



Shenandoah National Park

Macroinvertebrate Monitoring Resource Brief



2012 Status & Trends

Shenandoah National Park (SHEN) monitors benthic macroinvertebrate communities as part of the National Park Service (NPS) Vital Signs Program. Vital signs are 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 (Fancy et al. 2009). Within SHEN, benthic macroinvertebrates are monitored to help characterize the status and trends of park aquatic ecosystems. Standardized stream sites that are 100m in length are sampled for macroinvertebrates using a portable invertebrate box sampler (PIBS). Within each 100m site, 3 PIBS collections occur in random locations in riffles. Environmental variables such as stream widths, substrate characteristics, and water quality and quantity information are also collected. In 2012, a total of 34 sites along 26 park streams were sampled. Of the 34 sites that were monitored, 28 of these sites were “primary” sites and are monitored every year. The other 6 sites were “secondary” sites that are revisited once every 8 years.

Some aspects of aquatic ecosystem processes and associated responses to environmental stressors in SHEN can be driven by the physical environment. For example, the bedrock underlying a particular watershed can influence soil characteristics, and ultimately can drive processes that determine the impacts of acid deposition events (e.g. acid rain) on aquatic biota. This is because certain geologic types and their derived soil types are more capable of neutralizing acid inputs, and thus are better able to limit the impacts of acid deposition on stream water pH (see box below, right).

Data analysis for this report includes an assessment of the status (Figure 1) and trends (Table 1) of monitoring sites. The Virginia Stream Condition Index (VSCI, Burton 2003), a multimetric summary of macroinvertebrate community measures was calculated for each site. Because the VSCI represents a relatively simplistic data assessment, results should be interpreted with caution. More rigorous analyses occur on a five year basis, or as necessary. For the latest in-depth analysis of SHEN macroinvertebrate data, please see Jastram et al. (2013).

Results from 2012 indicate that some streams may be biologically impaired, likely as a result of acid deposition (Figure 1). Over the long term, trends in VSCI scores suggest that some sites may be ecologically improving (Table 1), although more rigorous assessments indicate stable or declining macroinvertebrate communities (Jastram et al 2013).

Monitoring Objectives

1. Establish status and trends of benthic macroinvertebrate assemblages at sites within geologic and elevational groups across SHEN by means of metrics that reflect abundance, richness, evenness, environmental requirements, ecological roles, and responses to various potential stressors.
2. Establish status and trends of habitat condition (both instream and riparian) and water quality at same selected sites within SHEN by means of habitat assessments and point-in-time measurement of core water quality parameters.
3. Relate the condition of benthic macroinvertebrate assemblages at same selected sites within SHEN to established regional biological criteria for ecological integrity.

Park geology and acid deposition

1. Watersheds that are underlain by siliciclastic bedrock are more susceptible to acid rain events because soil characteristics are such that acids are poorly buffered – this results in lower (i.e. more acidified) water pH.
2. In contrast, basaltic and granitic watersheds are better able to buffer acid deposition, leading to more neutral water pH.



Stonefly larva (Perlidae) - NPS photo

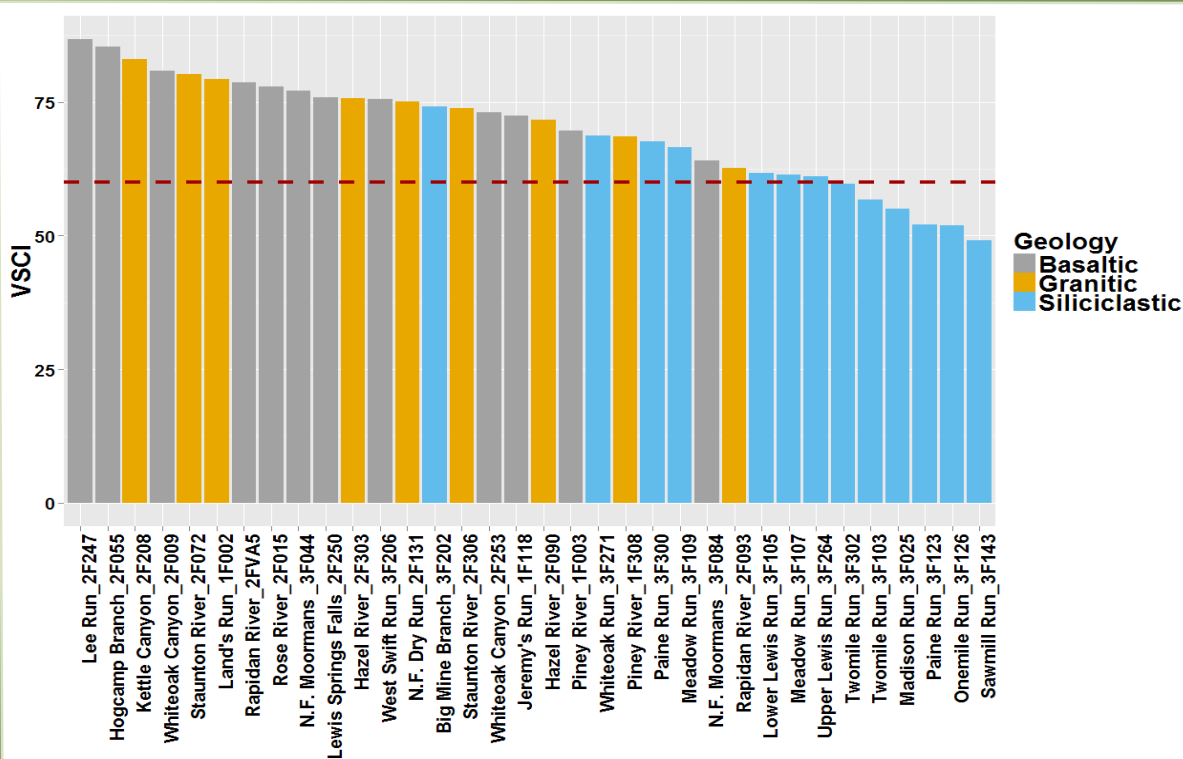


Figure 1. Virginia Stream Condition Index (VSCI) mean score by watershed geologic types in 2012. X axis shows stream names and site codes. Bars that score below 60 (i.e. dashed horizontal line) indicate potential stream impairment at that sample site. Note that siliciclastic streams (i.e. blue bars) tend to score lower than granitic or basaltic streams, likely as a result of acid deposition (Jastram et al. 2013).

STREAM	SITE	TREND	GEOLOGY
Hogcamp Branch	2F055	0.53	Basaltic
Jeremy's Run	1F118	0.34	Basaltic
N.F. Moormans	3F044	-0.20	Basaltic
N.F. Moormans	3F084	0.20	Basaltic
Piney River	1F003	0.29	Basaltic
Rapidan River	2FVA5	0.46	Basaltic
Rose River	2F015	0.29	Basaltic
Whiteoak Canyon	2F009	0.28	Basaltic
Whiteoak Canyon	2F253	0.77	Basaltic
N.F. Dry Run	2F131	0.53	Granitic
Hazel River	2F090	-0.02	Granitic
Hazel River	2F303	-0.01	Granitic
Land's Run	1F002	0.28	Granitic
Piney River	1F308	0.02	Granitic
Rapidan River	2F093	-0.71	Granitic
Staunton River	2F072	0.33	Granitic
Staunton River	2F306	-0.57	Granitic
Lower Lewis Run	3F105	0.01	Siliciclastic
Madison Run	3F025	-0.38	Siliciclastic
Meadow Run	3F107	0.92	Siliciclastic
Meadow Run	3F109	1.27	Siliciclastic
Onemile Run	3F126	-0.25	Siliciclastic
Paine Run	3F123	-0.26	Siliciclastic
Paine Run	3F300	0.70	Siliciclastic
Sawmill Run	3F143	-0.25	Siliciclastic
Twomile Run	3F103	0.22	Siliciclastic
Twomile Run	3F302	0.01	Siliciclastic

Table 1 (left). Virginia Stream Condition Index (VSCI) linear regression slope (i.e. trend) in primary sites (1987-2012). Significant trends ($p > 0.1$) are in italics and bold. Although a few sites do show a significant improvement in ecological condition (i.e. positive trend), a review of all sites across the park indicates that there is no trend in the VSCI, meaning that the park as a whole has stable macroinvertebrate communities according to the VSCI metric (sign test, $p > 0.1$). In contrast, Jastram et al (2013), following an intensive assessment of a much larger number of macroinvertebrate metrics, concluded that siliciclastic streams were declining in condition while basaltic and granitic streams were improving or showing no change in ecological condition. Jastram also noted evidence that stream temperature increases across the park (possibly as a result of climate change) may be negatively impacting macroinvertebrate communities.

References

- Burton, J. and Gerritsen, J. 2003. A stream condition index for Virginia non-coastal streams. Owings Mills, Md., Tetra Tech, Inc., 163 p.
- Jastram, J.D., C.D. Snyder, N.P. Hitt, K.C. Rice. 2013. Synthesis and Interpretation of Surface Water-Quality and Aquatic Biota Data Collected in Shenandoah National Park, Virginia, 1979-2009. USGS Report Series 2013-5157.
- Fancy, S.G., J.E. Gross and S.L. Carter. 2009. Monitoring the condition of natural resources in U.S. National Parks. Environmental Monitoring and Assessment 151:161-174.



A Portable invertebrate box sampler (PIBS) is used to collect macroinvertebrates from riffle habitats. NPS photo

Acknowledgements: Thanks to Matt Lippy and Kirk Dunn for their assistance in the field. Macroinvertebrate sorting and identification was conducted by Dr. Reese Voshell and Stephen Hiner at Virginia Polytechnic Institute.



Lead Scientist

Jeb Wofford
 Jeb_wofford@nps.gov
 Fish and wildlife biologist

Lead Technician

David Demarest
 David_demarest@nps.gov
 Fish and wildlife technician