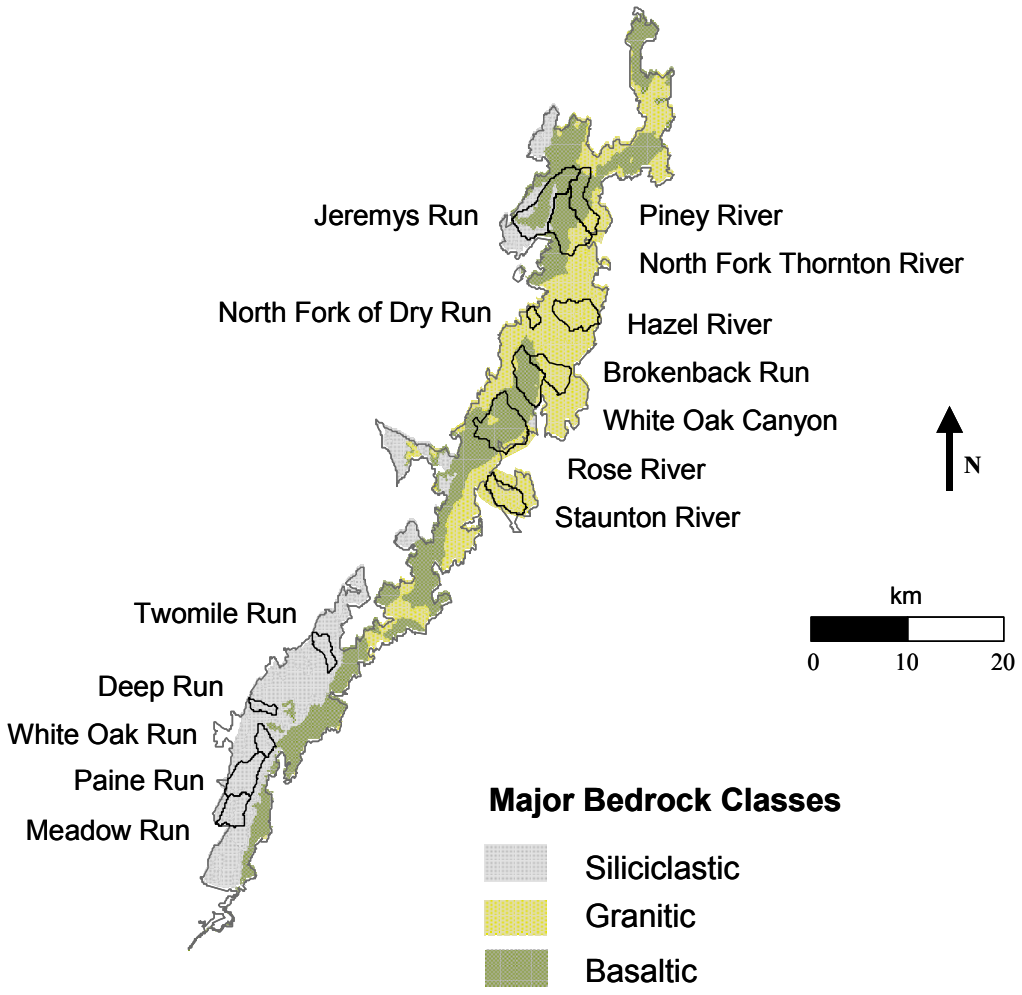
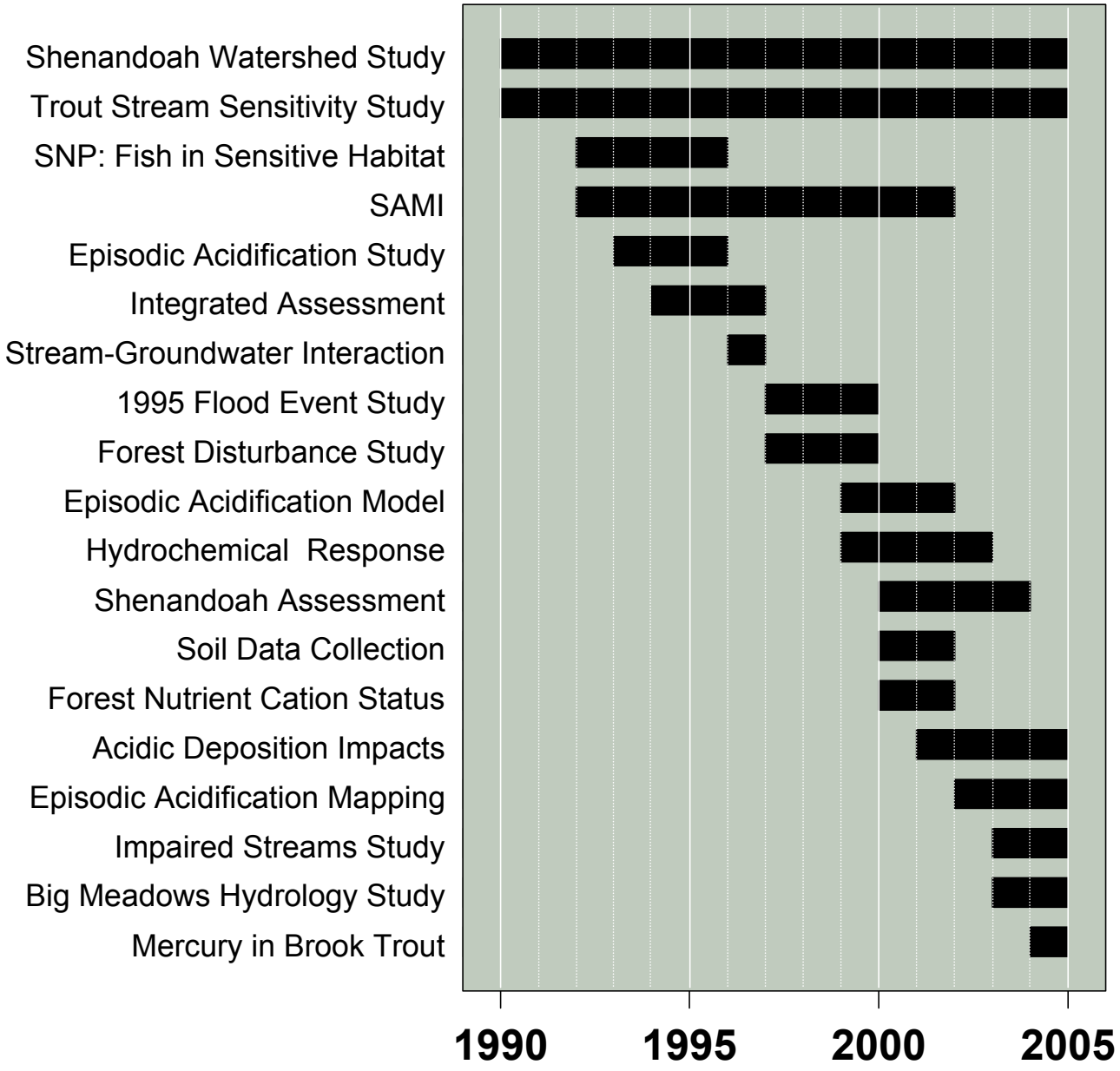
SHENANDOAH WATERSHED STUDY

Summary of Projects: 1990-2004



June 12, 2004

Fifteen-Year Time Line For Projects Involving Work in Shenandoah National Park: 1990–2004



Contents

(1) Shenandoah Watershed Study

Overview

The Shenandoah Watershed Study (SWAS) program has both scientific and resource-management objectives. The underlying scientific objective of the SWAS program has been to improve understanding of hydro-biogeochemical processes and factors that govern ecosystem conditions in the mountain watersheds of the Shenandoah National Park. This scientific objective complements a resource management objective that has been defined by the need to document and assess change that is occurring in SNP's ecosystems.

The SWAS program, together with associated SNP components of the Virginia Trout Stream Sensitivity Study, maintains a hydrochemical information framework in support of long-term research, monitoring, and assessment in SNP's relatively undisturbed watersheds. Most of the projects listed in this document have relied on information obtained through the SWAS program.

Current routine SWAS data collection includes a combination of quarterly and weekly waters quality sampling on 14 streams, continuous discharge measurement on 5 streams, and determination of precipitation amount and composition at 2 locations. Stream water monitoring is stratified based on SNP bedrock. Annual water analysis data and data quality assurance reports are provided to SNP Resource Management.

Dates: 1979–present

Sponsor: National Park Service

Primary Collaborators: U.S. Geologicial Survey, U.S. Environmental Protection Agency, Virginia Department of Game and Inland Fisheries, Virginia Department of Game and Inland Fisheries, Virginia Department of Forestry, University of Maryland, Virginia Tech

Publications:

The SWAS program (along with the VTSSS program) are the umbrella programs for University of Virginia research in Shenandoah National Park - all publications derived from this research can be attributed wholly or in part to the SWAS program - please see the SWAS bibliography for a compilation of journal articles, reports, books and theses deriving from the SWAS research.

(2) Virginia Trout Stream Sensitivity Study

Overview

The broad objective of the Virginia Trout Stream Sensitivity Study (VTSSS) is to support assessment of change in the acid-base chemistry of surface waters following enactment of the Clean Air Act Amendments of 1990. The specific objective is to determine temporal trends and status changes in the acid-base chemistry of streams in the western Virginia region that support reproducing populations of the indigenous brook trout.

Current routine VTSSS data collection includes 51 streams in western Virginia that are sampled on a quarterly basis in conjunction with quarterly sampling in SNP. The VTSSS program also supports episodic water quality sampling on 3 of the SWAS study streams within SNP.

Dates: 1987–present

Sponsor: U.S. Environmental Protection Agency

Primary Collaborators: National Park Service, Virginia Department of Game and Inland Fisheries, USDA Forest Service, Trout Unlimited

Publications:

The VTSSS program (along with the SWAS program) are the umbrella programs for University of Virginia research in Shenandoah National Park - all publications derived from this research can be attributed wholly or in part to the VTSSS program - please see the SWAS bibliography for a compilation of journal articles, reports, books and theses deriving from the VTSSS research.

(3) SNP: Fish in Sensitive Habitats

Overview

The objectives of SNP: FISH (Fish in Sensitive Habitats) were:

1) to describe the water chemistry, physical habitat, and fish communities in selected streams in Shenandoah National Park;
2) to determine if and how fish communities in these streams are influenced by stream acidification; and
3) to use current physical, chemical, and biological data to predict future trends in acidification and effects on stream biota.

Dates: 1992–1994

Sponsor: National Park Service

Primary Collaborators: U.S.D.A. Forest Service, Virginia Tech

Selected publications derived solely or in part from this project:

1995 Bulger, A. J., C. A. Dolloff, B. J. Cosby, K. N. Eshleman, J. R. Webb, and J. N. Galloway. The "Shenandoah National Park: Fish in Sensitive Habitats (SNP: FISH)" Project. An Integrated Assessment of Fish Community Responses to Stream Acidification. Water, Air, and Soil Pollution, 85: 309-314.

1995 Dennis, T.E. and A.J. Bulger. Condition factor and whole-body sodium concentration in a freshwater fish: evidence of acidification stress and possible ionoregulatory over-compensation. Water, Air, and Soil Pollution, 85: 377-382.

1995 Dennis, T.E. , S.E. MacAvoy, M. B. Steg, and A.J. Bulger. The association of water chemistry variables and fish condition in streams of Shenandoah National Park (USA). Water, Air, and Soil Pollution, 85: 365-370.

1995 Eshleman, K.N., L.M. Miller-Marshall, and J.R. Webb. Long-term changes in episodic acidification of streams in Shenandoah National Park, Virginia (USA). Water, Air, and Soil Pollution, 85: 517-522.

1995 Hyer, K.E., J. R. Webb, and K. N. Eshleman. Episodic acidification of three streams in Shenandoah National Park, Virginia, USA. Water, Air and Soil Pollution, 85: 523-528.

1995 MacAvoy, S. E. and A. J. Bulger. Survival of brook trout (Salvelinus fontinalis) embryos and fry in streams of different acid sensitivity in Shenandoah National Park, USA. Water, Air, and Soil Pollution, 85: 445-450.

1995 Newman, K.R. and C.A. Dolloff. Response of blacknose dace (Rhinichthys atratulus) and brook char (Salvelinus fontinalis) to acidified water in a laboratory stream. Water, Air, and Soil Pollution 85: 371-376.

1995 Webb, J. R., B. J. Cosby, F.A. Deviney, K. N. Eshleman, and J. N. Galloway. Change in the acid-base status of an Appalachian Mountain catchment following forest defoliation by the gypsy moth. Water, Air, and Soil Pollution, 85: 535-540.

1995 Dennis, T.E. The susceptibility of the Blacknose Dace, Rhinichthys atratulus, to acidification in Shenandoah National Park. 63 pp. Masters Thesis.

1996 MacAvoy, S.E. Susceptibility of the early life stages of brook trout, Salvelinus fontinalis, and adult blacknose dace, Rhinichthys atratulus, to acidification in Shenandoah National Park. 88 pp. Masters Thesis.

1997 MacAvoy, S.E. and R.C. Zaepfel. Effects of tricaine methanesulfonate (MS-222) on hematocrit: first field measurements on blacknose dace. Transactions of the American Fisheries Society, 126: 500-503.

1997 Hyer, K.D. Episodic acidification of streams in Shenandoah National Park, Virginia. 207 pp. Masters Thesis.

1998 Bulger, A.J., J.R. Webb, and B.J. Cosby. Current and projected status of coldwater fish communities in the southeastern U.S. in the context of continued acid deposition. Project Completion Report to Trout Unlimited.

1999 Bulger, A.J., B.J. Cosby, C.A. Dolloff, K.N. Eshleman, J.R. Webb, and J.N. Galloway. Shenandoah National Park: Fish in Sensitive Habitats. An integrated assessment of fish community responses to stream acidification. Project Completion Report to U.S. National Park Service.

2000 Bulger, A.J., J.R. Webb, and B.J. Cosby. Current, reconstructed past, and projected future status of brook trout (Salvelinus fontinalis) streams in Virginia. Canadian Journal of Fisheries and Aquatic Sciences, 57: 1515.

(4) Southern Appalachian Mountains Initiative

Overview

The Southern Appalachian Mountains Initiative (SAMI) was established to address concerns about the adverse effects of air pollution on environmental resources in the Southern Appalachian region. The geographic region of SAMI interest included the mountainous physiographic provinces of eight southeastern states. Particular emphasis was placed on Class I wilderness areas, including the Shenandoah National Park. SAMI undertook assessments of environmental effects related to air pollution in the region, including the effects of acidic deposition on forest and aquatic resources.

SAMI was conducted in two phases. Phase I was a pilot study that involved watershed assessment for two SWAS study streams in SNP. Phase II was a regional-scale study that involved assessment of current status and future conditions under a range of emission control options.

Dates: 1992–2002

Sponsor: U.S. Environmental Protection Agency, National Park Service, USDA Forest Service, cooperating states

Primary Collaborators: SAMI was a multiparty program involving the collaboration of state and federal resource management agencies, universities, utility companies, and conservation organizations with responsibilities and interest in the Southern Appalachian region.

Selected publications derived solely or in part from this project:

1993 Herlihy, A.T., P.R. Kaufmann, M.R. Church, P.J. Wigington, J.R. Webb, and M.J. Sale. The effects of acidic deposition on streams in the Appalachian mountain and Piedmont region of the mid-Atlantic United States. Water Resources Research, 29: 2687-2703.

1996 Herlihy, A.T., P.R. Kaufmann, J.L. Stoddard, K.N. Eshleman, and A.J. Bulger. Effects of acidic deposition on aquatic resources in the Southern Appalachians with a special focus on Class 1 Wilderness Areas. Report to the Southern Appalachian Mountain Initiative. 91 pp.

2001 Webb, J.R., T.J. Sullivan, and K.U. Snyder. Lithology-Based Landscape Classification for the SAMI Aquatic Effects Assessment. Report to the Southern Appalachian Mountains Initiative, Asheville, North Carolina.

2002 Sullivan, T.J., B.J. Cosby, R.K. Munson, J.R. Webb, K.U. Snyder, A.T. Herlihy, A.J. Bulger, E.H. Gilbert, and D. Moore. Assessment of the Effects of Acidic Deposition on Aquatic Resources in the Southern Appalachian Mountains. Final report to the Southern Appalachian Mountains Initiative, Asheville, North Carolina.

2004 Sullivan, T.J., B.J. Cosby, A.T. Herlihy, J.R. Webb, A.J. Bulger, K.U. Snyder, P. Brewer, E.H. Gilbert, D. Moore. Regional Model Projections of Future Effects of Sulfur and Nitrogen Deposition on Streams in the Southern Appalachian Mountains. Water Resources Research, 40.

(5) Episodic Acidification of Streams in Shenandoah National Park, Virginia

Overview

The project focused on quantifying relationships among:

1) the measured episodic hydrochemical responses of SNP streams:
2) estimated aggregated fluxes of precipitation and pollutants; and
3) several other site-based response and condition variables.

The project relied on existing data bases collected through the SWAS program, as well as additional intensive episodic intensive monitoring established and conducted through the SNP: FISH project.

Dates: 1992–1994

Sponsor: National Park Service

Primary Collaborators: University of Maryland

Selected publications derived solely or in part from this project:

1995 Eshleman, K.N., L.M. Miller-Marshall, and J.R. Webb. Long-term changes in episodic acidification of streams in Shenandoah National Park, Virginia (USA). Water, Air, and Soil Pollution, 85: 517-522.

1995 Hyer, K.E., J. R. Webb, and K. N. Eshleman. Episodic acidification of three streams in Shenandoah National Park, Virginia, USA. Water, Air and Soil Pollution, 85: 523-528.

1997 Hyer, K.D. Episodic acidification of streams in Shenandoah National Park, Virginia. 207 pp. Master Thesis.

1999 Eshleman, K.N., J.L. Moody, K.E. Hyer, and F.A. Deviney. Episodic acidification of streams in Shenandoah National Park, Virginia. Final Report from Cooperative Agreement #4000-2-1007 (supplement #4) submitted to Department of Interior, National Park Service-Air Resources Division (Denver, CO) and National Park Service-Mid-Atlantic Region (University Park, Pennsylvania).

(6) Shenandoah Watershed Study Data Assessment: 1980-1993

Overview

The objectives of the project were:

1) to document the characteristics of, and trends in, the concentration of major chemical components of streamwater;
2) to describe the trends and fluxes of these parameters;
3) to document the characteristics of, and trends in, the rate of wet and bulk deposition at four locations in SNP that collect precipitation;
4) to document the trends in the concentrations of gases and aerosols that contribute to dry deposition;
5) to determine if acid/base species are accumulating in SNP watershed; and
6) to determine if the current programs measuring inputs and responses should be modified to meet management concerns of SNP

Dates: 1994–1996

Sponsor: National Park Service

Selected publications derived solely or in part from this project:

1995 Eshleman, K.N., L.M. Miller-Marshall, and J.R. Webb. Long-term changes in episodic acidification of streams in Shenandoah National Park, Virginia (USA). Water, Air, and Soil Pollution, 85: 517-522.

1995 Webb, J. R., B. J. Cosby, F.A. Deviney, K. N. Eshleman, and J. N. Galloway. Change in the acid-base status of an Appalachian Mountain catchment following forest defoliation by the gypsy moth. Water, Air, and Soil Pollution, 85: 535-540.

1995 Galloway, J.N. Acid deposition: perspectives in time and space. Water, Air, and Soil Pollution, 85: 15-24.

1995 Galloway, J.N., J.R. Webb, and F.A. Deviney. Wet and Bulk Deposition to Shenandoah National Park. Report to the U.S. National Park Service.

1999 Galloway, J.N., F.A. Deviney, and J.R. Webb. Shenandoah Watershed Study Data Assessment: 1980-1993. Report submitted to National Park Service, Luray, Virginia.

(7) Stream-Groundwater Interaction in a Saprolite Aquifer

Overview

The project studied the relationships between precipitation, groundwater flow, and streamflow in a catchment dominated by a thick weathering profile. The objectives of the project were:

1) to conduct in-stream tracer tests using both conservative and non-conservative tracers within differing reaches;
2) to quantify the dynamics of stream-groundwater interaction through numerical modeling of experimental tracer data;
3) to examine water-table response within a saprolitic hillslope to precipitation events, using conservative chemical tracers to separate storm hydrographs into "new" and "old" water components; and
4) to develop simulations of the hydrograph and chemograph data from several storm events, and compare these simulations with observed stream discharge and chemistry

Dates: 1996-1998

Sponsor: University of Virginia, Virginia Water Resources Research Center

Selected publications derived solely or in part from this project:

1997 Carl, K.A. The influence of transient storage in the hyporheic zone on solute transport in South Fork Brokenback Run, Virginia. 60 pp. Masters Thesis.

1997 Greene, C.W. Characterization of runoff processes in a forested headwater catchment, Shenandoah National Park, Virginia. 137 pp. Masters Thesis.

1999 Scanlon, T.M. Modeling stream discharge and dissolved silica variations in a forested headwater catchment: A hydrological pathway approach. 91 pp. Masters Thesis.

2000 Scanlon, T.M., J.P. Raffensperger, G.M. Hornberger, and R.B. Clapp. Shallow subsurface stormflow in a forested headwater catchment: observations and modeling using a modified TOPMODEL. Water Resources Research, 36: 2575-2586.

2001 Scanlon, T.M., J.P. Raffensperger, and G.M. Hornberger. Modeling transport of dissolved silica in a forested headwater catchment: implications for defining the hydrochemical response of observed flow pathways. Water Resources Research, 37: 1071-1082.

(8) Understanding the 1995 Flood Event

Overview

This project was conducted following the catastrophic flooding that occurred in the Staunton River watershed and other watersheds in SNP. The objective of the study was to compare pre- and post-flood status of physical habitat, stream chemistry and fish community in the Staunton River.

Dates: 1997–1999

Sponsor: National Park Service, U.S. Geological Survey

Primary Collaborators: U.S. Geological Survey, U.S.D.A. Forest Service, Virginia Tech

Selected publications derived solely or in part from this project:

2001 Reinhardt, K. The effects of the June 1995 flood on stream chemistry of the Staunton River. 171 pp. Masters Thesis.

2002 Roghair, C.N., C.A. Dolloff, and M.K. Underwood. Response of a brook trout population and instream habitat to a catastrophic flood and debris flow. Transaction of the American Fisheries Society, 131:718-730.

(9) Assessment of Forest Disturbance in the Mid-Atlantic Region: A Multi-Scale Linkage Between Terrestrial and Aquatic Ecosystems

Overview

The objective of this project was to develop, test, validate, and demonstrate an analytical framework for assessing regional-scale forest disturbance in the mid-Atlantic region by establishing a multi-scale linkage between forest disturbance and forest nitrogen export to surface waters. The gypsy moth defoliation in SNP watersheds and the subsequent increase in the concentration and export of nitrogen in SNP streams were primary subjects for the project. Forest cover and mortality data were collected for SWAS study watersheds.

Dates: 1997–1999

Sponsor: U.S. Environmental Protection Agency

Primary Collaborators: University of Maryland

Selected publications derived solely or in part from this project:

1998 Eshleman, K.N., R.P. Morgan II, J.R. Webb, F.A. Deviney, and J.N. Galloway. Temporal patterns of nitrogen leakage from mid-Appalachian forested watersheds: role of insect disturbances. Water Resources Research, 34: 2005-2116.

2000 Eshleman, K.N. A linear model of the effects of disturbance on dissolved nitrogen leakage from forested watersheds. Water Resources Research, 36: 3325-3335.

2000 Eshleman, K.N., R.H. Gardner, S.W. Seagle, N.M. Castro, D.A. Fiscus, J.R. Webb. J.N. Galloway, F.A. Deviney, and A.T. Herlihy. Effects of disturbance on nitrogen export from forested lands of the Chesapeake Bay watershed. Environment Monitoring and Assessment, 63: 187-197.

2000 C.J. Fievet, J.R. Webb, and C. Gray. Forest Species Composition and Basal Area for Selected Watersheds in Western Virginia. Shenandoah Watershed Study, Department of Environmental Sciences, University of Virginia, Charlottesville, Virginia.

2001 Eshleman, K.N., D.A. Fiscus, N.M. Castro, J.R. Webb, and F.A. Deviney, Jr. Computation and visualization of regional-scale forest disturbance and associated dissolved nitrogen export from Shenandoah National Park, Virginia. The Scientific World, 1(S2): 539-547.

2001 J.K. Krawczel. Variations in Nitrate Concentrations in Streams of the Mount Rogers Area. Department of Environmental Sciences, University of Virginia, Charlottesville, Virginia.

2004 Eshleman, K.N., D.A. Fiscus, N.M. Castro, J.R. Webb, and A.T. Herlihy. Regionalization of disturbance-induced nitrogen leakage from mid-Appalachian forests using a linear systems model. Hydrological Processes (In Press).

(10) Hydrologic and Geochemical Controls on Episodic Acidification of Streams in Shenandoah National Park, Virginia: Development and Testing of a Predictive Model

Overview

This project involved calibration of a runoff-ANC model for 3 intensively studied watersheds representing SNP's major bedrock types (Paine Run, Staunton River, and Piney River). Soil-water lysimeters were installed in each of the 3 catchments, and soil-water samples were collected and analyzed. Hydrologic and topographic data sets for each of the 3 catchments were compiled.

Objective of the project were:

1) to develop a theoretical framework for quantifying transient, topographically controlled water movement and reactive mass transport in the subsurface;
2) to calibrate and test this framework at 3 catchments at time scales ranging from episodic to annual; and
3) to examine model sensitivity to both hydrological and geochemical parameters

Dates: 1999–2001

Sponsor: U.S. Geological Survey

Primary Collaborators: U.S. Geological Survey

Selected publications derived solely or in part from this project:

2001 Rice, K.C., S.W. Maben, and J.R. Webb. Title: Water-Quality Data of Soil Water from Three Watersheds, Shenandoah National Park, Virginia, 1999-2000. Open-File Report 01-236, U.S. Geological Survey, Washington, D.C.

2002 Chanat, J.G., K.C. Rice, and G.M. Hornberger, Consistency of patterns in concentration-discharge plots, Water Resources Research 38: 10.1029/2001WR000971.

2004 Rice, K.C., J.G. Chanat, G.M. Hornberger, and J.R. Webb. Interpretation of concentration-discharge patterns in acid-neutralizing capacity during stormflow in three small, forested catchments in Shenandoah National Park, Virginia. Water Resources Research 40, W05301, doi:10.1029/2003WR002709.

2004 Chanat, J.G. Hydrologic Mechanisms Underlying Episodic Concentration-Discharge Relationships in Headwater Catchments. Ph.D. Dissertation.

(11) Implications Of Catchment Structure For Time-Varying Hydrological And Hydrochemical Response In A Forested Headwater Catchment

Overview

This project involved development of a quantitative and predictive physically-based model of the hydrological response of a saprolite-granite catchment. The objectives of project were:

1) to develop a theoretical framework for quantifying transient, topographically controlled water movement and chemical transport in the subsurface;
2) to examine model sensitivity to hydrological and geochemical parameters;
3) to determine critical controls on concentration-discharge dynamics; and
4) to test this theoretical framework using a combination of hydrometric and tracer observations

Dates: 1999–2003

Sponsor: National Science Foundation

Selected publications derived solely or in part from this project:

2000 Scanlon, T.M., J.P. Raffensperger, G.M. Hornberger, and R.B. Clapp. Shallow subsurface stormflow in a forested headwater catchment: observations and modeling using a modified TOPMODEL. Water Resources Research, 36: 2575-2586.

2001 Scanlon, T.M., J.P. Raffensperger, and G.M. Hornberger. Modeling transport of dissolved silica in a forested headwater catchment: implications for defining the hydrochemical response of observed flow pathways. Water Resources Research, 37: 1071-1082.

2001 Hornberger, G.M., T.M. Scanlon, and J.P. Raffensperger. Modeling transport of dissolved silica in a forested headwater catchment: The effect of hydrological and chemical time scaled on hysteresis in the concentration-discharge Relationship. Hydrological Processes, 15: 2029-2038.

2002 Katul, G., Wiberg, P., Albertson, J. and G. Hornberger. A mixing layer theory for flow resistance in shallow streams. Water Resources Research 38 (11), 1250, doi:10.1029/2001WR000817

2002 Chanat, J.G., K.C. Rice, and G.M. Hornberger, Consistency of patterns in concentration-discharge plots, Water Resources Research 38: 10.1029/2001WR000971.

2002 Hornberger, G.M. Forecasting the Impact of Atmospheric Acidic Deposition on the Chemical Composition of Stream Water and Soil Water. In: Beck, M.B. (ed.) Environmental Foresight and Models: A Manifesto, Chapter 8, pp 131-145. Elsevier Science.

2003 Welsch, D.L. Modeling the influence of riparian soil air CO2 concentrations on stream water alkalinity. 110 pp. Ph.D. Dissertation.

2003 Chanat, J.G., and G.M. Hornberger, Modeling catchment-scale mixing in the near-stream zone—Implications for chemical and isotopic hydrograph separation, Geophysical Research Letters. 30 (2), 1091, doi:10.1029/2002GL016265.

2004 Chanat, J.G. Hydrologic Mechanisms Underlying Episodic Concentration-Discharge Relationships in Headwater Catchments. Ph.D. Dissertation.

2004 Rice, K.C., J.G. Chanat, G.M. Hornberger, and J.R. Webb. Interpretation of concentration-discharge patterns in acid-neutralizing capacity during stormflow in three small, forested catchments in Shenandoah National Park, Virginia. Water Resources Research 40, W05301, doi:10.1029/2003WR002709.

2004 Welsch, D.L. and G.M. Hornberger. Spatial and temporal simulation of soil CO_2 concentrations in a small forested catchment in Virginia. Biogeochemistry (In press).

(12) Assessment of Air Quality and Related Values in Shenandoah National Park

Overview

A comprehensive assessment of Shenandoah National Park air quality and related values. This assessment addressed visibility, vegetation, soils, streamwater chemistry, fish, and aquatic insects, as well as the human-made air pollutants that most affect them. It also projected future air quality, acidic deposition, and resource conditions and recovery, assuming implementation of four emissions control scenarios.

Dates: 2000–2003

Sponsor: National Park Service

Primary Collaborators: E&S Environmental Chemistry, Inc., U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration

Selected publications derived solely or in part from this project:

2003 Sullivan, T.J., B.J. Cosby, J.A. Laurence, R.L. Dennis, K. Savig, J.R. Webb, A.J. Bulger, M. Scruggs, C. Gordon, J. Ray, E.H. Lee, W.E. Hogsett, H. Wayne, D. Miller, and J.S. Kern. Assessment of Air Quality and Related Values in Shenandoah National Park. NPS/NERCHAL/NRTR-03/090, U.S. Department of the Interior, Philadelphia, Pennsylvania.

2004 Sullivan, T.J., B.J. Cosby, A.T. Herlihy, J.R. Webb, A.J. Bulger, K.U. Snyder, P. Brewer, E.H. Gilbert, D. Moore. Regional Model Projections of Future Effects of Sulfur and Nitrogen Deposition on Streams in the Southern Appalachian Mountains. Water Resources Research, 40.

2004 Webb, J.R., B.J. Cosby, F.A. Deviney, Jr., J.N. Galloway, S.W. Maben, and A.J. Bulger. Are brook trout streams in western Virginia and Shenandoah National Park recovering from acidification?, Environmental Science and Technology (In Press).

(13) Collection of Soil Samples in Shenandoah National Park

Overview

This project involved collection and analysis of soils samples from the primary SWAS study watersheds. Samples were collected from 79 locations selected to represent the major bedrock types and topographic positions in the study watersheds. The samples were collected and analyzed for acid-base properties to support model conducted for the project: Assessment of Air Quality and Related Values in Shenandoah National Park.

Dates: 2000-2001

Sponsor: National Park Service

Selected publications derived solely or in part from this project:

2003 Sullivan, T.J., B.J. Cosby, J.A. Laurence, R.L. Dennis, K. Savig, J.R. Webb, A.J. Bulger, M. Scruggs, C. Gordon, J. Ray, E.H. Lee, W.E. Hogsett, H. Wayne, D. Miller, and J.S. Kern. Assessment of Air Quality and Related Values in Shenandoah National Park. NPS/NERCHAL/NRTR-03/090, U.S. Department of the Interior, Philadelphia, Pennsylvania.

(14) Examination of Nutrient Cation Status in Western Virginia Forests

Overview

This project involved the collection of cores from northern red oak trees at a subset of (30) of the sites sampled in conjunction with project: Collection of Soil Samples in Shenandoah National Park. The cores were collect for analysis of base-cation chemistry of samples representing 10-year growth increments.

The objectives for the project were:

1) to determine the current relationship between the base-cation content of soils and the base-cation content of tree rings;
2) to determine the coincidence of past change in the base-cation status of soils (based on modeled reconstructions) and past change in the base-cation content of tree rings; and

3) to estimate future change in the base-cation content of trees based on modeled projections of future change in the base-cation content of soils

Dates: 2000–2001

Sponsor: Virginia Department of Forestry

Primary Collaborators: Virginia Department of Forestry

Selected publications derived solely or in part from this project:

2002 Blankenship, J.C. The potential use of trends in tree-ring chemistry as an indicator of soil acidification in Shenandoah National Park. Shenandoah Watershed Study, Department of Environmental Sciences, University of Virginia, Charlottesville, Virginia.

(15) Acidic Deposition Impacts on Natural Resources in Shenandoah National Park

Overview

The project consists of two main components:

1) a field component which includes stream-side fish bioassays to establish the sensitivity of additional fish species in SNP; and
2) a modeling component which will integrate recent advances in data and information on aquatic biota, streams, soils, vegetation and land use into a management accessible tool

Dates: 2001–2004

Sponsor: National Park Service

Selected publications derived solely or in part from this project:

2004 Krawzcel, J.K. Assessing the lethal and sublethal effects of stream acidification on five fish species in Shenandoah National Park. Masters Thesis.

(16) Development of a Park-Wide Geology and Topography-Based Map of Vulnerability to Episodic Acidification of Streams in Shenandoah National Park, Virginia

Overview

This project will build on previous episodic acidification studies and modeling to develop a park-wide map that will indicate the magnitude, frequency, and duration of episodic acidification in SNP watersheds.

Dates: 2002–2004

Sponsor: U.S. Geological Survey

Primary Collaborators: U.S. Geological Survey

(17) Identification of Native Brook Trout Streams That Are Impaired by Acidification

Overview

This project will obtain 12 monthly pH measurements from 20 of Virginia's most acidic native brook trout streams for the purpose of impaired streams listing. Data collection protocols conform to methods established by the Virginia Department of Environmental Quality to satisfy the reporting requirements of Section 303(d) of the Clean Water Act.

Six of the streams selected for data collection are located in SNP.

Dates: 2003–2004

Sponsor: Virginia Water Resources Research Center

Primary Collaborators: Virginia Department of Environmental Quality

(18) Hydrology of Big Meadows, Shenandoah National Park, Virginia: Assessment of a Sensitive Wetland System in the Blue Ridge Mountains

Overview

This project will involve collection of data to establish the hydrologic conditions and sensitivities of the Big Meadows wetland in Shenandoah National Park. The objectives of the study are as follows.

1. Document seasonal changes in the hydrology of wetlands and adjacent meadow areas at Big Meadows, including seasonal variations in inundated area, depths to the water table, soil moisture characteristics, and related parameters as needed for the park's Meadow Management Plan.
2. Determine relationships between the hydrology of Big Meadows ecosystems and the underlying ground-water system. Specifically, evaluate the effects of ground water withdrawals on wetland and meadow hydrology.
3. Provide data and models for assessing how ground-water use, climate change, and management activities will affect the water balance at Big Meadows.

Dates: 2003–2004

Sponsor: National Park Service

(19) Effects of Stream Water Chemistry on Mercury Concentrations in Brook Trout in Shenandoah National Park

Overview

This project will determine the distribution, abundance, and variability of mercury in fish within Shenandoah National Park. The goal of the study is to ensure that mercury contamination poses no threat to humans or fish populations in the park. Results of the study will:

1) provide data needed to evaluate human health risks associated with the consumption of contaminated fish in Shenandoah National Park;
2) determine the potential for acute or chronic problems with trout populations associated with Hg accumulation and toxicity; and
3) improve our understanding of the factors governing the bioavailability of mercury in stream ecosystems

Dates: 2004–2005

Sponsors: U.S. Geological Survey, National Park Service

Primary Collaborators: U.S. Geological Survey