
 - produce box-plots, by year, of each constituent for each season
 - if data are adequate, conduct appropriate statistical test for long-term trends for each constituent, by season
8. Results of these analyses will be summarized in readily-readable tables
9. Summaries of these analyses will include:
 - report on overall trends or patterns
 - report on data gaps/needs
 - report on which constituents/sites may be dropped from further monitoring

Water Quality Data Synthesis:

All data, summaries, and other information generated will be integrated into a GIS. Graphical presentations will include the point locations of:

1. all sampling sites
2. sites analyzed in this report
3. USGS gauging stations

4. point-source dischargers

Data layers within the GIS and attached to each point location will include:

1. site description (monitoring, gauge, discharger, etc.)
2. for monitoring sites: matrix of historic data
3. for dischargers: summary of permit information, including effluent limits and required monitoring scheme
4. for gauging stations: station number, years of record, current activity

Line elements on the GIS map will include (in addition to hydrography):

1. segments of designated beneficial uses
2. state-listed impaired segments

Data layers within the GIS and attached to each line element will include:

1. for beneficial uses: use designations and associated criteria
for 303(d) segments: constituents of concern, etc.

Development of a Macroinvertebrate Sampling Protocol

INTRODUCTION

Traditionally water chemistry measurements have been heavily relied upon for monitoring the quality of waters. However, measurements of water column chemistry only contain information on the conditions at the time the samples were taken (EPA 1994). Chemical measurements alone also fail to incorporate the cumulative effects of instream and riparian habitat degradation and adjacent land use practices. The use of macroinvertebrates as biological indicators of water quality and ecological integrity began in the early part of the 20th century (EPA 1990). Since then the use of biological assessment methods has become a standard tool of the scientific community and regulatory agencies.

The development of a macroinvertebrate biological monitoring protocol for the HTLN will be accomplished by reviewing the methods currently used by federal and state agencies, and testing those methods for applicability in the environments possessed within the network. The aquatic resources of HTLN are highly variable in terms physical, chemical, geological, and biological characteristics. These resources range from one of the largest rivers in the world, the Mississippi River, to small intermittent prairie streams. This will require the use of a flexible monitoring protocol allowing for the assessment of widely ranging habitats. The goal is to produce a set of protocols flexible enough to effectively monitor a diverse array of aquatic habitats, yet sensitive enough to detect ecological change over time and to be scientifically defensible. The protocol will include standardized data analysis and QA/QC procedures in order to facilitate information interpretation, understanding, and communication between Network personnel.

PROJECT APPROACH

Data Gathering and Review

CPCB will review and summarize specific, federal, state, and university methods for aquatic biological monitoring. State and regional methods for establishment and use of biological criteria, if they exist, will be compiled and reviewed for possible adaptation and use by NPS facilities in the Heartland Network. A review of stressor and indicator identification and their potential uses in bioassessment monitoring will include pertinent peer reviewed literature (e.g., Berkman et al. 1986, Lenat and Barbour 1994, Norton et al. 2000) as well as state and national guidance documents (e.g., Barbour et al. 1999 and Cuffney et al. 1993) and agency reports (e.g., Huggins and Moffett 1988, Rabeni et al. 1997, Donley et al. 1999). In addition, this review will include a characterization of potential reference conditions/sites for each network park.

Indicator and Metric Review and Selection

Based on the literature review indicators will be selected that 1) are easily measured, easily understood, scientifically sound, and cost effective, 2) are sensitive and responsive to larger landscape and smaller local anthropogenic stressors, 3) are responsive in a predictable and easily interpreted manner, 4) have responses that are sensitive enough to detect changes before major ecosystem changes have occurred, 5) have responses to certain changes that have little risk of artifacts and low variance in response to specific changes, 6) have well documented and known responses to both human and anthropogenic stressors.

Development of Scientific Methods

Based on the literature review CPCB will recommend field, laboratory, data analysis, and QA/QC procedures that will best serve the indicators to be measured. This will include statistical sampling designs, field and laboratory sampling narrative protocols, and standard operating procedures (SOPs) most appropriate for the collection and analysis of information pertaining to the indicators selected for each park.

Preliminary Field Study

Studies to determine precision and replicability of the recommended field and laboratory methods will be conducted on selected stream reaches within the Buffalo National River that represent both stressed and unstressed stream

conditions. 5 samples at each of 2 sites (stressed/unstressed) will be collected in spring and fall. This baseline data will determine the minimum sample size needed to determine a difference between stressed and unstressed sample sites and the level of uncertainty associated with type 1 and type 2 errors. Basic water quality and habitat data will be collected as part of this assessment. The extent of the water quality and habitat data collection will be jointly determined at a later date.

Final Protocol Development

The following outline identifies the suggested elements of a complete protocol as recommended by the NPS National Monitoring Coordinator (Personal communication Dr. Steve Fancy 2003) with some modifications. CPCB will be primarily responsible for the development of Background and Objectives, Sampling Design, and Field Methods, while NPS will be primarily responsible for Data Handling, Analysis and Reporting, Personnel Requirements and Training, and Operational Requirements.

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Ohio

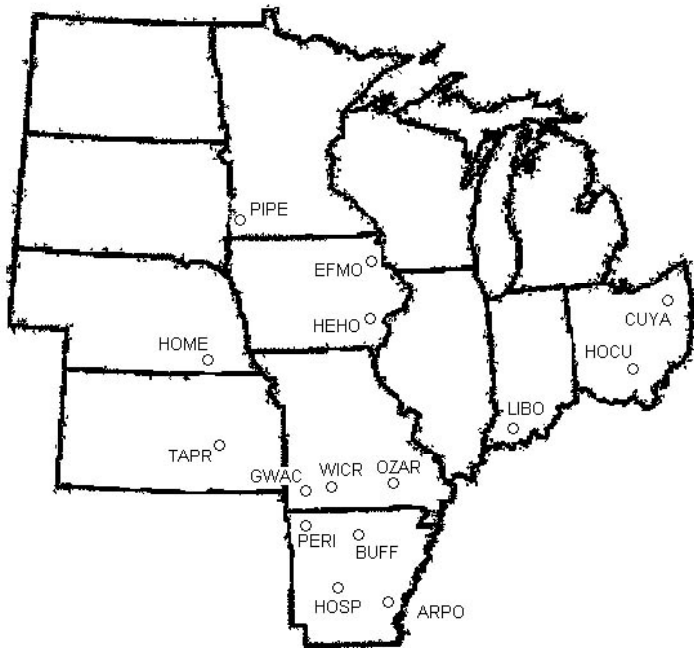
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HEARTLAND NETWORK



PARK UNIT	PARK UNIT CODE	STATE	SIZE (acres)
Arkansas Post National Memorial	ARPO	Arkansas	389
Buffalo National River	BUFF	Arkansas	95,730
Cuyahoga Valley National Recreation Area	CUVA	Ohio	32,859
Effigy Mounds National Monument	EFMO	Iowa	1,481
George Washington Carver National Monument	GWAC	Missouri	210
Lincoln Boyhood National Memorial	LIBO	Indiana	200
Herbert Hoover National Historic Site	HEHO	Iowa	186
Homestead National Monument of America	HOME	Nebraska	160
Hopewell Culture National Historic Park	HOCU	Ohio	721
Hot Springs National Park	HOSP	Arkansas	5,549
Pipestone National Monument	PIPE	Minnesota	282
Pea Ridge National Memorial Park	PERI	Arkansas	4,300
Tallgrass Prairie National Preserve	TAPR	Kansas	10,894
Ozark National Scenic Riverways	OZAR	Missouri	82,196
Wilson's Creek National Battlefield	WICR	Missouri	1,750

Related links

NPS Inventory and Monitoring Program <http://www1.nature.nps.gov/im/index.html>
Heartland Inventory & Monitoring Network <http://www1.nature.nps.gov/im/units/htln>
NPS Technical Information Center
<https://amoebawww.den.nps.gov/amoeba/TIC/TIC.NSF>
US EPA Groundwater & Water <http://www.epa.gov/safewater/>

DATA:

NPS Data Clearinghouse http://www.nps.gov/gis/data_info/clearinghouse.html
USGS National Water Information System (NWIS) <http://waterdata.usgs.gov/nwis/>
US EPA STORET database <http://www.epa.gov/storet/dbtop.html>
KU Academic Data Research Services Alliance <http://www.ku.edu/adrsa/data.shtml>

GIS:

National Spatial Data Infrastructure Clearing house
<http://fgdc.ftw.nrcs.usda.gov/servlet/FGDCServlet>
NPS Geography and Mapping Technologies <http://www.nps.gov/gis/>
NPS Metadata Management Tools
http://www.nature.nps.gov/im/units/mwr/gis/metadata/metadata_tools.htm
University of Alberta GIS tutorials
<http://www.biology.ualberta.ca/facilities/gis/index.php?Page=485>
NPS Interactive Map Center <http://maps2.itc.nps.gov/nps/resources.html>