



Aquatic Macroinvertebrate Monitoring Program

Introduction

There are approximately 240 species of aquatic macroinvertebrates known in Shenandoah National Park. Aquatic invertebrate samples have been collected on certain streams in the Park since 1986. Sampling was a direct response to the wave of gypsy moth (*Lymantria dispar*) defoliation in the southeastern United States. Aquatic insects have been used as indicators of stream health for many years. Different assemblages of insects have the ability to show variations in streamwater chemistry and flood and drought cycles.

Aquatic insects are numerous, have short life cycles, and are directly affected by changes in water chemistry and flow. These factors coupled with relative ease of sampling, makes them excellent indicators of aquatic ecosystem health. There is also more species diversity in the insect community than more highly visible organisms such as fish. A change in species composition is relatively easy to detect and can then be used to assess stream decline or recovery.



Park employee using a Portable Invertebrate Box Sampler (PIBS) on the Staunton River, April 2003.

Management Needs

Surface water originating in Shenandoah National Park ultimately flows through 51 counties in 3 states and the District of Columbia. Shenandoah National Park staff have sampled aquatic macroinvertebrates for 26 years. As stated above, the program was started in response to gypsy moth defoliation but the data can be used to assess many impacts such as trail and road erosion, road salt contamination, wastewater treatment plant effluent, past land disturbance, and acidification due to acid rain.

From 2006 to 2009, park staff located native brook trout (*Salvelinus fontinalis*) populations in 23 additional park streams. These streams have not yet been sampled for aquatic macroinvertebrates.

From 1998 to 2004, eight of 11 streams known to be low in acid neutralizing capacity (ANC) were sampled yearly. ANC is characterized as the ability of the geologic type neutralize (buffer) acid. Sampling lapsed in 2005 and 2007 and was again fully funded 2008- 2011 on an annual basis.

Current Procedures

Since 1993, data has remained consistent with one technician taking the bulk of the quantitative samples each year. Stream habitat data is collected at each site and the invertebrates are sent to Virginia Tech for identification within one month of the final sampling date each year. All data is entered into Microsoft Access. To date, 114 sites in 51 drainages have been sampled. There are roughly 81 "permanent" drainages that exit the Park.

What We Have Learned

A recent project looked at current and past land use in concert with invertebrate data. This was then compared to other data collected throughout the Blue Ridge region. From this work it was determined that Park streams appear to have recovered from land use practices prior to Park establishment, and that the roads, trails, and wastewater treatment plants are not causing any discernable impacts in the aquatic invertebrate assemblage.

There are six major geologic types which compose 18 variations of rock strata in the drainages sampled to date. The only streams that stand out as having a different aquatic macroinvertebrate community structure are in the siliciclastic formations. Streams that flow over siliciclastic bedrock are considered low ANC streams. There is no clear break in aquatic invertebrate communities within the granitic or basaltic geologic types. Analysis is continuing on a stream by stream basis and may show differences in flood and drought effects as more data is analyzed.



Happy Creek in Warren County sampled May 2004.



Aquatic Macroinvertebrate Monitoring Program (continued...)

References

Demarest, E. David, J. Reese Voshell, Jr., and Steven W. Hiner. 2002- 04. Internal Draft Document. Shenandoah National Park Long- Term Ecological Monitoring System, Aquatic Component User Manual. Shenandoah National Park, Luray, Virginia 22835.

Johnson, Zane B. and Craig Snyder. 2002. Recovery of Aquatic Macroinvertebrates Following a 500+ Year Flood Event in Shenandoah National Park. United States Geological Survey, Leetown Science Center, Aquatic Ecology Laboratory, Kearneysville, WV 25430.

Marshall, Brett D., and J. Reese Voshell, Jr. 1994. Effects of Gypsy Moth Defoliation on the Aquatic Biota of Headwater Streams in Shenandoah National Park. Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

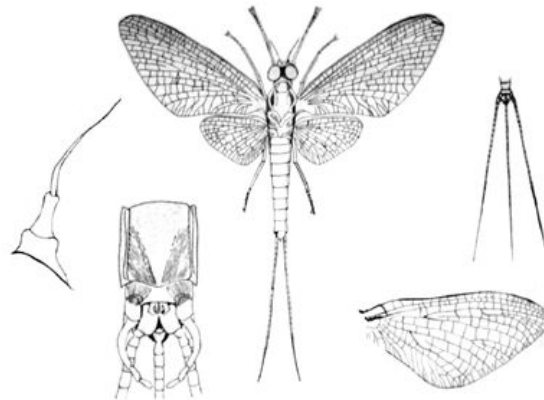
Moeykens, Michael D., and J. Reese Voshell. 2002. Studies of Benthic Macroinvertebrates for the Shenandoah National Park Long- Term Ecological Monitoring System: Statistical Analysis of LTEMs Aquatic Dataset from 1986 to 2000 on Water Chemistry, Habitat, and Macroinvertebrates. Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

Smith, Eric P., and J. Reese Voshell, Jr. 1994. Second Annual Report. Analyzing Long Term Ecological Monitoring Data to Determine Benthic Macroinvertebrate Community Responses to Stream Acidification in Shenandoah National Park. Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

Smith, Eric P., and J. Reese Voshell, Jr. 1997. Studies of Benthic Macroinvertebrates and Fish in Streams Within EPA Region 3 for Development of Biological Indicators of Ecological Condition. Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

Voshell, J. Reese, Jr., and Steven W. Hiner. 1990. Shenandoah National Park Long- Term Ecological Monitoring System, Section III, Aquatic Component User Manual. In: United States Department of the Interior, Shenandoah National Park long- term ecological monitoring system user manuals, Section III. USDI, NPS, Shenandoah National Park, Luray, Virginia 22835. 14- 16- 0009- 1558.

Voshell, J. Reese, Jr., and Steven W. Hiner. 1993. First Annual Report. Analyzing Long Term Ecological Monitoring Data to Determine Benthic Macroinvertebrate Community Responses to Stream Acidification in Shenandoah National Park. Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.



Example ephemeroptera adults.