



# Streamside Bird Monitoring Protocol for the Eastern Rivers and Mountains Network

## *Version 2.0*

Natural Resource Report NPS/ERMN/NRR—2012/592



**ON THE COVER**

Jennifer Dupree and Jason Liddle on Slater Creek at New River Gorge National River, March 2007.

Photograph by: Brady Mattsson.

---

# **Streamside Bird Monitoring Protocol for the Eastern Rivers and Mountains Network**

*Version 2.0*

Natural Resource Report NPS/ERMN/NRR—2012/592

Matthew Marshall<sup>1</sup>, Brady Mattsson<sup>2, 3</sup>, Kristina Callahan<sup>1</sup>, and Terry Master<sup>4</sup>

<sup>1</sup>National Park Service  
Eastern Rivers and Mountains Network  
University Park, PA 16802

<sup>2</sup>Warnell School of Forestry and Natural Resources  
University of Georgia  
Athens, GA 30602

<sup>3</sup>current address:  
U.S. Geological Survey  
Western Ecological Research Center  
California LCC  
Sacramento, CA 95819

<sup>4</sup>Department of Biology  
East Stroudsburg University  
East Stroudsburg, PA 18301

November 2012

U.S. Department of the Interior  
National Park Service  
Natural Resource Stewardship and Science  
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate high-priority, current natural resource management information with managerial application. The series targets a general, diverse audience, and may contain NPS policy considerations or address sensitive issues of management applicability.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received formal, high-level peer review based on the importance of its content, or its potentially controversial or precedent-setting nature. Peer review was conducted by highly qualified individuals with subject area technical expertise and was overseen by a peer review manager.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from <http://science.nature.nps.gov/im/units/ermn/> and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>).

Please cite this publication as:

Marshall, M., B. Mattsson, K. Callahan, and T. Master. 2012. Streamside bird monitoring protocol for the Eastern Rivers and Mountains Network: Version 2.0. Natural Resource Report NPS/ERMN/NRR—2012/592. National Park Service, Fort Collins, Colorado.

# Contents

|                                                                       | Page |
|-----------------------------------------------------------------------|------|
| Figures.....                                                          | v    |
| Tables.....                                                           | vii  |
| Appendixes .....                                                      | ix   |
| Revision History .....                                                | xi   |
| Executive Summary .....                                               | xiii |
| List of Key Acronyms.....                                             | xv   |
| Acknowledgements.....                                                 | xvii |
| Background and Objectives .....                                       | 1    |
| Background and History .....                                          | 1    |
| Target Users .....                                                    | 3    |
| Rationale for Monitoring Birds.....                                   | 4    |
| Streamside Birds .....                                                | 5    |
| Measureable Objectives .....                                          | 5    |
| Sampling Design.....                                                  | 7    |
| Parks Included.....                                                   | 7    |
| History of Sampling Design Development .....                          | 7    |
| Rationale for this Sampling Approach.....                             | 8    |
| Target Population, Sampling Frame, Sample Sites .....                 | 9    |
| Sampling Frequency, Replication, and Detectable Levels of Change..... | 11   |
| Sample Site Selection .....                                           | 12   |
| Sampling Site Summary .....                                           | 13   |

## Contents (continued)

|                                                               | Page |
|---------------------------------------------------------------|------|
| Field Methods .....                                           | 27   |
| Field Season Preparation.....                                 | 27   |
| Conducting Streamside Bird Surveys .....                      | 27   |
| Data Management .....                                         | 29   |
| Database Design.....                                          | 29   |
| Data Entry, Verification, and Certification.....              | 29   |
| Metadata Procedures .....                                     | 30   |
| Data Backups and Archiving .....                              | 30   |
| Data Dissemination .....                                      | 31   |
| Data Analysis and Reporting .....                             | 33   |
| Recommended Reporting Schedule and Format.....                | 33   |
| Recommendations for Routine Data Summaries and Analysis ..... | 34   |
| Operational Requirements .....                                | 43   |
| Personnel Requirements.....                                   | 43   |
| Qualifications, Training, and Safety .....                    | 44   |
| Annual Workload and Schedule .....                            | 45   |
| Facility and Equipment Needs .....                            | 45   |
| Startup Costs and Budget Considerations.....                  | 45   |
| Revising the Protocol .....                                   | 46   |
| Literature Cited .....                                        | 47   |

# Figures

|                                                                                                                                                                      | Page |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>Figure 1.</b> National parks in the Eastern Rivers and Mountains Network (ERMN). ....                                                                             | 3    |
| <b>Figure 2.</b> Brady Mattsson establishing point count stations along Bills Branch at New River Gorge NR 2007.....                                                 | 8    |
| <b>Figure 3.</b> Example of a streamside bird sampling site which consists of a 1 km reach with five point count stations spaced at 250 m intervals.....             | 10   |
| <b>Figure 4.</b> Location of 24 sampling sites selected for monitoring streamside birds at Delaware Water Gap NRA. ....                                              | 14   |
| <b>Figure 5.</b> Location of 25 sampling sites selected for monitoring streamside birds at New River Gorge NR.....                                                   | 16   |
| <b>Figure 6.</b> Location of six sampling sites selected for monitoring streamside birds at Gauley River NRA.....                                                    | 18   |
| <b>Figure 7.</b> Location of three sampling sites selected for monitoring streamside birds at Bluestone NSR.....                                                     | 20   |
| <b>Figure 8.</b> Location of 3 sampling sites selected for monitoring streamside birds at Allegheny Portage Railroad NHS.....                                        | 22   |
| <b>Figure 9.</b> Location of 3 sampling sites selected for monitoring streamside birds at Fort Necessity NB.....                                                     | 24   |
| <b>Figure 10.</b> Location of two sampling sites selected for monitoring streamside birds at Friendship Hill NHS. ....                                               | 26   |
| <b>Figure 11.</b> <i>Platanthera orbiculata</i> documented at Delaware Water Gap NRA in 2009 and 2012. Photo by Nicole Flood. ....                                   | 35   |
| <b>Figure 12.</b> Louisiana waterthrush frequency of occurrence (number of point count stations detected) by sampling site at Delaware Water Gap NRA 2007–2009. .... | 36   |
| <b>Figure 13.</b> Louisiana waterthrush at nest with nestlings. Photo by James P. Mattsson.....                                                                      | 37   |
| <b>Figure 14.</b> Map of the study area and specific sampling sites used by O’Connell et al. (2000) to develop the Bird Community Index (BCI).....                   | 39   |
| <b>Figure 15.</b> Bird Community Index of ecological integrity (O’Connell et al. 2000) for each sampling site at New River Gorge NR, 2007–2009. ....                 | 40   |

## Figures (continued)

Page

|                                                                                                                                                                                                                                                                                 |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Figure 16.</b> Percentage of sampling sites falling into four condition classes defined by the Bird Community Index of ecological integrity (O’Connell et al. 2000) for the Mid-Atlantic Highlands, Eastern Rivers and Mountains Network, and parks within the network. .... | 41 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

# Tables

|                                                                                                                                                                                                                                             | Page |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>Table 1.</b> Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 24 sampling sites selected for streamside bird monitoring at Delaware Water Gap NRA. ....           | 13   |
| <b>Table 2.</b> Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 25 sampling sites selected for streamside bird monitoring at New River Gorge NR. ....               | 15   |
| <b>Table 3.</b> Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 6 sampling sites selected for streamside bird monitoring at Gauley River NRA.....                   | 17   |
| <b>Table 4.</b> Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for three sampling sites selected for streamside bird monitoring at Bluestone NSR.....                  | 19   |
| <b>Table 5.</b> Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for three sampling sites selected for streamside bird monitoring at Allegheny Portage Railroad NHS..... | 21   |
| <b>Table 6.</b> Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for three sampling sites selected for streamside bird monitoring at Fort Necessity NB.....              | 23   |
| <b>Table 7.</b> Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 2 sampling sites selected for streamside bird monitoring at Friendship Hill NHS. ....               | 25   |
| <b>Table 8.</b> Biotic integrity elements, guild categories, response guilds, and guild interpretations used in an index of ecological integrity called the Bird Community Index (BCI; O’Connell et al. 1998a, 1998b, and 2000). ....       | 38   |
| <b>Table 9.</b> Roles and responsibilities for streamside bird monitoring.....                                                                                                                                                              | 43   |
| <b>Table 10.</b> Estimated annual costs to implement the streamside bird monitoring protocol in seven park units of the Eastern Rivers and Mountains Network.....                                                                           | 46   |



## Appendixes

|                                                                                                                                  | Page |
|----------------------------------------------------------------------------------------------------------------------------------|------|
| <b>Appendix A.</b> Bird species detected during implementation of the ERMN<br>Streamside Bird Monitoring Protocol 2007–2011..... | 55   |
| <b>Appendix B.</b> Name and contact information for personnel associated with the<br>Streamside Bird Monitoring Protocol .....   | 59   |
| <b>Appendix C.</b> Administrative record and peer-review comments. ....                                                          | 61   |



## Revision History

The Streamside Bird Monitoring Protocol consists of a narrative (this report) and Standard Operating Procedures (SOPs) that outline specific aspects of the monitoring protocol. The latest versions of the SOPs and additional supporting information can be accessed online at the National Park Service's Eastern Rivers and Mountains Network website (<http://science.nature.nps.gov/im/units/ermn>).

The narrative and each SOP have respective revision history logs to document changes in the protocol. The following revision history log is for the narrative.

Version numbers will be incremented by a whole number (e.g., Version 1.0 to 2.0) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.3 to Version 1.4) when there are minor modifications that do not affect requirements or procedures included in the protocol. Rows are added to the log as needed for each change or set of changes tied to an updated version number.

### Revision History Log

| Version # | Date           | Revised by    | Changes                          | Description/Justification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------|----------------|---------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0       | February 2010  | Matt Marshall | Finalized as Version 1.0 - DRAFT | The primary purpose of finalizing Version 1.0 in DRAFT form was to fully document the protocol and SOPs used during data collection for the years 2007–2010 which included specialized surveys for Louisiana waterthrush.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 2.0       | September 2012 | Matt Marshall | Published Version 2.0            | <p>Version 2.0 should be considered the primary reference for the ERMN Streamside Bird Monitoring Protocol.</p> <p>Version 2.0 fully documents data collection procedures starting in 2011 and any departures from the 2007–2010 data collection procedures.</p> <p>The protocol underwent peer review in February 2010 with all three peer reviewers recommending that the protocol be accepted. One reviewer recommended substantial re-writing for clarity. Concurrently, the ERMN and ERMN member parks decided to discontinue the specialized Louisiana waterthrush surveys described in Version 1.0. This decision led to a substantial revision of the protocol which is reflected in Version 2.0. Due to the timing, revisions based on the three peer reviews were also incorporated into Version 2.0.</p> |



## Executive Summary

The National Park Service has initiated a long-term ecological monitoring program known as “Vital Signs Monitoring” to provide the minimum infrastructure to allow more than 270 national park system units to identify and implement long-term monitoring of their highest-priority measurements of resource condition. This protocol outlines the justification and procedures for streamside bird monitoring within the Eastern Rivers and Mountains Network – one of 32 ecoregional “networks” or groupings of parks linked by geography and shared natural resource characteristics. The purpose of the streamside bird monitoring protocol is to collect and analyze data and report information that will help park management maintain or improve the ecological condition of park streams, including the rivers they are tributary to and the watersheds they drain.

“Streamside bird” refers to the breeding bird community surrounding streams. The area sampled in this protocol is along the park streams which are typically forested including a closed canopy over the stream. Therefore, the “streamside” bird community sampled is synonymous with what other monitoring programs refer to as “forest birds”, “breeding birds”, and “landbirds”. The important difference, and the purpose of including the term “streamside”, is not the bird community *per se*, rather that the physical area sampled is limited to the land area surrounding streams in each park.

Primary monitoring objectives of the streamside bird protocol are to:

1. Estimate occupancy, density, and/or indices of abundance annually for select bird species and guilds at the park (target stream network) and stream reach scale;
2. Estimate trends among years in occupancy, density, and/or indices of abundance for select bird species and guilds at the park (target stream network) and stream reach scale;
3. Calculate the Bird Community Index of biotic integrity annually at the park (target stream network) and stream reach scale; and
4. Compare trends in occupancy, density, and/or indices of abundance for select bird species and guilds within ERMN parks to regional and continental trends.

Point count surveys are the most widely used quantitative method of monitoring bird populations and are used for this protocol as well. The survey technique involves using a standardized methodology to record (“count”) all birds seen or heard during a fixed amount of time at count locations (“points”). The resultant counts are used as an index of population abundance and these data can be used to estimate abundance, density, and occupancy.

The Streamside Bird Monitoring Protocol consists of a narrative (this report) and Standard Operating Procedures (SOPs) that outline specific aspects of the monitoring protocol. The latest versions of the SOPs and additional supporting information can be accessed online at the National Park Service's Eastern Rivers and Mountains Network website (<http://science.nature.nps.gov/im/units/ermn>).



## List of Key Acronyms

|      |                                                   |
|------|---------------------------------------------------|
| ALPO | Allegheny Portage Railroad National Historic Site |
| BLUE | Bluestone National Scenic River                   |
| DEWA | Delaware Water Gap National Recreational Area     |
| ERMN | Eastern Rivers and Mountains Network              |
| FONE | Fort Necessity National Battlefield               |
| FRHI | Friendship Hill National Historic Site            |
| GARI | Gauley River National Recreational Area           |
| I&M  | Inventory and Monitoring                          |
| JOFL | Johnstown Flood National Memorial                 |
| NB   | National Battlefield                              |
| NERI | New River Gorge National River                    |
| NHS  | National Historic Site                            |
| NMem | National Memorial                                 |
| NPS  | National Park Service                             |
| NR   | National River                                    |
| NRA  | National Recreation Area                          |
| NSR  | National Scenic River                             |
| SOP  | Standard Operating Procedure                      |
| SRR  | Scenic and Recreational River                     |
| UNT  | Unnamed Tributary                                 |
| UPDE | Upper Delaware Scenic and Recreational River      |



## Acknowledgements

We would like to thank Bob Mulvihill and Bob Cooper for expertise and guidance during the development of this monitoring protocol. Kathy Penrod, Jeff Shreiner, Jesse Purvis, Kirk Stodola, and C. Snyder provided many helpful comments on earlier drafts of this protocol. We thank Daryl MacKenzie, Tim O’Connell, and Greg Shriver for their formal peer-reviews and excellent suggestions. Special thanks to Andy Steel and Leslie Morlock for providing much needed guidance on accessing sites and extensive GIS support. Thanks also to Delaware Water Gap NRA and New River Gorge NR for providing essential seasonal housing to us and our crews and many other forms of support, guidance, and assistance. Joe Yuhas and Elijah Carter developed many of the original directions to the sites. Finally, we cannot thank enough the many field technicians who conduct the streamside bird surveys.

The organization of this protocol follows the recommendations of Oakley et al. (2003), and some of the content was gratefully adapted from other NPS Inventory and Monitoring Network bird monitoring protocols, including the following:

Faccio, S., B. R. Mitchell, and P. S. Pooler. 2010. Breeding landbird monitoring protocol: Northeast Temperate Network. Natural Resource Report NPS/NETN/NRR—2010/198. National Park Service, Fort Collins, Colorado.

Gardali, T., D. Humple, M. Herzog, M. Koenen, D. Press, W. Merkle, and S. Allen. 2010. Riparian landbird monitoring protocol for Golden Gate National Recreation Area and Point Reyes National Seashore: version 4.4. Natural Resource Report NPS/SFAN/NRR—2010/207. National Park Service, Fort Collins, Colorado.

McIntyre, C. L., R. Drum, K. L. Oakley, E. Debevec, T. L. McDonald, and N. Guldager. 2004. Passerine bird monitoring protocol for the Central Alaska Monitoring Network: Denali National Park and Preserve, Wrangel-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve, Alaska. U.S. Department of the Interior, National Park Service, Denali Park, AK.



# Background and Objectives

## Background and History

Knowing the condition of natural resources in national parks is fundamental to the National Park Service's (NPS) mission to manage park resources "unimpaired for the enjoyment of future generations." Park managers are confronted with increasingly complex and challenging issues that require a broad-based understanding of the status and trends of park resources as a basis for making decisions and working with other agencies and the public for the long-term protection of park ecosystems. The overall purpose of natural resource monitoring in parks is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and to determine how well current management practices are sustaining those ecosystems (Fancy et al. 2009). Use of monitoring information will increase confidence in managers' decisions and improve their ability to manage park resources, and will allow managers to confront and mitigate threats to the park and operate more effectively in legal and political arenas.

The NPS has initiated a long-term ecological monitoring program, known as "Vital Signs Monitoring," to provide the minimum infrastructure to allow more than 270 national park system units to identify and implement long-term monitoring of their highest-priority measurements of resource condition (Fancy et al. 2009). The term 'vital signs' refers to a relatively small set of information-rich attributes that are used to track the overall condition or 'health' of park natural resources and to provide early warning of situations that require intervention. Vital signs are defined as a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values (Fancy et al. 2009). The broad-based, scientifically sound information obtained through this systems-based monitoring program will have multiple applications for management decision-making, research, education, and promoting public understanding of park resources.

NPS Vital Signs Monitoring is implemented programmatically through 32 ecoregional 'networks' or groupings of parks linked by geography and shared natural resource characteristics. The network approach, through shared funding and professional staff, also facilitates collaboration, information sharing, and economies of scale.

To be relevant to current management issues and anticipate future issues, monitoring programs must be scientifically credible and produce quality data that is readily accessible and explicitly linked to management decision-making processes. To meet those criteria, explicitly stated goals and objectives are critical. The NPS established (Fancy et al. 2009) programmatic goals for all 32 networks as they plan, design, and implement integrated natural resource monitoring. These goals are to:

1. determine the status and trends of selected indicators of park ecosystem conditions to make better-informed decisions and to work more effectively with other agencies and individuals for the benefit of park resources;
2. provide early warning of abnormal conditions of selected resources to help develop effective mitigation measures and reduce costs of management;

3. provide data to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments;
4. provide data to meet certain legal and Congressional mandates related to natural resource protection and visitor enjoyment; and
5. provide a means of measuring progress towards performance goals.

The complex task of developing a monitoring program requires a front-end investment in planning and design to ensure that monitoring will meet the critical information needs of each park and produce scientifically credible data that are accessible to managers and other researchers in a timely manner. To that end, each network follows an explicit program development and implementation strategy (Fancy et al. 2009) that includes a peer reviewed monitoring plan (Marshall and Piekielek 2007) and a series of detailed, peer reviewed, monitoring protocols that describe how data are to be collected, managed, analyzed, and reported (Oakley et al. 2003).

This protocol outlines the justification and procedures for streamside bird monitoring within the Eastern Rivers and Mountains Network (ERMN). The ERMN includes nine parks in New York, New Jersey, Pennsylvania, and West Virginia (Figure 1), which together encompass nearly 91,000 ha of land area and over 600 stream and river miles and within the parks' authorized boundaries. The network includes four smaller parks in central and southwestern Pennsylvania that have a primarily cultural or historical focus. These cultural parks are Allegheny Portage Railroad National Historic Site (NHS), Johnstown Flood National Memorial (NMem), Fort Necessity National Battlefield (NB), and Friendship Hill National Historic Site (NHS). The remaining five larger parks preserve segments of large rivers and generally extend to the ridgetops surrounding the river section. These river parks are Upper Delaware Scenic and Recreational River (SRR), Delaware Water Gap National Recreation Area (NRA), New River Gorge National River (NR), Gauley River National Recreation Area, and Bluestone National Scenic River (NSR).

In addition to streamside birds, the ERMN has developed monitoring protocols for vegetation and soils (Perles et al. 2009), benthic macroinvertebrates, surface water quality and flow (Tzilkowski et al. 2010), invasive species early detection (Keefer et al. 2010), and weather and climate (Marshall et al. 2012), and will develop protocols for riparian plant communities and air quality (Marshall and Piekielek 2007).

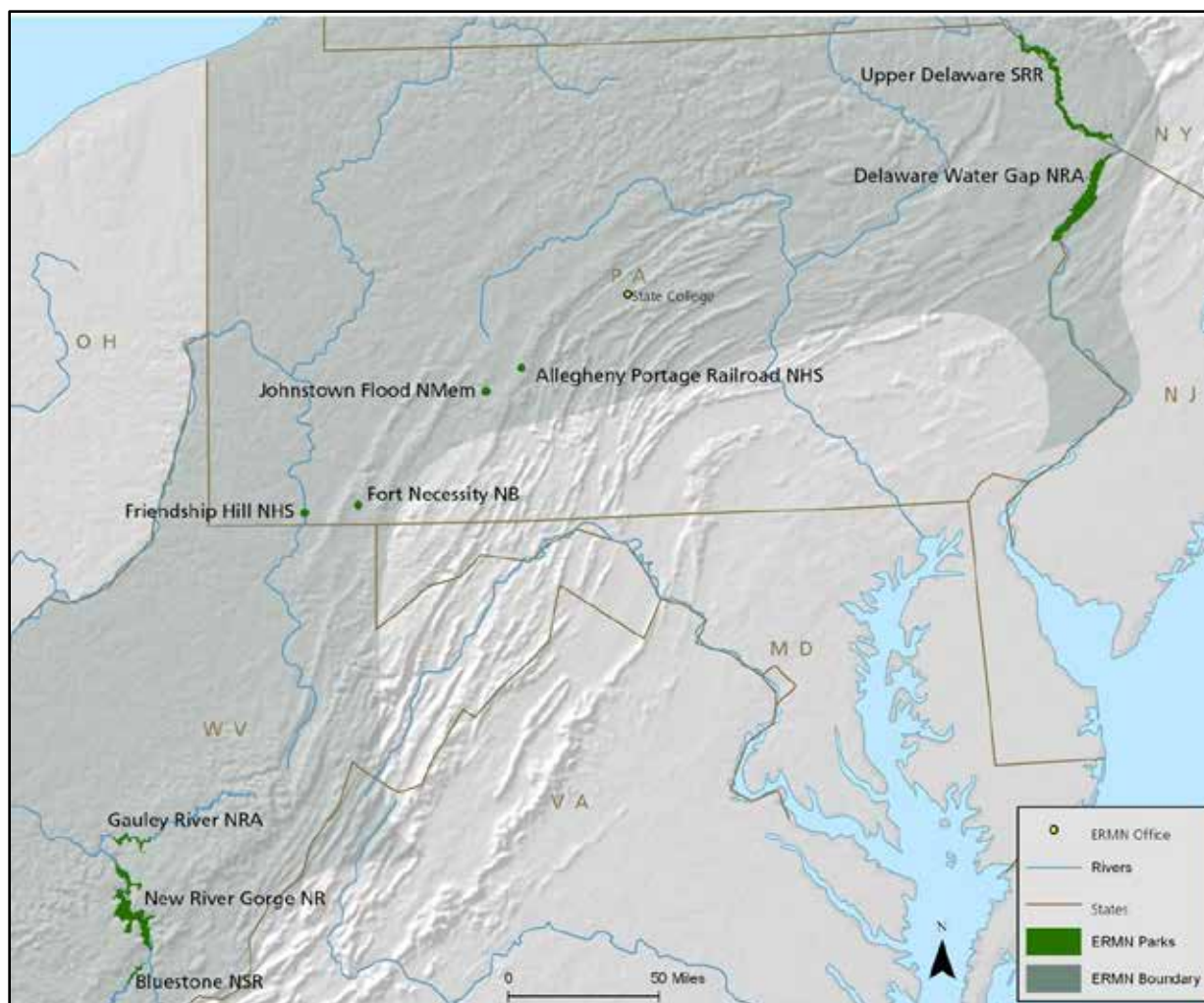


**Figure 1.** National parks in the Eastern Rivers and Mountains Network (ERMN).

## Target Users

This protocol will provide the ERMN and park managers with comprehensive long-term data about the status and trends in the bird community along park streams, including possible effects of ecological and anthropogenic stressors. Permanent sites will be monitored over time to document changes in the bird community. Analyses of the bird monitoring data will eventually include landscape scale analyses (changes in land use, cover types, patch size, and fragmentation) and links to water quality, benthic macroinvertebrate community, climate and weather, and vegetation monitoring.

Availability of these monitoring data will increase manager knowledge, improve their ability to steward park resources, and allow them to adjust and mitigate threats to park resources. The proposed monitoring strategy attempts to balance the immediate requirements of managers for current information (i.e., data on how current values compare to regional status and trends) against the necessity for insight into the changes occurring in bird communities and other stream and watershed conditions over time.

## Rationale for Monitoring Birds

One intent of the ERMN monitoring program is to evaluate status and trends of the condition of streams (and their contributing watersheds) flowing into and through member parks (Marshall and Piekielek 2007). Stream and watershed condition are evaluated, in part, using measures of ecosystem integrity, including streamside bird species and communities (Mattsson and Marshall 2010 and this report), benthic macroinvertebrates and water quality (Tzilkowski et al. 2010), and watershed land use, type, and configuration (Marshall and Piekielek 2007).

The primary stressors of interest across the ERMN include habitat loss and fragmentation from development (e.g., residential, commercial, energy) inside and outside park boundaries, over-browsing by white-tailed deer (*Odocoileus virginianus*), invasions of nonnative plants, pests, and pathogens with concurrent changes in plant communities, and acid and nutrient deposition with concurrent changes in soil and water quality (Rentch 2006). Monitoring spatial and temporal patterns in the occurrence (i.e., occupancy, density, and/or indices of abundance) of select landbird species or guilds that are known to respond to landscape and smaller-scale changes may serve as indicators of watershed conditions.

Breeding birds are an important component of park ecosystems, have been extensively studied, and exhibit numerous characteristics that support their use as cost-effective ecological indicators (O'Connell et al. 2000, Roberge and Angelstram 2006). In particular, their high body temperature, rapid metabolism, and prominent position in most food webs make them a good indicator of local and regional ecosystem change. Birds also respond in predictable and well-documented ways to ecological gradients such as extent of forest cover (O'Connell et al. 2000), intensity of acidic deposition (Hames et al. 2002), and importantly, effects of habitat loss and fragmentation (Robinson and Wilcove 1994, Faaborg et al. 1995, Robinson et al. 1995, Rosenberg et al. 1999).

Birds are also attractive as ecological indicators because 1) they are the most easily and inexpensively detected and identified vertebrate animals, 2) their taxonomy is well known, 3) a single survey method is effective for many species, 4) many reference datasets and standard methods are available (Ralph et al. 1993, 1995), 5) multi-agency groups focused on landbird monitoring are working to align objectives, coordinate monitoring efforts, and identify information gaps in North America (Pashley et al. 2000; Bart and Ralph 2005; Hutto and Ralph 2005, Lambert et al. 2009), and 6) accounting and managing for many species with different ecological requirements promotes conservation strategies at the landscape scale (Maurer 1993, Hutto and Young 2002).

Moreover, birds are a high profile group with wide public interest and many parks provide information on the status and trends of the park's avian community through their interpretive materials and programs. NPS hosts more visitors each year than any other federally managed lands (NABCI 2011) and one in five Americans watches birds, contributing \$36 billion to the U.S. economy in 2006 (Carver 2009), illustrating the influential role the NPS can play interpreting various ecological stories through birds.

## **Streamside Birds**

“Streamside birds” refers to the breeding bird community surrounding streams. The area sampled in this protocol is along the park streams which are typically forested including a closed canopy over the stream. Therefore the streamside bird community sampled (Appendix A) is largely synonymous with and comparable to what other NPS monitoring programs refer to as “forest birds” (Ladin et al. 2011), “breeding birds” (Goodwin and Wakamiya 2010), and “landbirds” (Faccio et al. 2010, Gostomski et al. 2010, Knutson et al. 2008). The important difference, and the purpose of including the term “streamside”, is not the bird community *per se*, rather that the physical area sampled is limited to the land area surrounding streams in each park. Additional rationale for focusing monitoring on the bird community along streams and how sites were selected is described in the Sampling Design section below.

## **Measureable Objectives**

Monitoring objectives were established to meet the overarching vital signs programmatic goals and the rationale for monitoring the resource described above, while clearly articulating what will be measured and the desired outcome of the protocol. The monitoring objectives are coupled with sampling (or statistical) objectives (see Sampling Design section below) and, in time, with park management objectives (Elzinga et al. 1998) in an iterative process. In this way, monitoring will not be a stand-alone activity, but, instead, an adaptive component of a larger process of natural resource management and decision making (Nichols and Williams 2006, Lovett et al. 2007). These objectives may also be refined at the park-level to fully integrate with management goals, possible management actions, and resource conditions.

The purpose of the streamside bird monitoring program is to collect and analyze data and report information that will help park management maintain or improve the ecological condition of park streams, including the rivers they are tributary to and the watersheds they drain.

Primary monitoring objectives of the streamside bird protocol are to:

1. estimate occupancy, density, and/or indices of abundance annually for select bird species and guilds at the park (target stream network) and stream reach scale;
2. estimate trends among years in occupancy, density, and/or indices of abundance for select bird species and guilds at the park (target stream network) and stream reach scale;
3. calculate the Bird Community Index of biotic integrity annually at the park (target stream network) and stream reach scale; and
4. compare trends in occupancy, density, and/or indices of abundance for select bird species and guilds within ERMN parks to regional and continental trends.

A secondary objective is to relate changes in bird community metrics to conditions of the surrounding landscape and watersheds in an effort to guide management actions in these parks. This can be accomplished by evaluating associations between bird metrics (described in Objectives 1–3 above) and other vital signs measuring watershed condition, including water quality, benthic macroinvertebrates, vegetation structure and composition, and landscape characteristics.



# Sampling Design

## Parks Included

The streamside bird monitoring protocol is implemented at all ERMN parks except Upper Delaware SRR and Johnstown Flood NMem. Upper Delaware SRR is not included due to its limited area of publicly owned land. The authorized boundary of Upper Delaware SRR encompasses approximately 26,000 ha; however, only about 12 ha are owned by the NPS. Furthermore, only 5% of the land within the authorized boundary (approximately 1,225 ha in total) is held by public entities (i.e., federal government, Commonwealth of Pennsylvania, State of New York, or Sullivan County Parks). Establishing sampling sites on private lands involves substantial risk of lost investment because the NPS has little control over the land use, access, and permissions. In addition, data collected from select publicly or privately owned parcels will not necessarily be representative of the park as a whole, making it difficult to draw inferences and guide management decisions. Johnstown Flood NMem is not included because the South Fork of the Little Conemaugh River (SFLCR), which flows through Johnstown Flood NMem, and one perennial unnamed stream are both maintained as open canopy due to cultural lakebed management. The SFLCR will also remain severely impaired due to acid mine drainage for the foreseeable future. A second stream tributary to the SFLCR is the only other perennial stream within Johnstown Flood NMem but is a prohibitively short stream segment to sample.

## History of Sampling Design Development

Development of the streamside bird monitoring protocol was initiated in 2007, with the first season of data collection occurring during March–July of that year following the procedures outlined in Version 1.0 of the protocol (Mattsson and Marshall 2010). Version 1.0 of the protocol was also implemented each of the next three years (2008–2010). Version 1.0 of the protocol stemmed directly from the ERMN Monitoring Plan (Marshall and Piekielek 2007), which specified that the monitoring protocol should focus on Louisiana waterthrush (scientific names are in Appendix A) as an avian indicator of stream condition. The Louisiana waterthrush is a riparian obligate bird species that breeds and forages along forested streams of the eastern United States (Mattsson et al. 2009) and the protocol was designed to include specialized surveys for this species during 2007–2010. Moreover, the sampling design and site selection scheme established for the streamside bird monitoring protocol was intended to be the common design for benthic macroinvertebrate sampling sites and water quality sampling sites (Tzilkowski et al. 2010), along with providing the framework (i.e., contributing watersheds) for estimating changing landscape characteristics (Marshall and Piekielek 2007). Collocation of streamside bird monitoring sites with sampling sites for other vital signs is intended to provide multiple lines of evidence to better evaluate trends in ecosystem condition at a local and landscape scale with both terrestrial and aquatic components.

For these two primary reasons (using Louisiana waterthrush as an indicator species and the desire to develop a common sampling design for other stream-based monitoring protocols) the sampling frame was identified as the network of perennial streams within the authorized boundary of each ERMN park. Specific sampling sites were then placed along these streams (Figure 2; further described below). Considerable discussion on these design considerations (and the field methods) occurred during two workshops in January 2007 among scientists, resource managers, and collaborators from the ERMN, NPS Water Resource Division, U.S. Geological



**Figure 2.** Brady Mattsson establishing point count stations along Bills Branch at New River Gorge NR 2007.

Survey (USGS), The Pennsylvania State University, University of Georgia, Powdermill Nature Reserve, and Oklahoma State University. A summary of these workshops is available in Appendix C.

Beginning in 2011, the specialized surveys that focused exclusively on Louisiana waterthrush were discontinued based on an analysis of competing costs versus information gained (Appendix C). However, point count surveys located along streams for the entire streamside bird community have continued since 2007. It should be noted that Louisiana waterthrush remains particularly well-sampled, in spite of the decision to discontinue specialized surveys, because point count stations are located along streams (where this species establishes its territories). The remainder of this document (Protocol Version 2.0) reflects these changes and the current focus of the protocol.

### **Rationale for this Sampling Approach**

Point count surveys are the most widely used quantitative method of monitoring bird populations (Ralph et al. 1995, Bart 2005, Rosenstock et al. 2002). The survey technique involves using a standardized methodology (Ralph et al. 1995) to record (“count”) all birds seen or heard during a fixed amount of time at count locations (“points”). Resultant counts are used as an index of population abundance. Tens of thousands of point counts are conducted annually in North America across a spectrum of scales, from short-term studies to long-term continental-scale surveys such as the Breeding Bird Survey (BBS; Sauer et al. 2008), and across federal, state, and private land management agencies (Simons et al. 2007). Point counts are used in this protocol for consistency with these other programs and to utilize the substantial literature on field methods and approaches to data analysis.

Because some birds present during the point count period are not actually detected, it is important to conduct the point counts in a way that allows estimation of a detection probability in order to adjust the raw counts. At least five different methods of estimating detection probabilities on avian point counts are currently available: distance sampling (Buckland et al. 2001); multiple-observer methods (Nichols et al. 2000, Alldredge et al. 2006); time-of-detection methods (Farnsworth et al. 2002, Alldredge et al. 2007); double sampling (Bart and Earnst 2002); and repeated-count methods (Royle and Nichols 2003, Kery et al. 2005). Conceptually, the probability of detection has two components: the probability that a bird is available for detection (i.e., if detections are auditory, the probability that the bird sings or produces some audible cue during the count period); and the probability of detecting a bird given that it is available (i.e., sings) (Diefenbach et al. 2007). Different methods estimate different components of the detection process. For example, distance sampling and multiple-observer approaches assume that all birds on a given sample plot are available (sing during the count period), and they estimate the probability of detection given availability. Time-of-detection and repeated count methods each provide unique estimates of the product of availability and detection given availability, but they cannot separate the two components (Simons et al. 2007).

In spite of these recent theoretical advances in our understanding of detection probabilities and new methods for estimating it in the field, some proposed remedies are themselves deficient and/or dependent on assumptions that are rarely met (Johnson 2008). The intent of this protocol is to conduct point counts in a generalized manner to allow a variety of subsequent analytical approaches as this area of scientific investigation improves and changes over time. That said, this protocol will not employ the prohibitively labor and cost intensive double-sampling and multiple-observer approaches but it will allow other analytical approaches and methods.

For the protocol described here, bird detections are placed into three distance bands (<50 m, 50–75 m, and >75 m) allowing analysis by distance sampling methods. Additionally, each 10 min point count is divided into 1 min intervals, and observers record each interval in which they detect each bird facilitating analysis by time-of-detection methods. Recording detections in this manner will also enable grouping of the data for direct comparisons to other monitoring programs using 3 min or 5 min point counts, such as the BBS (Sauer et al. 2008). Multiple, independent, point counts are conducted at each sampling site within a sampling season allowing repeated-count analysis methods as well. Additional information is provided in the Field Methods and Data Analysis and Reporting section below.

### **Target Population, Sampling Frame, Sample Sites**

Sampling is limited to the breeding season for eastern North America resident and neotropical (Central America, South America, and the Caribbean) migratory bird species which extends from approximately mid-May through July, depending on latitude, and includes all species that are known to breed or may potentially breed in the streamside sampling area of the respective parks (Appendix A). Members of the Orders Passeriformes (perching birds including songbirds) and Piciformes (woodpeckers) are particularly well sampled. While detections of nocturnal raptors (Strigiformes), diurnal raptors (Accipitriformes), waterfowl (Anseriformes), waders (Pelecaniformes), and turkeys and grouse (Galliformes) do occur, they constitute less than 1% of all detections which effectively precludes these groups from any meaningful trend analyses.

As described above, the sampling frame (or sampling area) is defined as the network of perennial streams within the authorized boundary of each ERMN park. A watershed or catchment area of  $\geq 1.0 \text{ km}^2$  was used to define streams with perennial flow (Paybins 2003). Large, “open-canopy” streams and rivers (watershed area  $\geq 100 \text{ km}^2$ ) were excluded from the sampling frame due to the habitat requirements of the Louisiana waterthrush and because they often host avian communities that are quite different than those found along closed-canopy streams (i.e., waterbirds and edge-associated species). Furthermore, these larger, deeper streams and rivers cannot safely be crossed on foot; if at all. A summary of streams and rivers excluded due to this criterion is provided below and in SOP 1 – Site Selection (Marshall et al. n.d.).

The sampling unit, or sample site, is a stream “reach” defined as a 250-m to 1-km length of stream established within the authorized NPS park boundary. This initial reach definition was based, again, on effective sampling of Louisiana waterthrush (Mattsson and Marshall 2010) but also includes stations spaced at 250-m intervals where point counts are conducted to sample the entire breeding bird community present. Each reach, therefore, has 2–5 point count stations depending on reach length (Figure 3).



**Figure 3.** Example of a streamside bird sampling site which consists of a 1 km reach with five point count stations spaced at 250 m intervals. The site depicted is Arbuckle Creek at New River Gorge NR.

The individual point count stations are located up to 25 m upslope of the actual stream (either side) to avoid excessive stream noise interfering with bird detections. Moreover, the effective bird detection distance is approximately 100 m (M.R. Marshall, *pers. Obs.*). Therefore, the target population and the area of inference is the community of breeding birds within a 125-m buffer of the perennially flowing, closed-canopy stream network in each park. All references in the protocol and associated reports to “streamside birds” are meant to imply this target population and area of inference.

### **Sampling Frequency, Replication, and Detectable Levels of Change**

Several levels of temporal and spatial replication are required in order to obtain parameter estimates (e.g., species abundance or occupancy) precise enough to meet the measureable objectives of this protocol (see “Background and Objectives”).

Because most birds vocalize (i.e., sing or produce other audible cues) in bouts rather than continuously (Poole 2005), and because most species differ in their vocalizing rate, temporal replication is used to account for this potential detection bias by reducing within-year variability (Link et al. 1994, Carlson and Schmiegelow 2002). Conducting repeat point counts at each station provides a means by which to account for birds that were unavailable during a previous or subsequent count. Each sampling site (i.e., stream reach) and associated point count stations will be visited two times per year between May and July. During each visit, an observer traverses the stream reach twice (i.e., upstream and downstream) stopping at each point-count station to conduct the 10-min point count and associated data collection. Each time the reach is traversed is referred to as a “pass.” By waiting 10 min between passes, each of these passes is considered an independent sample. Therefore, each site is sampled four times per year (two visits per year and two passes per visit).

The finest temporal sampling scale is a single minute during a single 10-min point count. Some analyses, such as the time-of-detection method, use these intervals and associated bird detections to model different singing rates and bouts to account for possible detection biases. These intervals are nested within the four repeat counts described above offering the possibility of several robust analyses.

Similarly, two levels of spatial replication are specified by this sampling design. The first, 2–5 replicate point count stations per site (i.e., stream reach), is to improve precision of site-specific parameter estimates by sampling multiple locations within a site to reduce within-site variability. The second, replicate sites within a park, is to increase precision of parameter estimates at the level of the entire sampling frame. The number of replicate sampling sites per park and how they were selected is described in the Sampling Site Selection section below.

Optimal allocation (precision of parameter estimates sufficient to meet program objectives) of spatial and temporal replicates depends on several factors and sources of variability. The initial number of sites and levels of replication in this protocol were based on available funding (i.e., four seasonal technicians), time constraints (six week sampling window), and power to detect population trends in other similar monitoring programs (e.g., Faccio et al. 2010). Preliminary analyses showed that this level of effort at New River Gorge NR, Gauley River NRA, and Bluestone NSR (four temporal replicate samples per site and 25 sites [spatial replicates]) is sufficient to estimate site occupancy of most species (Mattsson and Marshall 2009).

Additional analyses specifically designed to estimate detectable levels of change (i.e., power analyses) will be conducted after the sixth year of data collection. This timeframe is somewhat arbitrarily chosen but will ensure that sufficient data are available to thoroughly evaluate alternative design options should the initial design not meet program objectives. Moreover, these analyses should be conducted, if possible, in the context of park-specific management objectives and defined desired future conditions of park resources to ensure that the monitoring program not only meets its statistical objectives but also meets park management needs. Park management objectives have not been specified at the time of writing (January 2012). These analyses and any necessary changes to the sampling design will be added to the protocol when complete.

### **Sample Site Selection**

Sample site selection differed between the two largest parks (Delaware Water Gap NRA and New River Gorge NR) and the remaining five parks included in the protocol. Due to their larger size, only a subset of the many perennial streams and stream reaches could be sampled, given cost and personnel constraints. Consequently, a probabilistic design was employed to ensure unbiased and statistically rigorous inferences about streams that were not sampled but met the initial design conditions. Moreover, candidate streams at Delaware Water Gap NRA and New River Gorge NR were stratified based on four characteristics of their contributing watershed including: 1) watershed area or size; 2) percent of watershed area protected (i.e., within NPS or state park boundaries); 3) underlying bedrock fertility; and 4) watershed topography. Each of these four intrinsic characteristics has demonstrated direct or indirect effects on water quality parameters and benthic macroinvertebrate communities (Vannote et al. 1980, Church 2002, Klemm et al. 2002, King et al. 2005), which are of primary interest for other ERMN water-based protocols (e.g., Tzilkowski et al. 2010), and therefore included in the sampling design. Several of these intrinsic conditions, such as the amount of protection from land use change a watershed receives based on land ownership, for example, may also drive the composition of streamside bird communities. Additional description of these four characteristics is provided in SOP 1 – Site Selection (Marshall et al. n.d.).

Site selection proceeded in a stratified-random process and occurred in two stages. First, candidate streams were identified and randomly selected for sampling based on strata membership. Second, for all randomly selected candidate streams, an individual stream reach was randomly selected as the sampling site (i.e., location of point count stations). All reaches in these two parks are 1 km in length and, therefore, have five point count stations at each sampling site. The stratified-random site selection process is fully described in SOP 1 – Site Selection and a summary of selected sampling sites is below.

Although the stratified-random site selection strategy defined the sampling sites at Delaware Water Gap NRA and New River Gorge NR, that approach was not applicable at the other parks due to inherent park characteristics (e.g., small parcel size, linear park shape, land ownership patterns) and because, in general, too few streams were available for a logical random approach. To maximize coverage in these parks, all candidate streams (i.e., perennial streams defined by a 1.0–99.9-km<sup>2</sup> watershed area) were evaluated for possible inclusion. Sample sites were, again, limited to reaches within the authorized boundary of the park. However, reach length was allowed to vary from 0.25–1 km depending on the site in an attempt to include as many of the already limited number of candidate sites as possible. For most parks, all possible candidate streams and reaches are being sampled. A summary of the sampling sites is below.

## Sampling Site Summary

Sixty-six sampling sites (i.e., stream reaches), total, were selected for monitoring streamside birds. The following sections provide a summary of sampling sites for the seven park units in which the protocol is implemented.

### *Delaware Water Gap National Recreation Area*

Established in 1965, Delaware Water Gap NRA encompasses roughly 70,000 ac of mountain ridge, forest, and floodplain on both sides of a 40-mi segment of the Delaware River in the states of Pennsylvania and New Jersey.

Twenty-four sites were selected for streamside bird monitoring (Table 1, Figure 4; SOP 1 – Site Selection) in Delaware Water Gap NRA. Each site is 1 km in length and therefore consists of five point count stations. Monitoring began in 2007 at all sites with the exception of the Toms Creek, UNT (unnamed tributary) to Dingmans Creek, and Raymondskill Creek sites which were initiated in 2008.

**Table 1.** Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 24 sampling sites selected for streamside bird monitoring at Delaware Water Gap NRA.

| Site Name                               | Site ID   | Year Established | Reach Length (m) | No. Point Count Stations |
|-----------------------------------------|-----------|------------------|------------------|--------------------------|
| White Brook                             | DEWA.1001 | 2007             | 1000             | 5                        |
| Dunnfield Creek                         | DEWA.1002 | 2007             | 1000             | 5                        |
| UNT to Delaware River (Sunfish Pond)    | DEWA.1003 | 2007             | 1000             | 5                        |
| Vancampens Brook (Millbrook Village)    | DEWA.1004 | 2007             | 1000             | 5                        |
| Slateford Creek                         | DEWA.1005 | 2007             | 1000             | 5                        |
| Caledonia Creek                         | DEWA.1006 | 2007             | 1000             | 5                        |
| Fuller Brook                            | DEWA.1007 | 2007             | 1000             | 5                        |
| Van Campen Creek                        | DEWA.1008 | 2007             | 1000             | 5                        |
| Little Bushkill Creek                   | DEWA.1009 | 2007             | 1000             | 5                        |
| UNT to Dingmans Creek                   | DEWA.1010 | 2008             | 1000             | 5                        |
| Toms Creek                              | DEWA.1011 | 2008             | 1000             | 5                        |
| UNT to Toms Creek                       | DEWA.1012 | 2007             | 1000             | 5                        |
| Broadhead-Heller Creek                  | DEWA.1013 | 2007             | 1000             | 5                        |
| Hornbecks Creek                         | DEWA.1014 | 2007             | 1000             | 5                        |
| Dingmans Creek                          | DEWA.1015 | 2007             | 1000             | 5                        |
| Adams Creek                             | DEWA.1016 | 2007             | 1000             | 5                        |
| Raymondskill Creek                      | DEWA.1017 | 2008             | 1000             | 5                        |
| Spackmans Creek                         | DEWA.1018 | 2007             | 1000             | 5                        |
| Conashaugh Creek                        | DEWA.1019 | 2007             | 1000             | 5                        |
| Dry Brook                               | DEWA.1020 | 2007             | 1000             | 5                        |
| UNT to Adams Creek                      | DEWA.1021 | 2007             | 1000             | 5                        |
| UNT to Delaware River (Namanock Island) | DEWA.1022 | 2007             | 1000             | 5                        |
| Vancampens Brook (Donkey Hollow)        | DEWA.1023 | 2007             | 1000             | 5                        |
| UNT to Delaware River (Arrow Island)    | DEWA.1024 | 2007             | 1000             | 5                        |

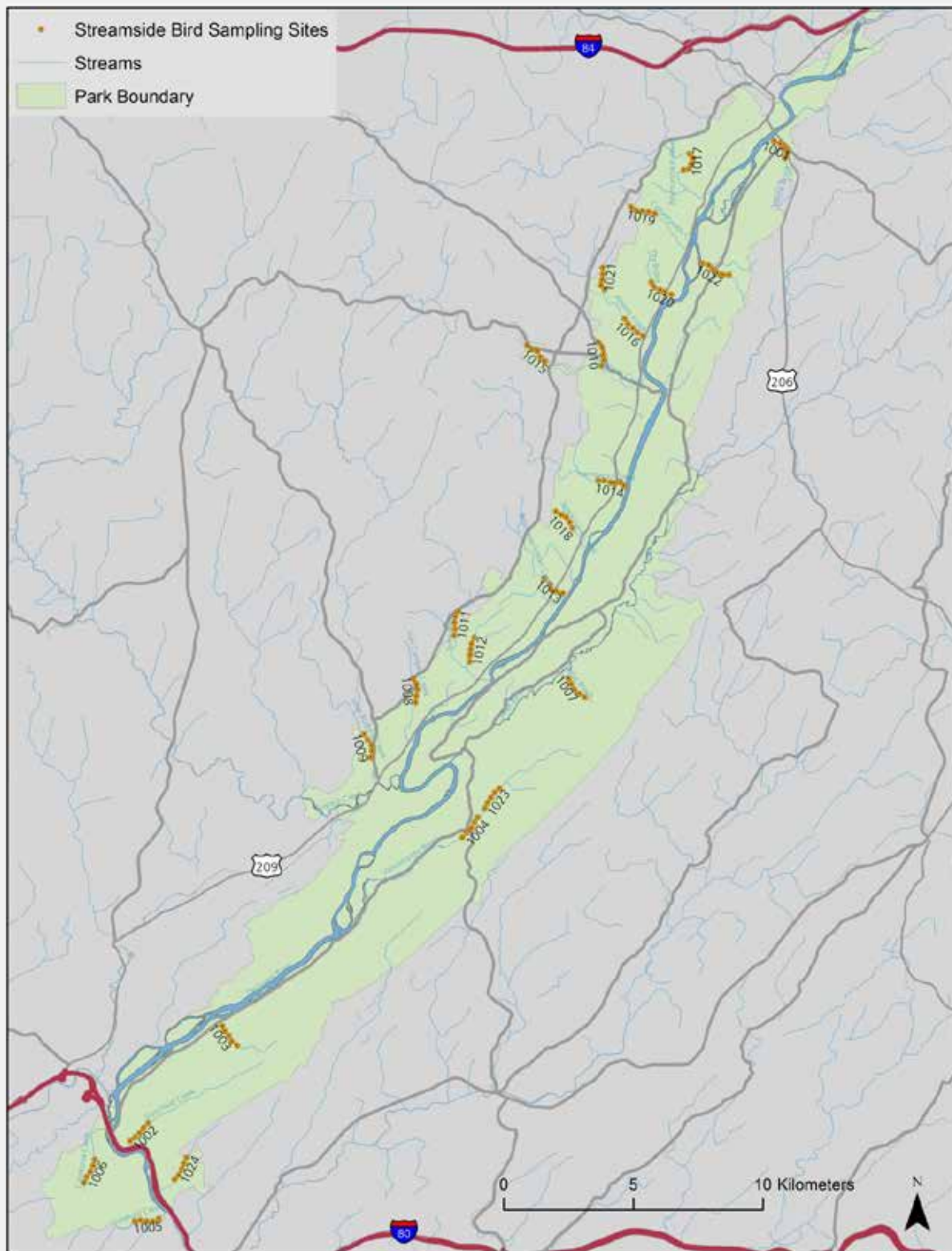


**Figure 4.** Location of 24 sampling sites selected for monitoring streamside birds at Delaware Water Gap NRA.

### ***New River Gorge National River***

Established in 1978, New River Gorge NRA encompasses more than 70,000 ac of rugged mountainous terrain along a 53-mi segment of the New River in the state of West Virginia.

Twenty-five sites were selected for streamside bird monitoring (Table 2, Figure 5; SOP 1 – Site Selection) at New River Gorge NRA. Each site is 1 km in length and therefore consists of five point count stations. Monitoring began in 2007 at all sites with the exception of the Big Branch, Davis Branch, and Keeney Creek sites which were initiated in 2008.

**Table 2.** Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 25 sampling sites selected for streamside bird monitoring at New River Gorge NR.

| <b>Site Name</b>                   | <b>Site ID</b> | <b>Year<br/>Established</b> | <b>Reach<br/>Length<br/>(m)</b> | <b>No.<br/>Point Count<br/>Stations</b> |
|------------------------------------|----------------|-----------------------------|---------------------------------|-----------------------------------------|
| Batoff Creek                       | NERI.1001      | 2007                        | 1000                            | 5                                       |
| Mill Creek                         | NERI.1002      | 2007                        | 1000                            | 5                                       |
| Meadow Creek                       | NERI.1003      | 2007                        | 1000                            | 5                                       |
| UNT to Meadow Creek                | NERI.1004      | 2007                        | 1000                            | 5                                       |
| Fall Branch                        | NERI.1005      | 2007                        | 1000                            | 5                                       |
| Big Branch                         | NERI.1006      | 2008                        | 1000                            | 5                                       |
| Laurel Creek                       | NERI.1007      | 2007                        | 1000                            | 5                                       |
| Dowdy Creek                        | NERI.1008      | 2007                        | 1000                            | 5                                       |
| Slater Creek                       | NERI.1009      | 2007                        | 1000                            | 5                                       |
| Buffalo Creek                      | NERI.1010      | 2007                        | 1000                            | 5                                       |
| UNT to Buffalo Creek               | NERI.1011      | 2007                        | 1000                            | 5                                       |
| Arbuckle Creek                     | NERI.1012      | 2007                        | 1000                            | 5                                       |
| UNT to Laurel Creek (Highland Mtn) | NERI.1013      | 2007                        | 1000                            | 5                                       |
| UNT to Laurel Creek (Backus Mtn)   | NERI.1014      | 2007                        | 1000                            | 5                                       |
| Davis Branch                       | NERI.1015      | 2008                        | 1000                            | 5                                       |
| Little Laurel Creek                | NERI.1016      | 2007                        | 1000                            | 5                                       |
| Richlick Branch                    | NERI.1017      | 2007                        | 1000                            | 5                                       |
| Wolf Creek                         | NERI.1018      | 2007                        | 1000                            | 5                                       |
| Keeney Creek                       | NERI.1019      | 2008                        | 1000                            | 5                                       |
| Camp Branch                        | NERI.1020      | 2007                        | 1000                            | 5                                       |
| Ephraim Creek                      | NERI.1021      | 2007                        | 1000                            | 5                                       |
| Fire Creek                         | NERI.1022      | 2007                        | 1000                            | 5                                       |
| Bucklick Branch                    | NERI.1023      | 2007                        | 1000                            | 5                                       |
| Bills Branch                       | NERI.1024      | 2007                        | 1000                            | 5                                       |
| Kates Branch                       | NERI.1026      | 2007                        | 1000                            | 5                                       |

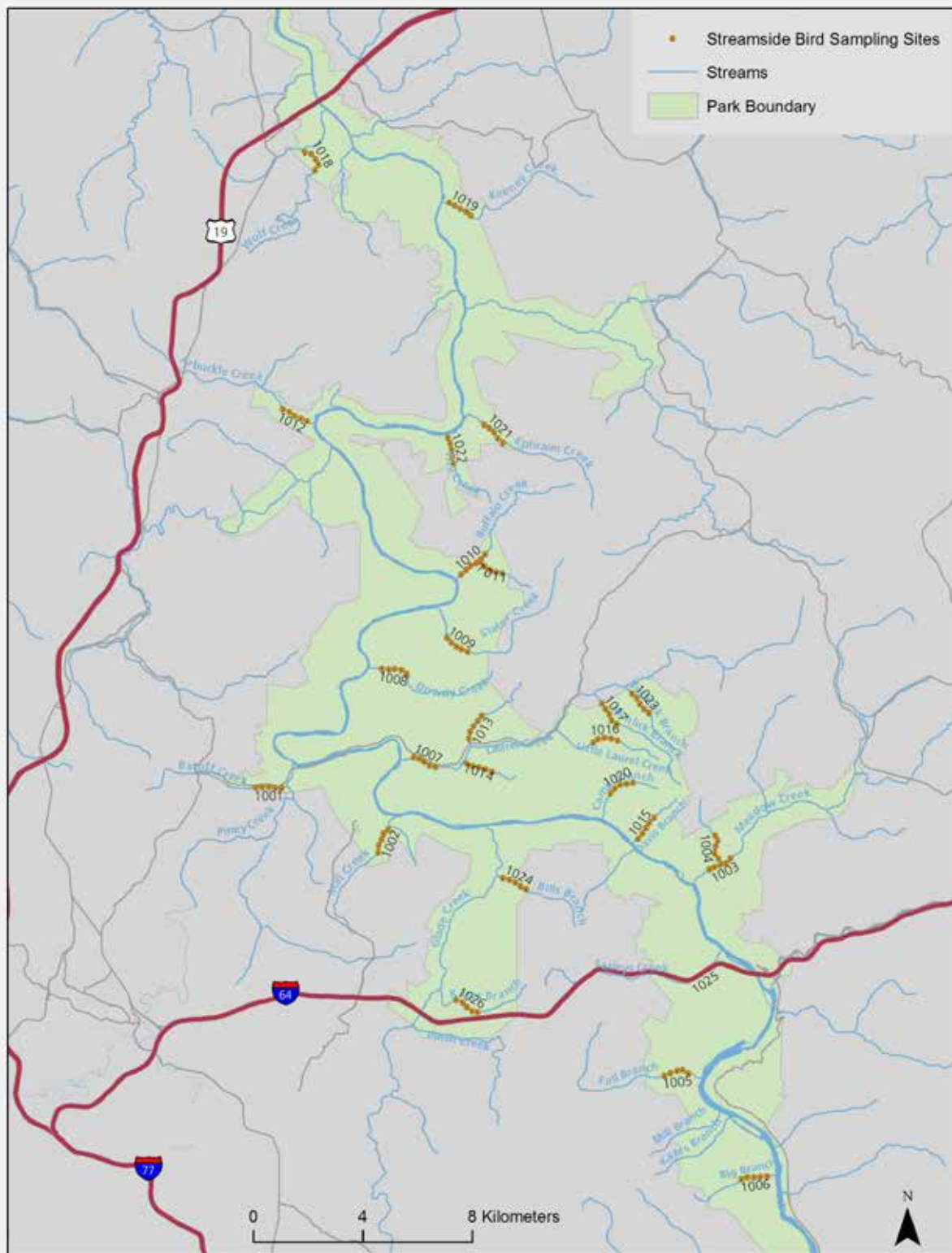


**Figure 5.** Location of 25 sampling sites selected for monitoring streamside birds at New River Gorge NR.

### **Gauley River National Recreation Area**

Established in 1988, Gauley River NRA encompasses more than 11,000 ac of rugged mountainous terrain along 25 mi of the Gauley River and 5 mi of the Meadow River in the state of West Virginia.

Six sites met the site selection criteria defined above but only three (Laurel Creek, Horseshoe Creek, and Meadow Creek) were randomly selected for inclusion and initiated in 2007 (Mattsson and Marshall 2010) at Gauley River NRA. Peter's Creek and Meadow River were too large to meet the size criterion and therefore excluded. It was later decided that Gauley River NRA had too few candidate sites for a logical random approach and all candidate sites were then considered for inclusion. As a result, the remaining three candidate sites were established in 2012 (Table 3, Figure 6). Reach length varies by site, ranging from 750 m to 1 km, and therefore sites consist of either four point count stations or five point count stations.

All six sites are located within the authorized boundary of the park, but none lie entirely on federally owned land. Permissions have been granted from the landowners for access and monitoring but in the event that landownership changes, new permissions must be sought to continue monitoring these sites.

**Table 3.** Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 6 sampling sites selected for streamside bird monitoring at Gauley River NRA.

| <b>Site Name</b> | <b>Site ID</b> | <b>Year Established</b> | <b>Reach Length (m)</b> | <b>No. Point Count Stations</b> |
|------------------|----------------|-------------------------|-------------------------|---------------------------------|
| Laurel Creek     | GARI.1001      | 2007                    | 1000                    | 5                               |
| Horseshoe Creek  | GARI.1002      | 2007                    | 1000                    | 5                               |
| Meadow Creek     | GARI.1003      | 2007                    | 1000                    | 5                               |
| Sugar Creek      | GARI.1004      | 2012                    | 1000                    | 5                               |
| Ramsey Branch    | GARI.1005      | 2012                    | 750                     | 4                               |
| Mason Branch     | GARI.1006      | 2012                    | 750                     | 4                               |

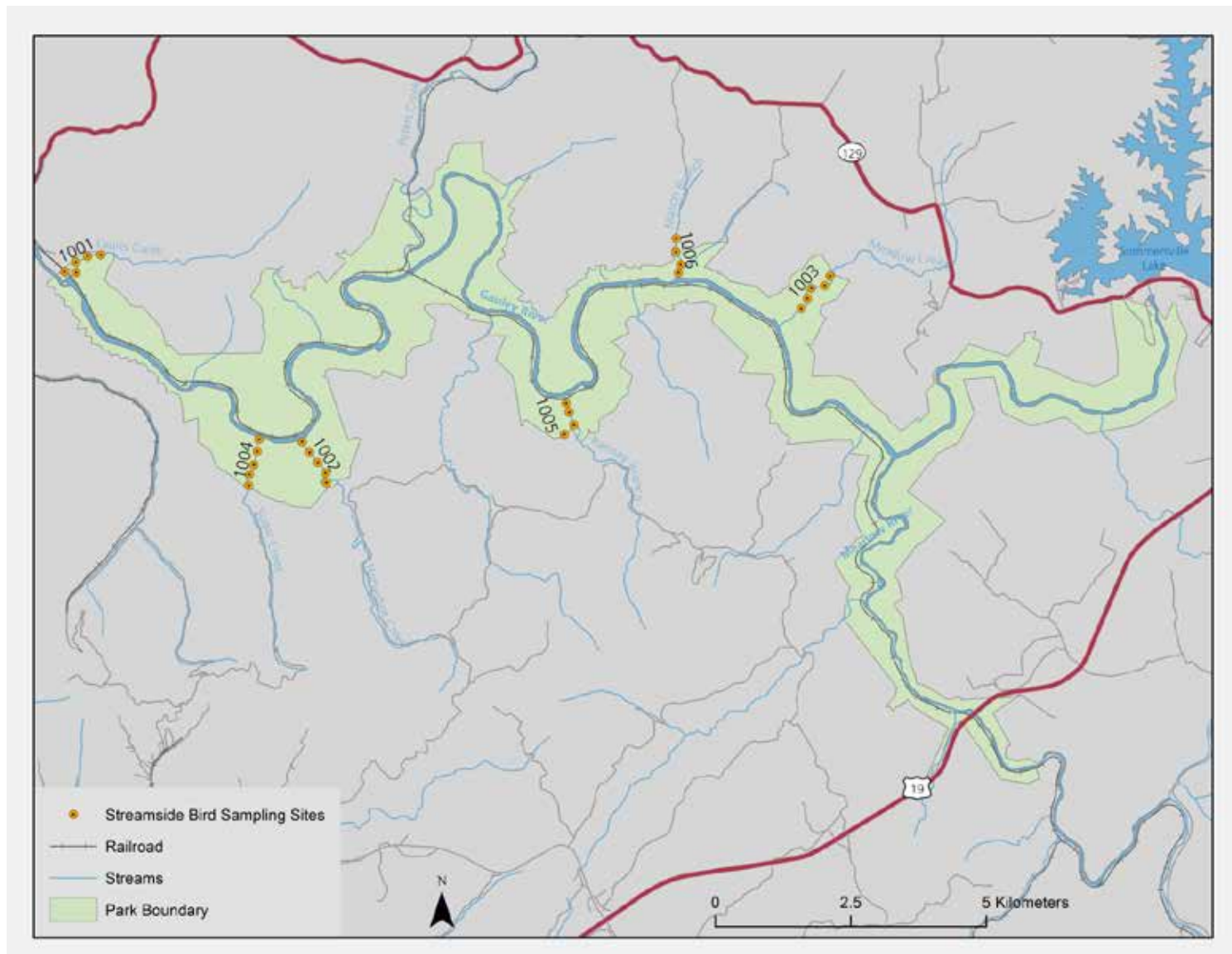


**Figure 6.** Location of six sampling sites selected for monitoring streamside birds at Gauley River NRA.

**Bluestone National Scenic River**

Established in 1988, Bluestone NSR encompasses more than 4,000 ac of Bluestone Gorge and 10.5 mi of the Bluestone River in southern West Virginia.

Five sites met the site selection criteria defined above and three are currently included in the streamside bird monitoring protocol (Table 4, Figure 7). Reach length varies by site, ranging from 500 m to 1 km, and therefore sites consist of three to five point count stations. A site along Indian Branch (BLUE.1001) was included and sampled in 2009 but discontinued due to excessively steep, unsafe terrain and several waterfalls. Landowner permission to access the fourth site (Jarrell Branch) was granted in 2012. Landowner permission to access the fifth potential site (Tony Hollow; BLUE.1005) has not yet been granted. Despite the requirement for private landowner permission for access, each site is located within the authorized park boundary on federally owned land.

**Table 4.** Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for three sampling sites selected for streamside bird monitoring at Bluestone NSR.

| Site Name              | Site ID   | Year Established | Reach Length (m) | No. Point Count Stations |
|------------------------|-----------|------------------|------------------|--------------------------|
| Mountain Creek         | BLUE.1002 | 2009             | 750              | 4                        |
| Little Bluestone River | BLUE.1003 | 2009             | 1000             | 5                        |
| Jarrell Branch         | BLUE.1004 | 2012             | 500              | 3                        |

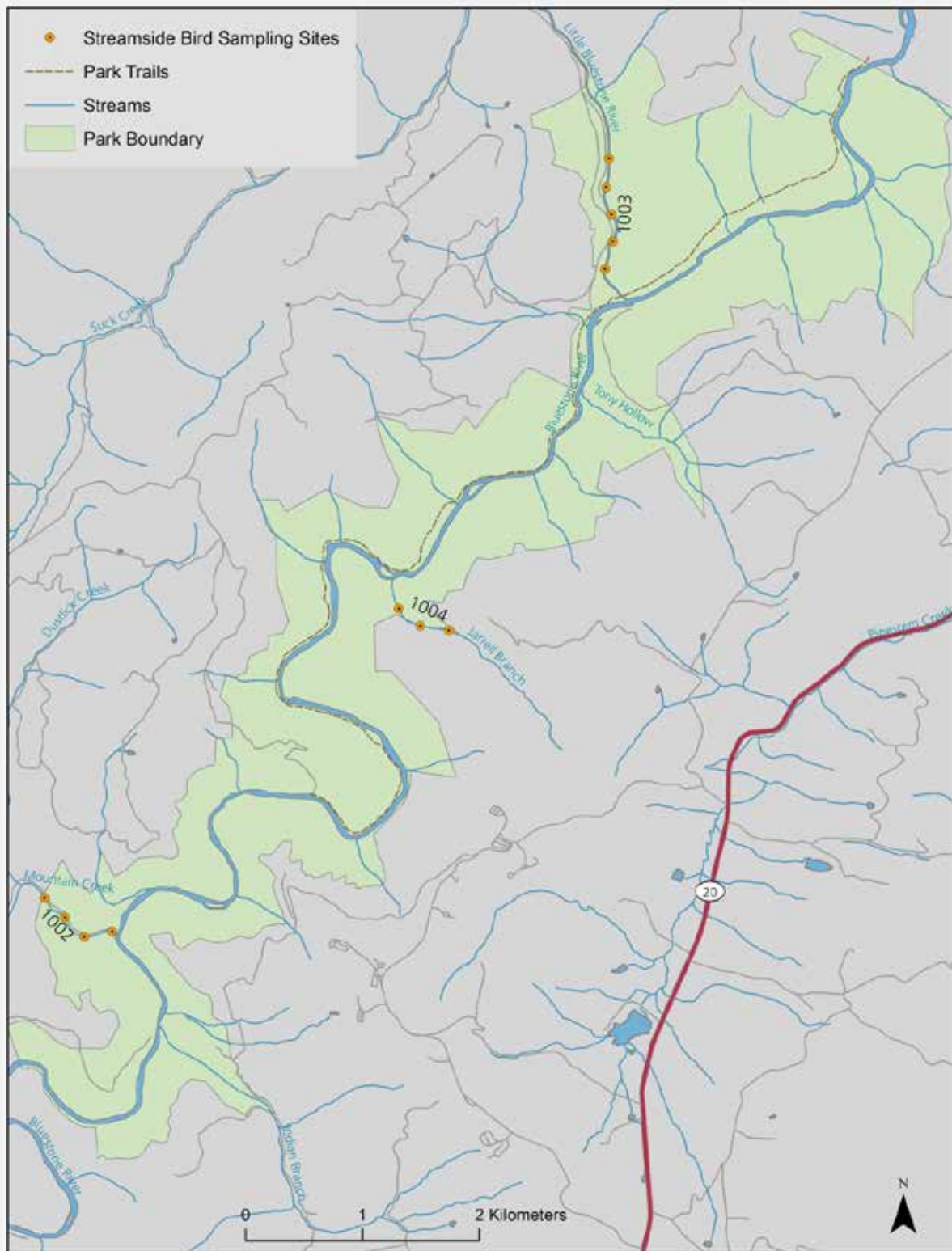


**Figure 7.** Location of three sampling sites selected for monitoring streamside birds at Bluestone NSR.

### ***Allegheny Portage Railroad National Historic Site***

Established in 1964, Allegheny Portage Railroad NHS encompasses slightly more than 1,200 ac of land area in central Pennsylvania to preserve and commemorate the historic Allegheny Portage Railroad. The park's main unit is located within the Blair Gap Run (BGR) watershed which, along with its natural resource values, serves as a municipal water supply for the cities of Altoona and Hollidaysburg, Pennsylvania. Due to the linear, winding nature of the park and BGR, there are only short segments of BGR and its tributaries that flow through park property. An attempt was made to establish streamside bird monitoring sites along as many of these segments as possible.

Four sites met the site selection criteria defined above and three are included in the streamside bird monitoring protocol (Table 5, Figure 8). Reach length varies by site, ranging from 500 m to 1 km, and therefore sites consist of either three or five point count stations. The fourth possible site (along the headwaters of BGR near the Lemon House) was not established because of excessively loud road/truck noise that precluded auditory sampling of birds.

**Table 5.** Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for three sampling sites selected for streamside bird monitoring at Allegheny Portage Railroad NHS.

| <b>Site Name</b>                   | <b>Site ID</b> | <b>Year<br/>Established</b> | <b>Reach<br/>Length<br/>(m)</b> | <b>No.<br/>Point<br/>Count<br/>Stations</b> |
|------------------------------------|----------------|-----------------------------|---------------------------------|---------------------------------------------|
| Millstone Run                      | ALPO.1001      | 2007                        | 1000                            | 5                                           |
| UNT to Blair Gap Run (Foot of Ten) | ALPO.1002      | 2008                        | 500                             | 3                                           |
| Blair Gap Run (Muleshoe)           | ALPO.1003      | 2009                        | 500                             | 3                                           |

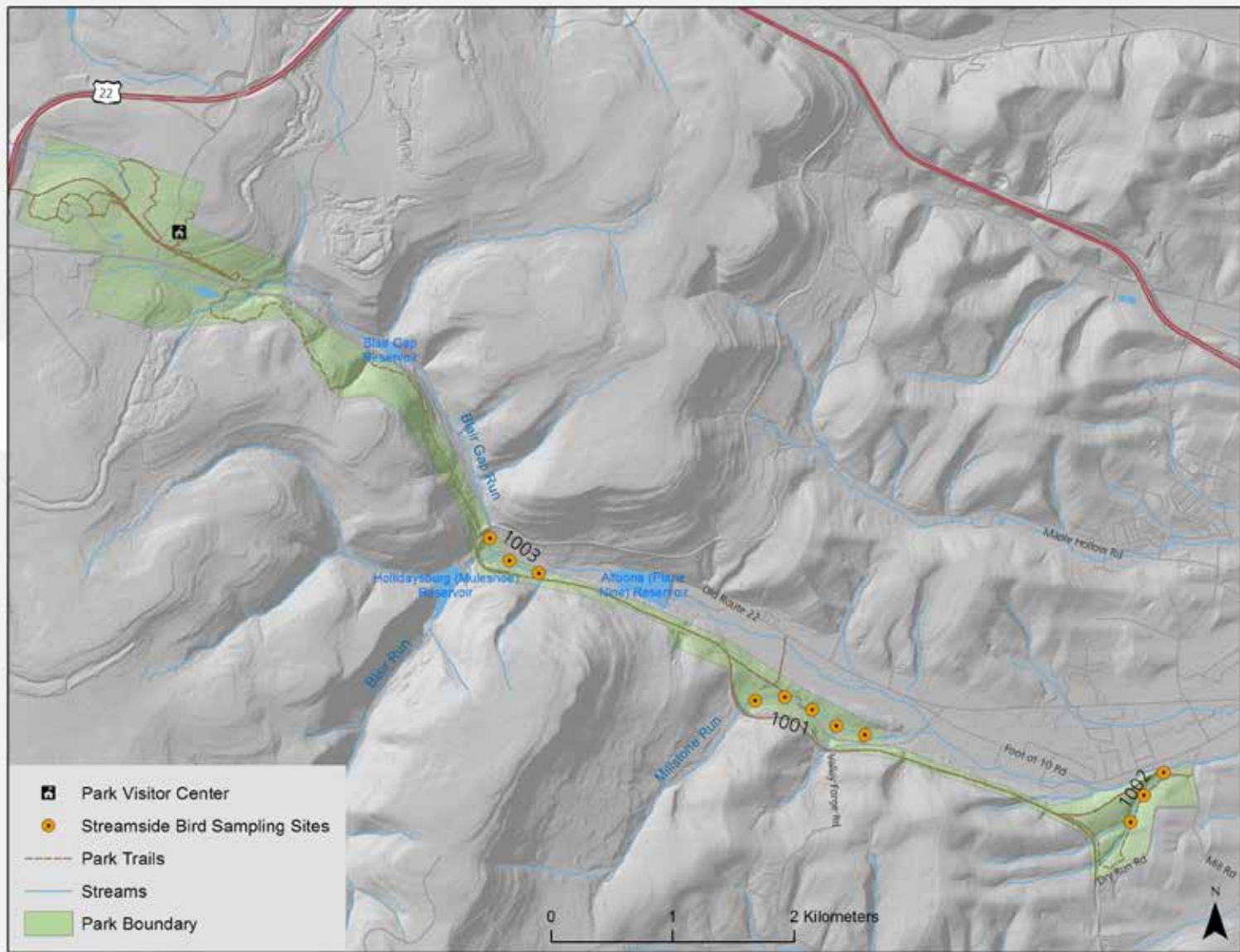


**Figure 8.** Location of 3 sampling sites selected for monitoring streamside birds at Allegheny Portage Railroad NHS.

### ***Fort Necessity National Battlefield***

Established in 1931, Fort Necessity NB encompasses slightly more than 900 ac of land area in southwest Pennsylvania to preserve and commemorate the early career of George Washington and the battle of Fort Necessity. The park's main unit is located on a slight plateau with several small streams originating on (and flowing off) park property. An attempt was made to establish streamside bird monitoring sites along as many of these segments as possible.

Three sites met the site selection criteria defined and are included in the streamside bird monitoring protocol (Table 6, Figure 9). Reach length varies by site, ranging from 250 m to 1 km, and therefore sites consist of two to five point count stations. Great Meadows Run was not considered as a candidate site because it is maintained as an open area for cultural resource interpretation.

**Table 6.** Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for three sampling sites selected for streamside bird monitoring at Fort Necessity NB.

| <b>Site Name</b>                | <b>Site ID</b> | <b>Year Established</b> | <b>Reach Length (m)</b> | <b>No. Point Count Stations</b> |
|---------------------------------|----------------|-------------------------|-------------------------|---------------------------------|
| UNT to Scotts Run (Picnic Loop) | FONE.1001      | 2008                    | 250                     | 2                               |
| UNT to Great Meadows Run        | FONE.1002      | 2008                    | 1000                    | 5                               |
| UNT to Scotts Run (Rankin Rd)   | FONE.1003      | 2008                    | 500                     | 3                               |

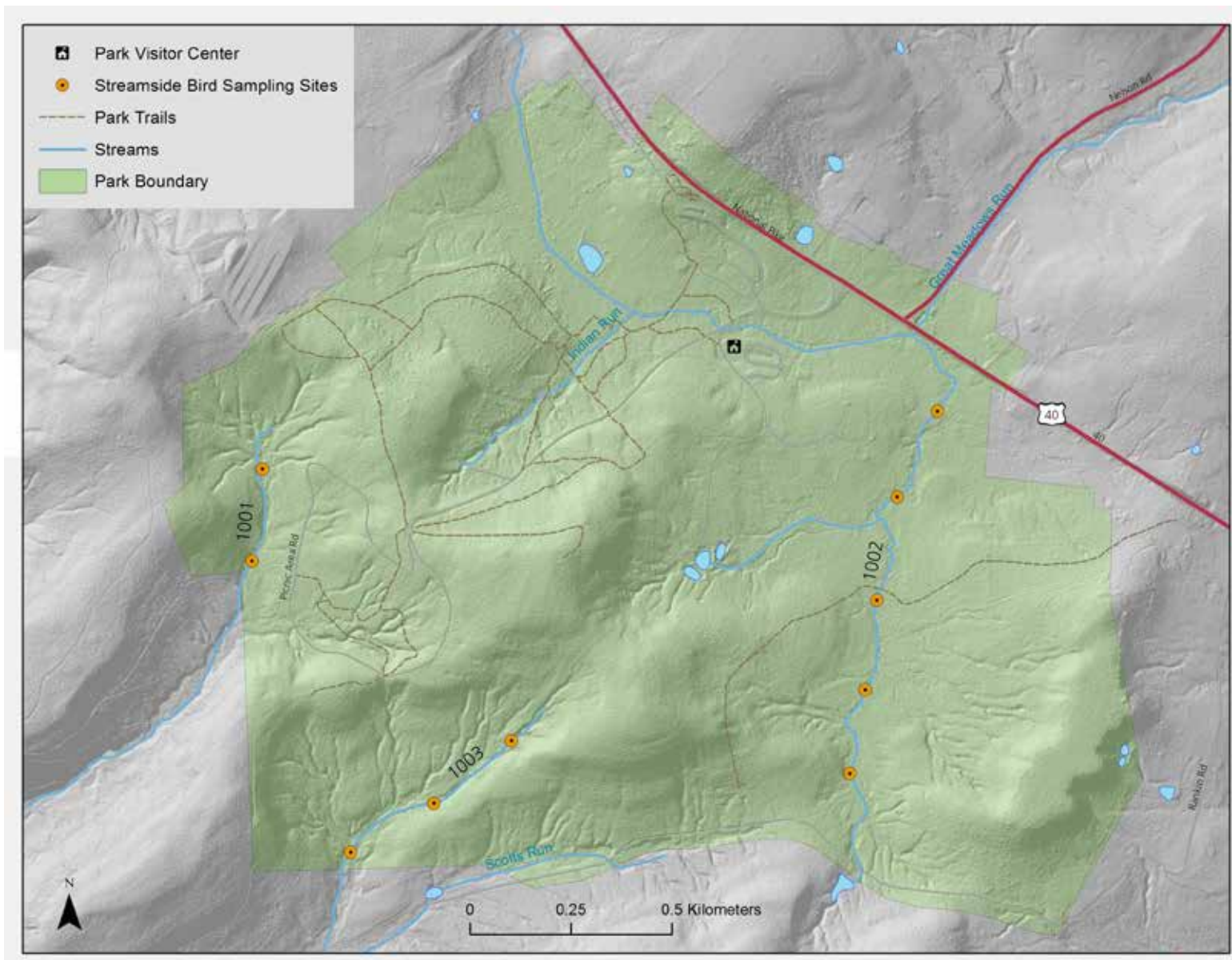


**Figure 9.** Location of 3 sampling sites selected for monitoring streamside birds at Fort Necessity NB.

**Friendship Hill National Historic Site**

Established in 1978, Friendship Hill NHS encompasses roughly 675 ac of land area along the Monongahela River in southwest Pennsylvania to commemorate and interpret Albert Gallatin, U.S. Secretary of Treasury for thirteen years under Presidents Jefferson and Madison.

The park has two perennially flowing streams and sites were established along both of them for streamside bird monitoring (Table 7, Figure 10). Reach length varies by site, ranging from 750 m to 1 km, and therefore sites consist of either four or five point count stations.

**Table 7.** Site name, unique site identifier (ID), year established, reach length, and number of point count stations per site for 2 sampling sites selected for streamside bird monitoring at Friendship Hill NHS.

| Site Name    | Site ID   | Year Established | Reach Length (m) | No. Point Count Stations |
|--------------|-----------|------------------|------------------|--------------------------|
| Ice Pond Run | FRHI.1001 | 2008             | 1000             | 5                        |
| Dublin Run   | FRHI.1002 | 2008             | 750              | 4                        |

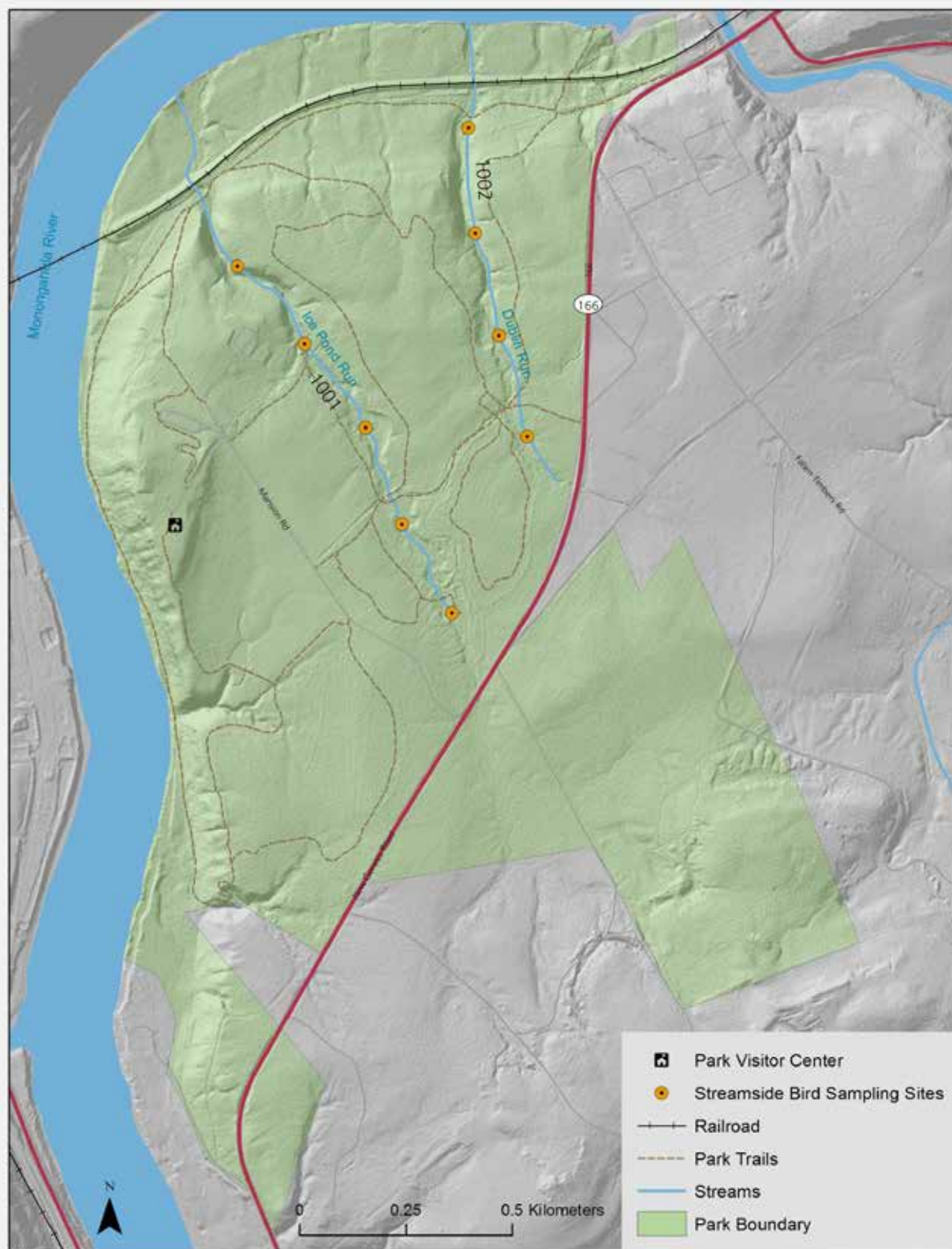


**Figure 10.** Location of two sampling sites selected for monitoring streamside birds at Friendship Hill NHS.

## **Field Methods**

### **Field Season Preparation**

The monitoring described in the protocol occurs annually mid-May through early July. However, the ability to successfully complete the field portion of the protocol will hinge upon thorough advance planning. This planning includes preparation of equipment, maps, field forms, and databases; advertising, hiring, and training field crews; securing housing and vehicles; among other responsibilities. Details on each of these activities are described in the Operational Requirements section below and associated SOPs (Marshall et al. n.d.).

### **Conducting Streamside Bird Surveys**

Each visit begins at sunrise and ends 4.5 hours after sunrise. Ideally, the visits are rotated among observers to account for observer biases; however, this is not always the case due to logistical and personnel constraints.

#### ***Point Counts***

The details of conducting the point counts and filling out the associated datasheets are described in SOP 8 – Conducting Point Counts (Marshall et al. n.d.). The basic procedure is to navigate to the site and first point count station and record stream noise and vegetation measurements. Then conduct the 10-minute point count and navigate to the next station. Repeat this process until the first pass (ranging from two to five point count stations depending on the site) is complete, wait 10 min and begin second pass. Crew members do not record stream noise and vegetation measurements on the second pass (it is assumed that these values do not change between passes of the same visit). During point counts, the following information for each individual bird detected is recorded: 1) species identity; 2) type of detection (e.g., song, call, drumming, visual); 3) the distance band of first detection (<50 m, 50–75 m, or >75 m of the point count station); 4) each 1-min interval the bird is detected; 5) if the bird is a juvenile; and 6) if the bird is flying over the canopy at the time of detection.

#### ***Vegetation and Stream Noise Measurements***

Wind-generated tree-fall gaps and, to a lesser extent, landslides, lightning, drought, and insect-defoliations play important roles in shaping the structure and composition of vegetation communities along streams in the ERMN (Rentch 2006). By governing the composition and successional stages of plant communities, these natural disturbances are important in structuring the composition of associated streamside bird assemblages (Greenberg and Lanham 2001, Saunders et al. 2006, Bowen et al. 2007). Rapid visual assessments of vegetation structure and composition surrounding each point count station will therefore be conducted.

Background noise can have dramatic effects on the spatial distribution, singing behavior, and detectability of birds (Lengagne and Slater 2002, Slabbekoorn and Smith 2002). While these effects have been demonstrated in response to anthropogenically generated noise (e.g., Petricelli and Blickley 2006), natural noise effects remain less understood. In mountainous regions such as the ERMN, noise generated by waterfalls and rapids is sufficient to affect bird behavior and detectability and, as such, hand-held sound (decibel) meters will be used to quantify noise generated by streams (henceforth, stream noise). Detailed descriptions of the vegetation measurements and how to record stream noise are in SOP 8 – Conducting Point Counts (Marshall et al. n.d.).



## **Data Management**

One of the most important goals of the NPS I&M Program is to integrate natural resource inventory and monitoring information into park planning, management, and decision-making. Collecting data on specific natural resources such as streamside birds is only the first step toward improving our understanding of park ecosystems. Sound data management practices enable us to analyze, synthesize, and model data, transforming them into useful information now and in the future. This section outlines the series of steps taken to ensure data stewardship, longevity, and information sharing.

### **Database Design**

The ERMN Streamside Bird Monitoring Database is a custom relational database developed in Microsoft Access to store all the data collected for the streamside bird monitoring protocol. The database consists of tables, queries, data-entry forms, and built-in reporting tools. The database builds on the Natural Resource Database Template which is a set of core database tables and the standard for the NPS I&M Program. The database is divided into two components: 1) one for entering, editing, and error-checking the current field season's data (i.e., the "field" or "working" database copy), and 2) another that contains the complete set of certified data for the monitoring project (i.e., the "master project database"). Each database component (working and master) is based on an identical underlying data structure (tables, fields, and relationships) and both components have an associated front-end database application ("user interface" with forms, queries, etc.). Each field crew is provided with their own copy of a working database into which they enter and quality-check data for the current season (see below) but do not have access to prior years' data. Once data for the current field season have been certified, they will be uploaded into the master database, which is then used to inform all reporting and analysis. This upload process is performed by the data manager using a series of pre-built append queries.

### **Data Entry, Verification, and Certification**

All data collected as part of the ERMN Streamside Bird Monitoring Program are entered directly into a working database by the observer who collected the data. Data entry consists of transferring raw data from field forms into the database - the procedures of which are covered during training (SOP 4 – Training Field Crews, Marshall et al. n.d.). Each data entry form is patterned after the structure of the field form and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users other than the protocol lead and data manager are required to only use these pre-built forms as a way of ensuring the maximum level of quality assurance.

Data verification immediately follows data entry and involves checking the database records against the original field data forms for accuracy. Data verification is necessary to ensure that values recorded on the field forms and keyed into the database match (i.e., there are no transcription errors or missing values). Verification occurs first by having the observer visually "proof" their own database records against their own field forms and then by having a second crew member (often working in pairs to check each other's data) also check that the field forms match the database records. There are separate "check boxes" on the data entry form of the database to indicate that these two steps are complete. Finally, the proofed and checked data are sent to the protocol lead (on a weekly basis) where he/she then checks for completeness and

logical consistency visually and through queries. The working database application facilitates the verification process by showing the results of pre-built queries that check for data integrity, data outliers and missing values, and illogical values.

The protocol lead compiles any questions or concerns regarding the data in a Microsoft Word document (called a “data review log”) referring to each issue by site, visit, and record number. The protocol lead sends the data review log to field crews within five days of receiving a database submission so that crews have sufficient time to address the concerns before submitting their next bout of data entry the following week. Once all discrepancies are resolved (documented in writing in the data review log) and fixed in the database, the data for that visit is “checked” as verified. Not all errors and inconsistencies can be fixed, in which case a description of the resulting errors and why edits were not made is then documented and included in the data review log.

Ideally, data are entered and proofed the day of collection to help ensure accurate mental recollection of confusing, unclear, or incomplete records. If this is not feasible, then this must be accomplished within one week of data collection.

Data certification is a benchmark that indicates that: (1) the data are complete for the period of record; (2) they have undergone and passed the quality assurance checks (“verification” as described above); and (3) they are documented and in a condition for archiving, posting, and distribution as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies which may or may not have been detected during quality assurance reviews. To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all data. The protocol lead (roles and responsibilities are described in the Operational Requirements section below) is responsible for certifying the data and providing it to the ERMN data manager. It is at this point that the data are appended to the master project database and archived (along with the data review log). Again, only certified data are used to inform analysis and reporting.

### **Metadata Procedures**

Data documentation is a critical step toward ensuring that data sets are usable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, condition, and other characteristics of a given data set. Additionally, metadata provide the means to catalog and search among data sets, thus making them available to a broad range of potential data users. Metadata for all ERMN monitoring data will conform to Federal Geographic Data Committee (FGDC) guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed, and synthesized. At the conclusion of the field season, the protocol lead and ERMN data manager will be jointly responsible for completed metadata.

### **Data Backups and Archiving**

Data backups and archiving occur at several points and in multiple ways in the data management process. The most basic level is to ensure that daily records entered into the field database are not lost. Upon closing/exiting the working database, the user will be prompted to make a backup of the underlying data. It is recommended that this be done on a regular basis – perhaps every day that new data are entered – to save time in case of mistakes or database file corruption. The most

recent database backup is sent (by placing it on a secure Web server) to the protocol lead each week as part of the data verification process (described above). In this way, the data are also backed-up in multiple locations. These periodic backups may be deleted once enough subsequent backups are made, and all such backups may be deleted after the data have passed the quality review and been certified.

The field data forms are also electronically scanned and converted to the .pdf file type at the time of data entry (i.e., field crew members do this daily for their own field forms) and placed on the designated secure Web server. This again, ensures that the raw field forms are also immediately converted to an electronic format and backed-up in multiple locations.

At the completion of the field season and the data certification process, the master database, associated metadata, data review logs, electronic scans of field forms, and all other relevant project materials are archived by the data manager (in conjunction with the protocol lead) on the ERMN server which is routinely backed-up including an off-site location. The paper field forms are clearly identified, organized, and filed in the protocol lead's office with all other relevant "hard copy" protocol documents.

### **Data Dissemination**

The majority of data analysis and reporting will be conducted by the protocol lead and collaborators. All completed reports and articles will be publicly available from multiple sources including the ERMN website (<http://science.nature.nps.gov/im/units/ermn/>) and the NPS integrated resource management information portal (<https://irma.nps.gov/App/Portal/Home>).

The intent is to also disseminate certified data to the Bird Point Count Database at the USGS Patuxent Wildlife Research Center (<http://www.pwrc.usgs.gov/point/>) on an annual basis so they are available to other researchers and the broader scientific community. This web-based, publicly accessible, and searchable repository for point count data collected in North America is a collaborative project among the Patuxent Wildlife Research Center, the USFWS National Wildlife Refuge System, and the American Bird Conservancy.

Requests for other ERMN streamside bird monitoring data should be directed to either the protocol lead or data manager (contact information is in Appendix B). Each request and potential release of data not available in the Bird Point Count Database described above will be reviewed on a case-by-case basis considering factors such as purpose, audience, data on sensitive species, and other factors.



# Data Analysis and Reporting

## Recommended Reporting Schedule and Format

Three types of reports will be produced for the ERMN Streamside Bird Monitoring Protocol: 1) annual summary reports; 2) Resource Briefs; and 3) periodic “variability and trends” reports.

Summary reports will be produced each year. They describe current condition of the resource and potentially provide early indications if data are outside the bounds of known variation. The intent is not to be all inclusive of the data available, but to provide a succinct interpretation of the recently completed field season’s monitoring events and findings (see below). In most instances, the purpose of these reports is to get summary information to park resource managers in a timely manner, and, as such, some of the data and conclusions will be regarded as provisional. Annual summary reports will generally not include discussion of trends, which will be covered in depth by the “variability and trend” reports. The primary audience is ERMN and member-park natural resource management personnel. It is likely that other researchers, collaborators, and interested parties, including the public, will also utilize these reports on occasion. Due to a modest lag-time in the availability of certified data it is expected that these reports will be completed roughly four months after the end of the field season (i.e., by November). The target outlet is the NPS Natural Resource Data Series. The peer-review process and publishing guidelines for this report series are available at <http://www.nature.nps.gov/publications/NRPM/>.

Resource Briefs are short (1–4 pages), concise summaries of relevant information. The idea is to produce an “eye-catching”, information-rich, executive summary of a longer report in an attempt to reach audiences not inclined to read the full report (e.g., park superintendents, other administrators, and perhaps the public). They may also be produced on a more immediate or timely topic for which a full report has not yet been produced. As such, Resource Briefs offer reporting flexibility both in timing and topic.

Periodic (5–10 years) “variability and trends” reports will expand on the annual status reports and provide scientifically defensible analyses of inter-annual variability and spatial and temporal patterns and trends (e.g., long-term trends for individual species or guilds and changes in the composition of streamside bird communities over time). These reports are intended to provide high-quality, peer-reviewed data and analyses that can be used in conjunction with other vital signs and/or park-based research projects and monitoring. Further, these comprehensive reports will place the observed results in both a regional and historical context by relating them to published literature, discussing the significance of the results relative to changing environmental factors, and providing management recommendations based on these findings when appropriate. The target audience is the same as for the annual reports but will likely be of increased interest to the broader scientific community as well. Peer-review will be more extensive than that which occurs for the annual summary reports. The target outlet is the NPS Natural Resource Technical Report Series. The peer-review process and publishing guidelines for this report series is available at <http://www.nature.nps.gov/publications/NRPM/>.

These reports, typically authored by the protocol lead but perhaps done in collaboration with a quantitative ecologist/statistician, will form the core reporting requirements and schedule for this protocol. Additional reports, data summaries, and presentations for a variety of purposes will be

performed as appropriate. It is likely that many topics covered in these reports will also be submitted to peer-reviewed scientific journals for publication.

All published reports will have a record created in the NPS Natural Resource Information Portal (<https://nrinfo.nps.gov/>) to ensure information sharing through a common, searchable, publically available database.

### **Recommendations for Routine Data Summaries and Analysis**

Perhaps more has been written in the scientific literature on the collection and analysis of bird point count data than about survey methods for any other biological taxon (Sauer and Droege 1990; Nichols et al. 2009). It is beyond the scope of this protocol to provide instructions for each analysis method. That said, the data collected for this protocol allow for a wide range of analyses and the recommendations below represent example summaries and analyses that should be conducted to meet program objectives (see Measureable Objectives section above). A wide variety of statistical approaches can be used to meet these objectives.

Each annual report should begin with a field season summary that describes and documents the year's accomplishments and significant events of the season (e.g., name of field crew members, number of sites visited, logistical issues, unusual weather, new tree fall gaps or other disturbances, and atypical events like extended periods of rain that delayed surveys). Any changes to the protocol (i.e., the way data were collected) that were implemented that year should also be described to help inform future analysis and interpretation.

Each annual report should also summarize any rare species or unusual occurrences that resource managers or other stakeholders (e.g., state agencies or natural heritage programs) may be interested in. This should not be limited to bird observations, since the field crew members spend many hours in the field and in areas where natural resource managers do not frequently visit. For example, an orchid species (*Platanthera orbiculata*) not documented in Delaware Water Gap NRA for more than 30 years was observed (Figure 11) by an avian field technician in 2009.

Reporting of invasive species that are part of the ERMN Early Detection of Invasive Species protocol should not be a part of the annual report since this occurs in other ways (Keefer et al. 2010).

The breeding bird composition and distribution should be summarized in each annual report using a variety of tables and graphs, potentially including:

- 1) tables of all species observed (by park) with total number of observations/detections (similar to Appendix A);
- 2) graphs of frequency of occurrence (number or proportion of sites where species/guild was detected) for specific species or guilds; and
- 3) descriptive statistics that report species relative abundance for specific locations and time periods (e.g., each site and year).



**Figure 11.** *Platanthera orbiculata* documented at Delaware Water Gap NRA in 2009 and 2012. Photo by Nicole Flood.

More complex analyses of species or guild-specific trends and changes in bird community composition over time will be carried out every five to 10 years and presented in “variability and trends” reports. In some cases, consultation with a qualified statistician will be needed at time of analysis, as statistical methods and software evolve rapidly. Regardless, there is well-developed literature on trend analysis of bird point count data to draw upon when deciding on the analytical approach (e.g., Ralph et al. 1995, Thomas 1996, Nur et al. 1999, Buckland et al. 2001, MacKenzie et al. 2002, MacKenzie et al. 2003, Thompson 2002, Bart et al. 2004, Nichols et al. 2009).

Thomas (1996) summarized the wide variety of statistical approaches for evaluating bird population trends, which generally boil down to regression approaches that model population size (or an index such as relative abundance) versus time. More recently, MacKenzie et al. (2002) described a technique for evaluation of trends in site occupancy rather than population size. Extensions to this general approach (i.e., Royle and Dorazio 2006, Royle and Kery 2007) can be applied to the hierarchical nature of the ERMN streamside bird data collection (i.e., 2–5 point count stations nested within a 500–1000 m sampling reach per sample site). ERMN streamside bird data collection methods also allow alternative approaches to be considered to account for imperfect detection while estimating abundance including repeat counts (Kery et al. 2005), time-of-detection (Alldredge et al. 2007) and distance methods (Thomas et al. 2005). The chosen approaches will allow estimation of parameters (e.g., occupancy, relative abundance, abundance, and density) that are explicitly linked to program objectives enabling evaluations of trends through time. Whatever approach is taken will be thoroughly described and documented in the ensuing report.

An example of a frequency-of-occurrence graph for Louisiana waterthrush at Delaware Water Gap NRA using data from 2007–2009 is shown in Figure 12. As described above (see Rationale for Monitoring Birds and History of Protocol Development), the Louisiana waterthrush (Figure 13) is a species that will be used as an avian indicator species to evaluate changes in stream and watershed condition. Also shown in Figure 12 are the number of point count stations (out of five possible) where Louisiana waterthrush was detected at least once (out of four possible visits to each station); that is, the point count station was “occupied” by a Louisiana waterthrush.

The reader can readily view the current year’s results (in this example 2009) and compare it to the prior years and the average of three years. The reader can also readily compare sites against each other and place their “own” park in a regional context by comparing it to similar figures for the other ERMN parks (not shown) in the report. Similar figures (also summarized by relative abundance instead of occupancy) should be generated for other species and guilds of interest. The data points in these figures (presented in annual reports) form the basis for trend analyses ultimately presented in the variability and trends reports.

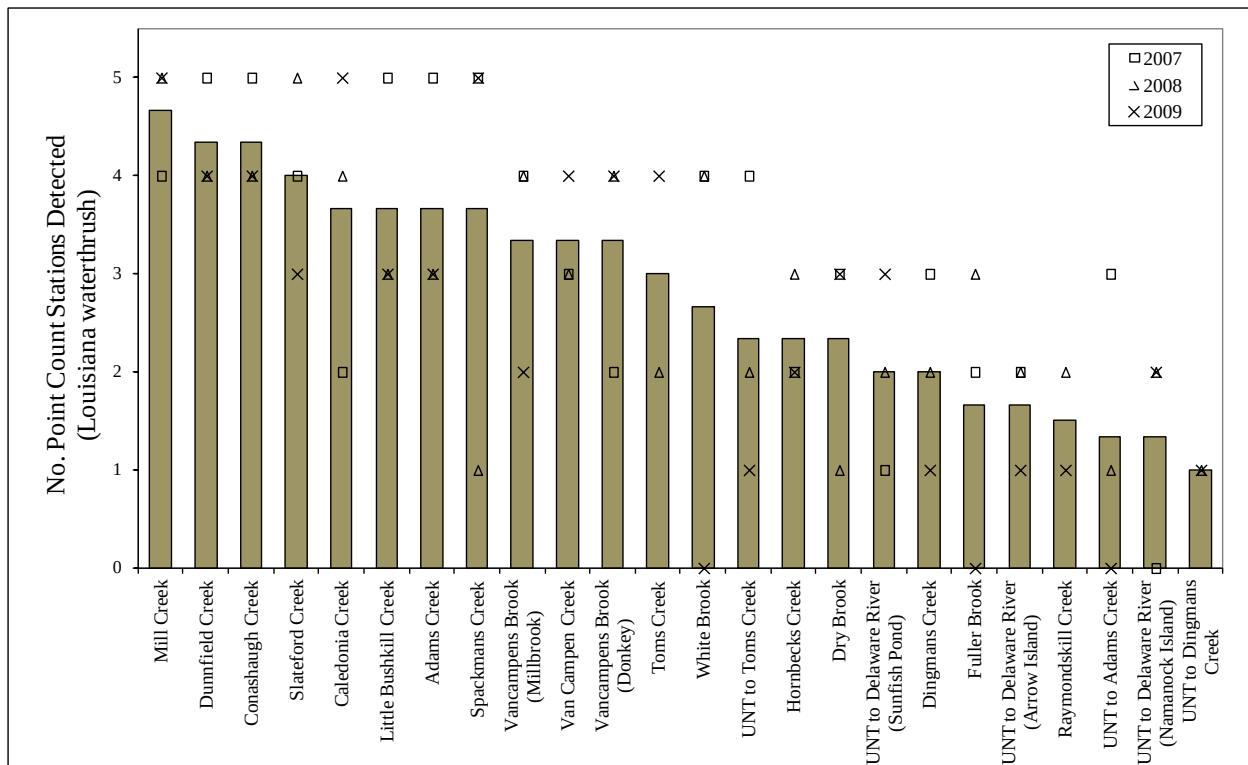


**Figure 12.** Louisiana waterthrush frequency of occurrence (number of point count stations detected) by sampling site at Delaware Water Gap NRA 2007–2009. Bar height is the 2007–2009 mean. Points depict values for individual years.



**Figure 13.** Louisiana waterthrush at nest with nestlings. Photo by James P. Mattsson.

### ***Birds as Indicators of Ecosystem Integrity***

Birds are often used as an indicator of ecosystem health or integrity and summarizing the “condition” of the bird community and reporting changes in the bird community over time is a primary objective of this program.

The Bird Community Index (BCI) is an index of biotic integrity (Karr and Dudley 1981) based on the breeding bird communities of the central Appalachians (O’Connell et al. 1998a, 1998b, 2000). The BCI is based on 16 response guilds with each guild broadly classified as “specialist” or “generalist” based on each guild’s relationship to specific elements of biotic integrity (Table 8). Each bird species is assigned to a response guild and the BCI ranks the overall bird community detected at a site according to the proportional representation of the species’ in the response guilds. Higher BCI scores (indicating higher biotic integrity) describe a community in which specialists are well-represented relative to generalists.

It is important to recognize that the BCI in its current formulation reflects land-use and land-cover types of the central Appalachians (e.g., mature and regenerating forest, pasture and row crop, urban and suburban area, and mined lands), each of which, in the absence of irreversible anthropogenic disturbance, would succeed to forest. Moreover, specialist guilds tend to be associated with extensive forest cover and a taller, more closed-canopy forest. Therefore, the sites with the highest BCI scores reflect bird communities associated with aspects of mature forest structure, function, and composition. For example, sites with higher BCI scores consist of a bird community with fewer omnivores, nest predators/brood parasites, and residents (i.e., generalists); but more bark probers, single-brooded species, and interior-forest obligates (i.e., specialists). Therefore, the biotic or ecological “condition” described by the BCI moves along a

**Table 8.** Biotic integrity elements, guild categories, response guilds, and guild interpretations used in an index of ecological integrity called the Bird Community Index (BCI; O’Connell et al. 1998a, 1998b, and 2000).

| <b>Biotic Integrity Element</b> | <b>Guild Category</b>         | <b>Response Guild</b>        | <b>Specialist</b> | <b>Generalist</b> |
|---------------------------------|-------------------------------|------------------------------|-------------------|-------------------|
| Functional                      | trophic                       | omnivore                     |                   | X                 |
| Functional                      | insectivore foraging behavior | bark prober                  | X                 |                   |
| Functional                      | insectivore foraging behavior | ground gleaner               | X                 |                   |
| Functional                      | insectivore foraging behavior | upper-canopy forager         | X                 |                   |
| Functional                      | insectivore foraging behavior | lower-canopy forager         | X                 |                   |
| Compositional                   | origin                        | exotic/nonnative             |                   | X                 |
| Compositional                   | migratory                     | resident                     |                   | X                 |
| Compositional                   | migratory                     | temperate migrant            |                   | X                 |
| Compositional                   | number of broods              | single-brooded               | X                 |                   |
| Compositional                   | population limiting           | nest predator/brood parasite |                   | X                 |
| Structural                      | nest placement                | canopy nester                | X                 |                   |
| Structural                      | nest placement                | shrub nester                 |                   | X                 |
| Structural                      | nest placement                | forest-ground nester         | X                 |                   |
| Structural                      | nest placement                | open-ground nester           | X                 |                   |
| Structural                      | primary habitat               | forest generalist            |                   | X                 |
| Structural                      | primary habitat               | interior forest obligate     | X                 |                   |

disturbance gradient from relatively intact, extensive, mature forest (high biotic integrity and high BCI scores) to highly developed or urban (low biotic integrity and low BCI scores) habitats.

The BCI was developed by O’Connell et al. (1998a, 1998b, 2000) as one component of the U.S. Environmental Protection Agency, Environmental Monitoring and Assessment Program’s (EPA-EMAP) Mid-Atlantic Highlands Assessment (MAHA). The BCI is particularly amenable to application by the ERMN Streamside Bird Monitoring Program for several reasons. First, the geographic extent of the MAHA (Figure 14) aligns well with that of the ERMN and, as a result, so do the bird species included (SOP 9 – Bird Community Index; Marshall et al. n.d.). This also means that the assessment of biotic integrity based on the bird community for the entire MAHA (O’Connell et al. 2000) provides an unparalleled regional context for comparisons to results within the ERMN. Finally, the sampling approaches employed by both efforts (five, 10-min point counts along a 1-km transect) are virtually identical.

A thorough description of the BCI and how it is calculated is provided in SOP 9 – Bird Community Index (Marshall et al. n.d.) but, briefly, bird species are assigned to the guilds and each guild is ranked (i.e., assigned a score) based on the proportion of the total bird species detected at a site within each guild.

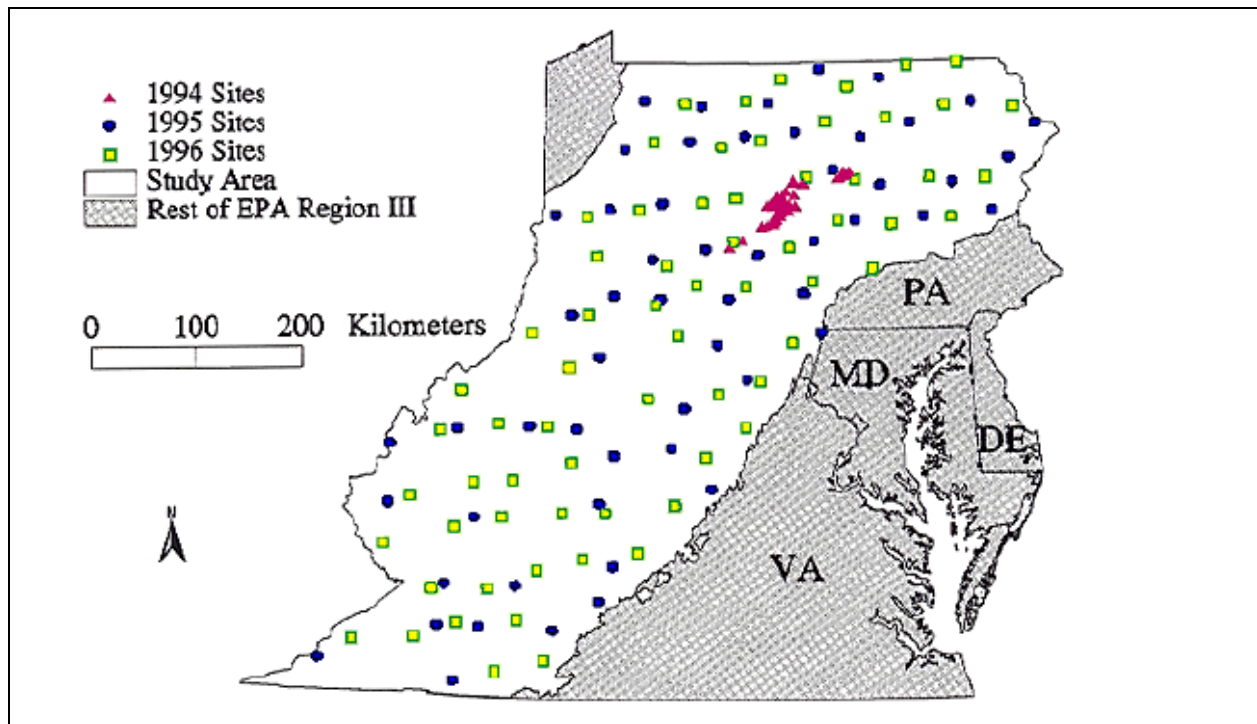


**Figure 14.** Map of the study area and specific sampling sites used by O'Connell et al. (2000) to develop the Bird Community Index (BCI).

The ranks determined for the 16 separate guilds are summed to produce an overall BCI score for the sampling unit (e.g., a sample site). O'Connell et al. (1998a, 1998b, and 2000) also established thresholds such that the overall BCI score places the sampling unit into one of four categories of ecological condition: “excellent” (highest-integrity), “good” (high-integrity), “fair” (medium integrity), and “poor” (low-integrity rural and low-integrity urban). The thresholds for these condition classes are as follows:

- highest integrity: 60.1–77.0
- high integrity: 52.1–60.0
- medium integrity: 40.1–52.0
- low integrity: 20.5–40.0

Figure 15 shows an example figure of the BCI scores for each site at New River Gorge NR from 2007–2009. These figures will be presented in each annual summary report so the reader can view the current year’s results (in this example 2009) and compare it to the prior years and the average of prior years. The reader can also readily see where each site falls along the continuum of low to high biotic integrity.

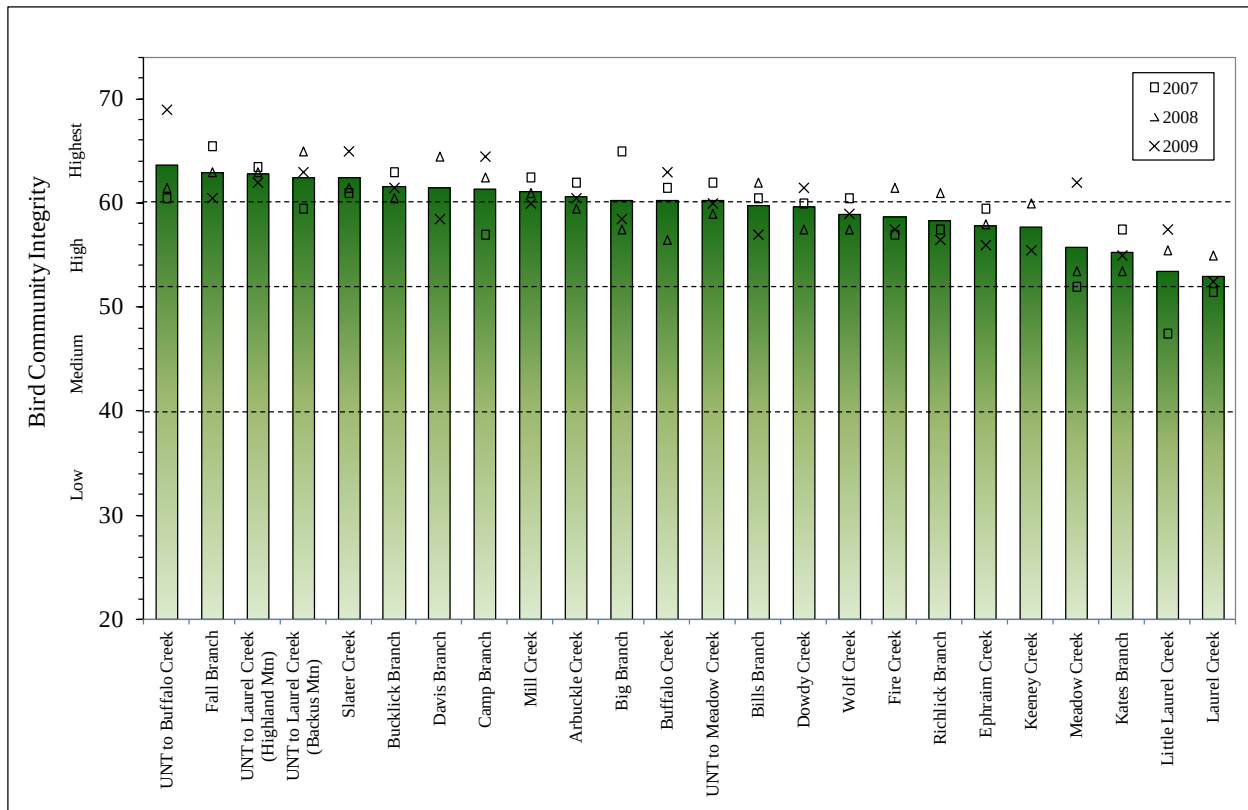


**Figure 15.** Bird Community Index of ecological integrity (O’Connell et al. 2000) for each sampling site at New River Gorge NR, 2007–2009. Bar height is the 2007–2009 mean. Points depict values for individual years. Higher values indicate higher ecological integrity. Dashed horizontal lines depict thresholds between low, medium, high, and highest ecological integrity.

O’Connell et al. (2000) applied the BCI to the entire mid-Atlantic region (referred to as the Mid-Atlantic Highlands) and, based on 126 randomly selected sites, determined the proportion of the region in each of the four condition classes (Figure 16). Recognizing that this analysis is a snapshot of condition from 1996, it provides an unparalleled regional context for which to compare the results obtained from within park boundaries (Figure 16). Similar figures, presented in the annual summary reports, should help resource managers place local results and findings into a meaningful regional context.

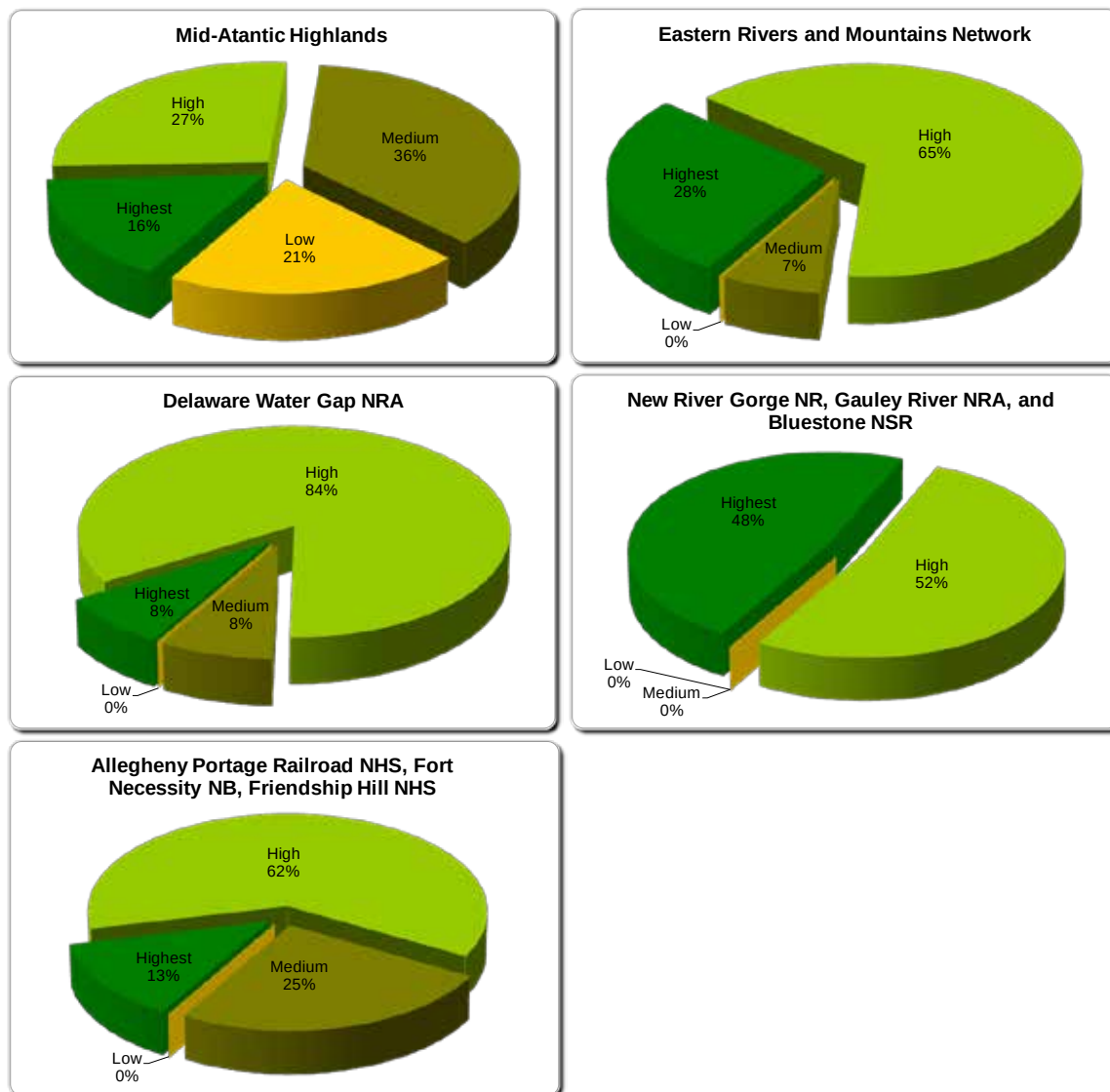


**Figure 16.** Percentage of sampling sites falling into four condition classes defined by the Bird Community Index of ecological integrity (O'Connell et al. 2000) for the Mid-Atlantic Highlands, Eastern Rivers and Mountains Network, and parks within the network.



## Operational Requirements

This chapter describes the personnel, qualifications, roles, responsibilities, schedule, and funding resources required to implement the streamside bird monitoring protocol.

### Personnel Requirements

Implementation of the streamside bird monitoring protocol requires a protocol lead, data manager, field crew members, and field crew leaders. General roles and responsibilities for required personnel are summarized below and in Table 9. Names and contact information for individuals who serve or have served in these roles are provided in Appendix B.

The protocol lead (preferably an ERMN employee) is responsible for overseeing the entire project and implementing the monitoring protocol. This does not mean that he/she plays active roles in each task but knows the rationale and requirements for each task and the responsible party for completing each task. The protocol lead is responsible for field season preparation, including organizing equipment, hiring field crews, conducting trainings, ensuring data entry and quality control, data analysis and reporting, and revising the protocol. The protocol lead may also collect data. Field crew members and field crew supervisors are responsible for data collection, data entry, and several levels of data review and quality control. Field crew supervisors are responsible for planning and coordinating daily activities while in the field (e.g., ensuring all sites are sampled the required number of times). The data manager is responsible for coordinating data management throughout the lifespan of the project. He/She develops data management guidance for the project, develops the proper database application for data storage, entry, and retrieval, and advises the protocol lead to ensure that the crew supervisors and field

**Table 9.** Roles and responsibilities for streamside bird monitoring.

| Role                                    | Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Protocol Lead</b>                    | <ul style="list-style-type: none"><li>· Implements program and provides oversight, administration, and budget tracking</li><li>· May serve as NPS key official, agreement technical representative, or contracting officers technical representative on agreements or contracts, as qualified</li><li>· Prepares for field season including hiring and training field crew members</li><li>· Assumes primary responsibility for data analysis and reporting</li><li>· Assists data manager with data certification.</li><li>· Liaison to Washington Support Office (WASO) programs, offices, and other I&amp;M networks</li><li>· Handles and coordinates data requests</li><li>· Coordinates review and changes to the protocol</li></ul> |
| <b>Field Crew and Field Crew Leader</b> | <ul style="list-style-type: none"><li>· Data collection</li><li>· Data entry</li><li>· Data review and quality control</li><li>· Recommend changes to the protocol in terms of field operations</li><li>· Crew supervisor plans and coordinates daily activities of the field crew</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Data Manager</b>                     | <ul style="list-style-type: none"><li>· Advises on data and information management activities</li><li>· Develops and maintains compliant and functional database</li><li>· Data archiving and long-term data security</li><li>· Posts data, metadata, reports, and other products to NPS data storage and delivery systems and network Web sites</li></ul>                                                                                                                                                                                                                                                                                                                                                                                 |

crew are properly trained on using the application. The data manager is also responsible for data archiving and long-term data security and posting of products to NPS websites and data delivery systems.

### **Qualifications, Training, and Safety**

Achieving the goal of accurate, reliable, and consistent data begins with the hiring process (SOP 3 – Hiring Field Crews; Marshall et al. n.d.) followed by a rigorous training program (SOP 4 – Training Field Crews; Marshall et al. n.d.). These topics and the related SOPs are among the most important parts of this protocol because they summarize the essential qualifications and skills field crew members must possess for this project, provide guidance on selecting and hiring these individuals, and outline the required training. The quality of the observer, combined with appropriate training, will determine the quality of the data. This cannot be overemphasized. Carefully screening of initial applicants, combined with rigorous training, can eliminate the more obvious visual, aural, psychological, and competency factors that affect observer variability (Kepler and Scott 1981, Ralph et al. 1993, McLaren and Cadman 1999).

The essential skills and experience necessary for field crew members include: identifying eastern forest birds by sight and sound (songs, calls, and drumming), using distance estimation techniques, good eyesight and good hearing ability, excellent physical condition, and backcountry experience. Crew members must already be proficient at identifying (by their vocalizations) the majority of bird species expected to be encountered. This is determined based on prior experience, reference checks, and a bird song quiz (see SOP 3 – Hiring Field Crews; Marshall et al. n.d.).

The physical and psychological demands of remote field work in the ERMN should not be underestimated and crew members need to be informed and mentally and physically prepared and qualified. Even the most skilled observer is of no use if they are unable to cope with adverse field conditions. Bird surveys in the ERMN demand a capacity for adjusting to waking well before dawn, safely navigating by car and foot to remote field sites using GPS, and carefully hiking through rugged, steep terrain with dense understory vegetation, deep creeks, and waterfalls.

Each crew member is required to participate in a one-week training prior to data collection (fully explained in SOP 4 – Training Field Crews; Marshall et al. n.d.). Training is designed to ensure that, upon completion, all crew members are able to identify (by sight and especially by sound) 100% of the bird species that are regularly encountered in the respective park unit(s) during point counts and >90% of bird species that have reasonable potential to be encountered. It is also essential that observers are able to accurately and consistently estimate distances to unseen, singing birds. Emphasis will be placed on following standard operating procedures for data collection to assure accuracy and consistency among observers. Training will also ensure that field crew members know how to navigate to point count stations and enter data into the provided MS Access database application.

The ERMN considers the occupational health and safety of their employees, cooperators, contractors, and volunteers to be of utmost importance, and is committed to ensuring that all seasonal field crew members receive adequate training on safety procedures, accident reporting, and emergency response prior to field work. All field crew members are equally responsible for

keeping safety topics covered during training at the forefront of daily activities throughout the field season. Safety procedures, emergency contacts, accident reporting, and radio use are outlined in SOPs 5 (Personal Safety), 6 (Radio Use), and 7 (Vehicle Accident Procedures; Marshall et al. n.d.).

### **Annual Workload and Schedule**

Implementation of the streamside bird protocol is a year-round responsibility for the protocol lead. Data collection, management, analyses, and reporting must be completed every year along with protocol revisions, website updates, budget and project management, and communications with parks and other interested parties. That said, the avian breeding season (May–July) of each year is the focal point for data collection and therefore dictates the annual schedule.

Beginning in January, the protocol lead should ensure that field equipment is organized and ready for use; ensure that housing, vehicles, and park radios are arranged and available; and begin the hiring process. Training typically begins during the second or third week of May, with data collection beginning as soon as the protocol lead determines that the crews are sufficiently trained and ready to begin. The field season, including training, is approximately eight weeks in length and is therefore typically completed by the first week of July.

The following timeline outlines the annual schedule for implementing the ERMN streamside bird protocol:

- 1) January–April (Protocol lead)
  - a. Hire field crews (SOP 3 – Hiring Field Crews)
  - b. Prepare for field season (SOP 2 – Before the Field Season)
- 2) May–July (Protocol lead and field crews)
  - a. Training (SOP 4 – Training Field Crews)
  - b. Conduct point counts (SOP 8 – Conducting Point Counts)
  - c. Enter and proof data (SOP 4 – Training Field Crews)
- 3) August–December (Protocol lead)
  - a. Analyze data
  - b. Prepare and submit annual report
  - c. Discuss results with park resource managers
  - d. Present results at professional meetings/peer reviewed publications

### **Facility and Equipment Needs**

This protocol requires no specialized equipment or facilities for ERMN personnel beyond normal office space, seasonal field housing, appropriate vehicles, and equipment storage needs. SOP 2 – Before the Field Season (Marshall et al. n.d.) contains a list of the equipment needed by survey crews.

### **Startup Costs and Budget Considerations**

This protocol was developed through a cooperative agreement with The University of Georgia's Warnell School of Forestry and Natural Resources. The agreement covered protocol research and development, field personnel, and data collection at New River Gorge NR, Gauley River NRA, and Bluestone NSR for the first four years of the program (FY2007–2010). The total budget for this agreement and its modifications was approximately \$375,000. An additional cooperative

agreement with a budget of approximately \$57,000 with East Stroudsburg University covered protocol development and data collection at Delaware Water Gap NRA from 2009 through 2010. Beginning in 2010 (and the 2011 field season) the ERMN Program Manager became the protocol lead and these cooperative agreements came to an end. Routine data collection now requires a field crew of two (one of which is the crew leader) at Delaware Water Gap NRA and another at the three West Virginia parks (total of 4 crew members). The protocol lead (who acts as the crew leader) and an additional crew member collect data at Allegheny Portage Railroad NHS, Fort Necessity NB, and Friendship Hill NHS.

Costs associated with implementing the annual field sampling portion of the streamside bird monitoring protocol are approximately \$32,900 with details provided in Table 10. This estimate includes wages for field crew leaders, crew members, transportation, housing, travel costs, and supplies that are used every year. Costs not shown include approximately 30% of the ERMN program manager's time to be the protocol lead.

**Table 10.** Estimated annual costs to implement the streamside bird monitoring protocol in seven park units of the Eastern Rivers and Mountains Network.

| <b>Budget Category</b>    | <b>NERI,<br/>GARI,<br/>BLUE</b> | <b>DEWA</b> | <b>ALPO</b> | <b>FONE,<br/>FRHI</b> |
|---------------------------|---------------------------------|-------------|-------------|-----------------------|
| Wages, contracts, fringe  | \$10,000                        | \$10,000    | \$0         | \$600                 |
| Travel                    | \$2,000                         | \$2,000     | \$300       | \$800                 |
| Supplies                  | \$1,000                         | \$1,000     | \$100       | \$100                 |
| Indirect if Univ. (17.5%) | \$2,000                         | \$2,000     | \$0         | \$0                   |
| Park housing              | \$0                             | \$1,000     | \$0         | \$0                   |
| Total                     | \$15,000                        | \$16,000    | \$400       | \$1,500               |

## Revising the Protocol

Protocol review and revision is an on-going task resulting in a “living” document. Feedback, review, and suggested changes should involve input from all of those involved in the project and should occur at least annually at the completion of each field season. This level of revision may or may not require actual changes to the protocol. The protocol will also be thoroughly reviewed roughly every five years (potentially coincided with periodic variability and trends reporting). The protocol lead and data manager (at a minimum) and, preferably, qualified external reviewers will critically evaluate the narrative, SOPs, associated database, analyses and reports produced thus far, and other products.

The protocol narrative and each SOP contain a revision history log located at the beginning of each document that is completed for each change to explain reasons for changes, and to assign a new version number to the revised SOP or narrative. Careful documentation of changes to the protocol and a library of previous protocol versions are essential for maintaining consistency in data acquisition and for appropriate treatment of the data during data summary and analysis.

## Literature Cited

- Allredge, M. W., K. H. Pollock, and T. R. Simons. 2006. Estimating detection probabilities from multiple-observer point counts. *Auk* 123:1172–1182.
- Allredge, M. W., T. R. Simons, and K. H. Pollock. 2007. Factors affecting aural detection of songbirds. *Ecological Applications* 17:948–955.
- Bart, J. 2005. Monitoring the abundance of bird populations. *Auk* 122:15–25.
- Bart, J., and S. L. Earnst. 2002. Double sampling to estimate bird density and population trends. *Auk* 119:36–45.
- Bart, J., K. P. Burnham, E. H. Dunn, C. M. Francis, and C. J. Ralph. 2004. Goals and strategies for estimating trends in landbird abundance. *Journal of Wildlife Management* 68:611–626.
- Bart, J., and C. J. Ralph. 2005. Suggestions for establishing a network of landbird migration monitoring sites *In* Ralph, C.J., Rich, T., eds., *Proceedings of the Third International Partners in Flight Symposium: General Technical Report PSW-GTR-191*, Albany, CA, US Forest Service, Pacific Southwest Research Station, p. 701–704.
- Bowen, L. T., C. E. Moorman, and J. C. Kilgo. 2007. Seasonal bird use of canopy gaps in a bottomland forest. *Wilson Journal of Ornithology* 119:77–88.
- Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. *Introduction to distance sampling: Estimating abundance of biological populations*. Oxford University Press, Oxford, U. K.
- Carlson, M., and F. Schmiegelow. 2002. Cost-effective sampling design applied to large-scale monitoring of boreal birds. *Conservation Ecology* 6:11.
- Carver, E. 2009. *Birding in the United States: A demographic and economic analysis*. U. S. Fish and Wildlife Service Report 2006-4, Arlington, Virginia, 20pp.
- Church, M. 2002. Geomorphic thresholds in riverine landscapes. *Freshwater Biology* 47:541–557.
- Diefenbach, D. R., M. R. Marshall, J. A. Mattice, and D. W. Brauning. 2007. Incorporating availability for detection in estimates of bird abundance. *Auk* 124:96–106.
- Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. *Measuring and monitoring plant populations*. U. S. Department of the Interior, Bureau of Land Management.
- Faaborg, J., M. Bittingham, T. Donovan, and J. Blake. 1995. Habitat fragmentation in the Temperate Zone. Pages 357–380 *in* T. E. Martin and D. M. Finch, editors. *Ecology and Management of Neotropical Migratory Birds*. Oxford University Press, Oxford, U. K.

- Faccio, S., B. R. Mitchell, and P. S. Pooler. 2010. Breeding landbird monitoring protocol: Northeast Temperate Network. Natural Resource Report NPS/NETN/NRR—2010/198. National Park Service, Fort Collins, Colorado.
- Fancy, S. G., J. E. Gross, and S. L. Carter. 2009. Monitoring the condition of natural resources in US national parks. *Environmental Monitoring and Assessment* 151:161–174.
- Farnsworth, G. L., K. H. Pollock, J. D. Nichols, T. R. Simons, J. E. Hines, and J. R. Sauer. 2002. A removal model for estimating detection probabilities from point-count surveys. *Auk* 119:414–425.
- Goodwin, S. E., and S. W. Wakamiya. 2010. Breeding Bird Monitoring: Mid-Atlantic Network 2009 Annual Report. Natural Resource Data Series NPS/MIDN/NRDS—2010/XXX. National Park Service, Fort Collins, Colorado.
- Gostomski, T., M. Knutson, N. P. Danz, B. Route, and T. W. Sutherland. 2010. Landbird monitoring protocol, Great Lakes Inventory and Monitoring Network. Natural Resource Report NPS/GLKN/NRR—2010/225. National Park Service, Fort Collins, Colorado.
- Greenberg, C. H., and J. D. Lanham. 2001. Breeding bird assemblages of hurricane-created gaps and adjacent closed canopy forest in the southern Appalachians. *Forest Ecology and Management* 154:251–260.
- Hames, R. S., K. V. Rosenberg, J. D. Lowe, S. E. Barker, and A. A. Dhondt. 2002. Adverse effects of acid rain on the distribution of the Wood Thrush *Hylocichla mustelina* in North America. *Proceedings of The National Academy Of Sciences Of The United States Of America* 99:11235–11240.
- Hutto, R. L., and C. J. Ralph. 2005. [Introduction - Regional monitoring programs](#). pp. 924–925 in: C. J. Ralph and T. D. Rich (Eds.). *Bird conservation implementation and integration in the Americas: Proceedings of the third international Partners in Flight conference*. 2002 March 20–24; Asilomar, California; vol. 2. Gen. Tech. Rep. PSW-GTR-191. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.
- Hutto, R. L., and J. S. Young. 2002. Regional landbird monitoring perspectives from the northern Rocky Mountains. *Wildlife Society Bulletin* 30:738–750.
- Johnson, D. H. 2008. In defense of indices: The case of bird surveys. *Journal of Wildlife Management* 72(4):857–868.
- Karr, J. R., and D. R. Dudley. 1981. Ecological perspective on water quality goals. *Environmental Management* 5:55–68.
- Keefer, J. S., M. R. Marshall, and B. R. Mitchell. 2010. Early detection of invasive species: surveillance, monitoring, and rapid response: Eastern Rivers and Mountains Network and Northeast Temperate Network. Natural Resource Report NPS/ERMN/NRR—2010/196. National Park Service, Fort Collins, Colorado.

- Kepler, C. B., and J. M. Scott. 1981. Reducing bird count variability by training observers. *Studies in Avian Biology* 6:366–371.
- Kéry, M., J. A. Royle, and H. Schmid. 2005. Modeling avian abundance from replicated counts using binomial mixture models. *Ecological Applications* 15:1450–1461.
- King, R. S., M. E. Baker, D. F. Whigham, D. E. Weller, T. E. Jordan, P. F. Kazyak, and M. K. Hurd. 2005. Spatial considerations for linking watershed land cover to ecological indicators in streams. *Ecological Applications* 15:137–153.
- Klemm, D. J., K. A. Blocksom, W. T. Thoeny, F. A. Fulk, A. T. Herlihy, P. R. Kaufmann, and S. M. Cormier. 2002. Methods development and use of macroinvertebrates as indicators of ecological conditions for streams in the Mid-Atlantic Highlands Region. *Environmental Monitoring and Assessment* 78:169–212.
- Knutson, M. G., N. P. Danz, T. W. Sutherland, and B. R. Gray. 2008. Landbird Monitoring Protocol for the U.S. Fish and Wildlife Service, Midwest and Northeast Regions, Version 1. Biological Monitoring Team Technical Report BMT-2008-01. U.S. Fish and Wildlife Service, La Crosse, Wisconsin, U.S.
- Ladin, Z., S. E. Goodwin, and W. G. Shriver. 2011. Avian Monitoring in the National Capital Region Network: 2007 – 2011. Natural Resource Data Series Report NPS/NCRN/NRDS—2011/in press. National Park Service, Fort Collins, Colorado.
- Lambert, J. D., T. P. Hodgman, E. J. Laurent, G. L. Brewer, M. J. Iliff, and R. Dettmers. 2009. *The Northeast Bird Monitoring Handbook*. American Bird Conservancy. The Plains, Virginia. 32 pp.
- Lengagne, T., and P. J. B. Slater. 2002. The effects of rain on acoustic communication: tawny owls have good reason for calling less in wet weather. *Proceedings of the Royal Society of London Series B-Biological Sciences* 269:2121–2125.
- Link, W. A., R. J. Barker, J. R. Sauer, and S. Droege. 1994. Within-site variability in surveys of wildlife populations. *Ecology* 75:1097–1108.
- Lovett, G. M., D. A. Burns, C. T. Driscoll, J. C. Jenkins, M. J. Mitchell, L. Rustad, J. B. Shanley, G. E. Likens, and R. Haeuber. 2007. Who needs environmental monitoring? *Frontiers in Ecology and the Environment* 5:253–260.
- MacKenzie, D. I., J. D. Nichols, G. B. Lachman, S. Droege, J. A. Royle, and C. A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. *Ecology* 83:2248–2255.
- MacKenzie, D. I., J. D. Nichols, J. E. Hines, M. G. Knutson, and A. B. Franklin. 2003. Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly. *Ecology* 84:2200–2207.

- Marshall, M. R., and N. B. Piekielek. 2007. Eastern Rivers and Mountains Network Ecological Monitoring Plan. Natural Resource Report NPS/ERMN/NRR—2007/017. National Park Service. Fort Collins, CO.
- Marshall, M., Knight, P., and J. Comiskey. 2012. Weather and climate monitoring protocol: Eastern Rivers and Mountains Network and Mid-Atlantic Network. Natural Resource Report NPS/ERMN-MIDN/NRR–2012/498. National Park Service, Fort Collins, Colorado.
- Marshall, M., Mattsson, B., Callahan, K., and T. Master. (n.d.). Standard Operating Procedures for the Streamside Bird Monitoring Protocol for the Eastern Rivers and Mountains Network. Available from <http://science.nature.nps.gov/im/units/ermn/> (accessed April 2012).
- Mattsson, B. J., and M. R. Marshall. 2009. Occupancy modeling as a framework for designing avian monitoring programs: a case study along Appalachian streams in southern West Virginia. *in* Proceedings of the Fourth International Partners in Flight Conference (T. D. Rich, C. D. Thompson, D. Demarest, and C. Arizmendi, Eds.), McAllen, TX.
- Mattsson, B. J., and M. R. Marshall. 2010. Streamside Bird Monitoring Protocol for the Eastern Rivers and Mountains Network. Natural Resource Report NPS/ERMN/NRR—2010/DRAFT. National Park Service. Fort Collins, CO.
- Mattsson, B. J., T. L. Master, R. S. Mulvihill and W. D Robinson. 2009. Louisiana Waterthrush (*Parkesia motacilla*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/151>
- Maurer, B. A. 1993. Biological diversity, ecological integrity, and neotropical migrants. Pages 24–31 *in* Finch, D.M. and P. Stengel, editors. Status and Management of Neotropical Migrant Birds. USDA Forest Service General Technical Report RM 229, Forest and Range Experiment Station, Fort Collins, Colorado, U.S.
- McLaren, A. A., and M. D. Cadman. 1999. Can novice volunteers provide credible data for bird surveys requiring song identification? *Journal of Field Ornithology* 70:481–490.
- Nichols, J. D., J. E. Hines, J. R. Sauer, F. W. Fallon, J. E. Fallon, and P. J. Heglund. 2000. A double-observer approach for estimating detection probability and abundance from point counts. *Auk* 117:393–408.
- Nichols, J. D., L. Thomas, and P. B. Conn. 2009. Inferences about landbird abundance from count data: recent advances and future directions. *Environmental and Ecological Statistics* 3:201–235.
- Nichols, J. D., and B. K. Williams. 2006. Monitoring for conservation. *Trends in Ecology & Evolution* 21:668–673.
- North American Bird Conservation Initiative (NABCI). 2011. The State of the Birds 2011 Report on Public Lands and Waters. U.S. Department of Interior: Washington, DC. 48 pp.

- Nur, N., S. L. Jones, and G. R. Geupel. 1999. A statistical guide to data analysis of avian monitoring programs. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA. 54 pp.
- Oakley, K. L., L. P. Thomas, and S. G. Fancy. 2003. Guidelines for long-term monitoring protocols. *Wildlife Society Bulletin* 31(4):1000–1003.
- O’Connell, T. J., L. E. Jackson, and R. P. Brooks. 1998a. A bird community index of biotic integrity for the Mid-Atlantic Highlands. *Environmental Monitoring and Assessment* 51:145–156.
- O’Connell, T. J., L. E. Jackson, and R. P. Brooks. 1998b. The bird community index: A tool for assessing biotic integrity in the Mid-Atlantic Highlands. Report 98-4 of the Penn State Cooperative Wetlands Center, Pennsylvania State University, University Park, Pennsylvania.
- O’Connell, T. J., L. E. Jackson, and R. P. Brooks. 2000. Bird guilds as indicators of ecological condition in the central Appalachians. *Ecological Applications* 10:1706–1721.
- Pashley, D. N., C. J. Beardmore, J. A. Fitzgerald, R. P. Ford, W. C. Hunter, M. S. Morrison, and K. V. Rosenberg. 2000. *Partners in Flight: Conservation of the Land Birds of the United States*. American Bird Conservancy. The Plains, Virginia.
- Paybins, K. S. 2003. Flow Origin, Drainage Area, and Hydrologic Characteristics for Headwater Streams in the Mountaintop Coal-Mining Region of Southern West Virginia, 2000-01. *Water Resources Investigations Report*. United States Geological Survey:28.
- Perles, S. J., J. C. Finley, and M. R. Marshall. 2009. Vegetation and soil monitoring protocol for the Eastern Rivers and Mountains Network. *Natural Resource Report NPS/ERMN/NRR—2009/DRAFT*. National Park Service. Fort Collins, CO.
- Poole, A. 2005. *The Birds of North America*. [Online.] Available at <http://bna.birds.cornell.edu/bna>.
- Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. *Handbook of Field Methods for Monitoring Landbirds*. USDA Forest Service General Technical Report PSW-GTR 144, Pacific Southwest Research Station, Berkeley, California, U.S.
- Ralph, C. J., S. Droege, and J. R. Sauer. 1995. Managing and monitoring birds using point counts: standards and applications. Pages 161–168 *in* C. J. Ralph, J. R. Sauer, and S. Droege, editors. *Monitoring Bird Populations by Point Counts*. USDA Forest Service General Technical Report PSW GTR 149, Pacific Southwest Research Station, Berkeley, California.
- Rentch, J. S. 2006. Structure and functioning of terrestrial ecosystems in the Eastern Rivers and Mountains Network: Conceptual models and vital signs monitoring. *Natural Resources Report NPS/NER/NRR—2006/007*. National Park Service. Philadelphia, PA.
- Robinson, S. K., and D. S. Wilcove. 1994. Forest fragmentation in the Temperate Zone and its effects on migrating songbirds. *Bird Conservation International* 4:233–249.

- Robinson, S. K., F. R. Thompson III, T. M. Donovan, D. R. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. *Science* 267:1987–1990.
- Roberge, J. M., and P. Angelstam. 2006. Indicator species among resident forest birds - A cross-regional evaluation in northern Europe. *Biological Conservation* 130:134–147.
- Rosenberg, K. V., J. D. Lowe, and A. A. Dhondt. 1999. Effects of forest fragmentation on breeding tanagers: A continental perspective. *Conservation Biology* 13:568–583.
- Rosenstock, S. S., D. R. Anderson, K. M. Giesen, T. Leukering, and M. F. Carter. 2002. Landbird counting techniques: Current practices and an alternative. *Auk* 119:46–53.
- Royle, J. A., and J. D. Nichols. 2003. Estimating abundance from repeated presence-absence data or point counts. *Ecology* 84:777–790.
- Royle, J. A., and R. M. Dorazio. 2006. Hierarchical models of animal abundance and occurrence. *Journal of Agricultural Biological and Environmental Statistics* 11:249–263.
- Royle, J. A., and M. Kery. 2007. A Bayesian state-space formulation of dynamic occupancy models. *Ecology* 88:1813–1823.
- Sauer, J. R., and S. Droege, Eds. 1990. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish and Wildlife Service, Washington, D.C., Biological Report 90(1).
- Sauer, J. R., J. E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, results and analysis 1966–2007. Version 5.15.2008. Patuxent Wildlife Research Center, Laurel, MD.
- Saunders, S. C., K. P. Lertzman, and M. A. Fuchs. 2006. Bird assemblages associated with vine maple gaps in coastal western hemlock forests of British Columbia. *Northwest Science* 80:165–176.
- Simons, T. R., M. W. Alldredge, K. H. Pollock, and J. M. Wettroth. 2007. Experimental analysis of the auditory detection process on avian point counts. *The Auk* 124:986–999.
- Slabbekoorn, H., and T. B. Smith. 2002. Habitat-dependent song divergence in the little greenbul: An analysis of environmental selection pressures on acoustic signals. *Evolution* 56:1849–1858.
- Thomas, L. 1996. Monitoring long-term population change: why are there so many analysis methods? *Ecology* 77:49–58.
- Thomas, L., J. L. Laake, S. Strindberg, F. F. C. Marques, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. L. Hedley, and J. H. Pollard. 2005. Distance 5. 0. Release 2. Research Unit for Wildlife Population Assessment, University of St Andrews, St Andrews, UK. <http://www.ruwpa.st-and.ac.uk/distance/>.

- Thompson, W. L. 2002. Towards reliable bird surveys: Accounting for individuals present but not detected. *Auk* 119:18–25.
- Tzilkowski, C. J., A. S. Weber, and C. P. Ferreri. 2010. Benthic macroinvertebrate monitoring protocol for wadeable streams in the Eastern Rivers and Mountains Network. Natural Resource Report NPS/ERMN/NRR—2010/DRAFT. National Park Service. Fort Collins, CO.
- Vannote, R. L., G. W. Minshall, K. W. Cummins, J. R. Sedell, and C. E. Cushing. 1980. River Continuum Concept. *Canadian Journal of Fisheries And Aquatic Sciences* 37:130–137.



**Appendix A.** Bird species detected during implementation of the ERMN Streamside Bird Monitoring Protocol 2007–2011.

| Order           | Family       | Common Name               | Scientific Name                  | Code | ALPO | FONE | FRHI | BLUE | GARI | NERI | DEWA |
|-----------------|--------------|---------------------------|----------------------------------|------|------|------|------|------|------|------|------|
| Anseriformes    | Anatidae     | Canada Goose              | <i>Branta canadensis</i>         | CANG |      |      |      |      |      | X    | X    |
| Anseriformes    | Anatidae     | Mute Swan                 | <i>Cygnus olor</i>               | MUSW |      |      |      |      |      |      | X    |
| Anseriformes    | Anatidae     | Wood Duck                 | <i>Aix sponsa</i>                | WODU |      |      |      |      |      | X    | X    |
| Anseriformes    | Anatidae     | American Black Duck       | <i>Anas rubripes</i>             | ABDU |      |      |      |      |      |      | X    |
| Anseriformes    | Anatidae     | Mallard                   | <i>Anas platyrhynchos</i>        | MALL |      |      |      |      |      |      | X    |
| Anseriformes    | Anatidae     | Hooded Merganser          | <i>Lophodytes cucullatus</i>     | HOME |      |      |      |      |      |      | X    |
| Anseriformes    | Anatidae     | Common Merganser          | <i>Mergus merganser</i>          | COME |      |      |      |      |      |      | X    |
| Galliformes     | Phasianidae  | Ruffed Grouse             | <i>Bonasa umbellus</i>           | RUGR |      |      |      | X    |      | X    |      |
| Galliformes     | Phasianidae  | Wild Turkey               | <i>Meleagris gallopavo</i>       | WITU |      | X    | X    |      |      |      | X    |
| Pelecaniformes  | Ardeidae     | Great Blue Heron          | <i>Ardea herodias</i>            | GBHE |      |      |      |      |      |      | X    |
| Pelecaniformes  | Ardeidae     | Green Heron               | <i>Butorides virescens</i>       | GRHE |      |      |      |      |      |      | X    |
| Accipitriformes | Cathartidae  | Turkey Vulture            | <i>Cathartes aura</i>            | TUVU |      |      | X    |      | X    |      | X    |
| Accipitriformes | Accipitridae | Bald Eagle                | <i>Haliaeetus leucocephalus</i>  | BAEA |      |      |      |      |      |      | X    |
| Accipitriformes | Accipitridae | Sharp-shinned Hawk        | <i>Accipiter striatus</i>        | SSHA |      |      |      |      | X    | X    |      |
| Accipitriformes | Accipitridae | Cooper's Hawk             | <i>Accipiter cooperii</i>        | COHA |      | X    |      |      | X    | X    | X    |
| Accipitriformes | Accipitridae | Red-shouldered Hawk       | <i>Buteo lineatus</i>            | RSHA |      |      | X    |      | X    | X    | X    |
| Accipitriformes | Accipitridae | Broad-winged Hawk         | <i>Buteo platypterus</i>         | BWHA | X    |      | X    |      |      | X    | X    |
| Accipitriformes | Accipitridae | Red-tailed Hawk           | <i>Buteo jamaicensis</i>         | RTHA | X    | X    |      |      |      |      | X    |
| Charadriiformes | Charadriidae | Killdeer                  | <i>Charadrius vociferus</i>      | KILL |      |      |      |      |      |      | X    |
| Columbiformes   | Columbidae   | Mourning Dove             | <i>Zenaida macroura</i>          | MODO | X    | X    |      | X    | X    | X    | X    |
| Cuculiformes    | Cuculidae    | Yellow-billed Cuckoo      | <i>Coccyzus americanus</i>       | YBCU | X    | X    | X    | X    | X    | X    | X    |
| Cuculiformes    | Cuculidae    | Black-billed Cuckoo       | <i>Coccyzus erythrophthalmus</i> | BBCU |      | X    |      |      |      |      | X    |
| Strigiformes    | Strigidae    | Eastern Screech-Owl       | <i>Megascops asio</i>            | EASO |      |      |      |      |      | X    |      |
| Strigiformes    | Strigidae    | Great Horned Owl          | <i>Bubo virginianus</i>          | GHOW |      | X    |      |      |      |      | X    |
| Strigiformes    | Strigidae    | Barred Owl                | <i>Strix varia</i>               | BADO |      |      | X    |      | X    | X    | X    |
| Strigiformes    | Strigidae    | Northern Saw-whet Owl     | <i>Aegolius acadicus</i>         | NSWO |      |      |      |      |      | X    |      |
| Apodiformes     | Apodidae     | Chimney Swift             | <i>Chaetura pelagica</i>         | CHSW | X    | X    | X    |      |      | X    | X    |
| Apodiformes     | Trochilidae  | Ruby-throated Hummingbird | <i>Archilochus colubris</i>      | RTHU | X    | X    | X    | X    | X    | X    | X    |
| Coraciiformes   | Alcedinidae  | Belted Kingfisher         | <i>Megasceryle alcyon</i>        | BEKI |      | X    |      | X    | X    | X    | X    |
| Piciformes      | Picidae      | Red-bellied Woodpecker    | <i>Melanerpes carolinus</i>      | RBWO | X    | X    | X    | X    | X    | X    | X    |
| Piciformes      | Picidae      | Downy Woodpecker          | <i>Picoides pubescens</i>        | DOWO | X    | X    | X    | X    | X    | X    | X    |
| Piciformes      | Picidae      | Hairy Woodpecker          | <i>Picoides villosus</i>         | HAWO | X    | X    | X    | X    | X    | X    | X    |
| Piciformes      | Picidae      | Northern Flicker          | <i>Colaptes auratus</i>          | NOFL | X    | X    | X    |      | X    | X    | X    |
| Piciformes      | Picidae      | Pileated Woodpecker       | <i>Dryocopus pileatus</i>        | PIWO | X    | X    | X    | X    | X    | X    | X    |

| Order         | Family        | Common Name                   | Scientific Name                   | Code | ALPO | FONE | FRHI | BLUE | GARI | NERI | DEWA |
|---------------|---------------|-------------------------------|-----------------------------------|------|------|------|------|------|------|------|------|
| Passeriformes | Tyrannidae    | Eastern Wood-Pewee            | <i>Contopus virens</i>            | EAWP | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Tyrannidae    | Acadian Flycatcher            | <i>Empidonax virens</i>           | ACFL | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Tyrannidae    | Least Flycatcher              | <i>Empidonax minimus</i>          | LEFL |      | X    |      |      |      |      | X    |
| Passeriformes | Tyrannidae    | Eastern Phoebe                | <i>Sayornis phoebe</i>            | EAPH | X    | X    |      | X    | X    | X    | X    |
| Passeriformes | Tyrannidae    | Great Crested Flycatcher      | <i>Myiarchus crinitus</i>         | GCFL | X    | X    | X    |      | X    | X    | X    |
| Passeriformes | Tyrannidae    | Eastern Kingbird              | <i>Tyrannus tyrannus</i>          | EAKI |      |      |      |      |      |      | X    |
| Passeriformes | Vireonidae    | Yellow-throated Vireo         | <i>Vireo flavifrons</i>           | YTVI | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Vireonidae    | Blue-headed Vireo             | <i>Vireo solitarius</i>           | BHVI | X    | X    |      | X    | X    | X    | X    |
| Passeriformes | Vireonidae    | Warbling Vireo                | <i>Vireo gilvus</i>               | WAVI |      |      |      |      |      |      | X    |
| Passeriformes | Vireonidae    | Red-eyed Vireo                | <i>Vireo olivaceus</i>            | REVI | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Corvidae      | Blue Jay                      | <i>Cyanocitta cristata</i>        | BLJA | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Corvidae      | American Crow                 | <i>Corvus brachyrhynchos</i>      | AMCR | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Corvidae      | Fish Crow                     | <i>Corvus ossifragus</i>          | FICR |      |      |      |      |      |      | X    |
| Passeriformes | Corvidae      | Common Raven                  | <i>Corvus corax</i>               | CORA | X    | X    | X    |      | X    | X    | X    |
| Passeriformes | Hirundinidae  | Tree Swallow                  | <i>Tachycineta bicolor</i>        | TRES |      |      |      |      |      |      | X    |
| Passeriformes | Hirundinidae  | Northern Rough-winged Swallow | <i>Stelgidopteryx serripennis</i> | NRWS |      |      |      |      | X    |      | X    |
| Passeriformes | Paridae       | Carolina Chickadee            | <i>Poecile carolinensis</i>       | CACH |      |      | X    | X    | X    | X    |      |
| Passeriformes | Paridae       | Black-capped Chickadee        | <i>Poecile atricapillus</i>       | BCCH | X    | X    |      |      |      |      | X    |
| Passeriformes | Paridae       | Tufted Titmouse               | <i>Baeolophus bicolor</i>         | TUTI | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Sittidae      | Red-breasted Nuthatch         | <i>Sitta canadensis</i>           | RBNU |      |      |      |      |      |      | X    |
| Passeriformes | Sittidae      | White-breasted Nuthatch       | <i>Sitta carolinensis</i>         | WBNU | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Certhiidae    | Brown Creeper                 | <i>Certhia americana</i>          | BRCR |      | X    | X    | X    |      | X    | X    |
| Passeriformes | Troglodytidae | Carolina Wren                 | <i>Thryothorus ludovicianus</i>   | CARW | X    |      | X    | X    | X    | X    | X    |
| Passeriformes | Troglodytidae | House Wren                    | <i>Troglodytes aedon</i>          | HOWR |      | X    |      |      |      |      | X    |
| Passeriformes | Troglodytidae | Winter Wren                   | <i>Troglodytes hiemalis</i>       | WIWR | X    | X    |      |      | X    | X    | X    |
| Passeriformes | Poliptilidae  | Blue-gray Gnatcatcher         | <i>Poliptila caerulea</i>         | BGGN | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Regulidae     | Golden-crowned Kinglet        | <i>Regulus satrapa</i>            | GCKI | X    | X    |      |      |      | X    | X    |
| Passeriformes | Turdidae      | Eastern Bluebird              | <i>Sialia sialis</i>              | EABL | X    |      | X    |      |      | X    | X    |
| Passeriformes | Turdidae      | Veery                         | <i>Catharus fuscescens</i>        | VEER |      |      |      |      |      |      | X    |
| Passeriformes | Turdidae      | Hermit Thrush                 | <i>Catharus guttatus</i>          | HETH |      |      |      |      |      |      | X    |
| Passeriformes | Turdidae      | Wood Thrush                   | <i>Hylocichla mustelina</i>       | WOTH | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Turdidae      | American Robin                | <i>Turdus migratorius</i>         | AMRO | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Mimidae       | Gray Catbird                  | <i>Dumetella carolinensis</i>     | GRCA | X    | X    |      |      | X    | X    | X    |
| Passeriformes | Mimidae       | Northern Mockingbird          | <i>Mimus polyglottos</i>          | NOMO |      |      |      |      | X    | X    |      |
| Passeriformes | Mimidae       | Brown Thrasher                | <i>Toxostoma rufum</i>            | BRTH |      | X    |      |      |      |      |      |
| Passeriformes | Sturnidae     | European Starling             | <i>Sturnus vulgaris</i>           | EUST |      |      |      |      |      |      | X    |

| Order         | Family        | Common Name                  | Scientific Name                | Code | ALPO | FONE | FRHI | BLUE | GARI | NERI | DEWA |
|---------------|---------------|------------------------------|--------------------------------|------|------|------|------|------|------|------|------|
| Passeriformes | Bombycillidae | Cedar Waxwing                | <i>Bombycilla cedrorum</i>     | CEDW | X    | X    |      |      | X    | X    | X    |
| Passeriformes | Parulidae     | Blue-winged Warbler          | <i>Vermivora cyanoptera</i>    | BWWA |      |      |      |      |      |      | X    |
| Passeriformes | Parulidae     | Golden-winged Warbler        | <i>Vermivora chrysoptera</i>   | GWWA |      | X    |      |      |      |      |      |
| Passeriformes | Parulidae     | Orange-crowned Warbler       | <i>Oreothlypis celata</i>      | OCWA |      |      |      |      | X    |      |      |
| Passeriformes | Parulidae     | Nashville Warbler            | <i>Oreothlypis ruficapilla</i> | NAWA |      |      |      |      |      |      | X    |
| Passeriformes | Parulidae     | Northern Parula              | <i>Parula americana</i>        | NOPA | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Yellow Warbler               | <i>Dendroica petechia</i>      | YWAR |      | X    | X    |      |      | X    | X    |
| Passeriformes | Parulidae     | Chestnut-sided Warbler       | <i>Dendroica pensylvanica</i>  | CSWA |      | X    |      |      |      | X    | X    |
| Passeriformes | Parulidae     | Magnolia Warbler             | <i>Dendroica magnolia</i>      | MAWA |      | X    |      |      |      |      | X    |
| Passeriformes | Parulidae     | Black-throated Blue Warbler  | <i>Dendroica caerulescens</i>  | BTBW | X    |      |      | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Yellow-rumped Warbler        | <i>Dendroica coronata</i>      | YRWA |      | X    |      |      | X    |      | X    |
| Passeriformes | Parulidae     | Black-throated Green Warbler | <i>Dendroica virens</i>        | BTNW | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Blackburnian Warbler         | <i>Dendroica fusca</i>         | BLBW |      | X    |      |      |      | X    | X    |
| Passeriformes | Parulidae     | Yellow-throated Warbler      | <i>Dendroica dominica</i>      | YTWA |      |      | X    | X    | X    | X    |      |
| Passeriformes | Parulidae     | Pine Warbler                 | <i>Dendroica pinus</i>         | PIWA |      |      |      |      | X    | X    | X    |
| Passeriformes | Parulidae     | Prairie Warbler              | <i>Dendroica discolor</i>      | PRAW |      | X    |      |      |      |      | X    |
| Passeriformes | Parulidae     | Blackpoll Warbler            | <i>Dendroica striata</i>       | BLPW |      |      |      |      |      | X    |      |
| Passeriformes | Parulidae     | Cerulean Warbler             | <i>Dendroica cerulea</i>       | CERW |      | X    |      | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Black-and-white Warbler      | <i>Mniotilta varia</i>         | BAWW |      | X    |      | X    | X    | X    | X    |
| Passeriformes | Parulidae     | American Redstart            | <i>Setophaga ruticilla</i>     | AMRE | X    | X    |      | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Worm-eating Warbler          | <i>Helmitheros vermivorum</i>  | WEWA |      |      |      | X    |      | X    | X    |
| Passeriformes | Parulidae     | Swainson's Warbler           | <i>Limnothlypis swainsonii</i> | SWWA |      |      |      |      | X    | X    |      |
| Passeriformes | Parulidae     | Ovenbird                     | <i>Seiurus aurocapilla</i>     | OVEN | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Louisiana Waterthrush        | <i>Parkesia motacilla</i>      | LOWA | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Kentucky Warbler             | <i>Oporornis formosus</i>      | KEWA |      |      |      |      |      | X    | X    |
| Passeriformes | Parulidae     | Common Yellowthroat          | <i>Geothlypis trichas</i>      | COYE | X    | X    | X    |      | X    | X    | X    |
| Passeriformes | Parulidae     | Hooded Warbler               | <i>Wilsonia citrina</i>        | HOWA |      | X    |      | X    | X    | X    | X    |
| Passeriformes | Parulidae     | Canada Warbler               | <i>Wilsonia canadensis</i>     | CAWA |      |      |      |      |      |      | X    |
| Passeriformes | Parulidae     | Yellow-breasted Chat         | <i>Icteria virens</i>          | YBCH |      | X    |      |      |      |      |      |
| Passeriformes | Emberizidae   | Eastern Towhee               | <i>Pipilo erythrophthalmus</i> | EATO | X    | X    | X    | X    | X    | X    | X    |
| Passeriformes | Emberizidae   | Chipping Sparrow             | <i>Spizella passerina</i>      | CHSP |      | X    | X    |      | X    |      | X    |
| Passeriformes | Emberizidae   | Field Sparrow                | <i>Spizella pusilla</i>        | FISP | X    | X    | X    |      |      | X    | X    |
| Passeriformes | Emberizidae   | Vesper Sparrow               | <i>Poocetes gramineus</i>      | VESP |      | X    |      |      |      |      |      |
| Passeriformes | Emberizidae   | Song Sparrow                 | <i>Melospiza melodia</i>       | SOSP | X    | X    | X    |      | X    | X    | X    |
| Passeriformes | Emberizidae   | White-throated Sparrow       | <i>Zonotrichia albicollis</i>  | WTSP |      |      |      |      |      |      | X    |
| Passeriformes | Emberizidae   | Dark-eyed Junco              | <i>Junco hyemalis</i>          | DEJU |      |      |      |      |      |      | X    |

| Order                    | Family       | Common Name            | Scientific Name                | Code       | ALPO      | FONE      | FRHI      | BLUE      | GARI      | NERI      | DEWA       |
|--------------------------|--------------|------------------------|--------------------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| Passeriformes            | Cardinalidae | Scarlet Tanager        | <i>Piranga olivacea</i>        | SCTA       | X         | X         | X         | X         | X         | X         | X          |
| Passeriformes            | Cardinalidae | Northern Cardinal      | <i>Cardinalis cardinalis</i>   | NOCA       | X         | X         | X         | X         | X         | X         | X          |
| Passeriformes            | Cardinalidae | Rose-breasted Grosbeak | <i>Pheucticus ludovicianus</i> | RBGR       | X         | X         | X         |           | X         | X         | X          |
| Passeriformes            | Cardinalidae | Indigo Bunting         | <i>Passerina cyanea</i>        | INBU       | X         | X         | X         | X         | X         | X         | X          |
| Passeriformes            | Icteridae    | Red-winged Blackbird   | <i>Agelaius phoeniceus</i>     | RWBL       |           |           |           |           |           | X         | X          |
| Passeriformes            | Icteridae    | Common Grackle         | <i>Quiscalus quiscula</i>      | COGR       | X         | X         | X         |           | X         | X         | X          |
| Passeriformes            | Icteridae    | Brown-headed Cowbird   | <i>Molothrus ater</i>          | BHCO       | X         | X         | X         |           | X         | X         | X          |
| Passeriformes            | Icteridae    | Baltimore Oriole       | <i>Icterus galbula</i>         | BAOR       |           | X         |           | X         |           | X         | X          |
| Passeriformes            | Fringillidae | House Finch            | <i>Carpodacus mexicanus</i>    | HOFI       |           |           |           |           |           |           | X          |
| Passeriformes            | Fringillidae | Pine Siskin            | <i>Spinus pinus</i>            | PISI       |           |           |           |           |           |           | X          |
| Passeriformes            | Fringillidae | American Goldfinch     | <i>Spinus tristis</i>          | AMGO       | X         | X         | X         |           | X         | X         | X          |
| Passeriformes            | Passeridae   | House Sparrow          | <i>Passer domesticus</i>       | HOSP       |           |           |           |           |           |           | X          |
| <b>Total species:</b>    |              |                        |                                | <b>118</b> | <b>52</b> | <b>70</b> | <b>48</b> | <b>42</b> | <b>63</b> | <b>77</b> | <b>106</b> |
| <b>Percent of total:</b> |              |                        |                                |            | 44%       | 59%       | 41%       | 36%       | 53%       | 65%       | 90%        |

**Appendix B.** Name and contact information for personnel associated with the Streamside Bird Monitoring Protocol

This appendix provides past and current names and contact information of personnel identified in the protocol narrative. Titles of roles in Table B.1 are based on those in the Operational Requirements section of the protocol narrative.

**Table B.1.** Name and contact information for personnel associated with the Streamside Bird Monitoring Protocol.

| <b>Role</b>           | <b>Name and Position</b>                                                          | <b>Start Date</b> | <b>End Date</b> | <b>Address</b>                                             | <b>Phone</b> | <b>E-mail</b>             |
|-----------------------|-----------------------------------------------------------------------------------|-------------------|-----------------|------------------------------------------------------------|--------------|---------------------------|
| Protocol Lead         | Matt Marshall,<br>ERMN Program Manager                                            | 1/1/2010          | Current         | 420 Forest Resources Building<br>University Park, PA 16802 | 814-863-0134 | matt_marshall@nps.gov     |
| Protocol Lead         | Brady Mattsson,<br>University of Georgia<br>US Geological Survey                  | 1/1/2007          | 12/31/2009      | U.S. Geological Survey<br>Sacramento, CA 95819             | 706-534-0896 | bmattsson@usgs.gov        |
| Data Manager          | Kristina Callahan,<br>ERMN Data Manager                                           | 1/1/2010          | Current         | 422 Forest Resources Building<br>University Park, PA 16802 | 814-863-2320 | kristina_callahan@nps.gov |
| Field Crew Supervisor | TBD Annually<br>(all crew members are documented in the Streamside Bird database) |                   |                 |                                                            |              |                           |
| Field Crews           | TBD Annually<br>(all crew members are documented in the Streamside Bird database) |                   |                 |                                                            |              |                           |



**Appendix C.** Administrative record and peer-review comments.

The administrative record of the Streamside Bird Monitoring Protocol includes the following components:

- C.1. Final peer review by Tim O’Connell (February 2010).
- C.2. Final peer review by Greg Shriver (February 2010).
- C.3. Final peer review by Daryl MacKenzie (February 2010).
- C.4. Comments by Kirk Stodola (August 2010)
- C.5. Comments by Jesse Purvis (January 2010)
- C.6. Comments by Craig Snyder (November 2008)
- C.7. Comments by Kathy Penrod (November 2008)
- C.8. Correspondence with Jim Peterson (February 2008)
- C.9. January 2007 bird monitoring workshop attendees and minutes.
- C.10. January 2007 water quality workshop participants, minutes, and outcomes.
- C.11. March 2010 decision to discontinue specialized surveys for Louisiana waterthrush but retain and shift monitoring focus to entire streamside bird community.



**C.1. February 2010 Tim O’Connell final peer review of ERMN Streamside Bird Monitoring Protocol.**

Timothy J. O’Connell, Associate Professor  
 Dept. of Natural Resource Ecology and Management  
 Oklahoma State University  
 240 Agricultural Hall  
 Stillwater, OK 74078  
 405-744-7593  
[tim.oconnell@okstate.edu](mailto:tim.oconnell@okstate.edu)  
<http://nrem.okstate.edu/faculty/oconnell.html>

Protocol review

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Protocol:</i><br>Eastern Rivers and Mountains Network<br>Streamside Bird Monitoring Protocol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <i>Reviewer:</i> Timothy O’Connell<br><i>Date:</i> 27 January 2010<br><br><a href="#">Responses from author: Brady Mattsson</a><br><a href="#">Date: February 2, 2010</a> |
| <i>Authors:</i> Mattsson, B.J. and M. R. Marshall                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                           |
| <b>BRIEF DESCRIPTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                           |
| This Protocol will be used to monitor the breeding bird community along wadeable streams in the Eastern Rivers and Mountains Network as part of the NPS Vital Signs Monitoring Program.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                           |
| <b>COMMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                           |
| <p><i>Program Guidance and Purpose</i></p> <p>1) Is the information well-written, logical, and understandable?</p> <p>Yes, although there are several places where the text could be improved through a critical copy edit. I have commented on these areas using track changes on the MSWord version of the document.</p> <p>2) Is the purpose for collecting the information clearly presented, appropriate, and valid?</p> <p>Yes. Right in the Executive Summary, the case is made that the condition of watersheds within Park boundaries is a top priority. A specific focus on Louisiana Waterthrush (LOWA) as an integrated indicator of watershed condition in the Eastern Rivers and Mountains Network (ERMN) makes sense, because this is a common species in the region that is an obligate user of streams providing structural, functional, and compositional elements of ecosystem integrity. The highest densities of this species occur in mature broadleafed and mixed forests, along streams with high water quality that provide diversity of riffles and runs with naturally eroding banks. Although there is some flexibility in foods consumed, LOWA are largely dependent on aquatic insect larvae of Ephemeroptera, Plecoptera, and Trichoptera, and those taxa in turn are</p> |                                                                                                                                                                           |

indicators of high water quality, relatively circumneutral water chemistry, and a diversity of riffles and runs in streams. Thus, a robust population of LOWA can indicate mature trees providing a closed canopy, large patch sizes, little influence from acid mine drainage or acid precipitation, well-oxygenated water, natural stream beds without excessive scouring or sedimentation, and a native prey base capable of supporting other aquatic organisms (e.g., trout) as well as terrestrial predators (e.g., other native songbirds).

In addition, LOWA is common enough within the ERMN to be expected to occur in any watershed providing such conditions. Thus, confidence in the absence of this species from a watershed is likely to be an indicator of some problem within the watershed, rather than due to the scarcity of the species throughout its range. This is an important question for any indicator that relies on information from migratory species. In the case of LOWA, this species winters primarily in Central America and the Caribbean, so the potential exists for disturbances in wintering areas or in transit to reduce populations to the point at which range contractions become evident on the breeding grounds. To my knowledge, this has not been demonstrated in LOWA. Habitats used in winter (generally mountain streams) seem to be relatively intact in Central America and the Caribbean, and we have little data to suggest that an unusually high proportion of LOWA are killed in passage, e.g., this species is very rarely listed as a casualty of window or tower collisions.

3) Is the specific scientific or scholarly merit for implementing the protocol well defined?

Yes, as indicated above, specific life history attributes of LOWA make it an ideal candidate for an integrated indicator of watershed condition in this region. Several recent studies devoted to this species have been published in recent years, and all contribute justification for using occurrence and abundance of this species as an ecological indicator.

*Objectives and Empirical Support*

1) Are the methodologies and purpose for conducting the activity clearly presented, appropriate, and valid?

Yes. In my experience, the proportion of specific life history traits among breeding birds is a robust indicator of ecological condition affecting such varied taxa as wetland plants, small mammals, stream amphibians, and benthic macroinvertebrates. When combined with the information gathered on LOWA, the monitoring proposed should provide reliable data for making assessments of baseline ecological condition of watersheds, as well as for tracking that condition in the future. Thus, the proposed monitoring fits in well with the program goals for NPS Vital Signs Monitoring.

2) Are the protocol objectives specific (attribute or species defined), measurable, and achievable?

Yes, the primary monitoring objectives are realistic, repeatable, specific, and falsifiable.

3) Is the location or spatial bounds of the monitoring specified?

Yes, spatial selection and sampling is well described. In particular, the consideration of subsurface geology for stratified sampling demonstrated great forethought.

4) Does the report or protocol include an appropriate literature review that puts the work in the context of previous work? \*note: this might be supplemented with materials from the Network monitoring plans available via websites.

Yes, I did not note any deficiencies in relevant literature.

5) Does the protocol stray too far from conventional or widely accepted methods? Can the objectives be addressed using simpler or more standardized techniques?

No, the methods are widely accepted and conventional.

Simpler techniques could be used to assess watersheds in the ERMN parks. For example, a combination of land cover analysis and water chemistry sampling could reveal broad structural and fine-scale, in-stream changes to watersheds. Such methods would not, however, demonstrate the *biological ramifications* of those changes, which the proposed monitoring should do well.

We agree. As described toward the end of “Measureable objectives”, compatible vital signs in the ERMN I&M program include landscape metrics and water quality metrics.

#### *Methods and Analysis*

1) Will the analyses and results address the stated objectives?

Yes. Bird community data will be collected and analyzed to produce Bird Community Index scores. Stream surveys will produce data on occupancy of breeding LOWA. Those two pieces of information will be the key to providing the assessment that meets the objective.

2) Are the indicators and methods used appropriate and justified?

Yes, well justified in the literature and in practice.

3) Is the current amount of sampling effort sufficient to address the stated objectives? Are there logistical constraints or unacceptable levels of variation that compromise the utility of the protocol?

Sampling is adequate to provide the necessary information. Post-hoc modeling of occupancy will reveal sampling deficiencies that can be corrected in subsequent seasons.

- 4) Are appropriate field, laboratory, library, and statistical methods used for data collection, analysis, and characterization of uncertainty?

Yes, the combination of efforts to reduce and model observer and sampling biases with specific estimates of occurrence rates are the state of the art in monitoring songbirds over broad areas. Certain riparian species (e.g., ACFL) are readily detectable. LOWA can be, or they can't. Once paired and nesting, song rate drops dramatically, and they are very easily missed. Thus it is easy to underestimate LOWA occurrence at sites that might be more productive and overestimate them at more degraded sites, i.e., sites where males may have difficulty finding a mate or where mates more often fall prey to nest predators.

I'd like to see –for LOWA males –data collected on song rate (April–June). Those that are singing frequently (e.g., 5–10 songs per minute) are very likely unpaired. Those that are generally not singing are generally not paired – or have lost their mate. Information on pairing status could provide subtle cues to quality of habitats. Those patterns might take many years to become evident but could be biologically important despite the ease with which the data could be collected.

We agree that singing males may be a poor indicator of breeding success. Under “LOWA transect surveys” in “Field Methods”, we summarize the scoring of LOWA pairing status. The scoring method does involve singing behavior of males, and these details are available in SOP #5 “Conducting Streamside Surveys.” Furthermore, we acknowledge that detectability of pairs (given occupancy) is extremely low in the ERMN, and this issue warrants further investigation into improving the monitoring design and/or to identify reasons for their crypticness.

The spatial distribution of LOWA could also be affected by habitat quality. In our work in Central Pennsylvania streams, territory size of males in degraded streams was much longer than 250 m, and we had observations of males at least 900 m from where they were initially banded in the same season. The predictability of an individual in any stream reach, therefore, is lower in more degraded sites where males are free to wander more widely without neighboring males in proximity objecting. Review of the monitoring plan after the first several years should examine carefully the number of visits necessary to provide reliable and accurate detection of LOWA males.

We agree that movements of LOWA into/out of transect intervals, if ignored, would lead to biased interpretations of interval-scale occupancy estimates. We will add a sentence under “Recommendations for Routine Data Summaries and Analysis” to describe a multi-scale occupancy approach to address this type of within-season movement of individuals.

- 5) Are the methods and analyses described sufficiently to allow for replication?

Yes, ample detail is provided to replicate the methods.

### *Findings and Utility*

- 1) Are the findings and conclusions drawn from analysis relevant to the scope and breadth of the monitoring plan being implemented?

If the question pertains to the conclusions that could be drawn once the plan is implemented, then yes.

- 2) Are differences from standard protocol methodologies adequately justified and supported?

Yes. For example, streamside sampling is tailored to the specific life history attributes of LOWA. This is appropriate, and the methods are well described.

- 3) Does this body of work, to the extent possible and practical, differentiate among facts, opinions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities.

I am fully supportive of the monitoring proposed for the purpose of assessing biological condition of watersheds in the ERMN. The ability to analyze watersheds for biological functions fits in well with NPS Vital Signs monitoring objectives. I expect that scholarly works (e.g., articles in peer-reviewed journals of science) will result from this program and will provide clear indication of objective research findings and any speculative conclusions.

- 4) What are the strengths, limitations, and potential usefulness to park managers and others of the activity?

Users of the information, park managers in particular, will gain insight into the magnitude and scale of forces that influence biological function within small watersheds. This will allow for identification of watershed attributes that indicate high priority for conservation, as well as prescriptions for restoration in degraded watersheds.

One key point that should be emphasized is that the reliance on a probability-based sampling selection provides justification that monitoring will accurately reflect watershed condition in the ERMN. One question I have related to this concerns expectations of change. Other than, for example, hemlock wooly adelgid expansion within park boundaries, the expected disturbances that could affect the ERMN are primarily extrinsic (e.g., acid mine drainage, climate change). It is unclear to me what park managers might have liberty to do in the face of flagging vital signs from monitoring.

We agree. Direct management actions by the NPS are restricted to the boundaries of individual parks, limiting the potential to address larger-scale issues like acid deposition & climate change. That being said, ERMN monitoring data could be the impetus for regional-level management actions. It is worth noting, however that more localized management actions like hemlock wooly adelgid treatments and backcountry closures could be influenced by ERMN monitoring results.

### *Miscellaneous*

For comparison to a site that is affected by AMD, should not the Johnstown Flood site be included in monitoring? Also, is it not important to document the recovery of the JOFL park following remediation efforts for AMD?

JOFL was excluded from monitoring largely because tributaries in this park are maintained through management as open canopy for historical reasons. The AMD issue is an important one, but not the primary reason JOFL was excluded.

---

2-3-2010 Email to Tim O'Connell: Please find attached our responses to your review. Brady added text in blue font in several sections of the review form. Please let us know if these responses satisfy your concerns.

2-3-2010 Email from Tim O'Connell: No objections from me, Matt - Brady's comments and your tweak are fine.

### *References*

**C.2. February 2010 Greg Shriver final peer review of ERMN Streamside Bird Monitoring Protocol.**

Dr. Greg Shriver  
Assistant Professor  
Wildlife Ecology  
257 Townsend Hall  
Department of Entomology and Wildlife Ecology  
University of Delaware  
Newark, DE 19716-2160  
Phone: (302) 831-1300  
Fax: (302) 831-8889  
Email: gshriver@udel.edu

**Protocol review**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Protocol:</i><br>Eastern Rivers and Mountains Network<br>Streamside Bird Monitoring Protocol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <i>Reviewer: Greg Shriver</i><br><br><i>Date:</i> 17 February 2010<br><br><i>Responses from author:</i><br><i>BJM: Brady J. Mattsson</i><br><i>Date: 3 March 2010</i><br><br><i>MRM: Matt R. Marshall.</i><br><i>Date 10 April 2012</i> |
| <i>Authors:</i> Mattsson, B.J. and M. R. Marshall                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                         |
| <b>BRIEF DESCRIPTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                         |
| This Protocol will be used to monitor the breeding bird community along wadable streams in the Eastern Rivers and Mountains Network as part of the NPS Vital Signs Monitoring Program.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                         |
| <b>COMMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                         |
| <i>Program Guidance and Purpose</i><br>1) Is the information well-written, logical, and understandable?<br><br>A lack of overall clarity in the protocol is my primary concern. I reviewed this protocol as if I was responsible for implementing it and I think, in its present form, it would be a challenge for someone that did not draft the protocol to actually implement it. I have made many comments on the protocol itself in areas I think could be clarified and will briefly describe some of the major concerns with clarity here:<br><br>Throughout the protocol, the writing and presentation of information tends to bury the most important information in the middle or end of the paragraph making it difficult to determine what is supposed to be done. I've tried to re-organize some sections so the reader can clearly see for example, which parks are included, which parks have a probabilistic design, how many watersheds per park, how many transects or point counts. I think the foundation of the design and the protocol are solid but there needs to be a revision that presents the information more clearly. |                                                                                                                                                                                                                                         |

BJM: We agreed with many of the suggestions for clarification in the protocol – see my specific responses in track changes in the protocol itself.

MRM: I agree and have conducted an almost entire re-write of the protocol and all SOPs focusing on clarity. Thanks for providing many good suggestions.

2) Is the purpose for collecting the information clearly presented, appropriate, and valid?

Yes. This is a major strength of the protocol narrative. There are excellent paragraphs related to the literature that links LOWA to riparian habitat condition, the methods used to assess watersheds and the stressors associated with them.

3) Is the specific scientific or scholarly merit for implementing the protocol well defined?  
Yes.

#### *Objectives and Empirical Support*

6) Are the methodologies and purpose for conducting the activity clearly presented, appropriate, and valid?

Yes but the clarity could be improved throughout the protocol. For example, it took me a couple of reads to figure out; 1) that there are transects for LOWA and point counts for other breeding birds, 2) that the transects are run on the first two visits and the point counts on the second two visits, 3) which parks are included, 4) which parks had a probabilistic design, 5) how these avian metrics will be linked to the macro-inverts, vegetation, or other vital signs, and 6) how a watershed was defined.

BJM: Please see my specific responses in track changes in the protocol itself.

7) Are the protocol objectives specific (attribute or species defined), measurable, and achievable?

No. The objectives need to be re-stated to include a time frame and effect sizes for specific metrics. Also, there are no details provided for how to actually calculate the Bird Integrity Index or what changes in those values mean over time.

BJM: Explicit statements of objectives are pending explicit statements of resource management objectives for the parks. We believe readers should consult O'Connell et al. (2000) for a thorough description of the calculation of the BCI, as this is beyond the scope of this protocol. Please see also my specific responses in track changes in the protocol itself.

MRM: The protocol now includes and SOP that fully describes the BCI, how it is calculated, and provides examples. Regardless, I still agree with Brady (and say so in the protocol and SOP) that interested readers should still read O'Connell et al. 1998a, 1998b, and 2000 for a complete understanding of the BCI.

8) Is the location or spatial bounds of the monitoring specified?

Yes, this is clearly presented and defined. I am still not clear on how a watershed was defined but the spatial sampling and the zones of inference are clearly defined.

[BJM: Regarding a definition of watershed, please see my specific responses in track changes in the protocol itself.](#)

9) Does the report or protocol include an appropriate literature review that puts the work in the context of previous work? \*note: this might be supplemented with materials from the Network monitoring plans available via websites.

Yes. This is a real strength of the protocol, especially related to justification for the four sampling strata at DEWA and NERI. I am also impressed with the level of detail and thought that is presented regarding how the candidate watersheds were selected. It is less clear to me how these watersheds were defined. I also think the clarity of the protocol could be improved if the writing was more specific. For example, instead of saying things like “many watersheds, or the majority of watersheds” provide the actual numbers or percentages. I’ve made specific reference to these sections on the protocol itself.

[BJM: Please see my specific responses in track changes in the protocol itself.](#)

[MRM: I agree and have conducted an almost entire re-write of the protocol focusing on clarity.](#)

10) Does the protocol stray too far from conventional or widely accepted methods? Can the objectives be addressed using simpler or more standardized techniques?

I am concerned about only using occupancy for the monitoring change over time because I think there is more information being collected here (relative abundance) that may be more sensitive to changes, especially given there are not that many watersheds being monitored within a specific park. I also think the section (detectable levels of change) on immigration and emigration rates does not really get at setting detectable levels of change but rather gets more into theoretical ideas about how occupancy analyses can represent immigration and extinction rates which can then be used to infer something about source / sink dynamics. Given that none of this is stated in the objectives section it all came as a bit of a surprise. I was expecting to see some more basic and standard information in this section related to LOWA occupancy, focal species metrics, and the BCI. Things like CV’s, number of reps per sample to detect some stated level of change.

I think the major issue with the present state of the proposal is the lack of clarity in the monitoring objectives section. When these objectives are stated such that they include desired effect sizes and a time frame then I think the methods will fall into place better. Given that the field sampling protocol for LOWA is using line transects and distance sampling (I think) why not estimate and monitor LOWA density? Are there too few detections? I don’t disagree with the occupancy focus of most all the analyses but if you have better information then I suggest those types of analyses are included as well. If you are really only detecting 1 LOWA per watershed the occupancy would be the best approach, but I think you are likely detecting more than 1 LOWA on 1 km transect.

BJM: Regarding the use of distance sampling for estimating waterthrush abundance, their territories are largely linear, so the line-transect-distance approach seems inadequate in this case. Please see also my response to #2 above and my specific responses in track changes in the protocol itself.

MRM: I agree and disagree. The protocol does not currently state specific desired effect sizes and a time frame. Nor do I think it should (at this stage of the game) without the park managers specifying management objectives. As described in the protocol, things like logistics, funding, season-length, etc. drove the number of sites we sample. It is our responsibility to analyze the current design in terms of a traditional power analysis (magnitude of trend detectable over time) and we will do this. However, that is just the first step in an iterative process where we would then go to the park managers and say: This is what we can do and the trend information we can provide. Is this what you want and how does it relate to management actions. Without this piece, I can't see a compelling reason to greatly increase or decrease the precision of the monitoring program. We just completed this type of analysis for the Vegetation and Soils Protocol and will use it as a case study for the argument I just outlined.

MRM: I agree. The objectives and the suggested analyses now include not just occupancy modeling, but also relative abundance and density estimates/trends for specific species and guilds.

#### *Methods and Analysis*

11) Will the analyses and results address the stated objectives?

see above comment

12) Are the indicators and methods used appropriate and justified?

Yes. Again, the foundation of this protocol is sound and the use of LOWA as an indicator of streamside forest condition is well justified. I also agree with the idea of using Bird Community Index as a means of capturing meaningful information from the suite of bird species detected. We are using this approach in NCRN and find it useful in the long-term because the variance estimates around the BCI score are much lower than if you attempt to do single species trend estimates. The BCI also provides a metric for setting management objectives...."to maintain or increase the BCI score on X % of the sample locations from X to X over some time period". I do think there should be more details provided on how to actually calculate the BCI, species guild memberships, and what changes in the BCI mean.

BJM: Please see my response to #2 under "Objectives and Empirical Support".

13) Is the current amount of sampling effort sufficient to address the stated objectives? Are there logistical constraints or unacceptable levels of variation that compromise the utility of the protocol?

I think the stated objective need to be more detailed before this question can be adequately addressed.

BJM: Please see my response to #2 under "Objectives and Empirical Support".

14) Are appropriate field, laboratory, library, and statistical methods used for data collection, analysis, and characterization of uncertainty?

Yes.

15) Are the methods and analyses described sufficiently to allow for replication?

I think this is a weakness of the protocol in its present form. I found it very difficult to determine how exactly I would conduct the surveys and to a greater extent, how I would analyze the data. After the 5<sup>th</sup> time through I figured out that they are 5 minute point counts; a detail that could easily be placed in the narrative section of the protocol. The focal species are not clearly defined, there are no details about how to calculate the BCI, bird species are not placed into guilds for this analysis, and I know from experience that there is a steep learning curve with R and WinBugs. I think the protocol and SOP's would be greatly improved if the details were more clearly spelled out. The authors have done a good job of presenting the justification and the background for why they are proposing to monitor each metric but the nuts and bolts of the protocol lack details. In the analysis sections, I would include the R code (or SAS code), provide tables that define the focal species, and the guild membership, an example of how to calculate the BCI. It is one thing to say that the database will calculate it automatically but what happens when someone gets asked a question about how that number was generated?

BJM: Regarding including the R/WinBUGS code for the sample analysis, this would require > 10 word document pages. We therefore instead decided to include my contact information for those interested in pursuing such analyses. Please see also my response to #2 under "Objectives and Empirical Support" and my responses in the protocol itself.

MRM: We no longer use the confusing and unnecessary "focal species" terminology. We also now have specific SOPs that describe the BCI, how it is calculated, and the guild membership for all species.

#### *Findings and Utility*

16) Are the findings and conclusions drawn from analysis relevant to the scope and breadth of the monitoring plan being implemented?

17) Are differences from standard protocol methodologies adequately justified and supported?

Yes.

18) Does this body of work, to the extent possible and practical, differentiate among facts, opinions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities.

Yes.

19) What are the strengths, limitations, and potential usefulness to park managers and others of the activity?

I see the metrics proposed in this protocol providing clear linkage between the streamside bird community and the condition of the stream reach or watershed within the park. Given how well the authors have described, justified, and provided background on the stressors to streamside habitats and how their proposed metrics relate directly to those stressor, I see park managers being able to use these data to set management objectives, monitor the response of mgt. actions, and argue for meeting better water quality conditions upstream from park resources.

#### *Miscellaneous*

1) Email response from Greg Shriver to Matt Marshall dated September 4, 2012:

Hi Matt:

I've read through the revised Streamside bird protocol and it is in wonderful shape! That was a major revision that has created a clear and concise protocol that should serve the ERMN and others interested in streamside bird monitoring and ecology well into the future. Thank you for keeping me in the loop. It is exciting to see a nearly completed product.

Please let me know if you need anything else from me. Feel free to add this email to the admin. record to indicate that you have more than addressed my comments on an earlier version of the protocol.

Best,

Greg

Greg Shriver  
Associate Professor Wildlife Ecology  
250 Townsend Hall  
Department of Entomology and Wildlife Ecology  
University of Delaware  
Newark, Delaware 19717-2160  
Telephone: (302) 831-1300  
Fax: (302) 831-8889  
Email: gshriver@udel.edu

#### *References*

**C.3. February 2010 Darryl MacKenzie final peer review of ERMN Streamside Bird Monitoring Protocol.**

Darryl I. MacKenzie  
Biometrician  
Proteus Wildlife Research Consultants  
PO Box 5193  
Dunedin  
NEW ZEALAND

Email: [Darryl@proteus.co.nz](mailto:Darryl@proteus.co.nz)  
Phone: +64 3 4861168  
Mobile: +64 21 773108

<http://www.proteus.co.nz>

Protocol review

|                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Protocol:</i><br>Eastern Rivers and Mountains Network<br>Streamside Bird Monitoring Protocol                                                                                                                                                                                                                                                                     | <i>Reviewer:</i><br>Darryl MacKenzie ( <a href="#">DM</a> )<br><i>Date:</i> 21 December 2009 – 3 February 2010<br><br><i>Author responses:</i><br><a href="#">BJM: Brady J. Mattsson</a><br><a href="#">MRM: Matt R. Marshall</a><br><a href="#">Date: 2 February 2010</a> |
| <i>Authors:</i> Mattsson, B.J. and M. R. Marshall                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                            |
| <b>BRIEF DESCRIPTION</b>                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                            |
| This Protocol will be used to monitor the breeding bird community along wadable streams in the Eastern Rivers and Mountains Network as part of the NPS Vital Signs Monitoring Program.                                                                                                                                                                              |                                                                                                                                                                                                                                                                            |
| <b>COMMENTS</b>                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                            |
| <i>Program Guidance and Purpose</i><br>1) Is the information well-written, logical, and understandable?<br><i>By and large, yes. But additional clarity is required on a number of key points including management objective, definition of a sampling unit, expected precision of resulting estimates.</i><br><br><a href="#">BJM: Please see responses below.</a> |                                                                                                                                                                                                                                                                            |

- 2) Is the purpose for collecting the information clearly presented, appropriate, and valid?  
*I struggle with the NPS ethos of monitoring to detect trends in various metrics. By definition, evidence of a trend will only become apparent after a certain timeframe has elapsed, with a longer timeframe required for a more subtle trend. If the intent is to only begin management once a 'significant' trend has been detected, for many species of conservation concern such an approach may ultimately prove more costly than a proactive approach where management makes decisions at systematic points in time to maintain the population above some level right from the inception of the programme.*

BJM: We acknowledge that it would be optimal to have explicitly stated management objectives before implementing a monitoring program. In the first paragraph under “Measureable objectives”, we implied that while park-specific management objectives currently do not exist, the design of this monitoring program aims to achieve existing nation-wide NPS goals of effectively monitoring indicators of ecological integrity across parks. Furthermore, results from this monitoring program may form the basis for actual management objectives rather than simply spawning further monitoring actions. In any case, as management objectives emerge (e.g., for particular parks, watersheds, guilds, or species), the monitoring program should be broad enough to accommodate informing such management goals. If it does not, then there is an expectation that the monitoring design will be adapted.

*DM response: (re: management objectives) This and similar comments is primarily a shot at the NPS higher-ups. Possibly someone further up the food chain may have read it, but probably not.*

BJM: Point well taken.

*DM response: (re: results from monitoring program forming basis for management objectives) In what sense? Can you give me examples?*

BJM: There are two poignant examples. First, the decline of eastern hemlock due to the introduced woolly adelgid is an ongoing concern throughout the ERMN that will continue to impact the riparian ecosystems in the parks. Potential management actions include tree injections and other chemical treatments. Second, overbrowsing by deer has suppressed regeneration of canopy tree species in at least some parks in the ERMN, and could have compounding effects on the riparian ecosystem.

*DM response: but possible not very efficiently. I'd argue that often it's better to belt managers around the head with a 2 by 4 for a year until they tell you what they really want to know instead of rushing out to collect data.*

BJM: Point well taken.

- 3) Is the specific scientific or scholarly merit for implementing the protocol well defined?  
*The foundations are there, but there is a lack of detail on management objectives in the sense of what do they want these systems to look like at some future point in time. This detail is possibly beyond the authors remit, but is vital for the authors to design a suitable monitoring programme.*

[BJM: Please see response to #2 above.](#)

#### *Objectives and Empirical Support*

- 4) Are the methodologies and purpose for conducting the activity clearly presented, appropriate, and valid?  
*As above, I found little in here to inform me of the overriding management objectives (in the sense of Nichols and Williams 2006 and Martin et al 2009), without which it is difficult to determine whether the proposed programme will provide useful information. This is not necessary the fault of the authors however, with such direction coming from the NPS, parks and any other stakeholders.*

[BJM: Please see response to #2 under “Program Guidance and Purpose”.](#)

- 5) Are the protocol objectives specific (attribute or species defined), measurable, and achievable?  
*The objective for this specific protocol are well described, but the context of the programme within the larger management decision process is lacking. The role of the monitoring should be to supply management with the information required by them to make current decisions, and also learn from previous decisions.*

[BJM: Please see response to #2 under “Program Guidance and Purpose”.](#)

- 6) Is the location or spatial bounds of the monitoring specified?  
*Yes*

- 7) Does the report or protocol include an appropriate literature review that puts the work in the context of previous work? \*note: this might be supplemented with materials from the Network monitoring plans available via websites.  
*Not assessed*

- 8) Does the protocol stray too far from conventional or widely accepted methods? Can the objectives be addressed using simpler or more standardized techniques?  
*Protocol proposes methods that are becoming widely accepted.*

#### *Methods and Analysis*

- 9) Will the analyses and results address the stated objectives?  
*Difficult to assess as no useful management objective against which to compare is given.*

[Please see response to #2 under “Program Guidance and Purpose”.](#)

10) Are the indicators and methods used appropriate and justified?

*The basic methods are reasonable, although I have concerns about the point-transect field sampling. If the basic intent is to establish presence/absence of species at the scale of the 75m point-stations or 250m transect segments (as stated), the 5 points or 4 segments along a 1-km transect may not be independent hence not suitable to use as independent sample units in an analysis, particularly if substantial spatial correlation is present. If inference at that scale is truly desired, then I would suggest considering a design where all appropriate streams are divided into 250m segments, and a sufficient number of these are randomly selected from throughout the park, or from within each stratum. The segments are then surveyed with the point-count station located within them. However, if inference of presence/absence is to be at the 1km transect level, the point-transect approach may be more appropriate, although the effective sample size is now the number of transects surveyed. The prime sampling unit of interest from the perspective of determining either presence or absence needs to be more clearly defined.*

MRM: The protocol now clearly defines that the 1km reach/transect is the sampling unit of interest.

*I appreciate that there may be logistical issues for ‘grouping’ the sampling units, but that may create some bias in the results if not accounted for. Royle and Kery (2007) is the prime citation for the analytic methods, but they do not describe how to deal with potential spatial correlation, nor do they cover hierarchical sampling in the sense of what is proposed here (identify strata, select watershed within strata, select transect within watersheds), although I can imagine that such methods might extend in such a direction.*

*Given that you are using stratified sampling design, this needs to be accounted for during the estimation. The analytic methods cited implicitly assume a simple random sampling scheme.*

BJM: Park managers are interested in watershed-specific conditions, and so we decided to ensure replication to account for spatial variation within watersheds by establishing (typically 4) adjoining 250-m point-transects in selected watersheds. As such, the spatial scales of inference may be at the level of individual point count stations, individual transect segments, and/or adjoining transect segments, depending on the specific management objectives or analysis question. In the second paragraph under “Relative Abundance and Trends”, we acknowledged that our spatial sample units are nested within larger transects and that this will be addressed through hierarchical modeling. This section of the protocol narrative was meant to give an overview of modeling approaches that could be understood by most practitioners rather than providing detailed mechanics.

In reality, we will use a random effect to account for spatial dependence among points or segments within each transect. In particular, we will include a separate intercept for each transect, whose posterior distribution will be based on the data and an uninformative normal prior distribution with its own mean and variance. Royle and Kery (2007) present an example (for Cerulean Warbler) hierarchical multi-season occupancy analysis that incorporates sample-level (or individual-level) heterogeneity, which is analogous to

incorporating an aggregated level of heterogeneity. For clarity, we will add a citation for Royle and Dorazio (2006), who present an example (for stream fish) of incorporating an aggregated level of heterogeneity for a single-season occupancy model.

To address the stratified random sampling design, we will add a sentence about incorporating stratum-level covariates that account for this stratification, perhaps with a citation for Thompson (2002).

*DM response: (re: scales of inference and using point count stations versus 1km transects) as you aggregate your effective sample size will decrease, along with your precision.*

BJM: To clarify, we will maintain the point or segment-level detections in the analysis, but we may focus on a derived variable that averages over the entire transect in the analysis. We acknowledge, however that our effective sample size may diminish due to dependence among nearby sampling stations.

*DM: If there is really interest in the watershed-specific conditions, an absolute minimum of 20–30 units per watershed will be required to give anything like a reasonable level of precision.*

BJM: We acknowledge variation among particular transects and account for this with random effects, and we admit our limitation of not being able to estimate “true” occupancy/change in occupancy for specific transects. For the most part, we will urge to managers that inferences about occupancy are in effect averaged over multiple watersheds rather than estimated for specific watersheds. However, we will report detection summaries for each transect with obvious caveats about imperfect detection and detection biases.

*DM: response: (re: intercept for each transect, whose posterior distribution will be based on the data and an uninformative normal prior) this sounds reasonable, but have no idea what sort of precision you’re going to end up with (although suspect it won’t be great). Have you tried it with some pilot or simulated data? Is the precision going to be sufficient for management purposes?*

BJM: Please first see sentence 2 under our initial response to #3 below. We will accept our current level of precision, then compare this with emerging management needs and adapt the sampling design if needed. We acknowledge this is far from ideal.

*DM response: (re: covariates that account for stratification) Not only that, but to scale up to a population level estimate of occupancy you need to use stratified sampling results to combine stratum-specific occupancy estimates.*

BJM: We will include in all models the stratum covariate as a random effect to account for this underlying sampling design.

11) Is the current amount of sampling effort sufficient to address the stated objectives? Are there logistical constraints or unacceptable levels of variation that compromise the utility of the protocol?

*Most of the discussion with respect to samples sizes revolved around the number of watersheds to be surveyed rather than number of transect segments within a watershed. If the segment is the primary sampling unit of interest (the basic piece of land at which you are attempting to establish either species presence or absence), the number of segments will be the ultimate determinant of precision. The authors have not presented any values associated with the expected level of precision of selected metrics given their proposed design.*

*For most birds species there will only be 2 opportunities to detect them at a point-station. If the probability of detecting a species given it is present at the point is less than  $<0.5$ , this may lead to an inefficient design and it may be preferable to reduce spatial replication and increase temporal replicates (see MacKenzie et al. 2006, Chap 6).*

*Their discussion of thresholds (pg 46–47) I found interesting and think is a more useful approach than ‘monitoring for trends’. I strongly suggest further discussion among the authors, the parks and stakeholders on defining management objectives, possibly based around this concept of thresholds. I do however disagree with some of the content of the final paragraph on page 46, a species may not be doomed for extinction if  $PSO < 50\%$ . As extinction and colonization operate on only occupied or unoccupied patches, we need to account for the relative split of the total sample size into these 2 categories. For example, if a system is in equilibrium then we’d expect  $PSO * e = (1 - PSO) * c$ , ie the fraction of places to go extinct to be replaced by the fraction of places that become colonized. This holds regardless of the value of PSO. If the left-hand side is larger the population will be declining, if right-hand side larger population is increasing.*

We will revise the “Replication” section to focus on replication of transect segments rather than watersheds. We will also summarize preliminary results of ongoing data analyses under “Data Handling, Analysis, and Reporting” to demonstrate current levels of precision of estimates and ability to detect changes in occupancy for selected species based on the first three years of data.

The sampling schedule for this protocol includes four visits per point count station, which includes two passes during each of two visit days. Please see Table 7 under “Conducting streamside bird surveys”. In any case, we will add a statement and citation(s) about low detectability and temporal replication under the “Replication” section.

While we agree that  $PSO * e = (1 - PSO) * c$  is a condition for equilibrium, we still would like to have some threshold level of PSO that ensures population viability. The formula presented by Ovaskainen and Hanski (2003) seems to provide such a threshold (albeit conservative), but we welcome an alternative approach. In any case, we will revise the fourth paragraph under “Detectable Levels of Change” to emphasize a threshold for viability rather than all-or-nothing extinction or persistence.

*DM response: (re: four independent visits per site) presuming occasions are independent.*

*BJM: To account for this likely dependence, we will include all models a covariate for whether the species was detected during a previous sampling occasion.*

*DM: Even 4 may be insufficient for species with  $p < 0.4$*

*BJM: We will select species that, based on preliminary analysis, have  $p \geq 0.4$  and that represent specific ecological guilds that are of interest (e.g., hemlock associates, ground-nesting forest-interior species).*

- 12) Are appropriate field, laboratory, library, and statistical methods used for data collection, analysis, and characterization of uncertainty?

*The general class of analytic methods proposed are suitable, however some extensions may be required given the proposed design (eg stratified random sampling, spatial correlation)*

Please see response to #3 under “Methods and Analysis”.

- 13) Are the methods and analyses described sufficiently to allow for replication?

*There is sufficient detail, but more clarity required.*

Please see responses above.

#### *Findings and Utility*

- 14) Are the findings and conclusions drawn from analysis relevant to the scope and breadth of the monitoring plan being implemented?

*N/A no data been collected yet*

- 15) Are differences from standard protocol methodologies adequately justified and supported?

*N/A no data been collected yet*

- 16) Does this body of work, to the extent possible and practical, differentiate among facts, opinions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities.

*N/A no data been collected yet*

- 17) What are the strengths, limitations, and potential usefulness to park managers and others of the activity?

*Huh?! Shouldn't the park managers be outlining what they're trying to do first hence what information they require from a monitoring programme?*

Please see response to #2 under “Program Guidance and Purpose”.

#### *Miscellaneous*

1-24-10 e-mail from Darryl:

1. *DM: In your examples (hemlock and deer), these sound like management actions, not objectives (at least how I think of them). If your objective is to maintain bird diversity in riparian corridors (for example), these are two possible actions that could be considered by managers to help reach that objective. In your current text you seem to be arguing that managers don't know what they want to do (eg maintain diversity) without monitoring for a while. I'd argue there's probably few cases where that's really true, but would agree that through monitoring you may learn of other potential*

*actions that could be taken.*

BJM: We agree. After talking further, we will move toward organizing a structured decision-making (SDM) workshop to explicitly define park-specific objectives, alternatives, and models to examine consequences and trade-offs in (likely linked) management decisions. We will begin with one park, e.g. DEWA, to develop an initial prototype and then repeat the SDM process for other parks in the network, with an ultimate goal of a network-level, perhaps nested SDM framework.

2. *DM: If sampling is not proportional to stratum weights, then only including a stratum covariate is not sufficient to get an overall estimate; you need to multiply the stratum-specific estimates by the stratum weights (a bit like model averaging).*

BJM: We will add a sentence or two under “Recommendations for Routine Data Summaries and Analysis” describing the need to apply stratum weights (i.e., proportion of samples in each stratum; Williams et al. 2002: 65) when estimating population-level metrics such as occupancy.

2-3-10 email from Darryl: *That looks fine (and encouraging).*

### *References*

*All references used here have been cited by the authors in their proposed protocol.*

References included in response:

Ovaskainen, O., and I. Hanski. 2003. Extinction threshold in metapopulation models. *Annales Zoologici Fennici* 40:81–97.

Royle, J.A., and R. M. Dorazio. 2006. Hierarchical models of animal abundance and occurrence. *Journal of Agricultural, Biological, and Environmental Statistics* 11:249–263.

Royle, J.A., and M. Kery. 2007. A Bayesian state-space formulation of dynamic occupancy models. *Ecology* 88:1813–1823.

Thompson, S. K. 2002. *Sampling* (2<sup>nd</sup> Edition). Wiley, New York, USA.

Williams, B. K., J. D. Nichols, and M.J. Conroy. 2002. *Analysis and management of animal populations*. Academic Press, San Diego, CA.

#### C.4. August 2010 Kirk Stodola comments on draft streamside bird monitoring protocol.

Kirk Stodola  
Avian Ecologist, Ph.D. Candidate  
University of Georgia

##### LOWA Transect Surveys

Objective: Assess stream quality by using Louisiana Waterthrush as an indicator species.

Protocol: Survey 30 watersheds in the New River Gorge National River and surrounding parks. One kilometer transects following stream/creek channel, made up of four individual 250 m intervals. Determine interval occupancy of “paired” Louisiana Waterthrush using various behavioral cues along with streambed usage of Louisiana Waterthrush.

Assessment: I like the concept of using LOWAs as an indicator of stream quality, but am leery of using a single species to do so unless a clearly defined relationship exists. In the case of LOWAs I do not know what the relationship between presence/absence and “stream quality” is and I think this needs to be defined before any results can be meaningfully interpreted. As for the actual methods employed, in theory I can see how pairing status may provide additional information above and beyond mere occupancy of singing males, however in practice I believe very similar information can be gained by focusing solely on “occupancy”. Pairing status should be high for breeding LOWAs, as with any other passerine that exhibits social monogamy. Even a highly skewed sex ratio of 45 females for every 55 males asserts that at least 80% of all males are paired. Consequently, a lot of information is needed to determine if a male is unpaired, and this information is difficult to attain. Additionally, occupancy of singing males may be just as good of an indicator to habitat quality as pairing status so long as males and females do not assess “habitat quality” in opposite ways. Sites with more males should have more females, whereas singing males at sites that have been previously unoccupied for the last 4 years should be more prone to be unpaired, or at least those sites should be viewed of lesser “quality”. Finally, assessing pairing status within individual transect intervals along a reach of stream is extremely difficult, due to low detection probabilities, which impede assessment of pairing status. There are too many behavioral issues, which I will subsequently address, that impede detection. 1- The species is not dichromatic, which hinders the detection of female breeding birds. 2- Louisiana Waterthrush move during the breeding season and will frequent multiple transect intervals within short time periods, leading to false detection of a paired interval. This is especially noticeable prior to breeding when females are choosing nesting sites, and then after successfully fledging young when the brood is split up and fed in two separate groups. 3- Louisiana Waterthrush can be fairly secretive at times (especially females on a nest) and coupled with the noise levels of the streams reduces the chances for detection. These characteristics, along with other less prominent ones, decrease detection of pairing status to below the level necessary to adequately assess which intervals have breeding pairs and which do not.

Recommendations: Unfortunately, I cannot surmise a better means of assessing pairing status, other than increasing the number of visit days well above the current 4, and even

then I believe this task would be difficult. Thus, I would recommend discontinuing this portion of the project. If monitoring LOWA is still a consideration, I would focus on attaining information pertaining to occupancy of singing males. I believe this is just as valuable as pairing status and can be coupled with attaining information on other species as well.

### Point Counts

Objective: Determine population trends of breeding birds throughout the New River Gorge National River and other areas in the vicinity.

Protocol: Survey 30 watersheds in the New River Gorge National River and surrounding parks. Five point count stations separated by 250 m located along 1 km of stream/creek channel. Each point conducted twice in a day and on two separate days for a total of four replicates. All birds seen or heard during a five minute interval are recorded. Additional information gathered: detection type, age, distance (3 bands), location (quadrats), and minute-by-minute tallies.

Assessment: I like the design of the point surveys and think it is a very efficient means of accounting for detection and determining probability of occupancy of streamside birds. Detection probability appears to be relatively high for most migratory species, and estimates of occupancy are accompanied by an acceptable amount of error. As a minor issue, I think that some of the information gathered is somewhat superfluous and may hinder detection of additional individuals and species. For instance, I found that I often concentrated on collecting quadrat information and the minute-by-minute tallies, which may have impeded my ability to detect additional individuals. While it was not my intent (or other observers) to place emphasis on these two pieces of information, you inevitably do so if that information is required. Furthermore, while both of these pieces of information may be valuable, in practice I question their utility. This is especially true with the quadrat information and while the minute-by-minute tallies could be valuable, I have trouble seeing how this information can be used. Using minute-by-minute counts as replicate counts would violate the assumption of independence if a distance cut-off is used (i.e. within 75m), because distance is not gathered along the minute-by-minute time frame. In addition, on ~10–15% of point counts minute-by-minute tallies are gross underestimates because there are too many birds and it is not possible to keep up singing rates, thus attaining signing rates is tenuous also. Finally, there may be issues with the species monitored due to the point counts being located close to a stream and being conducted later in the breeding season. Species such as Rose-breasted Grosbeak, Cerulean Warbler, Worm-eating Warbler, Black-and-white Warbler, may be more prevalent along ridge tops and not accessible along stream sides, while many resident species along with some early arriving migrant species are nearly finished with breeding towards the end of the counts and thus sing infrequently and are difficult to detect.

Recommendations: I would highly recommend the continuation of the point count surveys within the New River Gorge area. I believe this is a very well thought out and designed project. Given current protocol the only recommendations I would make would be to eliminate the gathering of quadrat information and minute-by-minute tallies, due to their potential influence on detection. While I understand that the issues brought forth above can be accounted for in a modeling framework, my experience made me leery of

this data, and modeling poor data gives you poor results. At the very least I would recommend conducting preliminary data analyses to assess their utility. Finally, this is a long-term monitoring program designed to assess watershed quality and species population abundance and trends. Because it is a long-term monitoring program it may not be necessary conduct point counts in the same location every year. Meaningful and reliable trends and changes should only be noticeable after 6–10 years. Changes on a faster time scale will be due to obvious habitat changes. Therefore, I would suggest discussing the addition of another set of point counts to complement those of the streamside counts, and to help cover those species underrepresented along streamsides. Specifically, I would suggest conducting the streamside surveys in even number years and forest interior (away from streams, along ridge tops) surveys in odd numbered years. Conducting these forest interior counts within the same watersheds as the stream side surveys may also help provide information about how habitat changes and changes in species composition higher up in a watershed affect species composition along streamsides. However, because point counts would not be conducted in concurrent years it would be beneficial to increase the precision of the occupancy estimate. This could be accomplished either by increasing the number of surveys or increasing detection probability. I would recommend the latter and believe this to be best accomplished by increasing the length of the point counts to 10 minutes to capture those infrequently singing resident and early breeding species. The 10 minute point count could be made up of two 5-minute back-to-back point counts, where the same individuals and distances are recorded for each 5 minute section, similar to the minute-by-minute tallies collected now, but on the 5 minute time scale.



C.5. January 2010 Jesse Purvis comments on draft of streamside bird monitoring protocol.

Jesse M. Purvis, Ph.D., Aquatic Ecologist  
New River Gorge National River  
Bluestone National Scenic River  
Gauley River National Recreation Area  
PO Box 246  
Glen Jean, WV 25846  
304-465-6513  
jesse\_purvis@nps.gov

Thanks very much for looking over the site selection sections! Good catch on the fertility language too, Jesse. My understanding is the same as yours and jives with Table 2 (p13) . How many times did I read that sentence and not really read that sentence...

So, I suggest some changes to the text (both on page 11 and 126). Please feel free to edit further (same to you Caleb, Rich, and Brady):

page 11. More fertile bedrock has greater buffering capacity and therefore streams that drain from such bedrock are less susceptible to acidification.

page 126. Bedrock fertility score – Index of stream buffering capacity based on geologic formations. Watersheds draining bedrock with limestone or shale have a higher score, are less prone to acidification, and tend to be more productive; whereas watersheds draining sandstone and granitic material have a lower score, are more prone to acidification, and tend to be less productive.

In practice I don't think this flip-flop in definition has ramifications on the actual sampling scheme. The low and high strata were defined by those "greater than average" and those "less than average" mean bedrock fertility score. We simply need to be clear in our own heads and in writing, obviously.

Am I not considering something?

Thanks again,  
-Matt

~~~~~  
National Park Service  
Eastern Rivers and Mountains Network  
403 Forest Resources Building  
University Park, PA 16802  
814-863-0134  
mobile: 814-571-8316  
fax: 814-863-2621  
matt\_marshall@nps.gov  
<http://science.nature.nps.gov/im/units/ermn/>

Jesse Purvis/NERI/NPS

01/14/2010 05:17 PM

To Matt Marshall/PHILADELPHIA/NPS@NPS

cc Scott Stonum/NERI/NPS@NPS

Su Re: Streamside Bird Protocol review<sup>(1)</sup>  
bje  
ct

Matt,

Protocol looks good.

I caught a typo or two, but didn't write them down and will try to go back and get them later.

I have some concerns about the bedrock fertility categorization. It was always my understanding that more fertile bedrock had higher buffering capacity, but this protocol interprets it the other way around. On page 11, the protocol notes that more fertile bedrock has lower buffering capacity. This is confirmed in Appendix A (page 126) where bedrock fertility **score** is defined as the inverse of acid neutralizing capacity (ANC). Generally, the most productive streams are those that drain limestone watersheds, and this is well known among Pennsylvania and Yellowstone area trout fishermen. The least productive streams usually drain watersheds of sandstone or granitic material that contribute very little dissolved minerals to stream water, and hence have very low ANC. This relationship between geology and fertility is well established for lakes, and has been examined to some degree in streams (including my dissertation). This relationship is also one of the reasons farmers add lime to low-pH (little or no ANC) fields to increase productivity.

Did I miss or misinterpret something here? I haven't examined Brady's citations for this material, so I may be off base, but this appears backwards to me. Perhaps this would be a good subject for an aside discussion next month.

Of much less consequence, the items in Appendix A categories are not all in alphabetical order, and it may be best to split at least one category (see the one that spans pages 125 and 126).

Cheers.

Jesse

\*\*\*\*\*

Jesse M. Purvis, Ph.D., Aquatic Ecologist  
New River Gorge National River  
Bluestone National Scenic River  
Gauley River National Recreation Area  
PO Box 246  
Glen Jean, WV 25846  
304-465-6513  
jesse\_purvis@nps.gov

\*\*\*\*\*

**Matt**

**Marshall/PHILADELPHIA/NPS**

01/04/2010 11:51 AM

To Richard Evans/DEWA/NPS@NPS, Jesse Purvis/NERI/NPS@NPS  
cc Caleb Tzilkowski/NERO/NPS@NPS, John Karish/PHILADELPHIA/NPS@NPS  
Subject: Streamside Bird Protocol review  
bje  
ct

Hey guys,

Happy New Year. Hope you had a break and enjoyed it.

I am emailing to let you know that the ERMN Streamside Bird Protocol is out for final peer review (coordinated by Karish). The reviewers are Daryl MacKenzie (developer of occupancy models; his review comments are already back and attached below), Greg Shriver (former NETN Coordinator, now faculty at U Delaware), and Tim O'Connell (Oklahoma State faculty and developer of the Bird Community Integrity Index we're using as well as a Louisiana waterthrush guru).

I know both of you took some time to glance at the protocol in draft form a little over a year ago as did Craig Snyder, Jeff Shreiner, and Terry Master, but I am hoping you may find time to look at sections of it again. Specifically, the sampling design and site-selection sections. As you know, we've based the BMI sampling and some basic water sampling on this design - so it is really intended to be the foundation of much of our stream-based monitoring. The watersheds selected will also be the focus of some of our landscape change monitoring so that all these pieces can be used to tell a story.

I don't expect you to look at all the "bird" stuff, but another look at the sites that were selected and how they were selected would be great (and pretty important).

Caleb will probably hit you up for a more complete review of the BMI protocol later this spring/summer but it doesn't provide as much detail on the site selection as Brady's original protocol does. Hence, the request for you to look only at this section (starts on page 8) of the protocol.

The materials for the reviewers are posted on the ftp site so you can grab a word or pdf version of the protocol there:

[ftp://npsftppwin:FTP04npswin@63.220.43.40/ermn/streamsidebird\\_protocol/](ftp://npsftppwin:FTP04npswin@63.220.43.40/ermn/streamsidebird_protocol/)

We've asked the reviewers to get comments to us by the end of January...

Sorry for another request!

-Matt

[attachment "NPS Protocol Reviewer Form\_MacKenzie.doc" deleted by Jesse Purvis/NERI/NPS]

~~~~~  
National Park Service  
Eastern Rivers and Mountains Network  
403 Forest Resources Building  
University Park, PA 16802  
814-863-0134  
mobile: 814-571-8316  
fax: 814-863-2621  
[matt\\_marshall@nps.gov](mailto:matt_marshall@nps.gov)

<http://science.nature.nps.gov/im/units/ermn/>

---

(1) -

<Notes:///85256D75004888B2/38D46BF5E8F08834852564B500129B2C/74D7A93D675FC812852576A1005A684D>

C.6. November 2008 Craig Snyder comments on draft of streamside bird monitoring protocol.

## **REVIEW OF BIRD MONITORING PROTOCOL FOR ERMN**

**Title:** Streamside bird monitoring protocol for the Eastern Rivers and Mountain Network (ERMN) (version 0.5).

**Authors:** Brady J. Mattsson

**Reviewer:** Craig Snyder, USGS Leetown Science Center.

**Date:** November 2008

### **Overall:**

The purpose of the document is to detail protocols for monitoring status and trends in streamside bird assemblages in park units within the ERMN. As requested, I focused my review on the two sections entitled “Background, Objectives, Target Users” and “Sampling Design and Methods”. In general, I found the document to be well thought out, well-written, and an accurate reflection of discussions that occurred during vital signs meetings that I attended where issues of objectives and sampling design were discussed. I provide more detail by individual section below.

### **Objectives**

The stated objectives are reasonable, clearly stated, and of sufficient detail. Although the desired level of precision of focal species population parameters was not stated, I suspect this is because the appropriate power analyses have not been conducted as of yet. Though as a general rule I think desired precision should be stated up front in monitoring and assessment programs, in reality, budget constraints will ultimately determine potential sampling effort and consequently statistical power. However, I think a thorough power analysis should be conducted prior to initiating monitoring to ensure that power will be minimally sufficient to meet monitoring objectives given budgetary limitations. I am certain that Brady intends to do just that using the data he has recently collected.

### **Focal Species Selection**

I believe the process of selecting focal species was suitable and well-justified. I especially like the recognition of several species as “sentinel” or indicator species whose presence or abundance is indicative of specific components of ecosystem condition.

### **Sampling Design and Methods**

This topic has been the subject of considerable discussion within the ERMN science advisory committee for several stream-related vital signs including aquatic macroinvertebrates and water chemistry, in addition to birds. As I see it, Brady has done an excellent job of taking the general consensus reached by everyone in these earlier meetings, and developing a set of specific monitoring design protocols. The stratified random approach to site selection based on landscape features (watershed area, percent of watershed area protected, underlying geology, and topographic relief) will be useful for the other stream-related vital signs as well. I think using the SD of elevation makes sense for relief, and I really like the way that geology was stratified (i.e.,

bedrock fertility) especially in DEWA where there was considerable variation in bedrock geology among watersheds. I also think the high and low ranges selected for each stratification variable are reasonable, although I would prefer a middle range for each. However, I do understand that this would result in too many strata to sample effectively given limited resources.

I also really like the modeling approach selected to adjust parameter estimates for imperfect detection. This is an extremely important and often overlooked issue for monitoring. I suspect this is particularly true for sampling bird assemblages with multiple investigators, but it applies to other assemblages as well. The discussion about how to optimize replication to inform modeling was very good, and I agree with all that was said. However, I suspect that some additional research into ways of optimizing replication and how to model detection for different species and guilds could benefit the program in the long-term.

I have two relatively minor comments that I think are worth considering before moving forward. First, the ranges selected for each stratification variable about each other. As a result, sites selected from the low range could be very similar to sites selected from the high range. For example, for watershed area, one site randomly selected from the low range may have a watershed area of 9.9 km<sup>2</sup>, and one from the high range may have a watershed area of 10.0 km<sup>2</sup>. Thus, although they are considered to be from two different watershed area classes, they are very similar. In this case this issue is probably unavoidable and I do not think it is terribly problematic in terms of selecting sites for monitoring because we are still likely to represent a pretty good gradient in the types of watersheds in each park. However, when analyzing the data for spatial and temporal trends in the backend, I recommend using the actual data (watershed area in this example) in a regression perspective instead of the bin data (high or low) in an ANOVA perspective.

Second, there was no discussion of whether the ongoing monitoring program would take a “fixed-site” approach whereby the same sites will be sampled each year in perpetuity, or a “panel” approach whereby each year some new sites are selected for monitoring. I suspect that, for now, the thinking is that a fixed site approach will be adopted. Assuming that a good job is done in the stratification, sites should be representative and monitoring results should give a good assessment of status and trends park/network wide. Moreover, I think, at least initially, it will be good to sample the same sites for numerous years to obtain good estimates of natural variation in estimated parameters, and possibly information on thresholds.

### **Editorial and Other Comments**

- Page 14, last full paragraph, next to last sentence: “calculated” should be “calculating”.
- Page 34, first full paragraph: “name?” should be replaced with the appropriate stream name.
- Page 42, paragraph under “Stream Noise Monitoring”, third sentence: misspelled anthropogenically”.
- Why was the Flatbrook River in DEWA not a potential watershed for sampling?

C.7. November 2008 Kathy Penrod comments on draft of streamside bird monitoring protocol.

Kathy Penrod, Natural Resource Specialist  
Allegheny Portage Railroad NHS/Johnstown Flood NMem  
110 Federal Park Road  
Gallitzin, PA 16641

Telephone: (814) 886-6128  
FAX: (814) 884-0206  
e-mail: kathy\_penrod@nps.gov

Review of  
Streamside Bird Monitoring Protocol for Eastern Rivers and Mountains Network DRAFT  
(Version 0.5)

Prepared by Kathy Penrod  
November, 2008

pp. 3 and 8: not sure this sentence is grammatically correct:  
Availability of these monitoring data will increase manager knowledge, improve their ability to steward park resources, and allow them to adjust to and mitigate threats to the park's aquatic resources.

p. 5, mid-page  
remove colon ":" after Roles and Responsibilities

p. 11, Heading for Table 1  
... Forest-interior species were assigned to habitat-association (i.e., hardwood, hemlock, or shrubby understory) and/or nest-placement...

p. 14, mid-page  
Percent of watershed preserved is estimated by dividing the watershed area within federal or state park ownership ~~divided~~ by the total area of that watershed.

p. 15, Table 2  
the abbreviations SD and CV are used without definition

p. 25, Table 3  
should the topography and bedrock fertility low/high strata for DEWA coincide?  
(i.e., <32.4 but ≥ 32.5 and < 0.138 but ≥ 0.139)

p. 26, Table 5  
footnote "a" is defined; footnote 'c' is not, and footnote 'b' could not be found

p. 29, Figure 8 and p. 29, Figure 9  
suggest using a red asterisk, cannot find the black one in Figure 8 and hard to find them in Figure 9

p. 37 – perhaps a question for Matt Marshall – was the unnamed tributary officially requested to be named “Valley Forge Creek”? I know there was talk of this a few years ago, but I don’t know if ERMN contacted USGS

p. 39, Figure 15, heading

... Solid and dashed borders represent medium- (1–9.99 km<sup>2</sup>) and small-sized (0.1–0.9 km<sup>2</sup>) watersheds, respectively...

Both watersheds shown appear to be solid lines – are both medium-sized? If so, change this sentence accordingly.

p. 41, formula for replication among watershed in NERI

superscript in V-1 looks like V1, suggest adding a space so the minus sign is visible;  
S is defined in the text but is not in the formula

p. 42, mid-page

“anthropogenically” is misspelled

p. 50, Table 7

under Product, Web Site Internet

Is there more than one report card(s)? If not, delete the plural

under Product, I&M Update

a quarterly ‘schedule’ and monthly ‘summary’ are inconsistent with each other; choose one and correct the other

p. 51, last sentence before ‘References’

The new version of the SOP and/or Protocol Narrative ~~is~~ will then be archived in the LTEM Protocol Library under the appropriate folder.

p. 54, Rentch 2005 citation

Is this supposed to read “On-line: [Online.]” ?

p. 55, U. S. Geological Survey 2007 citation

**Infrastructure. . [Online.]**

Omit the extra “.” and “[Online]”

p. 56, Whitehead et al 2002 citation

omit “[Online]”

p. 57 Appendix 1

under Round 5, Mill Br footnotes “b,e” need a comma separating them

pp. 61–64

many of the “words and phrases” definitions are incomplete – they appear to either be truncated cells in a table, or were never finished

please examine line by line, I counted 23 errors of this type

p. 63, definition of “Distance Method”

incorrect grammar: ...estimating relative abundance ~~by~~ that assumes abundance...

no page number, SOP # 1, Table 1.1

footnotes are incorrect – two footnotes “a”; missing footnote “c”

no page number, SOP#1, Table 1.2

remove extra “3.” That looks like a footnote to table – it appears to be a repeat of Section “3.” below it

SOP #2, second page,

## **I. Hiring Observers:**

### **1. Qualifications**

One of the essential components ... In addition to visual ~~ly~~ identification of LOWA, observers should ideally ...

SOP#2, sixth page

2. Ensure that trainees are informed and prepared for the training and survey events; everyone should bring binoculars, raingear, water-ready boots, appropriate clothing, field guides, and any other appropriate ~~for equipment~~ equipment for each day of training. Finally, Park or Network staff will ensure that field crews are provided with, and are comfortable with using, ~~and~~ emergency communication equipment (e.g., park radios or cell phones).

SOP #3, item I.4

The first sentence in Item 4 does not make sense

**NERI, GARI, BLUE Look for bright (perhaps faded) pink zipties (DEWA only) or flagging tape (all other parks) tied to a branch or trunk of a live tree or shrub.**

Later I think I read that DEWA has pink zipties – what is at NERI/GARI/BLUE ?

Is anything used at ALPO/FONE/FRHI ?

SOP #4

Table 4.2 is missing, jumps from Table 4.1 to 4.3

Table 4.3, park entrance is spelled incorrectly

Section IV.L

...This information takes little time to record and can be used ~~as~~ to develop a more complete list of focal species detected along streamside transects.

Section V.C.3

Part of the last sentence is underscored; remove underscore

Section V.D.3.

Remove the “and” before 6)

Section V.D.8

Should the last sentence read "...or LOWA transect survey" ?

SOP #5, last page

Section 4.e mentions WV parks – should this be corrected similar to Section 1.f to include all parks? (appears that 1.f was updated but 4.e was missed)

SOP #6, bottom of third page

...and proofed the same day it is collected...

SOP#6, bottom of sixth page, grammatically incorrect

...only unique codes may be entered. ~~T~~ to ensure that the species....

SOP #6, eighth page, midpage

Section III.C. replace "?" with server name

SOP #6, ninth page

Insert line space between sections IV.B.3 and IV.C

Correct line spacing issue in Section V.

All other sections are double spaced between sub-sections.

SOP #7

This appears to be incomplete at this time

SOP #8

Under annual report, grammatically incorrect sentence:

This report is derived SOP for Data Analysis left off.

Not sure what is intended here.

SOP#9

Under Procedures section 4.

4. ....Record the following information: previous version number; date of revision; revision editor (author); sections and page numbers where changes are made (changes made); editing rationale (reasons for change); and new version number....

Need to define revision editor as "author", "changes made" and "reasons for change", to agree with the headings of the Revision History Logs that begin each SOP.

**C.8.** February 2008 Jim Peterson correspondence regarding draft streamside bird monitoring protocol.

Dr. James Peterson  
Georgia Cooperative Fish & Wildlife Research Unit  
D.B. Warnell School of Forestry and Natural Resources  
University of Georgia  
Athens, Georgia 30602-2152

Email correspondence from Brady J. Mattsson regarding discussion with Jim Peterson:

Matt,

I had a chat with Jim Peterson today about the pros/cons of our random stratification scheme from last year. He applauded our approach of including geology & topography along with watershed size and % preserved. He could see no negative side to stratifying that way, assuming there were sufficient replicate watersheds in the broader categories of small vs. large watersheds and protected vs. less-protected watersheds. He agreed that subwatersheds could be pooled by any of the categories for analysis, and that stratifying by relatively extraneous factors (though he debated this as well) probably would only improve the integrity of the study by ensuring an even spatial distribution of sites. I know this might sound like we were just scratching each other's backs, but Jim is a pretty hard core dude who calls out BS when he hears it.

Above all, he urged that management actions resulting from specific changes in vital signs should be made explicit up front. We all know that NPS doesn't engage directly in land management, though! He offered to join in on a conference call, so just let me know what you think about that.

I believe we did have sufficient replication within each of the broader categories, as we surveyed at least 50% of candidate subwatersheds OR at least 19 subwatersheds in each category (see "strat\_wsheds(2)" in attached file).

I'll give you a ring tomorrow around 9am to talk about this some more.

-Brady



## C.9. January 2007 Bird monitoring workshop attendees and minutes.

### ERMN Bird Monitoring Workshop Minutes

Minutes compiled by: Brady J. Mattsson

1/12/07

Attendees: Brady Mattsson, Matt Marshall, Rob Brooks, Terry Master, Tim O'Connell, Su Fanok, Brad Ross, Bob Mulvihill, Jim Sheehan, Felicity Newell, Stephanie Perles.

- 1) Everyone that was invited attended the meeting, except for Petra Wood. Tim O'Connell and Su Fanok joined us via speakerphone.
- 2) Matt: there will be funds to hire seasonal bird technicians for at least a few years. He will eventually take the lead on implementing the bird protocol.
- 3) Brady presented his proposed bird monitoring protocol.
- 4) There seemed to be consensus that observers should record all bird species detected, not just focal species. The focal species, however, should have priority during surveys and especially LOWA.
- 5) Mulvihill: helped develop survey protocol for PA breeding bird atlas. They use five 75-second intervals during each point count. They classify birds as being within or beyond 75 m.
- 6) Brad: analyzing occupancy at the level of an individual point count would be more sensitive to changes occurring across a single watershed.
- 7) Brooks: suggested lumping multiple adjacent points in the analysis. He also suggested running multiple 1–2-km transects for a single watershed to account for variation within watersheds.
- 8) Mulvihill: countered that random sampling of 1–2-km reaches across watersheds should account for variation within watersheds.
- 9) Brad: FRHI has 1 good, 1 medium, and 1 poor-quality tributary, and these could be selected as Tier-2 watersheds (i.e., stressor gradient).
- 10) Matt: 2007 will be considered as a pilot year at minimum.
- 11) Brooks: can provide GIS data on geology for ERMN.
- 12) Mulvihill & Matt: throw out 25-m distance band and consider using 75-m band instead. This would enable comparisons with the PA breeding bird atlas. They also suggested ignoring evidence of nesting/mating status for all bird species, except LOWA.
- 13) There seemed to be consensus that I should also calculate BCI scores and abundance estimates.
- 14) Tim: consider adding DEJU & BHVI to list of focal species.
- 15) Felicity: LOWAs in W PA had lower clutch sizes, lower return rates, and lower pairing success in acidified streams compared to acid-neutral streams. LOWA breeding density, however, is a superior indicator of acidification.
- 16) Terry: consider recording breeding activities of ACFL to account for adelgid-related impacts.
- 17) Jim told Brady that there is no evidence that ACFL breeding success varies between hemlock and hardwood-dominated stands.
- 18) Terry & Bob Ross told Brady that they displaced point-counts away from stream if it was too noisy.

- 19) Bob Ross told Brady that Brad Nelson is conducting bird surveys at Allegheny NF for the past 1–2 years.
- 20) Mulvihill: Resident birds and LOWAs dominate the community until third week of April. After this point, spring migrants begin arriving and/or passing through.
- 21) Mulvihill: limit analysis to singing birds.
- 22) There seemed to be consensus that we should conduct point counts during both 4-week sampling periods.
- 23) Brad: tributary reaches within W PA parks are < 1 km, except for ALPO
- 24) Matt: suggested that we customize survey protocols for W PA parks.
- 25) Stephanie: streams will move over time within the valleys, so point count stations might need to shift as well.
- 26) EPA PIs: 0–4 LOWA territories per 1 km reach.
- 27) There seemed to be consensus that sampling 20–30 watersheds in each NERI & DEWA would be sufficient for making management recommendations.
- 28) Mulvihill: suggested placing autonomous recording units in focal watersheds to calibrate our detection estimates.
- 29) There seemed to be consensus that we should visit a subset of watersheds to collect more intensive data on LOWA territories (e.g., color-banding and nest monitoring) during late mornings, early afternoons, and the 1<sup>st</sup> 3 weeks in May. We could use Terry's sites for this. This will be useful for calibrating our estimates of LOWA density.
- 30) Rob: suggested conducting a Stressor Checklist as part of our bird monitoring. He also suggested that we prepare for shifting a transect if it intersects a dangerous waterfall.
- 31) Brady: we could mask out steep areas based on a 10-m resolution DEM.
- 32) Mulvihill: he has observed LOWAs defecating while foraging on many occasions. He suggested only including fresh splay in the analysis. Feeder streams (i.e., those that flow into main tributary streams) may influence LOWA use of the main tributary stream channel for a short distance downstream of each confluence, especially if the main channel is acidified or otherwise impacted.
- 33) Brady: we can use the density of feeder streams as a covariate in the analysis.
- 34) There was consensus that carrying a measuring wheel during surveys would be unnecessary. We only need to classify LOWA observations on a 250-m interval for the analysis.
- 35) Bob & Terry: Tim has point count data for C PA from EPA project (Tim left the meeting before we talked about this).
- 36) EPA PIs: open to collaboration on meta-analysis of relationships between fragmentation & LOWA nesting success.

**C.10.** January 2007 water quality workshop participants, minutes, and outcomes.



**Eastern Rivers and Mountains Network  
Water Quality and Quantity Protocol Development  
January 10–11, 2007  
School of Forest Resources  
Penn State University**

**Workshop Outcomes as seen by Matt Marshall**

The primary purpose of this two-day workshop was to clearly articulate the objectives of the ERMN surface water quality and quantity protocol so that Pete Murdoch and Scott Sheeder had a clear picture of what to design. Overall, I felt this workshop was definitely a success and greatly appreciate everyone's time, thought, and input. While we did make some headway on formulating the specific objectives needed to move forward, these still need work. For now, I include these slightly more refined objectives and also outline what I perceived to be the major breakthroughs or decisions around which the group coalesced. More detailed meeting "minutes", as recorded by Brady Mattsson, are also included below as is the contact information of all meeting participants.

**Monitoring Questions**

While we didn't begin the workshop with the following overriding monitoring questions, we did visit them briefly on the second day and they seemed to capture the general thinking of those involved with ERMN program development over the past several years.

1. What is the existing status and variability of select water quality parameters (concentrations and loadings) and flow within lotic waters of the ERMN parks?
2. What are the seasonal, annual and long-term trends in select water quality parameters (concentrations and loadings) and flow within lotic waters of the ERMN parks?
3. Are selected ERMN lotic waters in compliance with designated EPA beneficial uses?
4. Are the existing chemical and physical ranges at selected times and sites consistent with established Outstanding Natural Resource Waters or Special Protection designations?

In the end the group seemed to reach consensus on three primary areas or ways by which the

water quality and surface water hydrology protocol could address these questions.

## 1. Large Rivers - mainstem.

Objective: Document seasonal, annual and long-term status and trends in flow and select water quality parameter concentrations and loadings at a subset of existing USGS flow gages in the five ERMN riverine parks.

Given the existing park-based monitoring at NERI, GARI, and BLUE, as well as the monitoring associated with the Special Protection Regs at UPDE and DEWA, along with other logistical and sampling constraints, it was agreed that we should narrow our “mainstem” focus to collocating additional work at existing USGS gages. This would also meet our desire to calculate loadings at select sites.

The six existing USGS gage sites selected cover each of our five riverine parks and are as follows:

Callicoon or Lordsville (UPDE); Montague (UPDE and DEWA); Portland (DEWA); Thurmond (NERI); Belva (GARI); Pipestem (BLUE).

It is proposed that a continuous monitor (datasonde with core parameters and perhaps turbidity) be placed at each site. In addition, quarterly (seasonal) depth and width integrated samples will be collected. These samples will be analyzed for a “full suite” of parameters including the core parameters, Special Protection Regs parameters, and some 303(d)-listed constituents.

Target population consists of six “index” sites selected based on the current location of a USGS flow gage. We recognize that these non-random “index” sites don’t allow inference to the full length of the section of mainstem river occurring within each park, but do allow for a comprehensive, periodic assessment of the mainstem waters at the gage sites as they flow through park property.

Sampling frequency is continuous with datasondes and quarterly/seasonal for depth/width integrated samples.

## 2. DEWA and UPDE Special Protection Regulations and Boundary Control Points

Objective: Document deviations away from existing condition at the 28 established mainstem and tributary boundary control points as specified by the Delaware River Basin Commission Special Protection Regulations for DEWA and UPDE.

Consensus was reached that the ERMN should help support/augment monitoring associated with the existing Special Protection designations at DEWA and UPDE. This corresponds to roughly 14 mainstem sites (7 DEWA and 7 UPDE) and 28 tributary “boundary control points” (roughly 14 in each of DEWA and UPDE, respectively). Current monitoring is bi-weekly from May through September (10 grab samples per year) for essentially the core parameters. Existing condition and corresponding anti-degradation criteria have been (or currently are being)

established for several other parameters. Which parameters will be included and how this integrates with item 1 above and 3 below is yet to be determined. This will be a cooperative effort between the parks and the ERMN with the details (logistic and financial) to be worked out. (Al, Don, and Rich will help us flesh this out).

Target population consists of roughly 28 index sites (a.k.a boundary control points) that are part of the Special Protection Regulations. Sampling frequency is yet to be determined.

### 3. ERMN Tributary Watersheds and Streams

OK. Here is where things get a little more murky.

Objective: Document change of “x amount or percent” or exceedence of thresholds (parameter specific) in core (and select other) parameters over “y period of time” within select lotic waters of each ERMN park. Implicit in this objective is that there is some random or probability based sampling scheme so that inferences can be made to broader areas than the sample location. It was also argued that x and y may be different for each park and parameter. It was agreed that we’ll pursue this and work with Penelope to conduct power analyses and other simulations to help address this component.

So, how do we go about meeting this objective and learn as much as we can about these ecosystems? How also can we integrate among the other protocols (vegetation, soils, invasive species, macroinvertebrates, riparian birds)? Pete Murdoch presented a compelling case for designing a tiered program (4 tiers) with full integration among the tiers. His powerpoint presentation spells this out and gives examples such as the Collaborative Environmental Monitoring and Research Initiative (CEMRI) project that Pete spearheaded in the past and included work at DEWA. Briefly, the Tiers include 1) focal areas or watersheds with more intensive sampling to get at ecosystem processes. This is also where the other protocols could focus their efforts as well (e.g., collocate sampling); 2) gradient sites representing a range or gradient of known degradation due to current stressors and issues; 3) a broad, random survey of lotic waters; and 4) landscape scale / remotely sensed data and mapping.

I think the group clearly agreed that such an approach has tremendous value, but voiced a couple concerns over its appropriateness or financial applicability to the ERMN. First, the Tier – 2 or gradient sites may be more appropriately addressed in a research or special project context and thus fall outside the realm of Vital Signs (which should focus on general status and trends rather than particular issues). These gradient sites would be selected to address specific contemporary issues (acidic deposition, climate change, fecal coliform bacteria, outside park development). It was argued that it would be hard to select the most pressing issues, and we probably should not design too much around particular issues in a long-term program in case these issues don’t turn out to be the issues we care about 10 yrs later. This notion was countered by the idea that Vital Signs better be doing something about current issues and helping management address them if we want to be relevant and keep our funding. Second, there was immediate concern given the budget framework and staffing scenarios presented by Marshall that the ERMN could afford all three tiers (Tier – 4 is going to be addressed in the ERMN Landscape Dynamics protocol).

Furthermore, there were other suggestions and concerns about selecting some sites like gradient sites and focal watersheds deterministically rather than with some probability based scheme. Finally, it was argued that the Tier 3 with a fully random design may be better approached by incorporating some stratification to control for known, underlying, unchanging, natural differences/variability among streams.

After much discussion, it was agreed that we would proceed by pursuing basically two paths. First, Pete agreed to develop a straw-man incorporating all three tiers to evaluate cost concerns and other issues. Second, we will also proceed with evaluating a second, slightly different, approach that the group seemed to coalesce around; a compromise or what I will term a hybrid approach. It basically would turn out to be Tier 1 and a hybrid of Tier 2 and 3 (at least in my mind). Tier 2 (gradient sites) would be incorporated into the design by including the “percentage of the tributary watershed occurring outside park property or some other form of permanent protection”. The idea is to capture in a broad general way a watershed’s susceptibility to many of the stressors we know about or could occur down the road simply because the land area is not protected (we may want to consider private in-holdings as well). This would be the only “issue” we would design around explicitly.

Furthermore, tier-3 would not be fully random, but instead be a stratified random approach to selecting watersheds for sampling. The stratification would reduce variance and increase power to assess status and trend by controlling for underlying geology and stream order/watershed size. Thus, three criteria would be evaluated (geology or a surrogate, stream order/watershed size, and percent of watershed outside preserved areas). This process would unfold by first evaluating how many strata we have for each criterion, and thus how many classes of watersheds we have. We then select x watersheds from each class for sampling. This approach allows for park-wide inference (assuming all areas of the park fall into a class included for sampling).

This process would also result in a scheme that allows us to address and evaluate many “issues” if we are able to sample enough watersheds. These issues include residential development, acidic deposition, and even climate change if we are able to find watersheds largely protected or within park property without explicitly “designing” around them. A good blend of issue-driven monitoring and more general status and trends monitoring, in my mind.

Tier-1 sites (focal watersheds sampled more intensively and collocated with other vital signs) would be established in a subset of watersheds selected by the stratification process. For each stratum, we would have one (two?) focal watershed. How we choose to select focal watersheds remains an open question. Perhaps some type of “pairing” approach so we have “controls”, or perhaps choosing sites based on high NPS resource value, or perhaps based on other factors like access, existing monitoring, importance to other vital signs, etc.

Over the next several weeks, then, Brady and Scott will begin the largely GIS-based exercise of assembling needed and appropriate data layers for the stratification. They will coordinate with Murdoch and Marshall, obviously, but also Piekielek, Perles, Young, and GIS specialists at parks to gather data layers. Murdoch will also draft a strawman of all 3 Tiers for evaluation and comparison.

As a side note (and there are many I did not include in this document), I am assuming that once we agree on a way to select watersheds for sampling, we then use the GRTS framework already started by Pete to determine where within each watershed we actually sample. It probably won't be just a single site (1 km reach), so we'll have questions about how many sites need to be sampled per watershed in addition to how many watersheds should be sampled per strata. Or perhaps we will just sample one point, per watershed (the "pour" point). Also an open question.

Finally, it should be noted that we may take a different approach to site selection in our four smaller parks (ALPO, JOFL, FONE, FRHI) for obvious reasons.

That's about it for now. I encourage and appreciate feedback.

Matt

## Workshop Participants and Contact Information

|                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Peter Murdoch<br/>U.S. Geological Survey<br/>425 Jordan Road<br/>Troy, N.Y. 12180<br/><a href="mailto:pmurdoch@usgs.gov">pmurdoch@usgs.gov</a><br/>518 285-5663</p>                                                                                          | <p>Kathy Penrod<br/>Natural Resource Specialist<br/>Allegheny Portage Railroad NHS/<br/>Johnstown Flood National Memorial<br/>110 Federal Park Road<br/>Gallitzin, PA 16641<br/><a href="mailto:Kathy_Penrod@nps.gov">Kathy_Penrod@nps.gov</a><br/>814 886-6128</p> | <p>Craig Snyder<br/>USGS - Leetown Science Center<br/>11649 Leetown Road<br/>Kearneysville, WV 25430<br/><a href="mailto:csnyder@usgs.gov">csnyder@usgs.gov</a><br/>304 724-4468</p>                                                                                            |
| <p>Connie Ranson<br/>Natural Resource Specialist<br/>Fort Necessity National Battlefield/<br/>Friendship Hill NHS<br/>One Washington Parkway<br/>Farmington, PA 15437<br/><a href="mailto:Connie_Ranson@nps.gov">Connie_Ranson@nps.gov</a><br/>724 329-5818</p> | <p>Scott Sheeder<br/>Pennsylvania State University<br/>1 Land and Water Building<br/>University Park, PA 16802<br/><a href="mailto:sas371@psu.edu">sas371@psu.edu</a><br/>814 863-5541</p>                                                                          | <p>David R. Smith<br/>USGS - Leetown Science Center<br/>11649 Leetown Road<br/>Kearneysville, WV 25430<br/><a href="mailto:david_r_smith@usgs.gov">david_r_smith@usgs.gov</a><br/>304 724-4467</p>                                                                              |
| <p>Rich Evans<br/>Delaware Water Gap NRA<br/>Division of Research and Planning<br/>294 Milford Road<br/>Milford, PA 18337<br/><a href="mailto:Richard_Evans@nps.gov">Richard_Evans@nps.gov</a><br/>570 296-6952 x26</p>                                         | <p>Beth Johnson<br/>Northeast Region I&amp;M Coordinator<br/>University of Rhode Island<br/>105 Coastal Institute<br/>Kingston, RI 02881<br/><a href="mailto:Beth_Johnson@nps.gov">Beth_Johnson@nps.gov</a><br/>401 874-7060</p>                                    | <p>John A. Young<br/>USGS - Leetown Science Center<br/>11649 Leetown Road<br/>Kearneysville, WV 25430<br/><a href="mailto:jyoung@usgs.gov">jyoung@usgs.gov</a><br/>304 724-4469</p>                                                                                             |
| <p>Allan Ambler<br/>National Park Service<br/>Delaware Water Gap NRA<br/>Division of Research and Planning<br/>294 Milford Road<br/>Milford, PA 18337<br/><a href="mailto:Allan_Ambler@nps.gov">Allan_Ambler@nps.gov</a><br/>570 296-6952 x22</p>               | <p>Stephanie Perles<br/>Penn State and National Park Service<br/>Cooperator<br/>313 Forest Resources Building<br/>University Park, PA 16802<br/><a href="mailto:sjperles@yahoo.com">sjperles@yahoo.com</a></p>                                                      | <p>Jennifer Stingelin Keefer<br/>Penn State and National Park<br/>Service Cooperator<br/>425 Forest Resources Building<br/>University Park, PA 16802<br/><a href="mailto:jls227@psu.edu">jls227@psu.edu</a><br/>814 863-1904</p>                                                |
| <p>Jesses Purvis<br/>National Park Service<br/>New River Gorge National River<br/>P.O. Box 246<br/>Glen Jean, WV 25846-0246<br/><a href="mailto:Jesse_Purvis@nps.gov">Jesse_Purvis@nps.gov</a><br/>304 465-6513</p>                                             | <p>Barry A. Long<br/>National Park Service<br/>Water Resources Division<br/>1201 Oakridge Dr., Suite 250<br/>Fort Collins, CO 80525<br/>(970) 225-3519, (970) 225-9965 fax<br/><a href="mailto:barry_long@nps.gov">barry_long@nps.gov</a></p>                       | <p>Alan Ellsworth<br/>Regional Hydrologist<br/>National Park Service<br/>Philadelphia Science Office<br/>U.S. Geological Survey - WRD<br/>425 Jordan Road<br/>Troy, NY 12180-8349<br/><a href="mailto:Alan_Ellsworth@nps.gov">Alan_Ellsworth@nps.gov</a><br/>(518) 285-5604</p> |
| <p>Penelope S. Pooler Eisenbies<br/>Department of Statistics<br/>Mail Code 0439<br/>Virginia Tech University<br/>Blacksburg, VA 24061<br/><a href="mailto:ppooler@vt.edu">ppooler@vt.edu</a><br/>(540) 231-5329</p>                                             | <p>Don Hamilton<br/>Resource Management Specialist<br/>Upper Delaware SRR<br/>274 River Road<br/>Beach Lake, PA 18405<br/><a href="mailto:Don_Hamilton@nps.gov">Don_Hamilton@nps.gov</a><br/>570 729-7842</p>                                                       | <p>Caleb Tzilkowski<br/>318 Forest Resources Bldg<br/>Pennsylvania State University<br/>University Park, PA 1802<br/>814-863-1982<br/><a href="mailto:cjt111@psu.edu">cjt111@psu.edu</a></p>                                                                                    |

|                                                                                                                                                                                                             |                                                                                                                                                                                                                                        |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Brady J. Mattsson<br>Warnell School of Forestry and<br>Natural Resources<br>University of Georgia<br>Athens, GA 30602<br>706-542-1403<br><a href="mailto:bjmatt@warnell.uga.edu">bjmatt@warnell.uga.edu</a> | Matthew R. Marshall<br>National Park Service<br>422 Forest Resources Building<br>Pennsylvania State University<br>University Park, PA 16802<br>phone: 814-863-0134<br><a href="mailto:matt_marshall@nps.gov">matt_marshall@nps.gov</a> |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

## Workshop Minutes

Brady J. Mattsson

1/10/07

- 37) Water covers three vital signs, including hydrology, core water chemistry, and expanded water chemistry
- 38) Monitoring will trigger actions that could be to just conduct further, more intensive research to identify the source/cause of the trigger.
- 39) Park managers inform the ERMN PIs (henceforth, we/us/our) about their needs for monitoring.
- 40) Our protocols will augment and/or integrate with existing water sampling in the parks.
- 41) Some key Attendees:
  - a) Scott Sheeder: water PI, works at ALPO, FRHI, JOFL, FONE
  - b) Craig Snyder: studies ecological thresholds with respect to macroinvertebrates, incorporates levels of uncertainty, will evaluate management alternatives via structured decision analysis
  - c) Pete Murdoch: It's all about nested monitoring; An integrated multi-tiered (1–4) approach is best. Studied relationships between habitat fragmentation and soil/water chemistry at DEWA.
    - i) Tier 1: Focal watersheds. Conducted continuous monitoring of streams in three watersheds which corresponded with FIA points up-gradient of these stations.
    - ii) Tier 2: Samples (sampled randomly or deterministically) along a gradient of interest. He sampled boundary control points.
    - iii) Tier 3: Random sample (stratified or not) across entire study area. EPA-EMAP hexagons.
    - iv) Tier 4: Landscape metrics (i.e., remote sensing) across entire study area for complete coverage. NLCD (30-m resolution), DOQQs (1-m resolution).
- 42) Pete's proposed example design for WV parks:
  - a) Sampling frame: all tributary watersheds that feed into park rivers.
  - b) Tier 1: continuous monitoring stations in a few focal watersheds
    - i) 100% forest
    - ii) <100% forest
  - c) Tier 2: sample existing monitoring stations along a stressor gradient, e.g. Jesse's sites.
  - d) Tier 3: probability sample of 1-km reaches. 23,000 such reaches across ERMN in tributary watersheds. These reside in an excel spreadsheet and may be harvested.
- 43) Matt clarified that Tier-1 sites are hand-picked for targeted reason(s) as Pete has laid it out.

- 44) Beth indicated that vital signs monitoring is part of a larger effort that could integrate all existing data, not just data collected as part of this program. The goal of vital signs monitoring is to assess status/trends, as opposed to relate vital signs to changing climate and land uses. Monitoring not research.
- 45) Rich Evans: scale of management in DEWA is at boundary control points (BCPs).
- 46) Matt: needs of individual parks are the top priority for this program.
- 47) Brady's thoughts: this meeting would be more efficient if we would split into groups of 4–5 to tackle the specific questions laid out in the original agenda. However, it would be difficult to assign these groups to account for all the dimensions of the program: parks, networks, expertise, stake-holders, etc.
- 48) Al: BCP's are priority because of development threat
- 49) Jesse: interested in BCPs, but many of these points are inaccessible for monitoring at NERI/GARI. Therefore, he would prefer broader monitoring effort that accounts for all stream/river sections rather than focusing on threats of development.
- 50) Kathy: no BCPs in the W PA parks, only headwaters. Therefore, she also prefers a broader, more flexible sampling design. There are, however, opportunities for more watershed-specific trend monitoring, e.g. Brook Trout.
- 51) Craig: Tier 2 (gradient/issue) sampling could be funded outside ERMN vital signs, and the ERMN should focus on Tiers 1 and 3.
- 52) Rich: hemlock forests are disproportionately important (culturally and ecologically). Water quality, however, is the top priority in DEWA, including the main stem & tributaries.
- 53) Jesse: concerned about fecal coliform, primarily, residential development could become a problem, too. He really was not sure beyond this. He seemed a bit disenfranchised at this time point.
- 54) Rich: reservoir management and climate change are also important. He stressed the importance of demonstrating the health of the park, which promotes public approval of the national park system.
- 55) Jesse: agreed with Rich's last statement.
- 56) Brady's thoughts: need to coordinate with Matt & Pete to select sites before March!

1/11/07

- 57) Rich: do not stratify by conditions that can change over time. He noted that most 1<sup>st</sup> & 2<sup>nd</sup> order watersheds are completely within park boundaries. Most 3<sup>rd</sup> order watersheds, however, originate beyond park boundaries. One notable exception is Van Campen's Creek.
- 58) Matt: a fully random Tier 3 facilitates network-wide or national-level objectives, but this level of sampling is less useful to park managers.
- 59) Craig: Tier 2 can also accomplish these broader objectives if a stratified random sample is used.
- 60) Matt: tributary streams are defined as perennial streams that flow into the main stem.
- 61) Brady: suggested that we stratify by % of watershed inside/outside park.
- 62) Brady's thoughts: so, we are excluding intermittent streams?
- 63) Jesse: NERI 1<sup>st</sup> order streams are usually ephemeral, and there is only one perennial watershed with <10% of its area outside park.
- 64) Pete: advocates for establishing focal watershed(s), e.g. intensive monitoring on watershed entirely within park boundaries.

- 65) Jesse: suggested that we look at gradient of % watershed outside park and/or conservation lands rather than using a 10% cut-off.
- 66) Brady's observation: there is consensus that we need to sample watersheds <10% area outside park boundaries.
- 67) Rich: best to focus on 2<sup>nd</sup> & 3<sup>rd</sup> order streams.
- 68) Pete: Tier 2 is not necessarily based on random selection, these sites can be hand-picked across a known stressor gradient.
- 69) Jim: 30% of state forests are preserved, maps may be downloaded for free on-line.
- 70) Craig: we could stratify by bedrock types with respect to their relative acid-neutralizing capacity (ANC): basalt (high), clastic (low)
- 71) Stephanie: she knows geology classes with respect to ANC for DEWA
- 72) Craig: look at distribution of measured values for each stratum across ERMN to assess which strata have sufficient number of watersheds for statistical analysis. The simplest metric for bedrock geology would be % carbonate.
- 73) UPDE manager told Brady that we would need to contact private landowners before establishing transects unless these are on state game lands adjacent to UPDE.
- 74) John told Brady that he has a complete DEM map for DEWA, and he can send distribute this via CD.



**C.11.** March 2010 decision to discontinue intensive transect surveys for Louisiana waterthrush but retain and shift monitoring focus to entire streamside bird community.

March 2010

The following describes a series of discussions and subsequent decisions between the ERMN Program Manager (and Streamside Bird Protocol Lead) and the ERMN member park resource managers. It was during this exchange, specifically, that the decision to discontinue the intensive transect surveys for Louisiana waterthrush was made. Below are the three emails sent by Matt Marshall and the responses received.

*Email 1 from Matt Marshall to the following:*

*Don Hamilton, Rich Evans, Alan Ambler, Jeff Shreiner, Pat Lynch, Allan Ellsworth, John Karish, Kathy Penrod, Connie Ranson, Jesse Purvis, John Perez, Mark Graham, Caleb Tzilkowski, Andy Weber, Stephanie Perles, Kristina Callahan, Jaime Meyer, Jim Comiskey, Larry Hilaire, Scott Stonum, and Rich Egan.*

All,

I have been thinking about water and waterthrush since the review. Part 1 of this series is a quick breakdown of what we might "save" by cutting back on the streamside bird protocol. A few thoughts and then the options:

1. Regardless of future savings, we are committed to a "full" season this spring. Money is obligated, techs are hired, and we start in 1 month.
2. I would like to thoroughly (statistically and otherwise) evaluate the "costs" of these "savings" starting this fall. We'll have four years of data which may be enough. We had planned on something similar after the 5th year, but we can get started earlier in light of our collective thinking.
3. I have been doing some hard thinking about the budget these past few days and water is not the only area that has needs. I am considering these savings in terms of allocation to other program areas as well. There was fairly strong sentiment at the review that Rare Riparian Plants and long-term stability of the Veg and Soils protocols are important. Both could use some help (\$) as well.
4. The streamside bird protocol can be trimmed back in a couple ways. I present two options below.
5. As I said at the review, 15% of my time went onto the "streamside birds" part of the pie. This certainly bumped up the size of that pie slice. I could have left it out since you are all stuck with me regardless of how I allocate my time. But somebody has to lead the protocol and do some analyses. So, I present value with and without my time.

Option 1. This option cuts the protocol essentially in half by either (Option 1A) dropping the "early" visits to each transect which focus exclusively on LOWA. Or (Option 1B) by cutting the number of visits to each site down to just 1 (instead of two). Option 1A would keep the same number of field techs, but cut the length of the season in half. Option 1B would keep the season length the same, but cut the number of technicians in half. There are some smaller tradeoffs and problems with both options, but for simplicity I use the same dollar amount for both.

Option 2. This option drops the two "early" LOWA transect visits AND one of the two "late" visits. So, essentially, the protocol is a single visit to each transect during early summer. We could still record LOWA data and do the Point Counts (for all bird species), but we would only visit each transect 1 time. Two technicians could accomplish this by starting at BLUE in late-May and work their way north all the way through DEWA (in theory).

Here are the numbers with "savings" for each option:

74776 Current: w/o 15% of Matt's = 16% of pie

92326 Current: w/15% of Matt's time = 19% of pie (this value presented at 3-yr Review)

37500 Option 1: Cut program in half = 8% of pie

55050 Option 1: w/ 15% of Matt's time = 12% of pie

37500 Option 1 savings

14865 Option 2: Cut program to only 2 techs for point counts (1 visit per transect) = 3% of pie

32415 Option 2: w/ 15% of Matt's time = 7% of pie

59911 Option 2 savings

Stay tuned for the next installment of "Water and Waterthrush",

-Matt

~~~~~  
National Park Service  
Eastern Rivers and Mountains Network  
403 Forest Resources Building  
University Park, PA 16802  
814-863-0134  
mobile: 814-571-8316  
fax: 814-863-2621  
matt\_marshall@nps.gov  
<http://science.nature.nps.gov/im/units/ermn/>

*Email 2 from Matt Marshall to the following:*

*Don Hamilton, Rich Evans, Alan Ambler, Jeff Shreiner, Pat Lynch, Allan Ellsworth, John Karish, Kathy Penrod, Connie Ranson, Jesse Purvis, John Perez, Mark Graham, Caleb Tzilkowski, Andy Weber, Stephanie Perles, Kristina Callahan, Jaime Meyer, Jim Comiskey, Larry Hilaire, Scott Stonum, and Rich Egan.*

OK, now let's talk about water.

Most of my/our thinking since the review has been on the comments from a variety of people that the ERMN should focus on a core, baseline, water quality program that is consistent with the I&M mission (status and trends of a few ecological indicators). For the sake of discussion, let's move away from the idea of the ERMN supporting the DEWA UPDE "Scenic Rivers Monitoring Program" and present a brief vision of what a sustainable, core, baseline, water program that focuses on a few indicators could look like. This is hard to do over email, but I wanted to float an actual idea or "model" as a strawman. It may also be more than just a strawman, I also tried to justify why I think this may be the best approach given available resources and our core mission. But it is all tradeoffs and pros and cons...

Three guiding thoughts:

1. Focus on the "core" water quality parameters (Temp, Conductivity, pH, DO) and perhaps turbidity. A lot of thought by a lot of people went into the decision to call these the "core" parameters; and for good (ecological) reason.
2. Focus on continuous monitoring via multiparameter sondes. This approach better captures the dynamic nature of these systems and the nested "layers" of variability inherent in wq data that is missed by the grab-sample approach.

3. Focus on what we (primarily Caleb, Andy, and Kristina) can accomplish in a self-sustained, reliable, and stable program. Build out from there with partnerships and the hope of more money in the future.

#### Monitoring Objective:

Document the status, variability, and long-term trends in core parameters at diel, seasonal, and annual time scales at selected sites within ERMN park units.

#### Limitations of this approach.

1. While continuous sondes capture data at a high temporal resolution, the obvious tradeoff is the lack of spatial coverage.
2. Limited to the core parameters.

#### What would it look like?

The idea is for us to manage and deploy a small "fleet" of continuous sondes. I am not sure how many we could actually handle in our fleet but let's start with 5–8 as a goal (phased in over the next few years). We have 2 currently that are ready for some form of pilot work this spring. This means a total of 8 sites monitored at any one time (did I mention lack of spatial coverage?). We can increase the number of sites by going with a rotating/panel design (up to 24 sites across the ERMN if we "sample" every 3 years, for example). Or a combination of fixed and rotating sites. How do we choose the sites? Well, we look to you resource managers for that, but here are some ideas. Given the small number of sites that can be incorporated, we can take a largely hand-picked or "index" site approach. We could also use the "bird and bug" stratified random design and pick a stream in each meaningful strata ("index" site for that strata). Just ideas.

Or:

1. River sites. Lordville or Callicoon? Montague? Jesse has one at Thurmond (New River) already. Bluestone at Pipestem? Gauley or Meadow River? All could be co-located with USGS flow gages. Fixed or rotating? Justification: One site per river is not much, but would be the first data of its kind.
2. Protected trib sites. Dare I say "Tier 1" sites? Dowdy Creek, Bucklick Branch, Laurel Creek (Backus Mtn) are relatively "protected" by NPS ownership. As are VanCampens Brook, Dunnfield Creek, Caledonia, Dry Brook, and others. Justification: A long-term record of what is happening in our most protected sites seems like it would have a lot of value. These would be the "benchmark" sites against which other sites could be compared.
3. Resource value. Flat Brook jumps out. As does Blair Gap Run at ALPO.

#### Other thoughts:

1. What to do about the SRMP? I honestly don't know. One idea is not think of that program in a "monitoring" context but to think of it in a periodic "assessment" context. Essentially go out and find money every few years to do a good and thorough job "assessing" whether any degradation is occurring.
2. What to do about UPDE? We may have to keep some sort of partnership or extra money for UPDE on the table to do something more at this park since several other protocols are NOT being implemented there.
3. What to do about the small parks? Focus on ALPO.
4. Several other I&M Networks have taken the approach I describe above. Upper Columbia Basin Network has 3 sondes and 9 index sites in their program. Northern Colorado Plateau Network has about 9 sondes and 12–16 index sites in their program. UCBN has a very nice protocol and both networks have worked out many of the SOPs and issues. We could get up to speed quickly. Here are a few links if you are interested:

<http://science.nature.nps.gov/im/units/ucbn/monitor/waterchem/waterchem.cfm>

Example 2009 Annual Report:

[https://science1.nature.nps.gov/naturebib/biodiversity/2010-2-22/UCBN\\_2009\\_WQ\\_Annual-Report\\_BIHO\\_20100222.pdf](https://science1.nature.nps.gov/naturebib/biodiversity/2010-2-22/UCBN_2009_WQ_Annual-Report_BIHO_20100222.pdf)

Example 2009 Resource Brief:

[http://science.nature.nps.gov/im/units/ucbn/docs/Resource\\_Briefs/BIHO\\_WQ\\_ResourceBrief\\_20091012.pdf](http://science.nature.nps.gov/im/units/ucbn/docs/Resource_Briefs/BIHO_WQ_ResourceBrief_20091012.pdf)

<http://science.nature.nps.gov/im/units/ncpn/WQBrief.cfm>

So, hopefully you all did your homework on the drive home to help us make some decision soon. Call, email, whatever, **but please give some feedback over the next week and a half. I see a conference call in our future...**

-Matt, Caleb, Andy and KristinaAll,

*Email 3 from Matt Marshall to the following:*

*Don Hamilton, Rich Evans, Alan Ambler, Jeff Shreiner, Pat Lynch, Allan Ellsworth, John Karish, Kathy Penrod, Connie Ranson, Jesse Purvis, John Perez, Mark Graham, Caleb Tzilkowski, Andy Weber, Stephanie Perles, Kristina Callahan, Jaime Meyer, Jim Comiskey, Larry Hilaire, Scott Stonum, and Rich Egan.*

I recently revisited all of your responses to the "Water and Waterthrush" Parts 1 and 2. I have them available as a word file if anyone is interested.

In sum:

1. Strong support for a modification to the LOWA portion of the protocol including dropping the "early" surveys from the protocol which, essentially, cuts the work/\$\$ in half. Final decisions will be based on analysis and a better understanding of what we would lose in addition to what money we would save. We'll end up considering a variety of options and then make a decision in time to implement changes next field season.

2. Strong support for the development of a water quality protocol based on a small fleet of continuous datasondes (core parameters + perhaps turbidity). We will go down this path. Starting this year (next month) Andy will deploy the two ERMN sondes and a loaner from Ellsworth at either DEWA or UPDE and manage them through the fall (monthly data downloads and calibration). A pilot run. Streams only this year. Rivers will come later. I will also use the entire \$60,000 WRD funds for this year to purchase as many additional sondes (and accessories) as I can. Given contracting timelines, it is safe to assume they will not be available for use until next year. Next steps will occur over the winter when we come back to you to discuss sites (which, how many, and why). We'll develop a strawman to get the discussion going. I envision the ERMN managing a small fleet that would be rotated throughout the network. I also envision some fixed sites where a sonde is deployed every year. Park-based help (willingness to do monthly data downloads and calibration) will likely be essential for these fixed sites.

3. I think we can develop and implement a wq protocol based on sondes (see #2) without using all of the money we "save" from a modification to the Streamside Bird Protocol. I know that this discussion started with "cut back on LOWA to do more water", but other protocols have needs too. We will beef up the water slice of the pie, but I want to be up front that I am constantly running through other financial scenarios as well. Specifically, I am trying to rework the budget to see if we can add another GS-7 technician to work with Stephanie and her programs.

Won't make any final decisions on any of this without further input from you all.

Thanks,  
Matt

*Below are all the responses received with the signature of the writer included. Responses are not ordered in any particular way.*

---

Matt,

After I sent my e-mail on water I realized my part 2 suggestion is not realistic - putting one at each park would be a disproportionate allocation of resources. A spatial-size weighting however, leaves out the small (and possibly mid-size) parks altogether. I looked at the acreages of parks yesterday, and realize one sonde for the four small parks is the best we can probably do. I'm not very familiar with FONE streams, but if there are any extras, two would be better than one. I don't think ALPO's data is transferable to FONE. (FRHI could use FONE data and JOFL could piggyback on ALPO.)

This is a draft table I was playing with to see what a "fair allocation" might look like. We are definitely constrained below optimum on the number of sondes.

[attachment "park acreages.xlsx" deleted by Matt Marshall/PHILADELPHIA/NPS]

Do you think I should cc everyone with these thoughts, or is it enough to have this discussion with you? I would not send the table as it is up to those parks to decide, not me - but I do think we could allocate so many per park and let the parks decide on a sampling design.

Thanks,  
Kathy

Kathy Penrod, Natural Resource Specialist  
Allegheny Portage Railroad NHS/Johnstown Flood NMem  
110 Federal Park Road  
Gallitzin, PA 16641

Telephone: (814) 886-6128  
FAX: (814) 884-0206  
e-mail: kathy\_penrod@nps.gov

---

Hi Matt and others,

I'm finally getting back to everyone on the water/waterthrush discussion:

Part 1:

I place a third vote for Option 1A, pending a more formal analysis of the options this fall. As Rich and Don mentioned, I also would like to see more than one visit per site. However, I was taught any sample size less than four is precarious. So, I'm not sure if two will be much better than one. Nonetheless, the early LOWA counts seem the logical place to cut - especially if LOWA are widespread, their value as an "indicator" species may not be very good. Matt suggested at the meeting that territory size may be responsive to watershed health, but I believe that goes too far beyond our monitoring objectives to quantify. Overall, I would like to keep some bird counts and get some data on their status. So, I am in favor of keeping this as a "reduced" vital sign.

What is the rationale/power to detect trends of other networks using only one point count per site per season?

Part 2:

I also like the idea of continuous sondes. I'm not sure I like the idea of totally dropping all small parks. I am concerned about the need to report on WQ status and the fundamental purpose of the network. Eight

(or nine) sondes...nine parks... I'm thinking not to try to cover any tribs, but do try to get one "outflow" measurement from each park. If something is detected, it would mean additional reconnaissance to find the problem (which would likely be the park's responsibility). But, at least each park could have one point. The drawback is there would be no network-wide or park-wide inference, just a point-specific trends analysis. I doubt we are capable of getting enough points to make those inferences given the budget constraint anyway.

Regarding the suggestion to use the bird and bug stratified design - how many strata are there in total? This seems that it would also be problematic if more than eight or nine.

Skipping years (rotating panel design) - it seems that this would make it more difficult to detect trends - at three-year intervals, it could take 9–12 years before we see trends. If this is done, I suggest keeping the "basic" eight or nine sondes in place and rotating those in excess of eight or nine.

How important is flow data in detecting trends? I know it is important in dealing with issues - but, the network purpose is to detect the trend.

That's my thinking so far. I look forward to re-visiting this at the end of the sample season.

Kathy

Kathy Penrod, Natural Resource Specialist  
Allegheny Portage Railroad NHS/Johnstown Flood NMem  
110 Federal Park Road  
Gallitzin, PA 16641

Telephone: (814) 886-6128  
FAX: (814) 884-0206  
e-mail: kathy\_penrod@nps.gov

---

**Don Hamilton/UPDE/NPS**

03/12/2010 04:28 PM

To Richard Evans/DEWA/NPS@NPS  
cc Alan Ellsworth/PHILADELPHIA/NPS@NPS, Allan Ambler/DEWA/NPS@NPS, Andrew Weber/NERO/NPS@NPS, Caleb Tzilkowski/NERO/NPS@NPS, Jeffrey Shreiner/DEWA/NPS@NPS, Jesse Purvis/NERI/NPS@NPS, Jim Comiskey/FRSP/NPS@NPS, John Karish/PHILADELPHIA/NPS@NPS, John Perez/NERI/NPS@NPS, Kathy Penrod/ALPO/NPS@NPS, Kristina Callahan/NERO/NPS@NPS, Larry Hilaire/DEWA/NPS@NPS, Mark Graham/NERI/NPS@NPS, Matt Marshall/PHILADELPHIA/NPS@NPS, Patrick Lynch/DEWA/NPS@NPS, Scott Stonum/NERI/NPS@NPS, Stephanie Perles/PHILADELPHIA/NPS@NPS, Jamie Myers/UPDE/NPS@NPS, Richard Egan/Partner/NPS@NPS  
Su Re: Water and Waterthrush - part 2<sup>(1)</sup>  
bje  
ct

Matt and all:

Sorry it's taken a while to get back to you on this, but have had a few other things to focus on of late.

After reviewing the options presented, and discussing a vision for a future WQ monitoring program with Jamie and Rich, here are a few of our collective thoughts:

Option 1A seems to make the most sense to transition into after this season. With another year of early visit LOWA data, you may have adequately established their status on these streams, against which future (multi-year interval) monitoring can be compared. The higher resolution data is nice for early detection of meaningful change, but might it also be detecting a change in this species' winter habitat, or a migratory weather event resulting in fatalities? And basing a measure of ecological health of riparian forests on (2) point counts of multiple species, and using a bird index that holds promise as a trends measure (and is being adopted by others), sounds like a good way to go.

The \$37,500 ann. savings could purchase a number of sondes (5–6) with the core parameters.

What should we do about continued bacteria monitoring if we're relying heavily on sondes?

The SRMP will likely need to be thought of as a "periodic assessment" program, with the limitations on resources.

Higher priority tribs up here would likely be some we (may) have SPW standards established for.

We may be able to do more BMI trib sites here (with cooperative landowners), or deploy additional sondes in the river, as a more equitable sharing of network I & M funds.

Don Hamilton  
Natural Resource Specialist  
National Park Service  
Upper Delaware Scenic and Recreational River  
274 River Road  
Beach Lake, PA 18405-9737  
(570) 729-7842 (phone)  
(570) 729-8842 (fax)  
email: don\_hamilton@nps.gov

---

**Richard  
Evans/DEWA/NPS**

03/02/2010 12:15 PM

To Matt Marshall/PHILADELPHIA/NPS@NPS

cc Alan Ellsworth/PHILADELPHIA/NPS@NPS, Allan Ambler/DEWA/NPS@NPS, Andrew Weber/NERO/NPS@NPS, Caleb Tzilkowski/NERO/NPS@NPS, Don Hamilton/UPDE/NPS@NPS, Jeffrey Shreiner/DEWA/NPS@NPS, Jesse Purvis/NERI/NPS@NPS, Jim Comiskey/FRSP/NPS@NPS, John Karish/PHILADELPHIA/NPS@NPS, John Perez/NERI/NPS@NPS, Kathy Penrod/ALPO/NPS@NPS, Kristina Callahan/NERO/NPS@NPS, Larry Hilaire/DEWA/NPS@NPS, Mark Graham/NERI/NPS@NPS, Patrick Lynch/DEWA/NPS@NPS, Scott Stonum/NERI/NPS@NPS, Stephanie Perles/PHILADELPHIA/NPS@NPS

Su Re: Water and Waterthrush - part 2<sup>(2)</sup>

bje  
ct

Thanks Matt for laying out these Options and the associated \$\$ savings (included below). Some thoughts:

I'm not sure how we could really save much \$\$ by removing Matt's time, because somebody else would have to do the work Matt has been doing (I assume Matt's doing real work here!), & that would cost \$\$.

Also, Matt is an Ornithologist and quantitatively competent, so he's a good person to do this work. So it seems we should include Matt's time in evaluating the Options.

I think we really need to analyze the bird data and identify the types and amounts of information we would lose by each of these Options before making a final decision. Having said that, I'm very sceptical and hesitant about Option 2, because the information provided by one visit per site may be too minimal to detect trends etc., which is the goal of this program. Random factors e.g. bad weather etc. become more influential with only one visit per site. We might be able to make inferences about the park as a whole, but I think much less likely to be able to make conclusions about each individual site. What about the western PA parks - would they only get one visit per site too? If so, I don't think that we'd be able to learn much from that, unless something drastic happened.

So I'm only considering Option 1 w/ Matt's time, which would apparently "free-up" about ~\$37,500. I don't know how much WQ work we could buy with this amount; it doesn't seem like a trivial amount (hey, it's more than have the amount of the WRD \$\$!), but it doesn't seem like a lot either. Hopefully, Matt, Al, Don, & Jesse could suggest what kinds of WQ info. we could buy with this amount.

Depending on results of analyzing the bird data, I'm inclined to suggest that we seriously consider this Option 1 for next year. At the ERMN review Matt & I talked about the possibility of conducting more intensive LOWA studies periodically, e.g. every 4 or 5 years, which would be really nice to do if we could. (Matt, is there an ecological rationale for choosing a time interval for this, e.g. LOWA life history patterns?)

I've been an advocate for continuous WQ monitoring for a long time, and I like the proposal to deploy sondes. My experience with WQ makes me think that it'd be more cost effective & valuable to get solid scientific information about diel variations in DO, for example, at one site, than a bunch of DO grab samples from several sites. Continuous sondes will capture temporary but potentially critical episodic events e.g. low DO, low pH, or high conductivity or turbidity, which grab samples are very unlikely to detect. The example from BIHO NB revealed how conductivity, pH, and turbidity all "spiked" as a result of a fire in the watershed upstream. This episodic event may be as - or more - important to the ecology of the stream than the usual prevailing conditions. The daily variation (variance) of parameters like DO, pH,

& conductivity may be more important than the "typical" value captured by a single morning or afternoon grab sample value.

For reference, here are the numbers Matt provided for each option (I assume the numbers on the left are actual \$\$ amounts, e.g. \$ 74,776 = 16% -right Matt?):

74776 Current: w/o 15% of Matt's = 16% of pie  
92326 Current: w/15% of Matt's time = 19% of pie (this value presented at 3-yr Review)

37500 Option 1: Cut program in half = 8% of pie  
55050 Option 1: w/ 15% of Matt's time = 12% of pie  
37500 Option 1 savings

14865 Option 2: Cut program to only 2 techs for point counts (1 visit per transect) = 3% of pie  
32415 Option 2: w/ 15% of Matt's time = 7% of pie  
59911 Option 2 savings

- Rich

Richard A. Evans, Ecologist

\*\*\*\*\*

Delaware Water Gap National Recreation Area  
National Park Service  
294 Old Milford Rd.  
Milford, PA 18337  
telephone: (570) 296-6952 ext.26  
e-mail: richard\_evans@nps.gov

-----  
Hi Rich,

I still like Option 1 the best since we can include all birds but also keep the LOWA surveys - just not as many of them. June may not be the ideal time to survey LOWA, but they are still fairly conspicuous. Your point in your other email about random factors (particularly daily weather conditions) affecting individual surveys is very important and very true when it comes to counting birds. Cutting the first and last dates and keeping the middle two seems like a split that may lead to doing neither very well.

As for being logically consistent, I am open to a discussion of re-evaluating a few vital signs all together. The cons are the amount (time and \$) we already invested in birds (not just LOWA) and the fact that "breeding birds" was the last VS to fall into the second tier. So, I kind of feel we're OK with breeding birds even if LOWA doesn't prove to be the primary component. Regardless of how we revamp it, LOWA should be called out as a key measure of the protocol and reported on.

You just want brook trout. I know. But, really, what VS would you advocate for if not birds?

As for LOWA on degraded streams: the literature shows that there are fewer (not always completely absent) birds, more unpaired males (fewer breeding pairs), larger territories, lower nesting success, and decreased use of the main channel (increased use of presumably less-impaired side channels and seeps) on degraded streams. What we're seeing is not inconsistent with what we knew going in. You weren't "sold" something - they do seem to respond to in-stream degradation (not JUST the overall riparian condition even though they respond to that TOO). However, I am not sure we appreciated how difficult it would be to tease apart these more subtle responses over such a large area using the methods we proposed. We knew it would take effort/data, hence 8 temporal replicates. The studies that have

shown this are similar to Terry's work where a few streams and breeding populations are studied in detail with banded birds and nest monitoring, etc. We thought we could get at measures like "pairing success", "number of intervals occupied (akin to territory size)", "use of main channel" (Brady had a whole section in the earlier reports on "channel birds" trying to get at this, but I nixed it because the reports were 50 pages long and full of AIC values, etc.), etc. But this is proving difficult - at least with 3 years of data.

So, I was/am trying to be honest about what is working and what isn't working with the streamside bird protocol. By saying at the review that we have some outliers where LOWA are present on streams we know are impaired may have overstated things a bit and hastened their demise ("axeing the LOWA"). Across the 61 sites in the ERMN we do have a gradient. Many streams seem to be occupied by 4 breeding pairs per transect (the theoretical max). Many sites have all 4 intervals occupied by LOWA, but only 1-3 confirmed breeding pairs. Many sites have fewer than all four intervals occupied. Some sites have no LOWA at all.

Does this gradient ONLY reflect in-stream condition. No. But I certainly hope you never thought it would. I thought we were pretty clear all along that LOWA respond to instream condition, the riparian zone, and even the surrounding forest cover/structure. Which is why I was never an advocate of doing LOWA instead of benthic macros (as Brady thought possible). LOWA just provide part of the story. To me, the premise was that we have a bird species that responds to all the usual terrestrial stuff but ALSO responds to instream condition. That is what made it attractive.

AMD is also an interesting stressor in that a stream's contributing watershed can be in great shape, but you have this point source trashing the stream itself. Our outlier (Ice Pond Run at FRHI) is an otherwise "nice" watershed but has a severe AMD problem. LOWA are present, nest along the stream, but are not foraging in the stream. Does this invalidate LOWA as an indicator? I don't think so (unless you think LOWA only reflect instream condition, then yes). But it does make interpretation much harder (What are they indicating?) which violates a key attribute of a *good* indicator.

More later,

-Matt

~~~~~  
National Park Service  
Eastern Rivers and Mountains Network  
403 Forest Resources Building  
University Park, PA 16802  
814-863-0134  
mobile: 814-571-8316  
fax: 814-863-2621  
matt\_marshall@nps.gov  
<http://science.nature.nps.gov/im/units/ermn/>

**Richard Evans/DEWA/NPS**

03/02/2010 02:20 PM

To Matt Marshall/PHILADELPHIA/NPS@NPS

cc

Su Riparian Bird monitoring<sup>(1)</sup>

bje

ct

Matt,

Just another idea about how to "slice the pie": In your response to Jeff, you indicated that LOWA are pretty quiet by the last surveys. How about cutting the first and last dates, and keeping the middle two (and keeping the LOWA surveys, not just the point counts)? We started this VS based on LOWA; if we get rid of good LOWA surveys, maybe we should revisit the rationale for and value of this VS (to be logically consistent).

Also, I was surprised to learn at the ERMN review that LOWA at NERI nested adjacent to some pretty severely polluted streams. I thought the premise here was that LOWA would respond to stream degradation, and that the science of that had been pretty well worked out by Brady, Master, etc. I guess LOWA are better indicators of riparian condition (?).

-Rich

Richard A. Evans, Ecologist

\*\*\*\*\*

Delaware Water Gap National Recreation Area  
National Park Service  
294 Old Milford Rd.  
Milford, PA 18337  
telephone: (570) 296-6952 ext.26  
e-mail: richard\_evans@nps.gov

-----  
(1) –

1. Seems like the only way to do it since we have already invested so much. The more I think about this the more I realize that we will scale back in some way...no other vital sign is measured so intensively.
2. I too like the bird index and as it turns out NETN, NCRN and probably MIDN will be using the index as well (based on a single visit to each site I believe). Hope it is not just bitterness that brook trout and bog turtle weren't included. Just kidding.
3. We were working towards being able to estimate the occupancy/abundance of LOWA with a high degree of precision - hence the temporal replication (multiple visits to the same transect in both the early spring and during june). Assuming good estimates with high precision, we could detect meaningful changes sooner rather than later. Moreover, we were working towards using more ecologically informative measures like breeding pairs, stream use (as opposed to side channels and seeps), etc. than we could detect using point counts (which give us estimates of "singing male birds"). LOWA are also pretty quiet come June when we do the point counts because they are such early breeders. Point count data is also inherently "noisy" so, presumably, our ability to detect changes is less than what we could have achieved with more intensive effort on this riparian obligate species.
4. We are the only network/agency that I am aware of that has attempted to use LOWA in such an intensive effort. However, several agencies/groups are using a coarse measure of LOWA presence or something similar in broader riparian assessments.
5. We certainly could. Or if we pick a couple "focal watersheds" for more intensive wq monitoring or something, we could focus additional LOWA attention there instead of everywhere. I am most curious to see how well our current point counts track what we are finding with the more intensive LOWA surveys. Our first look at this in the 2007–2009 reports was somewhat inconclusive.

Thanks for the questions/comments. Keep 'em coming...

-----  
National Park Service  
Eastern Rivers and Mountains Network  
403 Forest Resources Building  
University Park, PA 16802  
814-863-0134

mobile: 814-571-8316  
fax: 814-863-2621  
matt\_marshall@nps.gov  
http://science.nature.nps.gov/im/units/ermn/

**Jeffrey  
Shreiner/DEWA/NPS**

03/02/2010 08:40 AM

To Matt Marshall/PHILADELPHIA/NPS@NPS  
cc Alan Ellsworth/PHILADELPHIA/NPS@NPS, Allan  
Ambler/DEWA/NPS@NPS, Andrew Weber/NERO/NPS@NPS,  
Caleb Tzilkowski/NERO/NPS@NPS, Don  
Hamilton/UPDE/NPS@NPS, Jesse Purvis/NERI/NPS@NPS,  
Jim Comiskey/FRSP/NPS@NPS, John  
Karish/PHILADELPHIA/NPS@NPS, John  
Perez/NERI/NPS@NPS, Kathy Penrod/ALPO/NPS@NPS,  
Kristina Callahan/NERO/NPS@NPS, Larry  
Hilaire/DEWA/NPS@NPS, Mark Graham/NERI/NPS@NPS,  
Patrick Lynch/DEWA/NPS@NPS, Richard  
Evans/DEWA/NPS@NPS, Scott Stonum/NERI/NPS@NPS,  
Stephanie Perles/PHILADELPHIA/NPS@NPS  
Su Re: Water and Waterthrush - part 1<sup>(1)</sup>  
bje  
ct

Matt et al.

The plan to analyze the data-cost of reducing the number of samples makes sense.

I never favored centering a vital sign around a single species and was glad that the point counts have been incorporated. I was also pleased to learn about the bird index which, though not tested over time, holds promise as a trends measure.

What do we lose by dropping the early season LOWA work, in terms of measuring the ecological health of the riparian forests?

How widespread is the use of LOWA vs point counts across networks or agencies?

Could we consider an intensive LOWA component every 5 years or something like that, to supplement annual point count data?

=====  
Jeffrey Shreiner \* National Park Service \* Delaware Water Gap NRA \* Resource Management & Science  
294 Old Milford Road \* Milford PA 18337 \* 570 296-6952 x28 \* fax 570 296-4706 \*  
Jeffrey\_Shreiner@nps.gov

The information contained in this e-mail is intended only for the individual or entity to whom it is addressed.

Its contents (including any attachments) may contain confidential and/or privileged information.

If you are not an intended recipient you must not use, disclose, disseminate, copy or print its contents.

If you receive this e-mail in error, please notify the sender by reply e-mail and delete and destroy the message.

-----  
(1) -

Notes:///85256D75004888B2/38D46BF5E8F08834852564B500129B2C/F3454DE842B10A21852576D40  
0569D91

You are correct and I still feel justified in using the funds in support of the SRMP for that reason. The only constraint is that we measure the "core" parameters if we measure anything at all. We're already doing this. So we've met the constraints. WRD has also said to me that we could use the the money to support the benthic macro program if we decided to (for example) so long as we continue to also measure the core parameters. The point is that WRD seems pretty relaxed on how the money is used as long as everyone in the ERMN is happy with how it is being used.

I should also add that what I proposed does not preclude us from using the data in a regulatory framework. It would obviously be limited to the core parameters, but if a state regulatory criteria says something like DO cannot go below 8.0 mg/l on any given day or below 9.5 mg/l for a "7-day mean" we could use the data collected in this regulatory way. (see attached resource brief for BIHO as an example of what I just described).

The biggest problem I see for the SRMP is that the DRBC protocol calls for bi-weekly sampling for 5 months. In other words, a different sampling protocol. However, we may be able to do something that DRBC says is OK (like "pull out" 10 samples from the continuous record on days when AI would normally collect a sample following the SRMP protocol). But, again, only for the core parameters. The other really big problem/shortcoming is that nutrients are a key part of the SRMP objectives and that would obviously be dependent on other money (in the current, but by no means final, proposal).

I don't necessarily see what I proposed most recently as being completely incompatible with the SRMP. It would obviously be a subset of the parameters and number of sites. And would require working with DRBC to see if we could develop a way to use the continuous data in the SRMP regulatory arena. That may be a good question for AI to ask Bob Limbeck.

By the way, you are the first to send any comments/questions whatsoever. Please keep them coming.

[attachment "BIHO\_WQ\_ResourceBrief\_20091012.pdf" deleted by Matt Marshall/PHILADELPHIA/NPS]

~~~~~  
National Park Service  
Eastern Rivers and Mountains Network  
403 Forest Resources Building  
University Park, PA 16802  
814-863-0134  
mobile: 814-571-8316  
fax: 814-863-2621  
matt\_marshall@nps.gov  
<http://science.nature.nps.gov/im/units/ermn/>

**Jeffrey  
Shreiner/DEWA/NPS**

03/01/2010 01:07 PM

To Matt Marshall/PHILADELPHIA/NPS@NPS

cc

Su Re: Water and Waterthrush - part 2<sup>(1)</sup>

bje

ct

Matt: somewhere I got the idea that the WRD \$ are earmarked for regulatory monitoring, hence the support of the SRMP for DEWA/UPDE. What are the constraints, if any, on these funds? Please clarify. Thanks.

=====

Jeffrey Shreiner \* National Park Service \* Delaware Water Gap NRA \* Resource Management & Science  
294 Old Milford Road \* Milford PA 18337 \* 570 296-6952 x28 \* fax 570 296-4706 \*  
Jeffrey\_Shreiner@nps.gov

The information contained in this e-mail is intended only for the individual or entity to whom it is addressed.

Its contents (including any attachments) may contain confidential and/or privileged information.

If you are not an intended recipient you must not use, disclose, disseminate, copy or print its contents.

If you receive this e-mail in error, please notify the sender by reply e-mail and delete and destroy the message.

-----  
(1) -

<Notes:///85256D75004888B2/38D46BF5E8F08834852564B500129B2C/54DCCDEDC41E35EA852576D40064422F>

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 962/117507, November 2012

**National Park Service**  
**U.S. Department of the Interior**



---

**Natural Resource Stewardship and Science**

1201 Oakridge Drive, Suite 150  
Fort Collins, CO 80525

[www.nature.nps.gov](http://www.nature.nps.gov)

EXPERIENCE YOUR AMERICA <sup>TM</sup>