



Shenandoah National Park

Fish Monitoring Resource Brief



2012 Status & Trends

Shenandoah National Park (SHEN) monitors fish 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, fish are monitored to help characterize the status and trends of park aquatic ecosystems. Monitoring occurs via 3-pass electrofishing at standardized sites that are

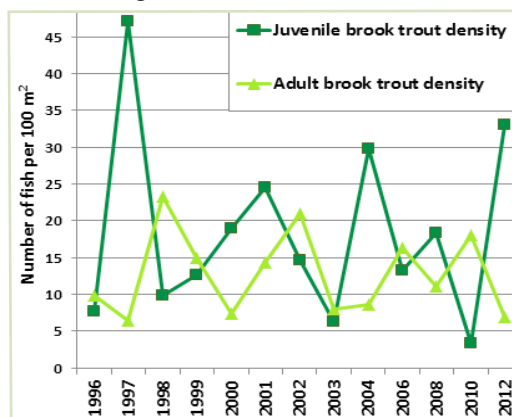


Figure 1. Brook trout density (# of fish/100m²)

100m in length. Fish are measured and weighed and environmental variables such as stream widths, substrate characteristics, and water quality and quantity information are also collected. In 2012, a total of 51 sites along 26 park streams were sampled. Of the 51 sites that were monitored, 41 of these sites are “primary” sites that were monitored every year until 2004 and then every other year thereafter. The other 10 sites were “secondary” sites that included revisits to sites that are sampled once every 8 years. Ultimately, during 2012, a total of 34,333 individual fish representing 20 species were captured from all monitoring sites. No new species were observed.

Brook trout are considered to be sensitive to environmental changes and are therefore closely monitored in SHEN. As depicted in Figure 1, brook trout recruitment during 2012 was exceedingly large, with very high densities of juvenile brook trout (i.e. “young-of-the-year”) when compared to prior years. Across the park, juvenile trout density averaged 33.0 trout per 100m², approximately 2

Monitoring Objectives

1. Determine long term trends in fish species abundance and biomass and community composition within selected stream sites over time.
2. Determine long term trends in condition factors and reproduction of game fish within selected stream sites over time.
3. Determine relationships between physical and biological parameters and fish community and population dynamics within selected stream sites over time.
4. Establish baselines and thresholds of fish population metrics that trigger additional research or management actions.

times higher than long-term averages (17.2 per 100m²) and representing a very successful year for brook trout reproduction in SHEN. Adult brook trout densities in 2012 averaged 6.9 trout per 100m² versus a long-term average of 13.3 trout per 100m² (Figure 1). Low adult trout numbers are at least partially a function of poor reproduction in prior



American Eel population increase in the Rappahannock watershed

Over the last decade, the park’s fish monitoring program documented a large increase the abundance of American eels in the Rappahannock watershed following the removal of Embrey Dam in 2004. Embrey Dam was an 8 foot structure located approximately 100 miles downstream of the park boundary. The dam impeded eel passage and therefore restricted the size

and number of American eels that were able to migrate to the park. Following dam removal, eel numbers in the park increased dramatically. See the following publication for details: Hitt, N.T., S. Eyler, J.E.B. Wofford. 2012. Dam removal increases eel abundance in distant headwater streams. *Transactions of the American Fisheries Society*. 141:1171-1179.

Park geology and acid deposition

- 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.
- In contrast, basaltic and granitic watersheds are better able to buffer acid deposition, leading to more neutral water pH.

2012 Status & Trends...

years (e.g. 2010). This 2012 adult density represents the second lowest on record while the 2012 juvenile density represents the second highest since sampling was initiated under current protocols in 1996.

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 more able to limit the impacts of acid deposition on stream water pH (see box above, left).

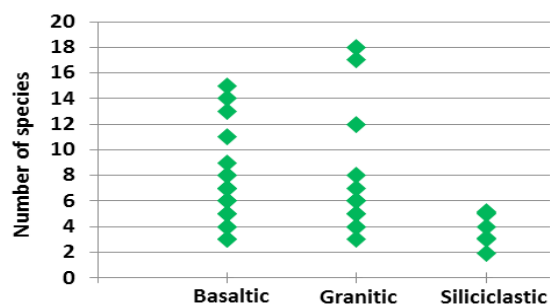


Figure 2. Species richness by watershed geologic types in 2012. Siliciclastic watersheds show much lower richness, likely a result of acid deposition and associated pH declines.

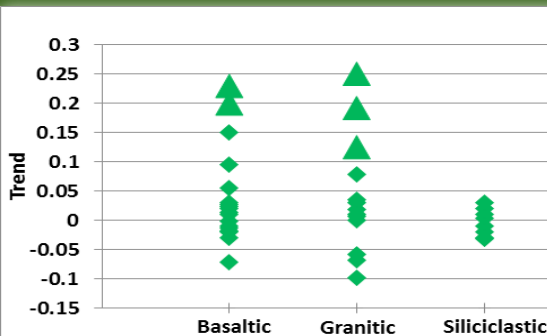


Figure 3. Trends in species richness by watershed geologic type from 1996-2012. Values above zero indicate an increasing trend. Larger triangles represent statistically significant trends ($p > 0.1$). Some basaltic and granitic watersheds are increasing in richness.

Figure 2 shows that fish species richness tended to be lower in watersheds underlain by siliciclastic bedrock when compared to basaltic or granitic watersheds, at least partially a result of acidification (Jastram et al. 2013). In addition, no siliciclastic stream sites showed significant trends in species richness, while multiple basaltic and granitic watersheds are definitively gaining species (Figure 3). Increasing richness may indicate an improvement or decline in ecological

health, depending on the specific species that are colonizing park watersheds. Some new species may be non-native warmer water fish colonizing the park due to recent increases in park stream water temperatures (Jastram et al. 2013). More research is needed in this arena and the park is pursuing those avenues.

Fish monitoring occurs on an every-other-year rotation and the next fish monitoring event will occur in 2014.

References and Acknowledgements

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.

We would like to thank M. Colgan, K. Dunn, S. Goebel, M. Lippy, K. McDonald, L. Thompson, S. Splangler, and numerous volunteers for their work this field season.



Photo by Scott Cornett



Lead Scientist
Jeb Wofford
Jeb_wofford@nps.gov

Lead Technician
David Demarest
David_demarest@nps.gov

Shenandoah National Park preserves cold water habitats that are important to a variety of fish species, including brook trout (above).