



Resource Management 2009

Patterns on the Landscape

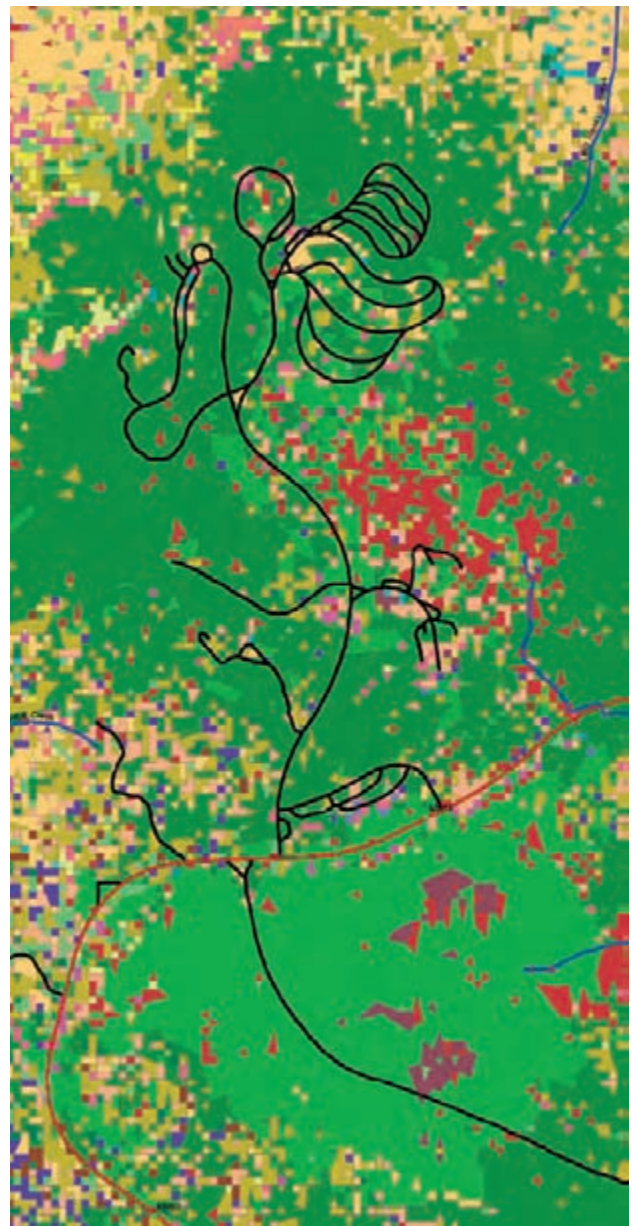
Building the Park Vegetation Map

Wendy Cass, Botanist

Have you every walked or driven through the Park and noticed how the mountain laurel prefers to grow on the drier southwestern slopes, and that tulip trees grow along the low elevation stream valleys? These patterns are particularly clear in the spring and fall when different tree species tend to take on distinctive shades of green, brown, or yellow, and are even easier to see if you are above the forest looking down from a height. If this is something you have seen, then you have taken note of some of the vegetation distribution patterns that occur in nature and that vegetation mapping strives to capture.

Vegetation maps provide an overview of the types of vegetation found on the landscape. Up-to-date vegetation maps are very valuable to park managers and scientists because they allow for the remote evaluation of land areas without having to spend the time and money required for a field visit. Park management activities as diverse as park planning, fire management, wildlife research, and visitor interpretation all benefit from current maps of vegetation distribution. Examples of vegetation map applications include: prediction of fire behavior, assistance in determining search conditions and good search locations for missing persons, prediction of areas of the park susceptible to particular insects and diseases, location of suitable habitat for particular invasive plants or rare plants and animals, documentation of certain cultural landscape boundaries, and assistance with restoration activities after a large-scale disturbance.

Vegetation maps need to be re-done periodically because vegetation grows and changes over time, and changes after disturbances and altered environmental conditions. The



A section of the Park vegetation map showing vegetation communities in the vicinity of Big Meadows.

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(continued from cover)

most recent vegetation mapping effort for SHEN began in 2000 as a collaboration between the US Geological Survey-Leetown Science Center, the Virginia Department of Conservation and Recreation-Division of Natural Heritage, the University of Maryland Center for Environmental Science-Appalachian Laboratory, NatureServe, and the Park. The purpose of the project was to map park vegetation to the community (a.k.a Association) level of the US National Vegetation Classification system while also investigating new methods for mapping the distribution of vegetation communities. The project was funded by the USGS Natural Resources Preservation Program (NRPP), with follow-up funding by the USGS-NPS Vegetation Mapping Program in 2008.

Legend

- Skyline Drive
- Mile Marker
- Park Roads
- Stream

Vegetation classification categories for Shenandoah National Park. Globally rare communities are marked with an (*) after their name. Communities excluded from the version 2.0 vegetation map because of their small size are marked with a (#) after their name.

VEGMAP 2005

- Central Appalachian / Northern Piedmont Chestnut Oak Forest
- Central Appalachian Acidic Cove Forest (White Pine - Hemlock - Mixed Hardwoods Type)
- Central Appalachian Acidic Oak - Hickory Forest
- Central Appalachian Acidic Seepage Swamp
- Central Appalachian Basic Boulderfield Forest
- Central Appalachian Basic Oak - Hickory Forest (Submontane / Foothills Type)
- Central Appalachian Basic Seepage Swamp
- Central Appalachian Basic Woodland
- Central Appalachian Circumneutral Barren
- Central Appalachian Dry-Mesic Chestnut Oak - Northern Red Oak Forest
- Central Appalachian Heath Barren
- Central Appalachian High-Elevation Boulderfield Forest
- Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)
- Central Appalachian Montane Oak - Hickory Forest (Acidic Type)
- Central Appalachian Montane Oak - Hickory Forest (Basic Type)
- Central Appalachian Northern Hardwood Forest
- Central Appalachian Pine - Oak / Heath Woodland
- Central Appalachian Rich Cove Forest
- Central Appalachian Woodland Seep
- Hemlock - Northern Hardwood Forest
- High-Elevation Greenstone Barren
- High-Elevation Hemlock - Yellow Birch Seepage Swamp
- High-Elevation Outcrop Barren (Black Chokeberry Igneous / Metamorphic Type)
- Low-Elevation Mixed Oak / Heath Forest
- Northeastern Modified Successional Forest
- Northern Blue Ridge Mafic Fen
- Northern Blue Ridge Montane Alluvial Forest
- Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type)
- Shenandoah Valley Sinkhole Pond (Typic Type)
- Southern Appalachian Cove Forest (Typic Montane Type)
- Successional Tuliptree Forest (Circumneutral Type)
- Sweet Birch - Chestnut Oak Talus Woodland

A vegetation community is identified on the landscape as a recurring assembly of plant species that are found growing together in a particular habitat. Vegetation communities do not usually have distinct boundaries. Instead, they grade into one another, gradually transitioning as environmental conditions change across the landscape. Communities are typically mapped using aerial and/or satellite imagery in conjunction with field plot data. The park's

2009 vegetation map was created using aerial and multi- and hyperspectral satellite imagery combined with data from 1175 field locations.

Aerial and satellite images are limited in their usefulness for vegetation mapping to the plant community level because they typically only capture the appearance of the vegetation from the top (canopy), making it difficult or impossible to view the shrub or



An example of the Central Appalachian Rich Cove Forest (CEGL 6237). This image was taken near Franklin Cliffs, and clearly shows the sugar maple (*Acer saccharum*) and lush mesophytic (moisture loving) herbs characteristic of this community type.

cover species that are so integral to community classification. The use of multi and hyper spectral imagery in development of the SHEN vegetation map helped to better discern different community types. However, additional map accuracy was obtained by including an ecological modeling component that identified prominent environmental gradients likely to influence vegetation distribution patterns.

Multivariate statistical analyses using complex ordination techniques were used to determine how the vegetation data from on the ground could be separated into distinct ecological communities along environmental gradients. This information was then analyzed with the imagery data to generate a map showing where different ecological communities were found on the landscape. As a whole, the ordinations indicated that bedrock, soil fertility, elevation, and topographic position are the most important environmental factors influencing major vegetation patterns in Shenandoah National Park. Other factors such as site moisture, slope shape, steepness, and aspect were also influential in determining the community type present.

The 2009 vegetation map includes 35 unique map classes. Thirty of these classes refer to natural community types consistent with National Vegetation Classification System Associations. General vegetation types included within this classification include examples of high and low elevation forests, woodlands, boulderfield forests, and outcrop barrens. Also included are less frequently encountered vegetation associations such as lichen/bryophyte communities, floodplains, wetlands, and seepage swamps. Ten of these 30 vegetation types represent globally rare community types. The remaining five map classes

are composed of three modified/successional community types that are often found on old fields or around home-sites. These include the Virginia pine successional forest; Northeastern Modified Successional Forest; and Successional Tulip tree forest. Also included are two broad classes of modified or disturbed vegetation, the Cultural Meadow, and Catastrophically Disturbed Forest, both of which are characterized by having 50% or more of the canopy removed by recent disturbances such as insects, fungal pathogens, drought, storms, or fires. All of these community types are mapped to a resolution (minimum mapping unit) of 0.5 ha, or an area measuring approximately 70 x 70 m.

The process of developing the park vegetation map has been complex. Three iterations of the map have been generated since the project started in 2000. Version 1.0 of the map was released in 2004, version 1.1 was released in 2006, and version 2.0 will be released in 2009 (Young, Fleming, Townsend, and Foster, 2009). These multiple versions resulted from our desire to achieve the greatest possible map accuracy, while also reflecting the most current vegetation community classification. Later versions of the map reflect the incorporation of additional field data, differences in the analysis and interpretation of plot data, map adjustments following field accuracy assessment, and refinements to the classification scheme. The 2009 Version 2.0 Vegetation Map represents the final product for this project. Full descriptions of all map classes and vegetation community types, as well as a detailed field key to the vegetation communities of the Park are currently available. Final mapping products and the project report will be available by April 2009.

Reference:

Young, Fleming, Cass, and Lea 2009. *Vegetation of Shenandoah National Park in Relation to Environmental Gradients - Revised vegetation classification, revised modeling, and additional accuracy assessment*. Final Report v. 2.0. Unpublished report submitted to the U.S. Dept. of the Interior, National Park Service. 81 pp. plus appendices, GIS products, and databases.



Vegetation mapping crew members walk through the Northern Red Oak Forest community (CEGL 8506) on Hogback mountain during training week activities.

Wetland Plants – Tasty Snack and Rare Resource

Wendy W. Hochstedler, *Biological Science Technician*

The Big Meadows Area (BMA) is a great place to observe wildlife (Figure 1). Countless visitors spend hours watching deer nibble and shred plants. But what happens when too many deer are in a small area and food resources are limited? A quick look around the BMA shows much evidence of what can happen when deer are abundant. Effects of this high concentration is easily visible in the distinct browse lines on trees and shrubs (Figure 2), a decreased regeneration of woody plants, and decreased cover of palatable plant species (e.g. lilies). This trend has been occurring for years, based on the Virginia Natural Heritage Report (Ludwig et al, 1993) which noted a dramatic decline in the diversity and vigor of native herbaceous species in BMA caused in part by heavy deer grazing and trampling. BMA currently has the highest deer densities measured in the park with ~140 deer per square mile as indicated by nighttime deer spotlight counts from 2003-2008. This greatly exceeds the estimated 30 deer per square mile in the park's backcountry.

One adult deer eats about 10 pounds of vegetation a day. Each leaf that a deer eats decreases that plant's photosynthetic ability and the amount of energy a plant has to put into growth of new leaf tissue, roots and reproductive parts. Direct browse of reproductive parts (flowers, fruits, and flowering stems) decreases a plant's ability to create offspring to sustain a population over time. This isn't typically a problem for a plant that might lose a leaf here or there every several years, but when deer densities are high, biodiversity and overall ground cover is reduced, and the types of

plants growing in an area can shift as palatable species are consumed (Horsley 2003). This is particularly a problem if deer find rare plant populations to be a tasty snack.

This last element is of particular concern in the management of the Big Meadows Area, land comprising less than 1/10th of 1% of the entire Park, but containing occurrences of 18% of the Park's rare plants. The BMA includes a 20 acre wetland called the Big Meadows Swamp (BMS, the Swamp). Officially termed a "fen", the BMS is fed by groundwater rich in calcium, magnesium, and iron. The nutrient rich waters of BMS combine with other site characteristics such as the geology, elevation, and environmental conditions to form an environment that supports the extremely rare Northern Blue Ridge Mafic Fen plant community. This vegetation community contains the highest concentration of rare plants per unit area within the entire park, and is found nowhere else in the world besides Big Meadows. Understanding the impacts of deer browse on this community is a critical link to making sound management decisions to protect these unique resources.

In order to document the effects of deer on this community and to protect portions of the rare plant populations from deer damage, the botany and wildlife programs at Shenandoah National Park (funded by a Natural Resources Preservation Program (NRPP) Regional Block Grant) identified sites for seven deer exclosures in areas of high rare plant density in the BMA in the spring of 2006. During July and August, information was collected on woody and rare plants along four transects and twenty sampling plots at each site. In the fall, nylon fencing was used to erect



Figure 1. White-tailed deer in Big Meadows.



Figure 2. A red spruce tree in Big Meadows with evident deer browse around the lower portion of the tree.



Figure 3. Deer exclosures were installed at seven sites in Big Meadows Meadow and Swamp in areas of high rare plant concentration to assess the effects of deer browse on these sensitive communities.



Figure 4. Three of the rare plant species—Canada burnet (*Sanguisorba canadensis*, left), linear-leaved willow herb (*Epilobium leptophyllum*, center), and blue-flag iris (*Iris versicolor*, right)—being monitored at deer exclosure sites.

a ~15 x 15 m four-sided deer exclosure at each site (Figure 3). In August of 2008 after the exclosures had been in place for two years, transects and plots (half inside the exclosure, half outside the exclosure) were resampled.

Canada burnet (*Sanguisorba canadensis*) was one of the target rare plant species at these sites (Figure 4). While Canada burnet leaves are common in the Swamp and central meadow, prior to the deer exclosures it was uncommon to see flowering individuals. Those that were seen were seldom over two feet tall and often hidden from

deer browse by woody vegetation. No flowering individuals were located in the sampling areas in 2006. In 2008, a difference was seen between the plants inside the exclosures and those outside the exclosures as some exclosures contained Canada burnet that were over five feet tall (Figure 5)! Inside the exclosures 3% of plants had flowers compared to less than 1% outside the exclosures ($p < 0.01$). When comparing the plots where Canada burnet was located, the number of flowering clusters was greater inside the exclosures than outside the exclosures (Figure 6, $p < 0.01$, $\text{mean} \pm \text{SE}$: inside 3.53 ± 1.45 , outside 0.05 ± 0.05). In addition, the length of Canada burnet basal leaves was longer inside the exclosure ($p < 0.01$, Figure 7), and the area covered by these plants was greater inside the exclosure ($p < 0.01$, Figure 8) compared to plants sampled outside the exclosures in 2008.

Gray birches (*Betula populifolia*), another rare plant in the Big Meadows Area, are a bushy tree typically with multiple trunks and young sprouts originating from the base. Most sprouts at the bases of gray birches in the BMA have been severely browsed by deer (Figure 9). When comparing the plots where gray birches were present, there

was greater coverage under 1.5 m of these trees inside the exclosure in 2008 than in 2006 before the deer were excluded ($p < 0.01$, $\text{mean} \pm \text{SE}$: in 2006 1.95 ± 0.81 , in 2008 12.42 ± 5.14). There was no difference in density or stem heights that we detected statistically, but a compelling visual difference existed between outside and inside the exclosures (Figure 9).

Other rare plant species such as the linear-leaved willow herb (*Epilobium leptophyllum*) and blue-flag iris (*Iris versicolor*) (Figure 4) showed no significant differences between outside and inside the exclosures. Iris did tend to have greater cover, more and taller clumps of leaves, and a greater proportion of seed pods per plant outside than inside the exclosures, but these differences were not significant and were present in 2006 as well, before the exclosures were in place. Non-rare woody plant species, however, did cover more area inside the exclosures in 2008 ($p < 0.01$, Figure 8).

Based on these findings after the deer exclosures have been in place for two years, it appears that deer are enjoying the rare Canada burnet and gray birch plants as a tasty snack. These preliminary results showed that deer browse is nega-



Figure 5. A tall flowering Canada burnet in the foreground, protected inside the exclosure from deer browse. A biological science technician setting up sampling transects at a deer exclosure site. Colorful flagging on the exclosures decreased deer entanglement.

tively impacting these populations, as well as decreasing overall woody cover under 1.5 m in the areas of these rare plants.

Over-abundant deer populations may also increase the likelihood of invasive plant species establishing in these sensitive areas (Eschtruth and Battles 2008), particularly garlic mustard (*Alliaria petiolata*), Japanese stilt grass (*Microstegium vimenium*), and oriental lady's thumb (*Polygonum caespitosum*), species that are already invading the Swamp and appear to be less palatable to deer than many native species. As these invasive species become more established, deer may browse even more heavily on palatable species like Canada burnet and gray birch. On a positive note, native plant species of low browse preference like the blue-flag iris may benefit from the selective over-grazing of other plants which

may free up more habitat for the iris over time.

Natural Resource staff need documentation of the long-term response of the Big Meadows plant communities to intensive deer browse. It is uncertain, however, how long the deer exclosures will remain in place due to problems with deer entanglement in the fencing and the periodic upkeep required.

The results of this study and other studies on deer population dynamics will be used to formulate a Deer Management Plan and an Environmental Impact Statement. These documents will allow park staff to better manage the deer populations at Big Meadows and other developed areas of the Park. Subsequent management actions may include herd control strategies, fertility control, or erecting large-scale

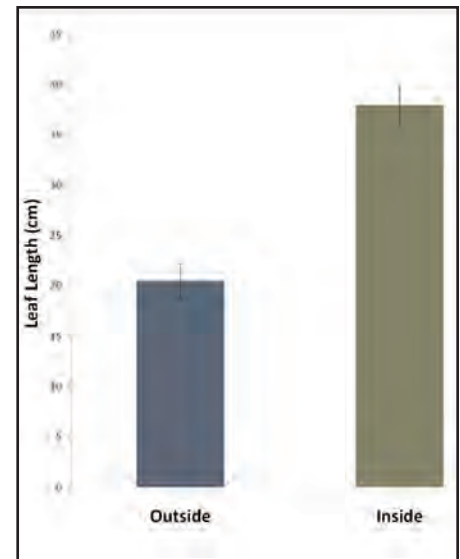


Figure 7. Mean length of Canada burnet basal leaves in plots where basal leaves were present at the deer exclosure sites in the Big Meadows area (outside n=20, inside n=17).



Figure 6. Canada burnet individuals at the site of one deer exclosure in Big Meadows. Only basal leaves were present in 2006 before the deer exclosure was in place (top), however in 2008, many flowering individuals were observed inside the exclosure (bottom).

protective enclosures. Realistically though, this won't happen for a long time. In the meantime, if deer densities remain high, small scale efforts like protecting individual gray birch trees with small cages shows promise in supporting the regeneration of these rare plants.

References

Eschtruth, A.K., and Battles, J.J. 2008. Acceleration of exotic plant invasion in a forested ecosystem by a generalist herbivore. *Conservation Biology*, in press, 12p.

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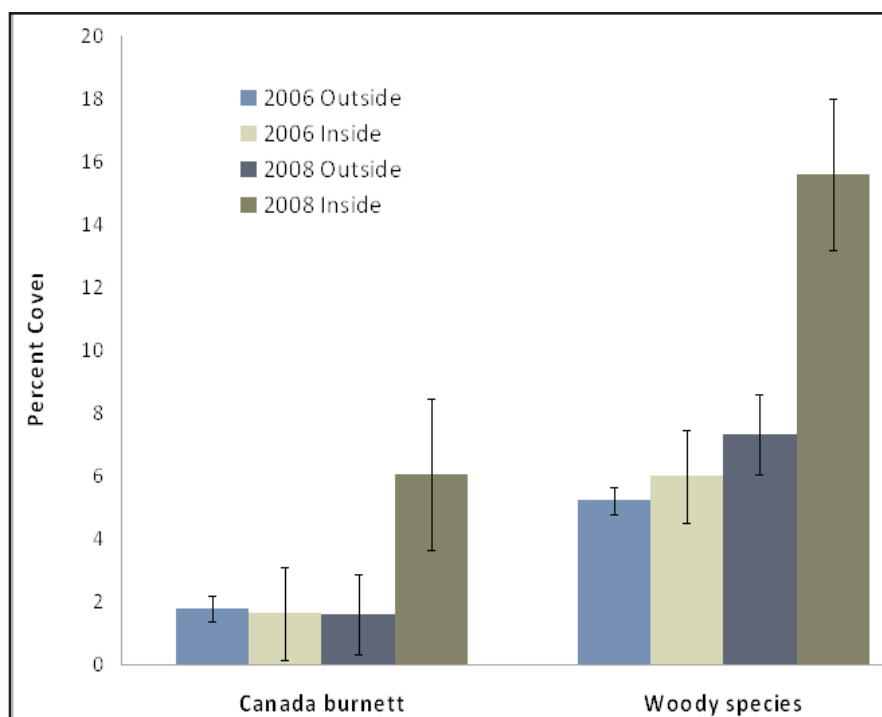


Figure 8. Average area covered by Canada burnett in plots where Canada burnett had coverage (outside n=27, inside n=26), and of non-rare woody species under 1.5 m in all plots (n=70) at the deer enclosure sites in the Big Meadows Area.



Figure 9. Gray birches inside an enclosure (left) have prolific tall sprout regeneration, whereas gray birches that have not been protected from deer in Big Meadows typically lack these tall sprouts (center) and have a cluster of browsed short sprouts around the base (right).

Old Rag Mountain Steward Program

Steve Bair, Backcountry Wilderness & Trails Manager

An article in Backpacker magazine's January 2009 issue, "Readers' Choice Awards for America's Best Trails," cites Shenandoah National Park's Old Rag Mountain as Virginia's top State hike. Blue Ridge Outdoors magazine describes Old Rag Mountain as Virginia's most popular hike year after year. Dozens of blogs and websites describe the trails, hikes, and individual recreation experiences on Old Rag.

Popular with hikers, backpackers and rock climbers Old Rag Mountain receives high volumes of weekend visitor use, particularly during the period April through early November. However, consequences of Old Rag's popularity and high levels of visitor use are the associated trampling damage to valuable natural resources on rock outcrops, sanitation and litter issues, lost and disoriented persons on the trails, and frequent incidences of injuries, including serious injuries requiring rescue and patient transport.

Spawned by the Park's Rock Outcrop Management Project and Plan (ROMP), as a response to specific concerns of Old Rag Mountain the Old Rag Mountain Steward program was initiated in 2007 by the Natural and Cultural Resources and Ranger Activities Divisions. The proposed program was intended as a volunteer stewardship program to help manage resource conditions and visitor use in the Old Rag Mountain region. The program is currently under development and in operation in the field, and is designed to accomplish the following objectives using volunteer resources:

- (1) Use opportunities to educate visitors about their

recreational impacts to resources (*i.e.*, vegetation trampling, litter, human waste, etc.) and Leave No Trace ethics and practices to help visitors manage their own impacts;

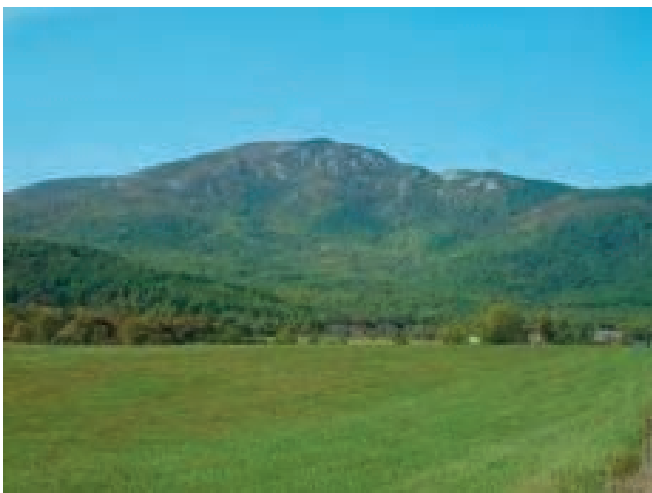
- (2) Provide information about Old Rag and the Park to visitors. Visitor information includes trail information for the Old Rag region, directions/time/distance to parking areas and other area sites, and general Park natural and cultural resources information;

- (3) Provide hiking safety advice to visitors as necessary; and

- (4) Provide assistance and initial response to lost and injured visitors, and size up emergency incidents to communicate to Park staff by Park radio or cell phone.

The Old Rag Mountain Steward program consists of volunteers provided by various outdoor groups and organizations, including Teamlink/Shenandoah Mountain Guides, regional university outing clubs, and interested individuals working to assist the Park to improve natural resource conditions and the visitor experience on Old Rag Mountain. Volunteers work on weekends of expected heavy visitation, typically from early May through early to mid-November as volunteer resources are available. Volunteers patrol areas of the popular Old Rag circuit hike (incorporating Ridge and Saddle Trails and Weakley Hollow Fire Road), specifically targeting the rock scrambles and summit ridge top area. Additionally, the program will use volunteers who do not meet the physical requirements for patrols, but do have the same knowledge and training base, to provide educational and informational presentations at the parking lot and trailhead in support of Mountain Steward program objectives. Initially, the outdoor adventure/team building organization Teamlink/Shenandoah Mountain Guides has been hired to assist the Park to recruit and train volunteers and to develop and establish the program.

Under the direction of Teamlink's Andy Nichols, Teamlink staff began to conduct patrols on Old Rag in early May 2008, and encouraged "tag-along" interested volunteers for initial orientation and training. Teamlink staff and volunteers patrolled the Old Rag region on most weekends through mid-November 2008. Teamlink accomplished successful recruitment of nearly a dozen volunteers and began a volunteer training program in earnest in October.



Old Rag Mountain

We anticipate the Old Rag Mountain Steward program will result in better informed visitors on Old Rag Mountain, provide better protection of sensitive vegetation resources on Old Rag, improve sanitation and litter conditions, prevent visitor injuries and improve response to visitor emergency incidents, and provide an overall improved weekend visitor experience on Old Rag Mountain. Park operations will benefit by the increased weekend presence of volunteers to help manage issues of heavy visitation. Improved prevention of and response to visitor injuries and lost individuals will lessen the impact of Old Rag visitation on park operations.

For additional information on the Old Rag Mountain Steward Program, see: <http://oldragmountainsteward.blogspot.com/>



Old Rag Mountain volunteers

Adopt-an-Outcrop Volunteer Program Launched in 2008

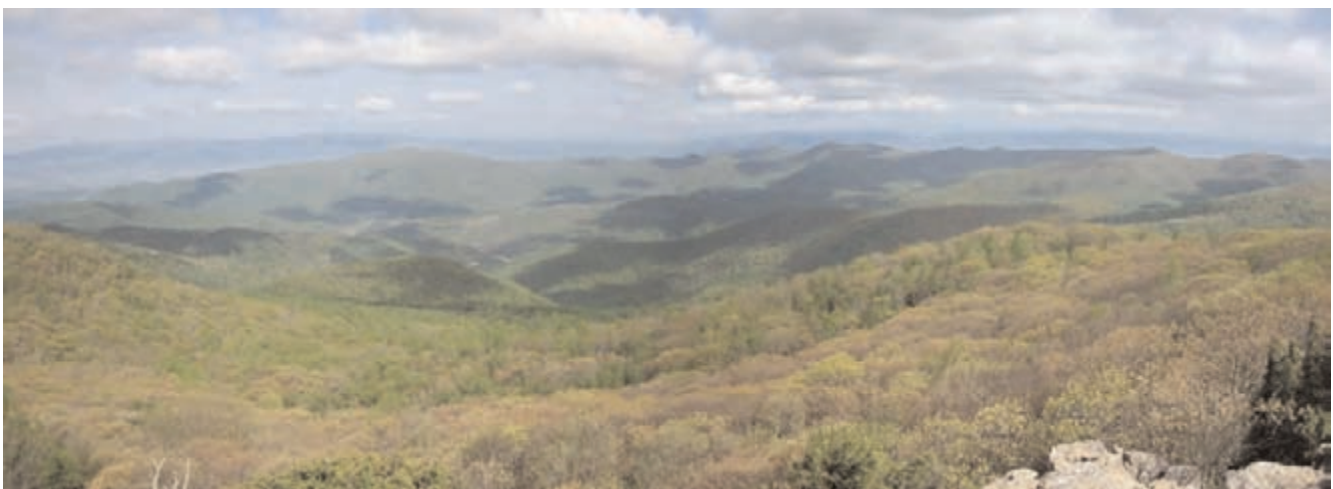
Wendy Cass, Botanist

Most visitors standing on the summit of Hawksbill mountain have no idea that they are in the middle of a globally rare plant community. They have come to enjoy the view, and pay no attention to the little tufts of plants poking out from the rock crevices beneath their feet. In many cases these are no ordinary plants. They are plants rare in Virginia that only survive in very limited habitats at the highest elevations. Each footstep on these rare plants damages them, and increases the chances that they will die and that the soil in which they are rooted will be blown or washed away.

Despite the popularity of the rock outcrops in SHEN, and the threats to their natural resources, Park staff members have little time to spend enforcing natural resource protection in these areas. What can be done about this problem? One recommendation of the recently completed Rock Outcrop Management project was to use volunteers to help protect rock outcrops.

In 2008 funding from the NPS Centennial Initiative was used to support establishment of a volunteer program to support rock outcrop monitoring and protection. This program, dubbed the Adopt-an-Outcrop (AOP) program, was designed to help limit human trampling of rock outcrop

Panoramic view from Bearfence mountain Adopt-an-Outcrop monitoring site.





Adopt-an-Outcrop 2008 program summer coordinator Sara Hall reviews rare plant monitoring methods with one of the project's chief stewards, Jack Price, on Little Stonyman Mountain.

sites, and provide monitoring data to track changes in rare plant population cover, health, and threats. To that end, funding was used to hire a seasonal biological science technician, and to purchase radios, cameras, field gear, uniform items, and to print monitoring manuals.

Planning for the Adopt-an-Outcrop program began in February 2008 and progressed to intensive work by vegetation program staff in June to documented monitoring sites, write field methods, and produce a volunteer guide. The field portion of the program began in July with 26 volunteers, many of whom were from the Old Rag Master Naturalists Program. This committed group of volunteers spent from 4 – 8 hours per month visiting their field monitoring sites to collect data on rare plants, talk with visitors, pick up trash, and maintain signs and barriers. Minimizing impact to the sensitive plant communities on cliff areas is one of the primary concerns of the program. Therefore, detailed monitoring is done only twice a year. Other site visits focus on visitor education, barrier and sign repair, and trash removal.

The plant monitoring data collected by AOP volunteers focuses on a series of photopoints. These images will allow park staff to observe changes in the cover and health of the rare plants over time. Among other things, data are also being collected on the area covered by each rare plant, plant characteristics, and the proximity of invasive plants to rare plant populations.

A particularly useful aspect of the program is the way it increases the presence of uniformed personnel on rock outcrops. This gives visitors more opportunities to ask questions and learn about rock outcrop conservation issues, and may help deter unwanted behaviors.

In 2008 the program included 17 monitoring sites and 26 volunteers. These volunteers contributed 443 hours of time over the first three months of the program. Monthly Adopt-an-Outcrop program site visits are set to continue in March 2009. A few additional volunteers are needed. Please contact Wendy Cass at 540-999-3500 x3432 if you would like to learn more about the program.



Example of a monitoring photopoint from Old Rag mountain showing mountain sandwort plants (*Minuartia groenlandica*) surviving in a crevice between rocks.

Regional Assistance: Fighting Invasive Species Requires Collaboration

James Åkerson, Director, Mid-Atlantic Exotic Plant Management Team

Shenandoah National Park receives technical and field assistance from the NPS Mid-Atlantic Exotic Plant Management Team. In this article, we'll look at two examples.

Volunteer Impacts. Most recently, after a three-year development period, the Team handed over the administration of the Short-term Volunteer Program so that the Park could use and direct the program for exotic plant management.

Volunteers are a powerful way to accomplish work and grow a citizen base of support and advocacy. Starting



A group of fifth-graders from the Mountain Laurel Montessori School of Front Royal, VA, pose after helping cut invasive shrubs near Dickey Ridge V.C.



Volunteers have included this 80-year old woman and her daughter who attended Save the Meadow volunteer event.



Volunteers participate in many ways. Individuals participate in special events such as Earth Day and National Public Lands Day.



Children participate with parents or schools

with youngsters, short-term volunteer programs help instill an association of fun with the importance in their service-learning and exploratory field trips. In an era of decreasing time outside in nature, short-term volunteer programs offer a way to "leave no child inside." While running volunteer events, park staff and volunteer leaders teach volunteers plant identification, discuss implications of exotic species invasions, and respond to volunteer's questions. Volunteers may well be the backbone and hope for getting things done in the future. Each volunteer event is an opportunity to pass along public information about invasive species threats and ecological education. Volunteers come from nearby communities and distant metropolitan areas.

In a 2-1/2 year period of fieldwork, fall 2005 – spring 2008, Shenandoah benefited from the labor of 1,179 volunteers who contributed over 2,500 hours of field work. They treated over 97 gross infested acres once containing highly invasive exotics such as garlic mustard, Oriental lady's thumb, mile-a-minute vine, and Oriental bittersweet vine. Each of those plants is an environmental threat by killing natives and creating monocultures of their own species. Once established, invaders affect whole ecological functioning.

An essential objective of the Mid-Atlantic Exotic Plant Management Team is to develop volunteer leaders who can help create a sustainable long-term future for operations. Volunteer leaders naturally take on increasing ownership for the overall health of the lands they help manage. They potentially become the best champions for resource protection and program development because of their first-hand knowledge of the challenges they face.

Sharing the Wealth. Parks are typically autonomous and interact very little day-to-day. The Mid-Atlantic



Families participate in special events or family events.



Group events have included schools, universities, and interest groups such as National Audubon, Defenders of Wildlife, and Jaycees.



A herbicide applicator owned by Booker T. Washington monument is used by other parks.



Team owned ATVs are loaned to parks.

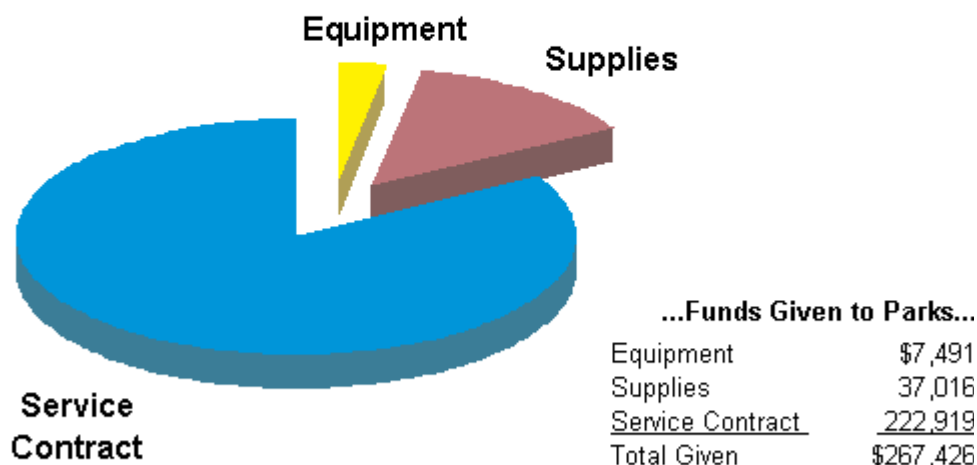
Exotic Plant Management Team acts as an organizing framework for the Cooperative of parks' approach to invasive plant management. The Team helps bridge communication between parks and facilitates one park helping another. Sharing capital costs is an excellent way for small park units to expand capacity that their budgets can't afford. Sharing of equipment is one of many ways that the Cooperative of parks helps the whole.

In addition to normal fieldwork, the Team augments partner park opera-

tions by purchasing services, supplies, and equipment on their behalf. Items include powersaws, brush cutters, backpack sprayers, environmental storage units for safe herbicide containment, and specific herbicides for invasive plant control. Virtually all park units have benefited from Team purchases through the years. Contracting the services for a portion of the Cooperative's work load helps increase the possible accomplishment during a season. It also allows for specialization and expertise to address particular challenges.

It is not likely the National Park Service will ever have enough funding to control all invasive species threats on its 84.4 million acres of land. Partnerships and collaboration are the best leverage to meet the challenges of new and existing invasives. Partnerships increase the potential fieldwork that can be accomplished. Partners broaden the thinking that goes into management decisions. All forms of alliances may be needed to combat the ill effects of introduced invasive species into the future.

Sharing of Mid-Atlantic Team Finances Partner Park Benefits, 2003 - 2008



Partner parks benefit from sharing the year-end finances of the Mid-Atlantic Exotic Plant Management Team. Funds are plowed into needed supplies and contracted services.

Exotic Plant Management Update

Jake Hughes, Biological Science Technician

Staff from Shenandoah National Park, along with hundreds of volunteers, continued to do battle with invasive exotic plants in the past year. In order to make most efficient use of the limited resources available, efforts were focused on species for which control, including eradication, is feasible (e.g., mile-a-minute and wavyleaf basketgrass) and areas of high ecological value (e.g., Big Meadows). Crews spent a total of 2890 hours in the field doing control work in fiscal year 2008. Nearly 43 % of this time was contributed by volunteers. More detailed information on program activities is available in the Shenandoah National Park Fiscal Year 2008 Exotic Plant Management Annual Report.

Mile-a-minute (*Polygonum perfoliatum*)

As in years past, a great deal of effort (41% of field time) went into controlling mile-a-minute at a number of sites throughout the Park. Since the discovery in 2002 of a large infestation of this annual vine at Hogwallow Flats Overlook, there has been a great deal of concern that mile-a-minute could become widespread in Shenandoah. Areas where gypsy moth or hemlock wooly adelgid activity, fire, windthrow or ice storms have thinned or eliminated the forest canopy are susceptible to invasion. Once established, mile-a-minute forms dense blankets of stems and foliage that can stifle forest regeneration.

A long-lived seed bank (3-7 years, by some estimates), seed dispersed hundreds of meters by wildlife, a short interval between germination and seed set (as little as 12 weeks) and a long period of

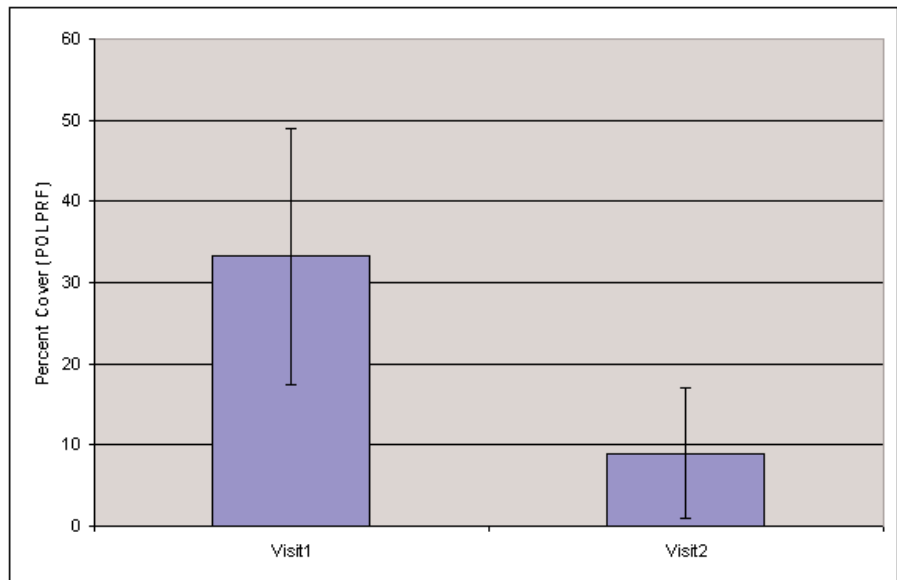


Figure 1. Pre-treatment percent cover of mile-a-minute in treatment monitoring plots (n = 9) in 2007 (visit 1) and 2008 (visit 2). Error bars are ± 2 standard errors of the mean.

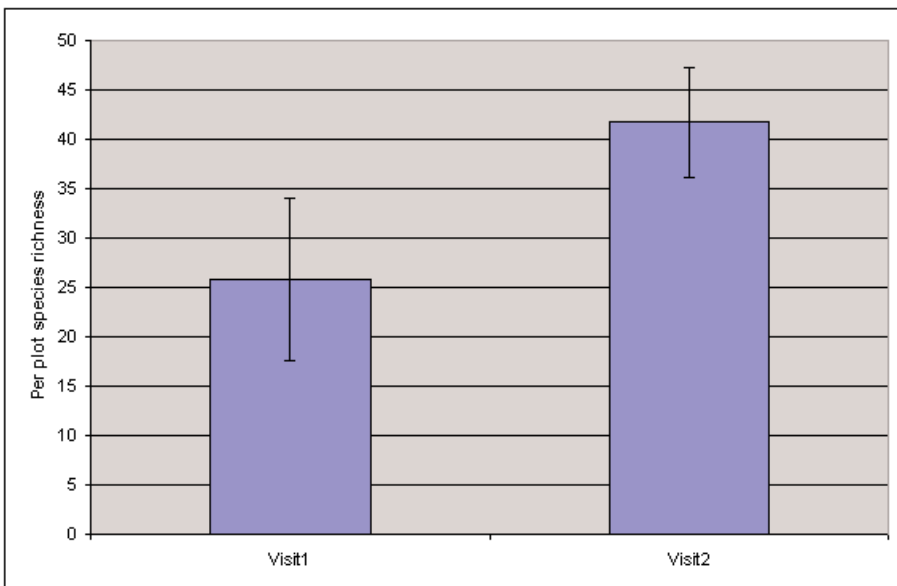


Figure 2. Mean species richness (number of species) in treatment monitoring plots (n = 9) in 2007 (Visit1) and 2008 (Visit2). Error bars are ± 2 standard errors of the mean.

seed production (as many as 4 months), make mile-a-minute an extremely difficult species to manage. After seven seasons of work, including several seasons spent developing control techniques and many lessons learned, an effective management protocol is in place and some progress is being made. Using a combination of hand-pulling, pre- and post-emergence herbicide application, six sites appear to be under control (*i.e.*, not expanding and with minimal to no seed production), though with continued maintenance required.

Four other sites, all in the North District are still extensive, though progress has been made at these locations as well. Analyses of data from treatment monitoring plots show that the coverage of mile-a-minute at these sites in 2008 was significantly lower than the year before (33% vs. 9% cover, paired t test, $t = 2.50$, $df = 8$, $p = 0.037$; figures 1, 3 and 4). Even more encouraging was the condition of the plant community following treatment in many areas; per plot native species richness was significantly higher post-treatment than before (26 vs. 42 native herb-layer species per plot, paired t test, $t = 4.94$, $df = 8$, $p = 0.001$; figure 2). Still, there remains a great deal of work to do.



Figure 3. Mile-a-minute infestation below Hogwallow Flats Overlook in July 2006. Nearly all of the ground-layer vegetation is mile-a-minute.

Mile-a-minute control, while still considered important, is consuming a large proportion of limited program resources. This comes at the expense of other priorities, including those listed below. Over the next two seasons, this effort will be evaluated to determine if current management goals are achievable for this species. If it is determined that these are unrealistic, they will be revised.

Wavyleaf basketgrass (*Opismenus hirtellus ssp. undulatifolius*) Unfortunately, 2008 brought the realization that Shenandoah National Park harbors yet another fast-spreading, potentially harmful invasive exotic plant that has to be addressed. Wavyleaf basketgrass, a shade-tolerant perennial grass with sticky seeds, was first discovered as a small patch near Swift Run Gap in 2005. By last year, surveys indicated that the grass had spread greatly and infested nearly 80 acres. In some areas, wavyleaf basketgrass completely covers the forest floor (figure 5). A significant portion of this acreage only contained seedlings, suggesting recent, rapid spread of seed in the previous season. Environmental compliance was completed for treatment of the site and work began shortly thereafter. Though time had to be taken



Figure 4. Same area as shown in figure 3 in July 2008, after two seasons of treatment. Mile-a-minute coverage is very low, with pokeweed (*Phytolacca americana*), and sprouts of spicebush (*Lindera benzoin*) and black locust (*Robinia pseudo-acacia*) among the native species now evident.

from other projects (5 % of total field time) to address this problem, slightly over half of the site, primarily the outer edge of the infestation, was treated with a combination of herbicide application and hand pulling. Six monitoring plots and several photopoints were also installed at the site.

Though it's obviously too early to tell whether our efforts to control wavyleaf basketgrass will be successful, there is hope that we can eradicate, or at the very least contain, this species before it becomes widespread and infests large areas in the Park.

Big Meadows

Big Meadows (including the Big Meadows Swamp) contains the highest concentration of rare plants in the Park and they are home to the world's only known occurrences of the Northern Blue Ridge Mafic Fen plant community. As a site of such conservation value, it commands high priority for invasive exotic plant management.

Work continued in 2008 on a variety of species in the Big Meadows area. Thirty-four percent of total control time went to controlling garlic mustard (*Alliaria petiolata*), Oriental ladythumb (*Polygonum*



Figure 5. Wavyleaf basketgrass patch near Swift Run Gap. The majority of the vegetation in the photo is wavyleaf basketgrass.

caespitosum), Japanese stiltgrass (*Microstegium vimineum*) and Oriental bittersweet (*Celastrus orbiculatus*) in the area. A substantial proportion of this time (883 hours) was contributed by volunteers.

As in our mile-a-minute work, recent efforts in the Big Meadows area are beginning to slowly show results. For instance, garlic mustard, a notoriously difficult species to manage, is beginning to show a decrease in abundance along the Story of the Forest Trail bordering the Big Meadows Swamp. Evidence of this can be seen in the rate at which the species has been

removed over time. Volunteers in 2006 spent an average of 27 hours per acre pulling garlic mustard. Only two years later, this was down to 11 hours per acre. It will be many more years before garlic mustard, not to mention the other exotics present in the Big Meadows area, are reduced to an acceptable level that can be maintained with a minimal amount of work. Still, there is reason to be optimistic.

2009

Exotic plant management is almost always a long-term proposition. Not surprisingly, the upcoming season will bring more of the same. Mile-a-

minute management will continue. Wavyleaf basketgrass control will receive a more significant proportion of available field time. And we will continue to try to keep various exotic species at bay in places like Big Meadows, the Limberlost and other high priority locations.

As always, we welcome help! If you're interested in coming out for a scheduled volunteer workday or in adopting a site to work in on your own time, please contact the Park exotic plant management program at 540-999-3500 ext. 3492 or Jake_Hughes@nps.gov.

Exotic Brown Trout Numbers Reduced in Park Streams

David Demarest, Lead Wildlife and Fisheries Biological Science Technician
In 2006, the fisheries program restarted its exotic trout removal program after a sabbatical of eight years. Brown trout compete directly with native Brook Trout and are therefore undesirable in park streams. Brown trout numbers had increased to a point where they were approximately 25% of the total trout population in two streams and a new population had inhabited Brokenback Run. There was no fisheries program in 2007, but in 2008 we had a crew dedicated to fisheries monitoring once again.

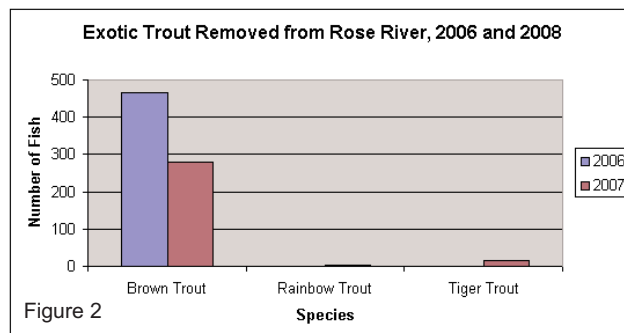
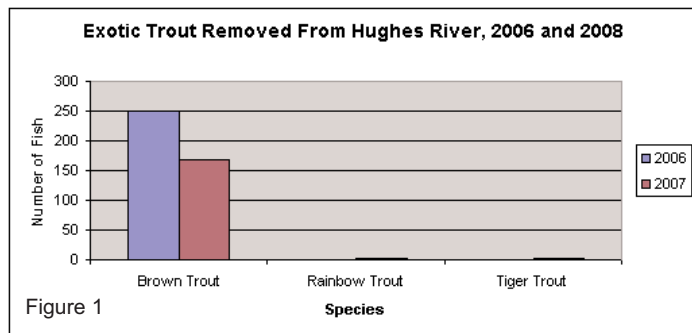
Many fishermen were upset with the Park Service for euthanizing so many brown trout in 2006. So during 2008, the Fisheries and Wildlife

Technician worked with the Virginia Department of Game and Inland Fisheries (VDGIF) to arrange to be able to transport most of the captured exotics to other warmer water streams outside of the park. Many volunteers from Trout Unlimited were utilized during the salvage effort. As a result, VDGIF was able to augment existing brown trout populations with approximately 370 fish in two streams in the Shenandoah Valley well outside of the park.

In 2008, there were no exotic trout found in Brokenback Run which was a surprising occurrence, since we removed 57 from the stream in 2006. This lack of browns allowed staff to spend a longer period of time removing fish from the Rose and Hughes Rivers. Due to the

lower numbers of brown trout found in the Hughes, it was felt that multiple passes on almost two miles of stream may help isolate adult fish and prevent them from spawning (Figure 1). The Rose River again had the largest population of browns. One pass was completed on one and a half miles, and a second pass was completed after rain events on the lower 200 meters of the Rose. Removal data for the Rose River can be seen in Figure 2.

It is hoped that reduction efforts will continue in the summer of 2009. The program, while a tiring and time consuming effort, has been successful in Piney and North Fork Moormans Rivers in the past. Hopefully Brokenback Run will be the next success!



Shawn Green Explores New Trails!

Steve Bair, Backcountry Wilderness & Trails Manager

Having served Shenandoah National Park as the park-wide Trails Coordinator directing the Park's trails program for ten years, Shawn Green retired from the National Park Service in June 2008. Along with his going down the path to retirement, he is also embarking on a new career path!

Shawn's legacy with Shenandoah and the National Park Service is a long and colorful one and goes well beyond his contributions and accomplishments as Trails Coordinator.

Shawn began his career in 1974 as a seasonal Park Aid in the Fees program (remember those positions, old-timers?!) working with the Park's first campground reservation system at Big Meadows Campground. The bear management policy was changing and the Park dumps were closed with new bear-proof trash cans installed throughout the park. Shawn recalls 21 "garbage bears" being trapped and relocated out of the Park that year. Robert Jacobsen was Park Superintendent at the time, and the Park was experiencing a major spike in backcountry visitor use as backpacking became a hugely popular outdoor recreation activity in the early to mid-1970s. A new and innovative backcountry camping policy was implemented to address declining resource conditions and a typically crowded visitor experience at designated backcountry campsites. Shawn became forever hooked on NPS backcountry use management. In fact, Shawn was already an avid backpacker, was part of that surging throng of 1970s backcountry users, had no car and therefore headed down a trail and backpacked on his days off! Shawn was there when a large portion of the Park's backcountry was selected and designated as Wilderness in 1976 and he found that to be a very exciting time in the Park's history.

Upon completing a four-year dual degree in Meteorology and Earth Sciences at Penn State University in 1976 (an aspiring AccuWeather man!), he spent several years as a seasonal Park Technician and Park Ranger working the backcountry at Shenandoah National Park ('74-'79), Zion National Park ('80), and Glen Canyon National Recreation Area('81). He landed his first permanent subject to furlough position at Gulf Islands National Seashore in '82, and found himself hired back at Shenandoah as the lead South District Backcountry Ranger in October of that same year. Having been an seasonal vagabond for so many years, Shawn finally settled down and homesteaded at Shenandoah. During his seasonal Ranger stint at Zion, Shawn met Ranger Linda Cowles; they later married at Shenandoah in a lit-



Shawn Green backpacking the Appalachian Trail

tle white church in Syria in Madison County, Weakley Hollow, just outside the Park. The Park Superintendent and Smoky the Bear were in attendance. Of course, Linda is presently working as the Park's Fees Program Manager (and also nearing retirement eligibility!). Shawn and Linda are raising two fine sons, Clancy and Colin.

Shawn attended the Federal Law Enforcement Training Center in Georgia in the spring of 1983 and was commissioned as a law enforcement Park Ranger until 2002. Shawn's primary interest and position remained as a Backcountry Ranger, and he additionally was active as a Wildland Firefighter and eventually attained Crew Boss certification in the mid-1980s. He directed the Fire Program in the South District for several years, and led fire crews in the Shenandoah region as well as on several western US assignments. He served as the Operations Chief on the '86 Big Run Fire, up until that time the largest fire in the Park's history. Shawn contributed to park emergency operations using his other Ranger skills as a trained Park Medic and in Search and Rescue operations as an Incident Commander and in other Incident Command positions, and as a member of the Park's first Technical Rescue Team. In the latter part of his career, he also performed as the Park's Safety Committee Chair for two years.

He directed Backcountry operations as the South District Backcountry Ranger and supervisor from 1982 until 1997 when a Park organization restructuring incorporated Shawn's extensive backcountry and trails skills, experience and knowledge into a new Trails Coordinator position within the Natural and Cultural Resources Division (Center for Resources at the time), Branch of Backcountry, Wilderness and Trails. The

creation of the Trails Coordinator position and Branch organization was due in large part to Shawn's role and involvement in development of the 1998 Backcountry and Wilderness Management Plan effort begun in late 1991. Shawn has been instrumental in solidifying a strong and effective relationship with the Potomac Appalachian Trail Club (PATC), other Appalachian Trail partners, and other trails volunteers and cooperators.

There are certain Park events and his achievements that Shawn reflects on most. The monumental forest change that occurred in the mid-1980s through early 1990s due to Gypsy Moth infestation and oak tree kill still leaves Shawn in awe; Shenandoah had been primarily an open forest with thousands of large, old spreading oak trees – most of which are now dead and fallen to the forest floor, and the forest has generally become brushy and dense with new vegetation growth. The historic rain event, flooding and debris flows of '95 had severe park-wide impacts, and the South District's North Fork Moormans River Road was nearly completely wiped away, gone for all time in just one day. The storm-damaged trail recoveries, as well as the healing of some scenic mountainsides and

streams over time, were a thing to behold over the next several years.

Shawn is especially proud of the teamwork and achievements of the Trails program and Backcountry/Trails Branch during his decade as Trails Coordinator. The new Trails organization was seriously tested in '98 with severe January ice storms closing the Drive and many miles of trails for many weeks; the response in clearing trails of thousands of ice damaged trees and limbs and in organizing and managing the PATC volunteer clean-up response was highly successful and proved the effectiveness and efficiency of the newly organized Trails program. The Trails program experienced rapid growth in skills competence and teamwork, gaining new training, new skills, new equipment, and wilderness traditional hand tool expertise. Program employees trained with regional Forest Service partners and with a contractor from Maine to learn and hone trails highlining and grip hoist techniques and skills, rock work skills, and cross-cut saw use and maintenance skills. This advanced training, new skills, experience and equipment led to the accomplishment of more and more complex trails projects, and also contributed to the simultaneous increase in PATC volunteer trail

work skills and commitment to wilderness stewardship. Shawn is a PATC member and continues in his attachment to the Park and Trails program as a volunteer trails overseer in the South District.

Throughout Shawn's 34-year Park Service career, the foremost impression he has left with co-workers, colleagues and partners has been his friendship, dependability, common sense, sense of humor, and quiet strength in character and leadership. Shawn's resolve and personal strength is particularly evident in his nearly complete recuperation from a very serious back injury he incurred several years ago. Clearly, the support and professional physical therapy Shawn received during his recovery period has greatly influenced his choice of a new profession as an occupational therapist following retirement, for which he has returned to school. Presently, Shawn enjoys the support of his family and friends as he continues his studies through online courses and at Jefferson College of Health Sciences in Roanoke.

We wish Shawn and his family all the best as Shawn continues down the new and exciting path he has chosen!

2008 Centennial Initiative Seasonal Employee Program

Steve Bair, Backcountry Wilderness & Trails Manager

The National Park Service (NPS) has embarked on the Centennial Initiative program to provide additional funding to parks with the objective to improve resource conditions, facilities and operations in anticipation of the 2016 Centennial celebration of the creation of the NPS.

During the 2008 season, additional funding was made available to Shenandoah National Park's Backcountry, Wilderness and Trails program to hire several short-term temporary "seasonal" positions. Two Centennial employees were hired as Park Rangers for the Park's backcountry staff to supplement the one existing temporary position and pro-



Backcountry centennial employee assisting a PATC volunteer.

vide the Park's first backcountry and wilderness management "field crew" in nearly six years. Numerous projects and tasks were performed which enabled the program to begin to "catch up" in some deficient program areas due to the long-term staffing deficit. An additional four employees were hired in the Trails program as laborers to support and supplement Trails staff in various Recreation Fee program-based trailwork projects.

Enabled by supplemental funding of the Centennial Initiative for seasonal positions, the following accomplishments were achieved:

Backcountry and Wilderness Centennial Staff Accomplishments

Visitor Services

- Day Hikers - provided services to 160 groups of day hikers totaling of 494 visitors in the backcountry on 39 different trail areas
- Overnight Hikers - provided services to, and checked backcountry permits on, 45 groups of overnight hikers totaling 131 visitors in the backcountry
- Rock Climbers – provided services to 2 groups of Rock climbers totaling 7 people on 2 trail areas
- Provided backcountry day and overnight trip planning services for visitors at Thornton Gap Entrance Station every weekend of the summer season for over 300 visitors
- Directed 20 Boy Scouts as volunteers to construct designated campsites, install bear-resistant food storage poles, and paint a new "sleeping platform" at the Byrds Nest #3 shelter towards converting that structure and grounds to an Appalachian Trail (AT) overnight hut facility.

- Helped in the pre-fabrication of new moldering (composting) privies for installation at three AT huts; helped to construct a moldering privy "bin" at the Byrds Nest #3 AT shelter conversion site.

Backcountry Campsite Inventory, Monitoring, and Restoration

- Inventoried and monitored impact levels related to backcountry management standards on 204 backcountry campsites in 17 trail areas
- Restored 43 backcountry campsites that exceeded backcountry management standards
- Removed and restored 66 backcountry campfire sites
- Removed over 40 gallons of garbage from the backcountry
- Properly disposed of 45 human solid waste impacts

Backcountry Sign repair replacement or installation

- Repaired, replaced, or installed 74 signs in the backcountry

Trail Restoration

- Rehabilitated 12 impacted sections of cut switchbacks on trails
- Maintained 24 sections of revegetation barrier fencing on trails and at camping areas
- Removed over 20 tree blow-downs from trails during the course of work

Trails Centennial Staff Accomplishments

Four Centennial employees were hired into the Park's trail crews: two employees were assigned to the North District trail crew, one to Central District and one to the South District. These employees greatly contributed to both routine trail work

and projects accomplished by the crews.

- Cleared fallen trees from trails, cut encroaching vegetation on trails and cleaned and repaired water control structures on nearly 100 different trails and administrative roads

- Assisted in constructing a new access trail between the Appalachian Trail and the new Rockfish Gap Entrance Station site to serve hiker access to the station upon its completion

- Assisted in constructing more than 65 new water control structures and steps on numerous damaged trail sections

- Worked with volunteers, including those with the Potomac Appalachian Trail Club (PATC), on projects on popular trails including Saddle (Old Rag) and Thompson Hollow trails

- Worked alongside the Youth Conservation Corps (YCC) for 8 weeks, instructing the high school student trail workers how to work on trails safely and efficiently

- Assisted in Search and Rescue incidents as needed (most notably the Martins Search)

- Completed CPR and First Aid training; one Centennial employee assisted in administering CPR to a stricken hiker

- Assisted the Backcountry crew with backcountry campsite rehabilitation and restoration on the Jeremys Run and Nicholson Hollow Trails

- Provided visitor enjoyment and safety not only through accomplishing trail work, but in interacting with hikers encountered on trails during the work day

The Park anticipates similar Centennial Initiative funding support for these same operations in 2009.

75 Years:

Shenandoah and the Civilian Conservation Corps

Kandace Muller, Museum Specialist

Every year, over the last weekend of September, Shenandoah National Park revisits its beginning with an annual reunion of the Civilian Conservation Corps (CCC) alumni. This past September the CCC alumni and park celebrated a seventy-five year relationship. In 1933, with the country in the midst of the Great Depression the government started a new program. The Emergency Conservation Work (ECW) program would become known as the Civilian Conservation Corps and significantly affect the shaping of Shenandoah National Park. Over a period of ten years the program provided employment to a many Americans, improved State and Federal Park lands and forests. Camps at Shenandoah grew through these years to include: NP-1 at Skyland, NP-2 at Big Meadows, NP-3 at Baldface, NP-4 (later NP-26) at Front Royal Remount Station, NP-5 (later NP-27) at Grottoes, NP-9 at Sperryville, NP-10 at Pinnacles, and NP-12 at Piney River. By July 15, 1942 all the camps in Shenandoah would be closed as the depression softened and America entered WWII.

The first National Park System CCC camp was at Skyland in what would become Shenandoah National Park. Shenandoah was not an established park in 1933 when the call for work projects went out. J.R. Lassiter, the Chief Engineer working on Skyline Drive, rather than a Park Superintendent, responded asking for help with the Drive. The proximity of Shenandoah to Washington, DC made it a good prospect for publicizing the CCC program and on August 12, 1933, President Franklin Roosevelt came to Shenandoah for just that purpose.

Until the establishment of Shenandoah National Park in December

1935, the CCC worked on a narrow right-of-way along the Drive. After establishment, the CCC and NPS landscape architects worked on the Drive to improve problems caused by the original narrow work space. They gentled slope gradients, built out dramatic overlooks, and added a drainage system to correct for erosion. The CCC Boys built guardrails and walls along the Drive, first with logs then stone. They created a picturesque landscape.

In addition, they helped remove families from the park to new Resettlement Communities. They constructed facilities for the Virginia Sky Line Company, the new park concessionaire. The boys worked on cabins like Pocosin Cabin which still sits along the Appalachian Trail serving the public. The boys built fire towers, fought forest fires and installed infrastructure putting in a water system and telephone lines. Dead chestnut trees were cut and the wood used for various construction projects. They took on an incredible revegetation task planting and removing trees and brush. These included gooseberries which served as an intermediate host for the pine bark blister rust virus decimating the park conifers. An attempt was made to eliminate the exotic *Ailanthus* tree in the Swift Run area, an effort which continues to this day.¹ The boys used their off time to drive into local communities and interact with local citizens. Some learned skills that shaped their careers and some met future spouses while working in local CCC camps. It was the labor of these young men that brought to fruition the vision held by the engineers and park superintendents.

Their experiences in the Civilian Conservation Corps were often pivotal moments in the lives of these

men, many of whom would continue to return to Shenandoah for years. This past September 27th and 28th, whether in their eighties or nineties, some of them and their families made their way to Shenandoah National Park to commemorate and share their experiences as CCC Boys. The public was welcome to join them as they revisited what the CCC experience meant to them and the park. Our new Superintendent, Martha Bogle joined and spoke to them as one of her first events in the park. They talked with each other, park staff and visitors, and drew parallels between the past and the present. Some commented on the natural look of the park today. Lawrence McGlynn and his family saw a dream of his come true when he was presented with a certificate making him an honorary Park Ranger. On the 28th, Rapidan Camp volunteers gave some of the alumni a tour of Camp Rapidan to see the changes there.

Speaking to a reporter attending the reunion, Whitey Groves spoke of what the CCC experience meant to him and the park. "I love coming up here, he said. I can see the growth of trees I helped plant. Looking out over the Big Meadows area of the park, he said the CCC's effort made the park what it is today. I can recall when you could look across that, and it was all barren, he said. It looked like a war area."²

Today that concept of barrenness is hard to envision, the winding Skyline Drive takes visitors on a trip through forest and by beautiful vistas. Concessionaires provide lodging and dining. The NPS staff gives programs and maintains trails for the enjoyment of the public. The CCC Boys and park staff "re-created" the natural landscape we see today. The park will continue to welcome these men, so integral to

its creation as long as they continue to come. Reed Engle in his book, *Everything is Wonderful*, said it well when he wrote of the CCC Boys, "All of them will forever be a part of Shenandoah National Park."

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Update on Work of Cultural Landscape Preservation Field School, Summer 2008

David Washburn, Master of Landscape Architecture student State University of New York, College of Environmental Science and Forestry

This past summer in beautiful Shenandoah National Park, five landscape architecture students from the State University of New York College of Environmental Science and Forestry (SUNY ESF) and Cornell University participated in a six-week summer landscape preservation field school sponsored by the Olmsted Center for Landscape Preservation (OCLP), a program of the National Park Service Northeast Regional Office, in partnership with the Department of Landscape Architecture at SUNY ESF. The purpose of the field school was to give students training in methods and practices of cultural landscape preservation while undertaking field inventory and research necessary for the completion of cultural landscape inventories (CLI) at five landscapes in Shenandoah. The CLI is a comprehensive inventory of all historically significant cultural landscapes within the National Park System.

The five landscapes inventoried by the field school at Shenandoah in-

cluded Rapidan Camp, Big Meadows, Dickey Ridge, Park Headquarters and the South River Picnic Area. As part of the students' training, experts from the National Park Service, SUNY ESF, and the University of Virginia came to the field school to discuss various topics related to the Shenandoah landscapes, including natural and cultural resource management, national park design and planning, archival research, maintenance and operations, and flora and fauna. This field school was the second held at the park by OCLP and SUNY ESF, following one in 2006 that inventoried the cultural landscape of the Appalachian Trail.

During their six weeks at Shenandoah, field school students documented the historic and existing conditions of the five cultural landscapes, work that included research at park archives and written and graphic field inventory of existing landscape characteristics and features. The characteristics and features documented included topography, natural and planted vegetation, roads and trails, buildings, views, and small-scale features such as picnic tables, fireplaces, and signs. As the field

school ended, the work shifted to one of consolidation and organization. The graduate assistant for the field school, David Washburn, took the lead on this phase by organizing collected documentation and creating detailed existing maps for each site using data collected during the field school. Work on the maps will be finished this spring.

As David finishes the maps, staff at the Olmsted Center, under the direction of CLI Coordinator Jeff Killion, will complete the five cultural landscape inventories. Once complete, the five CLIs will provide key documentation for park managers to plan for preserving the significant characteristics and features of the landscape, and to understand and interpret the landscape's history and significance. This inventory work will ultimately aid the park in meeting the mission of the National Park Service to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The inventories will be completed by the end of the summer.

The Park's Nuisance Wildlife Aversive Conditioning Program

Rolf Gubler, Biologist

In 2008, the park hired two temporary "aversive conditioning" wildlife technicians to deal with parkwide wildlife habituation and food-conditioned animal issues. These technicians were also responsible for educating visitors and cooperators about proper food storage and trash management.

In addition to aversive conditioning duties, the technicians were responsible for tracking nuisance wildlife incidents and patterns, taking nuisance wildlife reports, performing visitor and employee education, dealing with food storage and wildlife feeding issues, dealing with overflowing trash problems in developed areas, deploying bear traps if needed, assisting with capture/relocation operations, and transcribing nuisance wildlife voice-mail calls from the nuisance wildlife hotline (x3490 option 3) and entering them into the park's Sharepoint Wildlife Incident Reporting database. This Sharepoint site serves as a central clearinghouse for all nuisance wildlife reports & incidents within the park. It can be accessed by any park staff wanting to track the progression of a problem animal in a given area.

The wildlife technicians worked a Friday-Monday schedule that concentrated their time on the most problematic human/wildlife conflict periods. Most of their aversive conditioning work was directed at nuisance black bear and beggar deer in developed areas or along Skyline Drive. They used light-handed aversive conditioning techniques (yelling, car horn), to moderate (stone throwing, sling shot), to more heavy handed techniques (paintballs, rubber batons). They were instructed to use the most light-handed technique to achieve

the desired response in the habituated animal (fear of humans). Aversive conditioning works by establishing dominance over the habituated animal. It works best when it is employed early when an animal is only slightly habituated. It doesn't work as well once an animal becomes highly habituated or food-conditioned.

Habituated – When a wild animal has no response to repeated human stimulus (is indifferent to humans) and has lost some or all of its fear of humans.

Food-conditioned – A wild animal that seeks out humans for food (through association). This stage is more difficult to deal with, and often the only recourse is to relocate or euthanize the animal.

Last season, all staff operated off of an approved 2008 SHEN Aversive Conditioning Guideline. Additionally, all staff that performed advanced aversive conditioning (using rubber slugs, bean bag rounds, rubber buckshot) had gone through a Law Enforcement Non-lethal Rounds Training and Certification Course at the Headquarters Range. These employees included the lead Wildlife Technician along with select staff from Natural Resources and Law Enforcement. For basic aversive conditioning training (orientation and target training with slingshots) staff had to go through the NCR training course beforehand. In June 2008, we held several field training sessions at Big Meadows for designated employees (mostly campground staff and hosts).

Overall, we had a busy season with nuisance bear activity. The busiest times were from late May through early September. The aversive conditioning technicians and other park

staff hazed approximately 50-60 bears (all habituated at some level) throughout the summer. There were a total of 189 Bear-related entries in the 2008 reporting system (Note that some of those were bears that were foraging along the roadside that displayed mild habituation but may not have been hazed. Additionally there were some repeat offenders that inflated that total). Only four bears had to be capture/immobilized and relocated (a sow and 3 cubs at Skyland Lodge Area in June). There were 20 non-bear nuisance wildlife entries in 2008. They were mostly habituated bucks at Loft Mt. CG or Big Meadows CG.

The most commonly used aversive conditioning tools in 2008 were slingshots and the paintball gun. There weren't many opportunities where staff could use a shotgun with rubber projectiles. We often were using these tools with at least some visitors within sight (e.g. developed areas) where it was more appropriate for us to use a paintball gun vs. a shotgun. We always had a designated staff member explaining our operation when we did aversive conditioning within sight of the public. We found through our experiences in 2008, that the paintball gun worked quite well as an aversive conditioning tool for bears. An added advantage of a paintball gun is that it can be used to mark (with special oil-based paint rounds) a habituated bear you want to keep track of.

In 2008, the park had two back-country nuisance bears that required posting "Problem Bear" advisories. One was a persistent subadult (possibly food-conditioned) that occasionally followed hikers along upper Cedar Run trail. That bear stopped harassing hikers

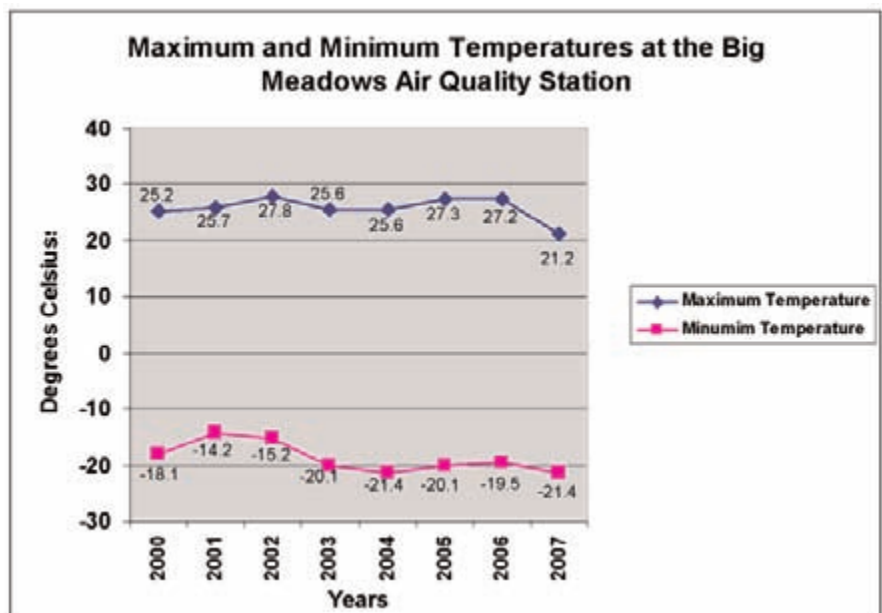
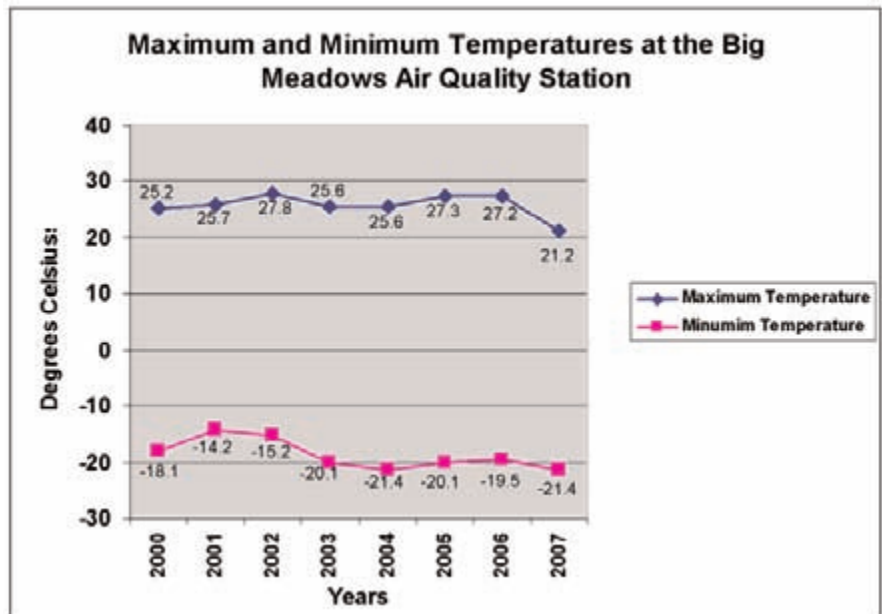
in September - around the time the acorns came in. The other was a food-conditioned subadult that had gotten into rock climbers' unattended packs at least twice near the summit of Old Rag Mt. This bear was problematic for 3-4 weeks in mid-summer but became less of nuisance after the acorn drop. Most parkwide nuisance bear activity dropped off in mid September (except for a food-conditioned subadult at Loft Mt. Campground that developed a taste for canned beer in October).

Overall, our aversive conditioning and nuisance wildlife management program is working and is reducing the number of park bears that have to be relocated. One of the most important components of the program was how the wildlife technicians communicated with visitors and concessioners about human/bear conflicts, trash management and food storage issues. By monitoring potential trouble spots (e.g., Skyland Dorm, Big Meadows Campground) and regularly communicating with visitors and concession staff about these issues, we were able to head off many nuisance animal problems in these developed areas. The wildlife technicians also got a lot of support from our campground staff and law enforcement staff because they were out there every weekend dealing with the problems and providing training, updating staff, and educating the public. As a result, I think all staff was more inclined to help and work as a team on various nuisance wildlife issues.

Please Help Us: This season, when you see habituated or nuisance behavior in bear or deer, please leave a detailed message on our Nuisance Wildlife Hotline at x3490 option 3.

Air Quality Updates

Liz Garcia, Physical Science Technician



Ozone Monitoring in 2007

The overall purpose of the National Park Service Gaseous Pollutant Monitoring Program (GPMP) is to establish and monitor the status and trends of each park unit ambient air quality conditions and to determine if the park is exceeding the National Ambient Air Quality Standards (NAAQS) set forth by the U.S. Environmental Protection Agency (EPA). These standards regulate ground-level ozone and sulfur dioxide and define the national targets for acceptable concentrations of each pollutant.

In 2007 the NAAQS standard for ozone was 0.08 ppm over an 8-hour period. An exceedance of the standard occurs when the 8-hour ozone concentration is greater than or equal to 85 ppb. An exceedance is not the same as a violation. A violation occurs when the 3-year average of the fourth highest daily maximum 8-hour average ozone concentration equals or exceeds 85 ppb.

The year 2007 was the third year in a row that there were no exceedan-

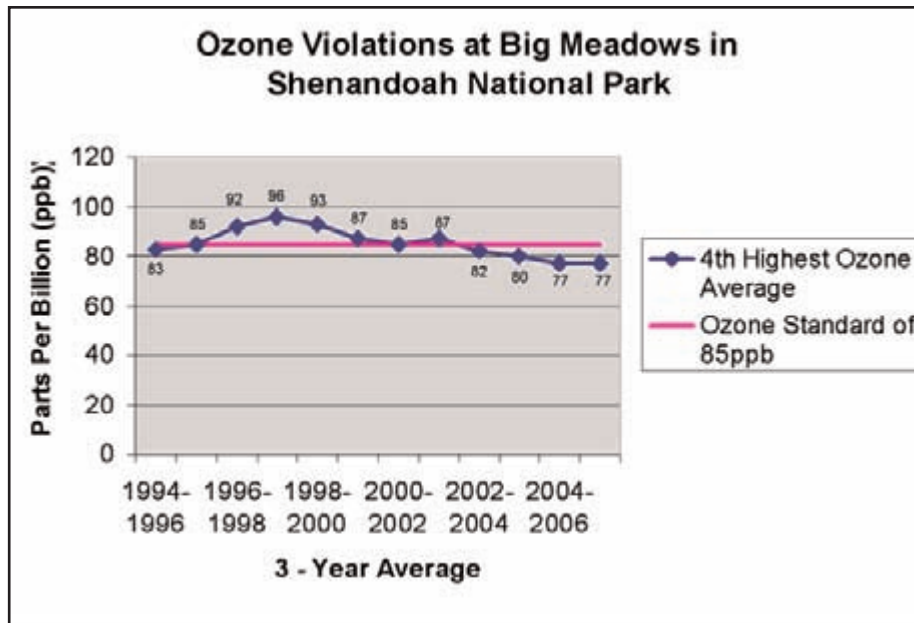
ces of the standard for Ozone. The 1st highest ozone level was 75 ppb, below the NAAQS by 10 ppb. The 4th highest ozone level was 73 ppb, which helped keep the 3-year average of 77 ppb out of violation of the NAAQS standards for the 4th year in a row.

The EPA proposed a new ozone standard in 2007 and announced the new standard of 75 ppb on March 12, 2008. The new standard replaces the previous standard of 85ppb. Under the new standard, many parks including Shenandoah National Park will likely be in non-attainment and fall under the State Implementation Plan for improving air quality.

Park visitors should consider the possibility of adverse health effects due to poor air quality, especially if they are sensitive to respiratory stresses. Help us clean up the air we breathe by doing your part to reduce automobile use by participating in a car pool or walk when pos-

sible. Also, when operating a vehicle you should reduce the time spent with the engine idling. Turn off the engine while talking or waiting to pick up others. This not only saves gas and money but reduces the amount of NOx and VOCs emissions that are produced that form ozone. Be sure to check and keep your tire pressure maintained. When refueling a vehicle, don't top off the tank and if possible try to fill the gas tank after dusk especially when ozone levels are expected to be high. If you use household, workshop or garden chemicals, use them in a way to keep evaporation to a minimum during poor air quality days. All the little things you do to help add up, especially if everyone pitches in a little.

Ray, J. D. 2008. Annual data summary 2007: Gaseous Pollutant Monitoring Program, National Park Service Air Resources Division. Natural Resource Report NPS/NRPC/ARD/NRR—2008/065. National Park Service, Denver, Colorado.



Data can be found at <http://ard-aq-request.air-resource.com/>

Changes in Ozone Monitoring for 2008

John Ray, Annual data summary 2007

On March 12, 2008, the EPA issued new, more stringent National Ambient Air Quality Standards (NAAQS) for ozone by lowering the ozone standard from 84 parts per billion (ppb) (0.08 ppm) to 75 ppb (0.075 ppm) for both the primary and secondary standard¹. The new standard is a significant enhancement to protection of both human health and for vegetation and other natural resources. The primary standard is designed to better protect human health, and the secondary standard is intended to provide protection against "welfare" effects, including harm to native vegetation in protected areas^{1,2,3}. By law, the EPA is required to base the NAAQS on science while providing an adequate margin for human safety.

Many NPS units exceed the existing ozone NAAQS, prompting concerns for human health and vegetation. Affected parks issue health advisories to visitors and employees on high ozone days because ozone harms lung tissue and can cause respiratory problems. The new lower ozone standard will result in NAAQS exceedances at more parks. Also, there will be a greater number of days considered unhealthy in parks, and thus more health advisory alerts. Based on recent data, ozone concentrations in 11 parks operated by the NPS and state agencies violate the new standard. Data from the NPS portable stations and state monitoring near parks suggest another 73 sites have ozone concentrations that exceed the new standard. Rural counties without ozone monitoring may also exceed the standard.

NPS interpolation mapping of ozone estimates that more than 150 park units may have concentrations

that exceed the standard. How the EPA will structure rural monitoring and the specific requirements used to determine areas in violation are unknown at this point. Ozone also affects vegetation. Visible plant injury and reduced growth from ozone have been documented in parks. Ozone can cause stress on entire ecosystems by reducing the ability of sensitive plant species and genotypes to adapt to or withstand environmental stresses, including freezing temperatures, pest infestations, or root disease. In addition, because it interferes with photosynthesis, ozone decreases the potential for carbon sequestration by plants. When revising the ozone standard the EPA did not adopt a separate secondary standard to protect "public welfare"^{2,3}.

In all past designations of non-attainment, EPA has required a minimum of 3 years' of ozone data collected according to EPA monitoring regulations using certified equivalent-method analyzers. Usually attainment status is determined at the county or metropolitan level based on monitors in those areas. Many natural areas and national parks are in rural areas and counties that do not have monitoring. Furthermore, when a park is in more than one county usually only the county with the direct monitoring data gets the designation status. Examples of this are Joshua Tree NP and Shenandoah NP where NPS monitoring showed a violation of the old NAAQS, but only the county in which the monitor was located received a non-attainment designation.

In its announcement of the new standard, the EPA provided a map and list of counties it expects to violate the new standard. Combining this information with the parks that are projected to violate the NAAQS

based on monitoring and the parks in the >75 ppb O₃ interpolation areas a map can be generated based on counties. More than 150 park units fall within counties that by measurement or interpolation might violate the new standard. Since counties are designated nonattainment based on monitors within their boundaries, this map is an estimate of which counties and parks will be represented by monitors and which ones will not. If the counties become designated as nonattainment the parks would benefit from clearer air associated with the control measures that might be implemented.

Citation

Ray, J. D. 2008. Annual data summary 2007: Gaseous Pollutant Monitoring Program, National Park Service Air Resources Division. Natural Resource Report NPS/NRPC/ARD/NRR—2008/065. National Park Service, Denver, Colorado.

References

¹ EPA Final Rule on Revision to the National Ambient Air Quality Standard for ozone, March 12, 2008. <http://www.epa.gov/groundlevelozone/actions.html#mar07s>

² Proposed Rule; National Ambient Air Quality Standards for Ozone, 40 CFR Part 50, July 11, 2007. http://www.epa.gov/groundlevelozone/pdfs/20070711_proposal_fr.pdf

³ Review of the National Ambient Air Quality Standards for Ozone: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper, EPA-452/R-07-007 July 2007. http://epa.gov/ttn/naaqs/standards/ozone/data/2007_07_ozone_staff_paper.pdf

Year	1st Highest Ozone Concentration (ppb)
1994	90
1995	93
1996	87
1997	95
1998	110
1999	101
2000	93
2001	95
2002	101
2003	104
2004	87
2005	81
2006	81
2007	75



Items in Brief...

How Many Trees Are in the Park?

Wendy W. Hochstedler, Biological Science Technician

Over 33 million living trees! Oaks are the most common trees in the park, followed by red maples then sweet birches (Figure 1). A cross-cut of oak tree trunks also occupy the most space of all tree species, followed by tulip trees (Figure 2). These numbers, based on 2007 long-term forest monitoring data, define a tree as anything with a trunk diameter greater than 10 cm. Information like this gathered by the forest monitoring program in Shenandoah provides Park managers a better understanding of how the trees and shrubs are changing over time, as well as how future disturbances may impact the Park's plant resources. For example, the Asian long-horned beetle is known to prefer maples, birches, elms and black locust. Based on forest monitoring data, about 27% of the trees in the Park are susceptible to damage from this exotic pest.

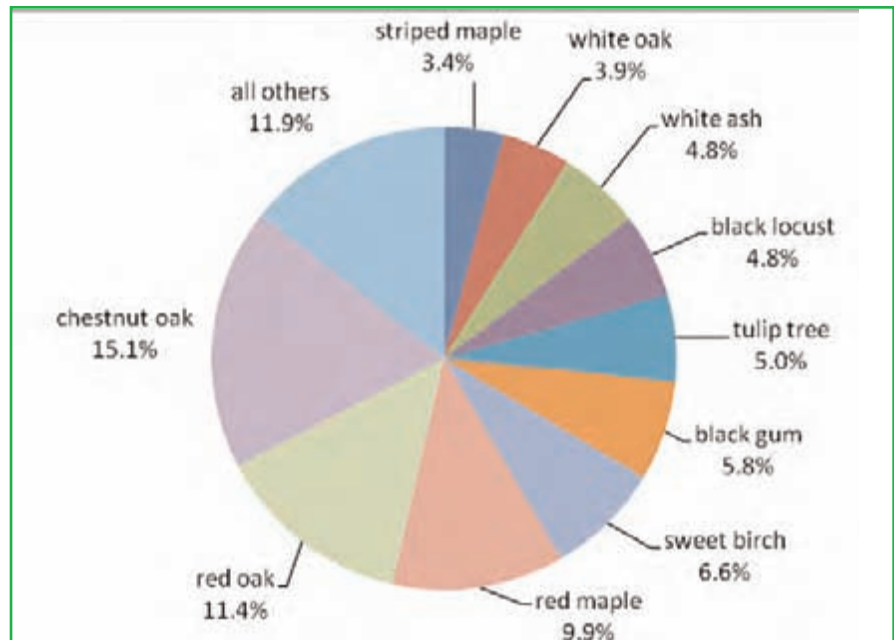


Figure 1. The ten most common tree species in Shenandoah in 2007. Percentages represent the number of trees of one species relative to the total number of trees of all species, or relative density. These species are chestnut oak (*Quercus prinus*), red oak (*Quercus rubra*), red maple (*Acer rubra*), sweet birch (*Betula lenta*), black gum (*Nyssa sylvatica*), tulip tree (*Liriodendron tulipifera*), black locust (*Robinia pseudoacacia*), white ash (*Fraxinus americana*), white oak (*Quercus alba*), striped maple (*Acer pensylvanicum*).

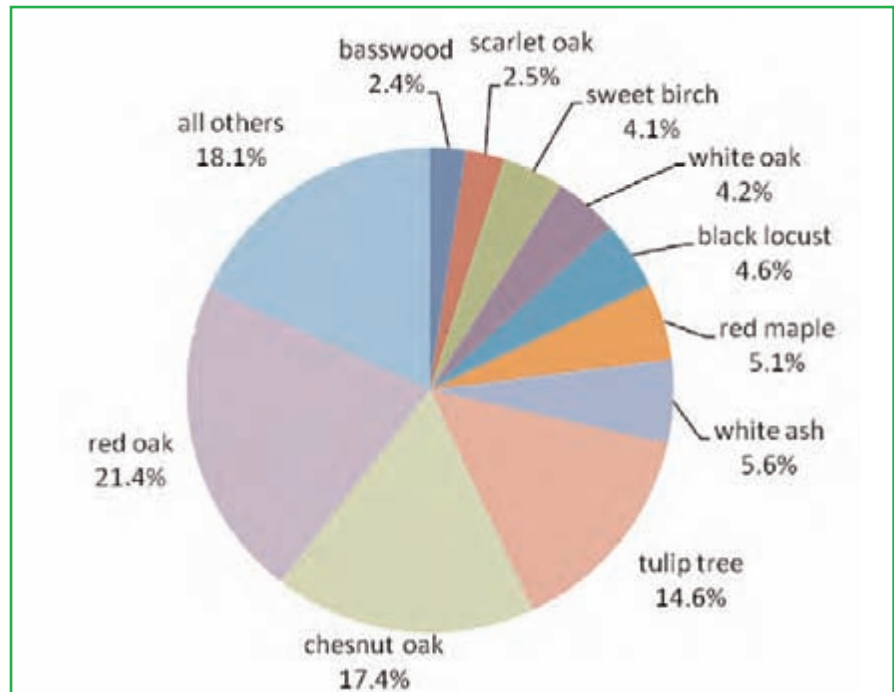


Figure 2. The ten tree species in Shenandoah (2007) with the greatest basal area. Basal area is the area of a given section of land that is occupied by the cross-section of tree trunks near their base. Percentages represent the basal area of one tree species relative to the total basal area of all tree species for a given area of land, or relative basal area. These species are red oak (*Quercus rubra*), chestnut oak (*Quercus prinus*), tulip tree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), red maple (*Acer rubra*), black locust (*Robinia pseudoacacia*), white oak (*Quercus alba*), sweet birch (*Betula lenta*), scarlet oak (*Quercus coccinea*), basswood (*Tilia americana*).

2008 Sudden Oak Death Early Detection Surveys

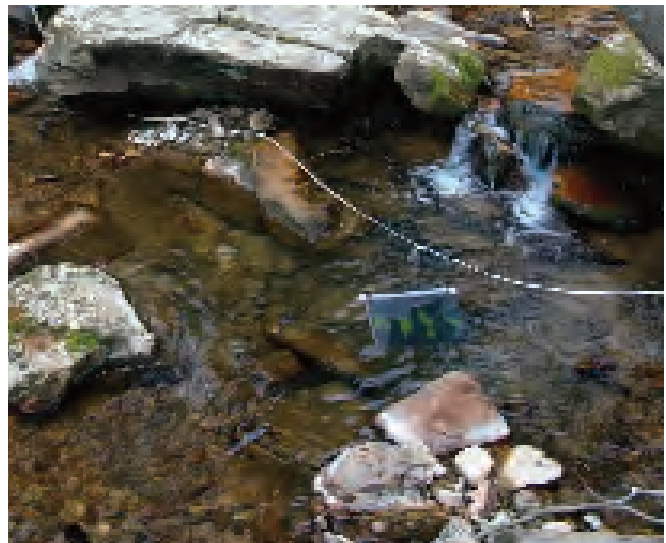
Dale Meyerhoeffer, Biological Science Technician and Rolf Gubler, Biologist

In 2008, Park staff participated with the Virginia Department of Forestry (VDOF) in early detection surveys for *Phytophthora ramorum* (Pr), the pathogen that causes Sudden Oak Death (SOD). The project, sponsored and funded by the U. S. Forest Service, uses a stream baiting technique (submerged rhododendron leaves in a mesh bag) to survey an entire watershed with a single downstream survey site. Ten Park watersheds (five on each side of the mountain) of 6,000-12,000 acres each were surveyed, with three baiting periods in the Spring and Fall at each site. An additional 10 survey sites were chosen by the VDOF to represent the other half of the statewide SOD survey effort for 2008.

SOD was first observed in California in 1995, although the pathogen Pr was not identified until 1999. The disease, which has caused extensive oak mortality on the West coast, affects many species, although symptoms vary. Some of these species act as carriers and are not killed by the pathogen Pr but do express leaf and shoot symptoms (e.g., rhododendron, mountain laurel, huckleberry, azaleas, viburnum, and camellia). Other species such as northern red oak, pin oak, and chestnut oak are susceptible to Pr caused mortality via girdling of the tree (SOD). It is unknown what effect SOD might have on eastern forests, but with ample hosts and a favorable climate, a frightening scenario may be possible – especially when considering how much oak is present in eastern forests. Note: It is important to mention the connection between the risk of movement of Pr from California via carrier species sold through the nursery trade, and the pathogen's arrival into Virginia by that mechanism. If Pr killed these carrier plants, it would be easier to detect SOD in the commercial nursery setting and the risk of spread would likely be lower.

Pr spores, like those of other *Phytophthora* species, are waterborne. SOD Stream baiting takes advantage of *Phytophthora*'s affinity to water. Recently harvested rhododendron leaves are placed in mesh bags and are left in streams until *Phytophthora* symptoms develop. Then the leaves are shipped to two labs which use different methods to detect Pr. Although native *Phytophthora* species were detected on 95% of the samples from the Park, no harmful *P. ramorum* was detected in 2008.

With much of Park's vegetation susceptible to SOD, the stakes are indeed very high. Eradication of SOD on the West Coast has had limited success. Early detection is critical to any future control efforts. We hope to continue to cooperate with the USFS and VDOF on future SOD early detection surveys. Our gratitude is extended to the VDOF and USFS for allowing us to join and receive training in this important cooperative survey effort.



Stream baiting for *Phytophthora ramorum*.

Fact Sheets – New and Old

With the arrival of a new Superintendent, it was timely this past fall for members of the Division to prepare new Fact Sheets and to update older ones. These would be used to get the new Superintendent “briefed in” on the many activities within the park's Resource Management Division. New Fact Sheets were prepared for the Cultural Re-

sources and Backcountry, Wilderness, and Trails operations. Each workgroup prepared about a half a dozen documents. Concurrently the Natural Resources operation updated many of its extensive collection of Fact Sheets. All of these are available on the park's website under the Management – Our Staff and Offices sections.

Key Positions Filled in the Division

During 2008, two key positions were filled with permanent, fulltime employees. The first of these was the park's Physical Scientist (actually filled as an Ecologist) with responsibility for air quality, water resources, geology, soils, and meteorology. This position was actually vacant for several years so filling it has been most beneficial. The second position was the park's Wildlife Biologist who has responsibility for fisheries, amphibians, reptiles, aquatic invertebrates, and large mammals except deer.

Jim Schaberl has filled the Ecologist position. He has come to us from Mt. Rainier National Park where he had been the park's Wildlife Biologist. He also worked at Voyageurs National Park where he was heavily involved in water and air issues and at Saratoga National Historical Park where he was the park's resource manager. Jim has a Master's degree from the State University of New York and a Bachelor's degree from West Virginia University. Since his arrival he has jumped in with both feet and is in-

involved in work related to air quality critical loads, global climate change, climate friendly parks, TMDL planning, and water quality monitoring.

Jeb Wofford has filled the Wildlife Biologist position. He has come to us from the Sawtooth National Recreation Area, a unit of the National Forest System in Idaho. He worked at the Sawtooth as a Zone Aquatic Ecologist and has held a variety of other positions as a Fisheries and Biological Technician in a wide variety of locations including Alaska, Oregon, and the Great Smoky Mountains. Jeb has a Master's degree from Oregon State University and a Bachelor's degree from Washington and Lee University here in Virginia. Although his time with us has been pretty brief, he has become immersed in various efforts, including planning associated with the park's long-term monitoring program, and reviewing of a variety of project proposals.

Both employees are great additions to our team here at Shenandoah.



Jim Schaberl



Jeb Wofford

National Historic Landmark Designation

Skyline Drive in Shenandoah National Park was recently designated a National Historic Landmark (NHL). The Drive has been listed on the National Register of Historic Places since 1997 and listing as a NHL elevates recognition of the Drive's historic significance. National Historic Landmarks are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States. These places form a common bond between all Americans. Today fewer than 2,500 historic places bear this national distinction. Shenandoah National Park now has two NHLs, Skyline Drive and Camp Hoover, President Herbert Hoover's recreational retreat.

Update: Chronic Wasting Disease (CWD)

Rolf Gulbier, Biologist

CWD is a neurological disease found in deer, elk, and moose. CWD belongs to a family of diseases known as transmissible spongiform encephalopathies. The disease is caused by abnormal, protein-like particles called prions that slowly attack the brain, causing an animal to progressively become emaciated, display abnormal behavior and ultimately die. There is no known treatment for CWD. There is currently no evidence to suggest CWD poses a risk for humans or domestic animals.

In 2002, the National Park Service issued guidance to parks on CWD response. This was done because the disease is considered to be exotic outside of certain areas in the western United States. That guidance mandated surveillance if a park was within 60 miles of a detection as well as restrictions on animal movement, the need for cooperation with the states, and decision-making related to disease management within a NEPA framework.

In 2005, CWD was detected in Hampshire County, WV. Since then, 37 deer have tested positive for CWD from 2005-2008. The closest positive case to the park from that outbreak area was in Yellow Spring, WV. Yellow Spring is located 25 miles from Front Royal. That puts the entire North and Central Districts of the park within the 60-mile radius CWD surveillance area.

- In 2008, SHEN tested 13 deer through its opportunistic surveillance program. Most samples came from road-killed deer from Central District. All samples were negative for CWD.
- In 2008, SHEN hired two seasonal Wildlife Technicians. Part of their duties included monitoring the northern two thirds of the park for CWD-symptomatic deer. No symptomatic deer were found.
- In 2008, SHEN convened a Science Team (with VDGIF participation) to develop the scope and alternatives of a CWD Detection and Assessment Plan Environmental Assessment (EA). Michele Batcheler (NERO Wildlife Biologist) wrote the draft EA (with major input from SHEN and other NPS staff (e.g., BRMD, EQD). It is currently being finalized.
- The Chronic Wasting Disease Detection and Assessment Plan EA places emphasis on surveillance and determining disease prevalence. The park will receive funding for preparation of an Environmental Impact Statement (EIS) aimed at disease management should it show up in the park. The park has received notice that funding will be available for EIS preparation starting in 2010.

CWD Surveillance activities continue and periodic conversations/meetings are maintained with VDGIF staff.

Court Settlement Funds from American Electric Power — An Update

When air quality regulations are not fully adhered-to by industrial facilities such as coal-fired power plants, options include litigation by affected groups. Sometimes an out-of-court settlement is developed instead of a full legal hearing. One such settlement identified Shenandoah, Great Smokies, and Mammoth Cave National Parks to gain two million dollars from American Electric Power (AEP) in 2007.

Settlement funding from AEP is currently managed by the NPS-Air Resources Division. In discussion with parks, the Air Resources Division established a spending strategy which includes three primary areas: 1) Funding a regionally-integrated Appalachian Trail Mega-Transect Atmospheric Deposition Effects study across several states, 2) Funding smaller projects submitted by each of the three parks named in the

settlement to include Shenandoah, and 3) Maintaining a discretionary reserve fund for smaller, future needs.

At Shenandoah, our current park-specific priorities for this fund focus in two areas. First, we intend to develop watershed-specific critical loads for aquatic and terrestrial resources. Critical loads are thresholds for atmospheric deposition below which significant harmful ecological effects do not occur. Thresholds provide managers, policy-makers and regulators scientifically-derived information to guide decisions.

Second, we wish to implement parts of the park's Clean Air Restoration Effort (CARE) initiative, a plan to reduce consumption of fossil fuels and power in the park and through public education. Plans are to begin projects in 2009.

A New Native Plant Find

Wendy Hochstedler, Biological Science Technician

In June of 2008, Gary Fleming of the Virginia Department of Natural Heritage (VA-DNH) discovered a native plant previously not documented in the Park, flatstem spikerush (*Eleocharis compressa*). This member of the Sedge Family (Cyperaceae) was located in a seep at the base of a boulder along Dickey Ridge North where the roots formed a thick, creeping mat in the water. As its name suggests, the stems are flattened, 8–45 cm in height and 0.5–1.8 mm wide with an oval flowering spikelet at the top. This was the first record of this species in the Blue Ridge Mountains; all other known occurrences in Virginia are in the Piedmont or Ridge and Valley regions. In addition, it was surprising to find this population in the habitat where it was located—a Central Appalachian Basic Woodland community (see Patterns on the Landscape in this issue). In Virginia this spikerush was previously only known to be located either in limestone glades and or on flood-scoured rivershore outcrops. The flatstem spikerush is listed as “imperiled” within Virginia, but as “uncommon but not rare” globally (VA-DNH). Six other species of spikerush are found in the Park.



The flatstem spikerush (*Eleocharis compressa*) was discovered in a seep along north Dickey Ridge during 2008.

A Lichen Far From Home

(selected from Irwin Brodo's Nature Note, wwh)

Wendy Hochstedler, Biological Science Technician

On the side of a rock outcrop protruding among the talus boulders of Blackrock in the south district (Figure 1), a lichen survey team for the Rock Outcrop Management Project found a large yellowish green patch they had never seen before. After careful removal of a sample, the lichen was sent to experts at the New York Botanical Garden and the Canadian Museum of Nature (CMN) in Ottawa with the message, “Is this lichen special in some way, and does it make the area where it was growing worthy of special protection?” Indeed, it was a special lichen. Based on chemical analyses, the lichen was identified as *Calvitimela talayana* (Figure 2), an arctic-alpine lichen then only known from a few places in Siberia! Its discovery made it a new record for the North American continent.

When a population of plants or animals is found to be far from its main area of distribution, it is said to have a “disjunct distribution” which can help tell a fascinating story of the distributions and migrations of living things over the past millennia. *Calvitimela talayana* is a good example. Its presence at high elevations in the Southern Appalachian Mountains probably reveals a remnant population of a distribution pattern that once included all of the arctic regions or the Northern Hemisphere and extended southward along the north-south running mountain chains. Unlike “younger” likely alpine habitats in the Rocky Mountains or Adirondacks, the Southern Appalachians have been constantly available for colonization since the Cretaceous, 100-65 million years ago, and undoubtedly served as a refuge during the Tertiary period that followed. *Calvitimela talayana* may be far from its original home, but it has obviously found a suitable second home here in Shenandoah.



Figure 2. specimen of *Calvitimela talayana* collected from Blackrock in the south district of Shenandoah National Park. [Image is 4.1 cm across.]



Figure 1. View to the northwest from the quartzite talus field at Blackrock in the south district of Shenandoah National Park.

New Park Geology Map and Database To Be Released Soon

Jim Schaberl, Ecologist

We're proud to announce a new geologic map for the Shenandoah National Park Region. A culmination of years of field investigation, the mapping program was led by Dr. C. Scott Southworth of the U.S. Geological Survey (USGS).

Shenandoah National Park's geologic history is varied and includes sedimentary formations in southern regions of the park to a variety of ancient lava flows, igneous and metamorphic rocks at other locations. The park's geology is significant in many respects and is the foundation upon which ecological processes occur. An understanding of geology is critical to examining the ecological health of terrestrial and aquatic systems.

An important review of park geology was developed in the 1970's by

Tom Gathright. Geological maps of the area were developed but were not very detailed, were difficult to use at the park-scale, and were in need of revision. Dr. Southworth and a team of five other geologists began their work in the park area several years ago and built upon a similar mapping effort to the East of Shenandoah.

The products from this research are many. A new, detailed geologic database will be used immediately by interdisciplinary scientists from USGS, NPS, and academia. County governments in the region are very interested in groundwater resources documented in this process.

The new geology map and database will clearly be useful to the park by all disciplines. A pre-release copy was provided to the park

and the detail and sophistication are impressive. Even small features are clearly presented. The information will also help garner support for a soils inventory – the next step required to understand and properly manage our physical resources.

The final products will be delivered to the park very soon. Subsequently, a USGS Open File report will be published and posted on a USGS website. Plans are to develop a Scientific Investigations Map and Report printed for distribution at the park visitor centers – available in about four years from now. Meanwhile, the map will be featured, studied and showcased in the upcoming Virginia Geological Field Conference – held in the park this fall.

Gypsy Moth Update, 2008

Dale Meyerhoeffler, Biological Science Technician

Due to a resurgence of gypsy moths in parts of the Park in 2007, 2500 acres in the North District had to be aerially sprayed in May, 2008. This was the first aerial spray treatment in the Park since 1995. A biological pesticide, Btk (*Bacillus thuringiensis kurstaki*) was applied at Matthews Arm Campground and along many parts of the Skyline Drive (600 feet on both sides) in the North District to reduce hazard tree formation. Although the spray was effective, portions of the treated area were eventually attacked by hungry gypsy moth caterpillars moving in from neighboring untreated areas that had been com-

pletely defoliated. Aerial surveys by the Virginia Department of Forestry indicated that 11,750 acres were defoliated in the Park in 2008.

The key players in combating the gypsy moth, however, are not men and machines but nature and biological agents. Gypsy moth populations in the Park were kept at low levels from 1996 through 2006 largely due to the effects of the fungus *Entomophaga maimaiga*. The resurgence of gypsy moths in 2007 was mainly attributable to reduced Spring rainfall, which curtailed the development of the *Entomophaga* fungus. Ample spring/summer rains in 2008 activated the fungus again. *Entomophaga*, along with NPV (*Nu-*

cleopolyhedrus virus), parasites and predators, inflicted heavy gypsy moth mortality this summer. Unfortunately, some forests were heavily defoliated (e.g., Matthews Arm Campground) before these natural agents became effective. Fall, 2008 surveys found significantly fewer egg masses, many of which were small and thin and subjected to greater parasitism. All in all, nature's fine display of boom and bust phenomena, along with a little help from man, promises a much reduced 2009 gypsy moth population, with no spray treatments anticipated.

(See photo of aerial spraying, next page.)



Aerial spaying for gypsy moth at Shenandoah National Park

Photos from Shenandoah, 2008



Studying the land



Battling invasive exotics



Planting for restoration



Be careful!



2009
Resource Management Newsletter
was produced by the
Division of Natural and Cultural Resources
Shenandoah National Park
National Park Service

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