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Monitoring in the Context of Climate Change

Status and Trends

The Mid-Atlantic Network is composed of nine small cultural resource parks in the Piedmont and Coastal Plain, and one large natural resource park, Shenandoah National Park, in the Blue Ridge Mountains. Shenandoah NP was designated as a prototype monitoring park in the early 1990s, and has been tracking the status and long-term trends of a variety of natural resources for close to 30 years. These long-term monitoring programs have not only provided a valuable foundation for their expansion to other network parks, but have recorded trends in park resources that provide invaluable information related to the onset of regional climatic changes. More recently, monitoring has begun in the other Mid-Atlantic Network parks.

Under all climate change scenarios, we expect to see a variety of changes across all parks in the Mid-Atlantic Network. Though not established specifically to monitor climate change, the vital signs monitoring will detect changes in park ecosystems, including alterations in weather and climate patterns, changes in water quality and quantity, and the long-term effects on a variety of aquatic and terrestrial plant and animal communities.

Monitoring Highlights

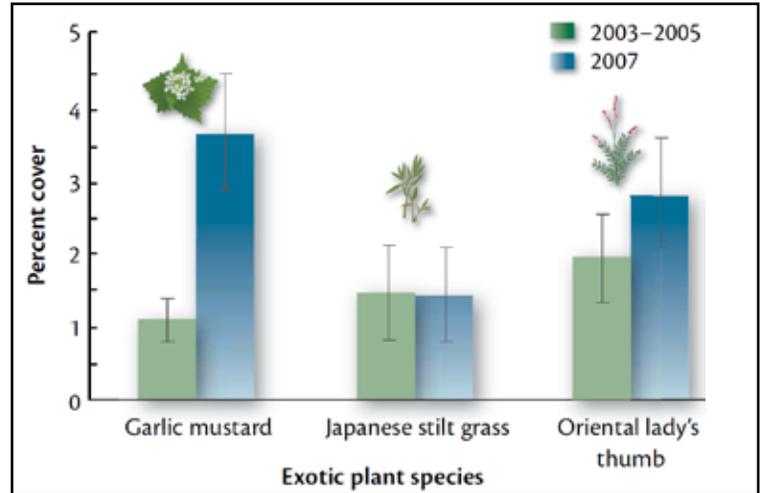
WEATHER AND CLIMATE

Climate is a dominant factor driving the physical and ecological processes in the Mid-Atlantic Network parks. Climate change is likely to result in increased temperatures, variations in quantity and timing of rainfall, and increased frequency and severity of weather related disturbances such as floods and droughts. The Mid-Atlantic Network is reporting on weather and climate for all network parks. Because the vast majority of parks do not have weather stations on-site, data are drawn from a wealth of cooperative weather stations surrounding each park.

WATER QUALITY AND QUANTITY

Many of the rivers that pass through the Mid-Atlantic Network parks originate in the Blue Ridge Mountains, some in Shenandoah NP. The park contains the headwaters of three major rivers, the James, Potomac, and Rappahannock, which flow into the Chesapeake Basin. In recent decades, a major threat to aquatic resources has been regional acidification from wet and dry atmospheric deposition. Climate change will further stress the aquatic resources in Shenandoah NP through increasing water temperatures and alterations in the fluvial regimes. Important cold water fisheries, including brook trout populations, are threatened. Mid-Atlantic Network parks, including Shenandoah NP, are collecting a variety of water quality and quantity parameters, including:

- Timing and quantity of water flow at continuous stream and river gaging stations in Shenandoah NP and Valley Forge NHP.



Invasive exotic species spread in forests of Shenandoah NP.

- Water quality core parameters including plans to install temperature loggers throughout the network.

TERRESTRIAL VEGETATION

As the climate changes across the Northeast Region, we expect to see a modification in the range and distribution of plant species and vegetation communities. Altered disturbance regimes will also increase the spread of invasive exotic plants, pests, and pathogens. Network monitoring includes:

- Forest health metrics in all parks including tree growth, mortality, and regeneration; understory species presence and abundance; standing and coarse woody debris.
- Rare plant species in Shenandoah NP to detect changes in known occurrences.
- Early detection of invasive exotic plant and animal species that will affect ecosystem ecological integrity.



Forest vegetation sampling in Gettysburg NMP. Photo by J. Comiskey.



Shenandoah National Park is 90% forested and contains just under 80,000 acres of designated wilderness. Photo by NPS.

TERRESTRIAL FAUNA

As terrestrial habitats are altered, we expect to see changes in the composition of faunal communities. Though species with limited mobility will be affected most adversely, mobile species may stop using park habitats in favor of more suitable habitat elsewhere. Network monitoring includes:

- Tracking the presence and relative abundance of forest and grassland breeding bird species in many of the cultural network parks. High priority bird species are monitored at Shenandoah NP.
- High elevation communities in Shenandoah NP that are most susceptible to climate change. Such habitat hosts globally threatened species such as the Shenandoah salamander (*Plethodon shenandoah*) whose range is restricted to a few locations in the park.

AQUATIC FAUNA

Major threats to aquatic ecosystems include an increased frequency and intensity of weather events that will result in floods and droughts. Rising temperatures will threaten native brook trout (*Salvelinus fontinalis*) that depend on cold water temperatures, and aid in the expansion of non-native fish populations and diseases. The cold water streams and rivers

of Shenandoah NP are most susceptible. Network monitoring includes:

- Tracking the status and trends in fish communities of Shenandoah NP.
- Aquatic macroinvertebrates, important biological indicators of upstream conditions, in all network parks.

Network Collaboration

Addressing climate change in the Mid-Atlantic Network will depend on increased scientific understanding and collaboration with other climate change monitoring networks and agencies, such as the U.S. Fish and Wildlife Service's Land Conservation Cooperatives (LCCs). Additional examples include the involvement of Shenandoah NP in the National Science Foundation's National Ecological Observatory Network (NEON), and funding opportunities to study the risk posed to high elevation, rare plant communities by climate change.



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