Shenandoah National Park

National Park Service
U.S. Department of the Interior

Resource Management

Near Stream Recovery After the Flood of 1995

By David Demarest

June 27, 2005 will be the 10-year anniversary of the formation of two small storm cells, one in Madison County and one in Albemarle County, Virginia, which dropped up to 24 inches of rain in localized areas in less than 10 hours time. These two cells unleashed their precipitation after four days of steady rains had already saturated the soils. The resulting floods were determined (by magnitude) to be 400 to 2,000 year occurrences. There were three major watersheds severely impacted by these two events in Shenandoah National Park. The Rapidan and the Staunton Rivers (actually a tributary to the Rapidan) in Madison County, Virginia were inundated during the day while the North Fork of the Moormans River in Albemarle County, Virginia was affected in the early evening and night.

The resulting floods were determined (by magnitude) to be 400 to 2000 year occurrences.

The damage to the lower portions, typically below 2,200 feet elevation, of these three watersheds was astounding. Prior to the floods, the Staunton River had a full tree canopy classified as 90 to 100 percent coverage over the stream for its entire length, while the Rapidan and North Fork Moormans Rivers had about 65 to 95 percent canopy coverage over the water. The floods destroyed all vegetation along the three rivers and left a corridor 75 to 100 meters (246 to 328 feet) wide through the forest. These storm events also obliterated roads and trails as well as cultural resources in and around Shenandoah National Park. Of the three, the Staunton and Rapidan drainages were characterized by the formation of debris flows and deep channels cut to bedrock in the tributaries, while the North Fork Moormans watershed was characterized by large slippages of soil from the hills surrounding the stream and some debris flows.

This photograph is from point 2P009. It was taken on the Staunton River in May 1996 and shows a pile of woody debris from the trees that were uprooted. It is approximately 90 meters long and 20 meters tall. Prior to the flood, there was 90-100 percent tree canopy over the river at this point.

In the spring of 1996, a project was initiated to photo document the vegetative re-growth along the drainages. Points were selected in each of the watersheds where pictures could be taken looking in more than one direction. To ensure that future pictures were looking at the same scene, compass bearings were recorded, and each photograph has since been aimed toward the same bearing. There are 13 permanent points in the North Fork Moormans drainage, 11 points in the Staunton River drainage, and four points in the Rapidan River drainage.

The vegetative changes in the last nine years have been almost as dramatic as the flood event itself.

In the three drainages, a total of 91 photographs were taken twice a year. The first set of photos, taken in the early spring, shows the amount of vegetation left at the end of winter and its ability to hold soil. The second set of photos, taken near the end of summer, shows the amount of vegetation that has grown and provides canopy cover. Some of the photos also document how the stream channels are changing over time. All of the points have been located and mapped using Global Positioning Systems.

The first pictures were taken in April of 1996. These show very little over-wintering vegetation and are a close representation of the areas directly after the flood. Two major exotic trees, tree of heaven (*Ailanthus altissima*), and princess tree (*Paulownia tomentosa*), are colonizing most of the areas. Common mullein (*Verbascum thapsus*), another exotic, which had invaded early on is now mostly shaded out, and seems to exist only on the margins of streams and trails where it can receive more sunlight. The tree of heaven and princess tree are over 30 feet tall in most places and have reached 40 feet in others. The only native plant keeping up with the tree of heaven and princess tree is black locust (*Robinia pseudoacacia*). In all three drainages, black locust became established about 1998, black and yellow birch (*Betula lenta* and *Betula alleghaniensis*) in 1998 and 1999, Virginia pine (*Pinus Virginiana*) and tulip tree (*Liriodendron tulipifera*) in 1999, and red oak (*Quercus rubra*), in some places, in 2000. Sycamores (*Platanus occidentalis*) started sprouting from stumps and roots on the

Figure 1. 3P006, North Fork Moormans River April 1997. Prior to the flood this section of stream had approximately 80 percent tree canopy cover.

stream edges in 1996 but were easily washed/broken off in successive floods. Sycamores are 15-20 feet tall in the North Fork Moormans but do not seem to be as prevalent in the Staunton drainage.

The dominance of exotics can be seen in areas like the princess tree grove on the right hand side of the

Figure 2. 3P006, North Fork Moormans River September 2004. Most of the trees on the right hand side of this picture are princess tree and tree of heaven with some birch, black locust, and sycamore.

pictures of 3P006 (North Fork of the Moormans River). Photography was not started at this location until 1997, but it is an excellent site for documenting stream and vegetative changes. Included are the spring 1997 (Figure 1), fall 2004 (Figure 2), and a third view of the site in late May of 2004 (Figure 3) showing some of the

Figure 3. A view from 3P006 taken in late May 2004 looking slightly to the right of the normal bearing to show the end of the princess tree bloom. Many of the trees had already lost their blossoms at this point.

princess tree in bloom. It is easier to see the height of the exotics and the reason they out compete the native plants (mostly the short green plants) in Figure 3.

The vegetative changes in the last nine years have been almost as dramatic as the flood event itself. The plant community will continue to evolve and mature, but it will take many more years to get the full tree and shrub canopy needed to help cool and feed the stream.

David Demarest is a Biological Science Technician.

Fisheries Projects Update

By Jim Atkinson

Shenandoah Fisheries Monitoring Program: During 2004, a larger suite of streams was sampled than in previous years to incorporate additional fieldwork associated with the U.S. Geological Survey (USGS) "Mercury Bioaccumulation in Fish" and the "Brook Trout Genetic Diversity" studies that both provided additional funding for the 2004 field program. A total of 69 sites along 37 park streams were sampled during the 2004 field season including all of the annual and non-annual streams originally scheduled, all of the non-annual streams originally scheduled for 2005 and seven additional streams that have not been sampled for over 20 years. This latter group of streams includes the East Fork (Heiskell Hollow) of Compton Creek and Jordan River in north district; Devil's Ditch, the upper Conway River, Lee Run and Elk Run in the central district; and Upper Lewis Run in south district. Monitoring program highlights include:

- The parkwide sample included 32,694 fish of 29 species. The total included 9,779 brook trout, 65 brown trout (principally from the Rose and Hughes Rivers) and 21 rainbow trout (principally from the Moorman's River, North Fork).

- Parkwide brook trout populations experienced a dramatic rebound from the population lows recorded during 2003. This seems to be largely due to a highly successful spawn during the past fall and winter and near optimal water levels during the period.

- The only noteworthy exception to the positive brook trout trend was the documented collapse of the trout population in Lower Lewis Run in South District. During the survey of the entire park section of the stream, only two adult female brook trout were encountered. This small stream had a fairly robust trout population as recently as 1997. A research project targeting small, naturally acidic streams containing at-risk fish populations is proposed to better understand the cause(s) of the collapse of this population and anticipate future problems.

- Rainbow trout reproduction was documented in the lower Moorman's River for the first time since Robert Lennon's (U.S. Fish and Wildlife Service) 1957 observation of reproducing rainbow trout in the stream. Eighteen juvenile and one large adult rainbow trout were captured within the lower most of three monitoring sites on the Moorman's. A single adult was captured within the middle site which is in the vicinity of the Big Branch tributary.

- A single adult rainbow trout was recorded within the lower most monitoring site in Whiteoak Canyon Run and a single adult brown trout was recorded within Happy Creek, approximately 1.0 mile upstream of Front Royal, Virginia.

- Several yellow bullheads (a new species for the park) were recorded from established monitoring sites in Happy Creek (north district) and Hawksbill Creek (south district).

Investigation of Mercury Bioaccumulation in Fish: This collaborative study with the U.S. Geological Survey (USGS), Leetown Science Center and the University of Virginia was initiated in 2004 as a one year project to determine the distribution, abundance, and variability of mercury in fish within Shenandoah National Park, and to assess the relationship between streamwater chemistry and mercury accumulation in brook trout. The intent of the study is to ensure that mercury contamination poses no threat to humans or fish populations in the park. Results of the study will: (1) provide data needed to evaluate human health risks associated with the consumption of fish in Shenandoah National Park (SHEN); (2) determine the potential for acute or chronic problems with trout populations associated with mercury accumulation and toxicity; and (3) improve the understanding of factors governing the bioavailability of mercury in stream ecosystems. The study makes use of the extensive water chemistry database developed as part of the Shenandoah Watershed Study (SWAS) to provide the basis for sample site selection and the context for interpreting data.

A total of 512 fish from 17 park streams were collected for mercury analysis. These included brook trout (420), blacknose dace (30), brown trout (15), white sucker (15), smallmouth bass (15), American eel (12) and rock bass(5). The fish were shipped in three separate batches to the Trace Element Research Lab at Texas A&M University for analysis. A summary of results will be available upon completion of the final report in 2005.

Investigation of Brook Trout Genetic Diversity: This ongoing study, initiated by the USGS Leetown Science Center in 2001, will provide a complete genetic profile of nearly every brook trout population in the park through the identification and characterization of microsatellite DNA (deoxyribonucleic acid) markers. During 2004, adipose tissues were collected from 453 brook trout from 10 park streams and submitted for DNA analysis. This brings the total number of brook trout sampled from SHEN streams to 2439. This year, DNA was extracted and prepared for microsatellite DNA analysis in over 600 previously collected trout. Microsatellite DNA analysis was performed on the 2002-2003 samples from 16 sites (685 brook trout) representing all three of the major drainages (Potomac, Rappahannock and James) that occur within the park. Statistical analyses have shown a high degree of genetic differentiation in trout among the three drainages and among tributaries within the drainages. Brook trout from the six Rappahannock River drainage samples that have been analyzed are highly divergent from the fish sampled from the Shenandoah and James Rivers. A range-wide comparison of brook trout indicates that the fish inhabiting the upper reaches of the Rappahannock River are genetically similar to southern Appalachian brook trout sampled from Great Smoky Mountains. This result appears consistent with historical stocking records, yet contradicts the conclusion reached decades ago that the introductions of the non-native brook trout were unsuccessful. This study is funded through 2006.

Mid-Atlantic Network Fish Species Inventory: During 2004, inventory efforts were completed within Appomattox Courthouse National Historical Park (APCO), Booker T. Washington National Monument (BOWA), Eisenhower National Historic Site (EISE), Fredericksburg and Spotsylvania National Military Park (FRSP), Gettysburg National Military Park (GETT) and Valley Forge National Historical Park (VAFO).

Electrofishing survey within Gill's Creek, BOWA.

Stream sections within APCO and BOWA were resampled during late spring to provide some contrast to the late summer sampling effort within these parks in 2002. Selected stream sections within FRSP were resampled during early spring in an attempt to detect anadromous shad and again in late summer to take advantage of a return to normal flow conditions following the drought of 2002. Intensive sampling efforts were completed in stream sections within EISE and GETT during August and early September. During early October, a crew from the Pennsylvania Fish and Boat Commission (PFCB) completed an electrofishing survey along the section of the Schuylkill River that flows through VAFO. In addition to participation from the fisheries biologist and crew from Shenandoah National Park, sampling efforts within APCO and BOWA included equipment and personnel from the Virginia Department of Game and Inland Fisheries (VDGIF). Sampling efforts within EISE, GETT also included personnel and equipment from the PFBC. A total of 15 sites along 10 streams were sampled in all of the parks combined during 2004. Inventory highlights include:

- The diversity and high density of fishes encountered in the limestone streams within EISE. A total of 16,851 fish representing 31 species were captured at EISE in less than two days of electrofishing within two park streams.
- The documentation of bigeye jumprock (*Scartomyzon ariommus*), a globally rare Catostomid (sucker family) within Gills Creek at BOWA.
- Nearly one third of the fish community diversity within Gills Creek is comprised of Catostomids. A total of 10 species have been detected within the section that flows through or adjacent to BOWA including quillback (*Carpiodes cyprinus*), northern hogsucker (*Hypentelium nigricans*), Roanoke hogsucker (*Hypentelium roanokense*), black jumprock (*Scartomyzon cervinus*), bigeye jumprock, golden redhorse (*Moxostoma erythrurum*), shorthead redhorse (*Moxostoma macrolepidotum*), silver redhorse (*Moxostoma anisurum*), V-lip redhorse (*Moxostoma*

Multi-agency crew electrofishing the upper Appomattox River within APCO.

pappillosum), and white sucker (*Catostomus commersonii*).

- A population of mottled sculpin (*Cottus bairdi*) encountered in the central Piedmont (Wilderness Run, FRSP). These fish are more typical of coldwater streams in the Blue Ridge and Valley and Ridge physiographic provinces. Within Virginia, disjunct to distant mottled scuplin population isolates only occur within the Rappahannock and James Drainages.

- A population of silverjaw minnows (*Ericymba buccata*) encountered in the upper Coastal Plain (Hazel Run, FRSP). This is the only known record of the species within the Rappahannock Drainage from the upper Coastal Plain. These fish more typically occur in the central to upper Piedmont regions of the drainage.

Northeast Coastal and Barrier Network Fish Species Inventory: During 2004, continued inventory efforts at George Washington Birthplace National Monument (GEWA) were completed following a total of five visits to the park. The primary effort was associated with two, three-day visits, one during late May and one in late August. In addition to participation from the fisheries biologist and crew from Shenandoah National Park, a significant component of the inventory during these visits was accomplished through the assistance of equipment and personnel from the U.S. Fish and Wildlife Service per an interagency agreement. A number of additional sites were added within Pope's Creek from the original 2003 sites and the addition of fyke nets during 2004 produced the largest fish sample sizes from the combination of sampling techniques employed. From late August through late September, three additional visits were made to the park involving one to three of the Shenandoah fisheries staff during which intensive angling surveys were focused along the stream channel at the confluence of Pope's Creek and the Potomac River. Inventory highlights include:

A fyke net set within Pope's Creek, GEWA.

- A total of 34 fish species have been detected within GEWA from all survey efforts over the past two years. The expansive Pope's Creek system is dominated by white perch (*Morone americana*).

- Of the various sampling techniques employed within the Pope's Creek system including electrofishing, trawling, seining, minnow traps, eel pots, fyke nets and angling, fyke nets proved to be the most efficient technique followed by seine hauls and angling.

- Angling was most effective at the mouth of Pope's Creek within two hours before high tide and within the first half hour following. Otherwise, tidal currents were too severe and fish foraging levels appeared to decline.

Seining fish near the entrance to Pope's Creek, GEWA.

Jim Atkinson is a Wildlife & Fisheries Biologist.

Improving Distribution of Natural Resource Information

By Gordon Olson

The year 2004 marked an important turning point related to the presence of the park's natural resource operation on the World Wide Web. Development of web material contributes to two key values that heavily influence the success of many programs. First, preparation and availability of natural resource information helps to educate the public and share ideas and data with other professionals engaged in similar work.

Second, writing web material forces park staff members to synthesize and summarize their data.

Extensive web material was written for the Nature and Science Profile that appears on the standard National Park Service template for the park. Pilot material and web page design was done for inventory and monitoring programs. This material was posted on the Park's In Depth website. In addition, a page describing the backgrounds and roles of natural resource personnel and how to contact them was added to the In Depth site.

Gordon Olson is a Supervisory Biologist.

Monitoring Program Reformulated

By Gordon Olson

Shrinking budgets of recent years are forcing reconsideration of fundamental approaches to the design of the park's monitoring program. After considerable thought and discussion on the part of park staff members, a recommendation to reduce the intensity of sampling for major program components emerged. The most significant changes will be in the aquatic biota and vegetation programs. Rare plants and vegetation monitoring will now be monitored every other year. Fish and aquatic invertebrates will also be monitored every other year on the years the vegetation programs are not being implemented. This rotation will be implemented beginning in 2005. Other changes that are occurring include the suspension of the Monitoring Avian Productivity and Survivorship (MAPS) program (actually suspended in 2004) and reductions in funding available to support the Shenandoah Watershed Study (SWAS). Concurrently virtually all travel funds have been eliminated from the monitoring program and funding for general supplies is greatly reduced. Unfortunately all of this means that quantity of resource information and its frequency of collection are being reduced. This will eventually have implications in terms of management of park resources.

Along with these cost saving measures, the Natural Resource Branch has been seeking to establish two permanent technician positions that would be focused on botanical and exotic plant programs. These positions are considered essential to the stabilization of the monitoring program. The new positions would join the existing Biological Technician position to form an interdisciplinary team to rotate through fieldwork associated with forest vegetation, rare plant, fish, and aquatic invertebrate monitoring.

Gordon Olson is a Supervisory Biologist.

Mitigation Agreement Finished and Implementation Begins

By Gordon Olson

After several years of discussion and negotiation, Dominion Power (formerly VEPCO), the Environmental Protection Agency, the National Park Service, and the Department of Justice came to agreement on a Mitigation Plan which outlines actions to be taken at Shenandoah National Park in response to a Consent Decree that mandated restoration efforts that are needed as a result of damage from air pollution. Under the Decree, the National Park Service received $1 million from Dominion Power. Other actions were also required of Dominion on behalf of a number of other entities.

The Mitigation Plan outlines how the $1 million would be spent at Shenandoah. The three main thrusts of the Plan are fleet conversion (use of hybrid technology and replacement of older diesel technology) improved use of biodiesel fuel, and public education related to mobile emissions sources. Dominion Power wanted the focus of the Plan to be on mobile emission sources (automobiles, trucks, trains, airplanes). During 2004, the park purchased two of what could be up to 10 hybrid vehicles and put them in service and an order for a new diesel trash compactor has been placed. Plan implementation will continue over the next four years with more vehicle replacements, retrofits, and public education media development.

Gordon Olson is a Supervisory Biologist.

Winds of Change for Air Resources Operations

By Gordon Olson

In November of 2003, the park's Air Resources Specialist (Christi Gordon) transferred to another position with the U.S. Forest Service in New Mexico. The hope had been to refill her position but shrinking budgets forced reassessment of that decision. In April of 2004, it was decided that Gordon Olson, the Natural Resource Branch Chief, would assume collateral duties as the park's Air Resources Specialist. Since that time he has gradually picked up projects and responsibilities that Christi had. Unfortunately his multiple responsibilities have limited his ability to assume all of the functions that Christi has had.

Also, during 2004, a new Air Quality Monitoring Technician position was created. Liz Garcia has filled this position (see related article). She now has full responsibility for management and operation of the monitoring station at Big Meadows. The position is funded by the National Park Service Air Resources Division in Denver, Colorado. Now that Liz is on board, it has allowed us to relieve Shane Spitzer, Physical Scientist, of duties related to air quality monitoring. Shane will now focus his time on park programs related to water, geologic, soil, and meteorological resources. These moves bring Shane's position in line with position management guidelines, allow a professional scientific position to focus on program management, and provide renewed energy to Shane.

Gordon Olson is a Supervisory Biologist.

The Mid-Atlantic Exotic Plant Management Cooperative: Controlling Exotic Plants Amid Budget Shortfalls

By James Âkerson

Abstract

The Mid-Atlantic Exotic Plant Management Cooperative is made up of 12 national parks in Virginia, Maryland, and Pennsylvania. Throughout the Cooperative, park budgets have dwindled, reducing the time and resources dedicated to managing exotic plants. The traveling team has become a stop-gap for minimal monitoring and control work. The Cooperative remains active by using innovative methods of getting things done. Hallmarks include inter-park cooperation and collaboration with volunteer organizations, outside agencies and neighbors.

Highlights for Fiscal Year 2004

- The Cooperative controlled over 25 invasive species in 12 national parks totaling 388 acres.
- The traveling team collaborated with Shenandoah National Park and a park neighbor to control bamboo along a mutual boundary. The collaboration better assured treatment longevity and effectiveness to make sure the exotic did not quickly recolonize from off-park.
- The Cooperative expanded its functional capacity by utilizing Student Conservation Association interns and park volunteers, and by initiating a private sector contract. The expanded results had excellent success.
- The Cooperative added one new park by using funds that park provided for exotic plant control.
- Shenandoah National Park hosted a Congressional field tour on the subject of forest health issues in cooperation with the U.S. Department of Agriculture-Forest Service.
- The Cooperative increased public awareness of invasive species issues by participating in five newspaper and magazine articles, publishing eight articles in professional journals and newsletters, creating three articles posted to National Park Service websites, and speaking at four public or professional meetings. School ecology and biology classes were targeted to increase awareness.
- The Mid-Atlantic Cooperative is assisting the Commonwealth of Virginia by having the Team Liaison sit on the state's Invasive Species Advisory Committee. The committee's commission is to devise a statewide invasive species watch list and draft a statewide strategic invasive species plan.

Background

The Cooperative is within a diverse and highly productive region spanning the coastal plains of Chesapeake Bay, the vigorous Piedmont, and the hills and valleys of the Blue Ridge Mountains. Biological diversity of the region is one of the greatest in North America. On the other hand, exotic plants threaten to destroy native diversity and ecosystem health by displacing natives and changing the complex web of interactions with simplified monocultures. Protecting the natural legacy of the region is essential to assure that future generations enjoy its expanse and beauty.

The Cooperative uses an integrated pest management approach where prevention and early detection are emphasized. Control methods include hand pulling, manual and power assisted cutting, prescribed fire, and herbicide application. Park staffs work closely with facility concessioners, construction contractors and farmer permittees to avoid new exotic plant introductions.

Partner parks and states: *Appomattox Court House NHP, VA; Booker T. Washington NM, VA; Colonial NHP, VA; Eisenhower NHS, PA; Fredericksburg and Spotsylvania County Battlefields Memorial NMP, VA; George Washington Birthplace NM, VA; Gettysburg NM Park, PA; Hampton NHS, MD; Petersburg NB, VA; Richmond NBP, VA; Shenandoah NP, VA; Thomas Stone NHS, MD.*

2004 Accomplishments - All Parks	
Inventoried Acres	3,480
Gross Infested	3,053
Infested Acres	483
Treated Acres	388
Monitored Acres	123
Retreated Acres	10
Restored Acres	0
Controlled Acres	0

Park employee and Russian Intern apply herbicide to Japanese honeysuckle at Booker T. Washington National Monument near an historic tobacco barn.

James Åkerson is a Supervisory Ecologist & Team Liaison. Norman Forder, Dale Meyerhoeffer, and M. Kate Jensen are Biological Science Technicians.

Abandoned Developments Exotic Plant Survey: 2004 Preliminary Results

By James Åkerson

Abstract

Last year the results of Shenandoah National Park's 2003 exotic plant survey that focused on its 350-plus miles of park boundary were reported. In this issue, findings are presented of the 2004 survey associated with the grounds adjacent to farmsteads, dwellings, and other structures that have been abandoned. The survey statistically sampled 10% of the 700 sites documented in the park's geographical information system.

Results of the field work indicate that the most common exotic tree is tree of heaven (*Ailanthus altissima*), accounting for one-third of all nonnative trees found. Young ailanthus was also the most common plant in the shrub layer. The next most common shrub was Oriental bittersweet vine (*Celastrus orbiculatus*). Most common herb was garlic mustard (*Alliaria petiolata*). It was followed by Oriental lady's thumb (*Polygonum caespitosum*), and Japanese stiltgrass (*Microstegium vimineum*).

Geographically, the north district is the most heavily infested area in the park. It has 75% of the tree of heaven and garlic mustard found in the survey. Oriental bittersweet vine is also more common in the north district. Central and south districts have heavier infestations on the east side. However, the north district is greatly more infested on its west side. Importantly, the field data bear out the hypothesis that exotic plants are concentrated near abandoned development and diminish with distance from them, indicating that abandoned developments act as infestation centers in the park's backcountry and wilderness areas.

Introduction

Beginning in 1997, the park staff conducted a series of exotic (nonnative) plant surveys in an effort to discover the locations and dominance levels of exotic plants in Shenandoah National Park. Surveys focused on developments along Skyline Drive (1997-1998), current fire roads (1998-2000), and along the park boundary (2003). The purpose of the 2004 survey was to gather information about exotic plants at abandoned developments such as old farmsteads, home sites, and other structures in the park.

When Shenandoah National Park was dedicated in July 1936, much of the area was open farm land. Henry Heatwole (1999) estimates that there had been 10,000 people living in the area in 1900. Changing economies (and environments!) greatly reduced the human population in the Blue Ridge Mountains during that century. Many left the mountains due to loss of the once plentiful American chestnut (*Castanea dentata*) when chestnut blight wiped them out in the early 1930s. By 1935, Sheaffer (1999) believes 465 families lived in the area that became the park the following year. The structures they left behind ranged from tiny cabins to large farms complete with house, barns and other outbuildings, as well as churches, mercantile and the other buildings associated with farms, homes and communities. In this report, we refer to such sites collectively as abandoned developments.

Intact chimney at 2EX441.

Abandoned developments are of interest concerning exotics for two reasons. First, people often plant exotics as ornamentals or as shade trees on home sites. Second, invasive exotics (those known to aggressively take the place of natives) often colonize disturbed areas. Human habitation and farming disturbs the landscape, creating ideal sites for invasives to get a foothold. This makes developments a potential source for exotic plant presence and subsequent expansion by highly invasive species. The 2004 survey tested such a hypothesis by determining: (1) the exotic plants and their relative dominance near abandoned developments, (2) the distance of exotic plant spread or penetration into the surrounding environment, and (3) whether the number and dominance of exotics diminished with distance from abandoned developments.

Methods

Seventy survey sites became the desired target to achieve a 10% sample of the 700 documented sites in the Park[1]. Several different proposed sets of 70 survey sites were created using a random number generator. The mapped sets were compared to choose one where the survey sites were not predominantly clumped together leaving other park areas unsampled.

[1] It became apparent in the course of the survey that at least one historic site was actually outside the park boundary.

Global Positioning System (GPS) coordinates of the chosen site plan were loaded into a GPS unit to aid the field crew (Donald Roop and Stephanie Siersma) to find each site.

Once on location, the field crew attempted to find the center of the original home site. Chimneys, fireplaces, foundations or concentrations of artifacts were used as reference points. Trees such as apples, pears and walnuts, and ornaments like mock orange and daffodils were also used to find the old development center. (Only one complete standing structure was found during the survey.) The team established an origin near the reference for the start of a set of plots called a transect. New GPS coordinates were taken at the origin and recorded on the site record sheet to correct the initial ones provided.

Exotic plants were inventoried using a series of plots along two transects at each site location. The azimuth direction of the first transect was selected from a random number table (1-360 degrees). The second transect headed away from the same origin at the opposite direction (180 degrees) from the first transect. The first plot of each transect was located near the origin, usually at six meters. The prior surveys, mentioned above, placed the first plot at the interface of the disrupted zone and natural surroundings. But, after more than 60 years of abandonment and regrowth, the interface of the abandoned developments had become indistinguishable.

Siersma looks for exotics in the 1 by 1 meter subplot.

Subsequent plots were at 50 meter intervals for a total of seven plots along the 300-meter transect or until no exotics were found in a plot.

The circular plots were 1/100-hectare, using a 5.64-meter radius. Exotic species were identified and divided into three categories where *forbs* were less than one meter tall, *shrubs* were one to five meters, and *trees* were more than five meters. Vines growing into trees were counted as shrubs. Percent ground cover for each nonnative tree, shrub, and forb species was estimated as well as the total cover for each of the three categories. Within each plot, a 1 m^2 subplot was established and centered 2.82 meters due north of plot center. Nonnative plants were individually counted and the percent cover was estimated within each subplot. Tree species were identified as belonging to one of three size classes based on diameter at breast height (DBH) where *class 1* trees were less than 7.5 cm DBH, *class 2* trees were between 7.5 cm and 15.0 cm DBH, and *class 3* trees were greater than 15.0 cm DBH. Nonnative tree canopy cover was visually estimated and the total canopy cover was calculated using a spherical densiometer. Slope position, forest cover type, ground aspect, and slope steepness in percentage were also determined at each plot.

Notes were taken between the plots to document anecdotally any changes or occurrences of disturbance or exotic plant presence.

Results

Over the course of the summer, the survey team visited 69 abandoned development sites and surveyed 129 transects with 448 plots. Additionally, two sites at Skyland and one site at Rapidan Camp were not surveyed because the data from sites in current, active use would be inconsistent with the other sites. More than half of the sites were in the central district (36 sites). North district had 18 sites and south district had 15 sites. The survey used Skyline Drive as the dividing line between east and west as a matter of convenience. The Drive generally follows the ridge tops separating east and west slopes. There were 49 sites (71%) on the east side of the Drive and 20 (29%) on the west. Seventeen sites were in designated Wilderness (25%).

Table 1: Breakdown by location of abandoned development survey sites at Shenandoah National Park, 2004.

Park District	West	East	**Totals**	(Wilderness)
North	5	13	**18**	(4 – all east)
Central	7	29	**36**	(10 – all east)
South	8	7	**15**	(3 – all west)
Totals	20	49	**69**	(17)

Trees: The field crew found 132 exotic trees. Of those, 66% were tree of heaven (*Ailanthus altissima*). North district had 64 tree of heaven, 74% of all surveyed tree of heaven. Only 11 (13%) were found in the central district and 12 (<14%) in south district. Tree of heaven was more common on the west side than the east. Tree of heaven was found in 35% of the western plots and only 12% of eastern plots. The next most common exotic trees were apples and pears (15% of total), found most often in the central district. While apples and pears are not native, they are not invasive. Only 4% of total exotic trees found during the survey were princess tree (*Paulownia tomentosa*).

Shrubs: The shrub class includes any exotic plant between one and five meters tall. This class took in a wide range of plants. There were ordinary shrubby plants such as Japanese barberry (*Berberis thunbergii*) and multiflora rose (*Rosa multiflora*). Tall samples of wineberry (*Rubus phoenicolasius*) also fell into the shrub class. Young tree of heaven trees were classed as shrubs. Also in the shrub class were high growing vines including honeysuckle (*Lonicera japonica*) and bittersweet (*Celastrus orbiculatus*).

Overall, the most numerous shrubs were young tree of heaven. They turned up in 46 plots (10%). The

greatest number was in the north district, but they were also quite common in the other two districts. In the north district the most common shrub was Oriental bittersweet vine. It was found in 30 plots (18%). It was found in nine plots in the central district and only one plot in the south district. Multiflora rose was unusual because it was more common in the south district than in the other two districts.

Table 2: Exotic species found in the tree, shrub and forb layers of the abandoned development survey plots at Shenandoah National Park, 2004.

TREE LAYER	SHRUB LAYER	FORBS LAYER
Ailanthus altissima	Ailanthus altissima	Alliaria petiolata
Pyrus malus	Celastrus orbiculatus	Polygonum caespitosum
Pyrus communis	Rosa multiflora	Microstegium vimineum
Paulownia tomentosa	Rubus phoenicolasius	Lonicera japonica
Prunus avium	Lonicera japonica	Ailanthus altissima
Acer platanoides	Berberis thunbergii	
Also found in tree layer	**Also found in shrub layer**	**Also found in forbs layer**
Celastrus orbiculatus	Philadelphus coronarius	Polygonum persicaria
Lonicera japonica	Ligustrum sinense	Commelina communis
Syringa vulgaris	Syringa vulgaris	Perilla frutescens
	Acer platanoides	Narcissus pseudonarcissus
		Convallaria majalis
		Hemerocallis fulva
		Coronilla varia
		Vinca minor
		Achillea millefolium
		Iris X germanica
		Hesperis matronalis

Forbs: The most common exotic herb was garlic mustard (*Alliaria petiolata*). It appeared in 75% of the north district plots and 59 and 62 percent of central and south district plots, respectively. The west side had more exotic forb layer plants than the east. Garlic mustard was found in 59% of the western plots and 26% of the east. Next most common forb was Oriental lady's thumb (*Polygonum caespitosum)*, which was found in one-third of the plots. Stiltgrass (*Microstegium vimineum*) was found in one-third of the north district plots. It was much less common in the central and south districts, occupying only 3% and 7%, respectively.

A common thought regarding exotic plants is they invade and colonize disturbed sites only. The field data indicate this is not true for garlic mustard, Oriental lady's thumb, and Japanese stiltgrass. These shade tolerant plants flourish under undisrupted forest canopy as long as soil conditions are suitable for them. They are not found on drier soils, however.

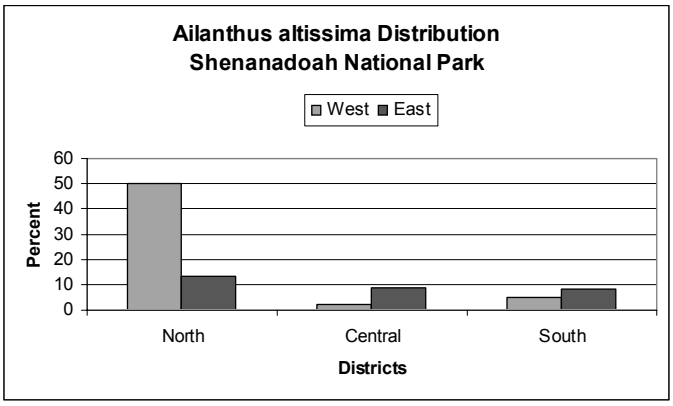


Chart 1: Percent of tree of heaven (*Ailanthus altissima*) by district found in the abandoned development survey of Shenandoah National Park, 2004.

Wilderness: There were 17 abandoned developments in Wilderness areas, amounting to 25% of the survey sites. Of these, four were in the north district, ten in central and three in the south district. The north district sites had 15 tree of heaven in 33 plots for an average of 45% of plots. This is close to the average for the rest of the north district. Central district had two three of heaven in 36 plots. There were no exotics in the three south district sites. By chance, the south district sites were all in very dry areas. Garlic mustard was found in 66% of the north district plots and 47% of the central district plots. This is about 10% lower than those districts as a whole. Oriental bittersweet was found in only four plots, two in the north and two in the central districts.

Geography: Exotic plants were more likely on the east side than the west side except for the north district which had the most on the west side (see Chart 1). North district was the most infested of the three districts (see Chart 1 and others). Finally, infestation levels diminished with distance from the centers of abandoned developments (see Table 3).

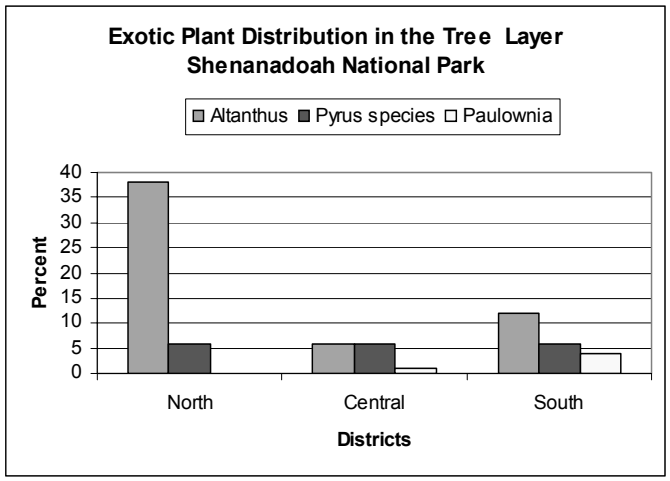


Chart 2: Percent of exotic trees by district found in the abandoned development survey of Shenandoah National Park, 2004.

Discussion and Conclusions

The survey field crew made several observations while in the field. The common forbs, Japanese stiltgrass and

Oriental lady's thumb were most often found in damp areas. Garlic mustard could be found in slightly dryer areas. Exotics were rarely found in very dry forest sites with a healthy native understory.

The field crew noted that abandoned developments varied greatly in size and impact on the surroundings. Some were apparently large, well run farms. Long, well made walls still attest to the size of the farm and its labor force. Many home sites were small cabins. Lee Sheaffer (1999), in *Appalachian Trail Guide to Shenandoah National Park*, writes that one-half the families living in the area in 1935 were tenet farmers, living in small, simple homes. Several of the surveyed abandoned developments were structures other than home sites. Site 1EX414 was part of the old Panorama hotel. Sites 3EX508 and 3EX509 were part of the Blackrock resort. And sites 2EX461 and 2EX463 were part of the U.S. Marine Corps camp that supported Rapidan Camp. It would have been interesting to have pre-classified the abandoned developments and compared them.

The survey protocol states that when a plot has no exotics, no further plots are necessary on that transect. The data show the number of infested plots drops at a steady rate, indicating the number of exotics decreased with distance. This supports the theory that exotic plants would be concentrated at the development center and diminish with distance away. Chart 5 illustrates this very well. Garlic mustard, Japanese stiltgrass, Oriental bittersweet, tree of heaven and wineberry all decrease with distance from the origin of the transects.

Of all the abandoned developments, large farms appear to be the most likely to harbor exotic plants and to have high concentrations of them. A supplemental survey of large farms may be a way to focus in on the highest likelihood for deep forest infestation and to plan exotic plant control treatments to reduce forest impacts.

North district has the greatest infestation of interior dwelling exotic plants. This is also borne out in last year's park boundary survey results. Of trees, tree of heaven appears to be the greatest threat. It also produces a great number of seeds, is fast growing, and releases chemicals that inhibit the germination of other plant species. The Pyrus group of apples and pears is not spreading and does not threaten native species. In time, natural forest growth will crowd them out. Princess tree (*Paulownia tomentosa*) should be watched, but in this survey, was not numerous enough to merit specific action.

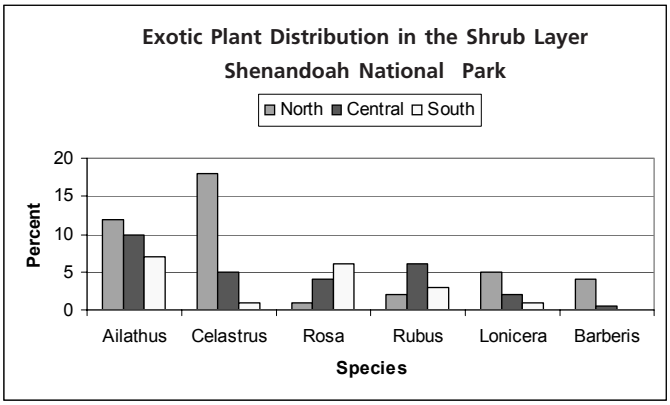


Chart 3: Percent of exotic shrubs by district found in the abandoned development survey of Shenandoah National Park, 2004.

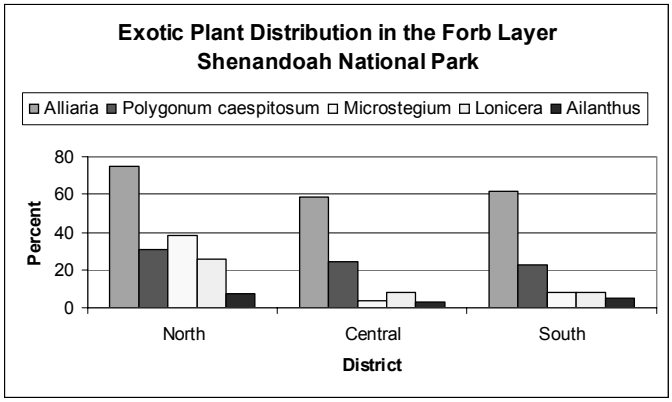


Chart 4: Percent of plots with exotic forbs by district found in the abandoned development survey of Shenandoah National Park, 2004.

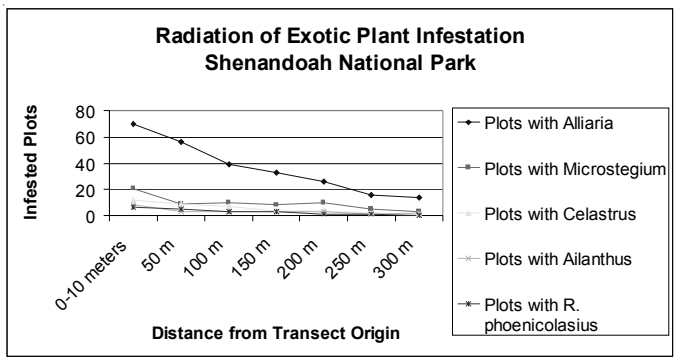


Chart 5: Radiation of infested plots for several exotic plant species in the abandoned development survey of Shenandoah National Park, 2004.

Literature cited

Heatwole, Henry. 1999. *Guide to Shenandoah National Park and Skyline Drive*. Shenandoah Natural History Association, Luray, Va.

Sheaffer, Lee. 1999. *Appalachian Trail Guide to Shenandoah National Park*. Potomac Appalachian Trail Club, Vienna, Va. 368 pp.

James Åkerson is a Supervisory Ecologist.

Table 3. Number of exotics detected in the abandoned development survey radiating from transect origins at Shenanodah National Park, 2004.

Distance from Origin --->	0-10 meters	50 m	100 m	150 m	200 m	250 m	300 m
Number of plots with exotics	124	79	71	56	41	32	23
Plots with Alliaria	70	56	39	33	26	16	14
Plots with Microstegium	21	9	10	8	10	5	3
Plots with Celastrus	12	9	7	4	4	2	1
Plots with Ailanthus	8	3	3	3	3	1	2
Plots with R. phoenicolasius	6	5	3	3	1	1	0

Big Meadows Management and Monitoring Continue with Assistance from the Fire Program and Maintenance Division

By Wendy Cass

Vegetation management at Big Meadows continued in 2004 with the implementation of mowing and burning treatments. For the purposes of management, the Meadow has been divided into three approximately equal sections termed the east, central, and west management zones. In 2004, Meadow management included winter mowing of the east zone by Shenandoah Maintenance Division, and a spring burn of the central and west zones by the Shenandoah Fire Management Office. In 2005, management will include dormant season mowing of the central zone, and an early spring burn of the west zones.

Biotechs sample herbaceous vegetation along a transect in Big Meadows.

Data on the composition and cover of woody and herbaceous vegetation within the Meadow were collected in August 2004 by members of the botany and fire effects monitoring crews. The data from this project have been entered into a database, but have not yet been examined for trends.

Wendy Cass is a Botanist.

Progress Made Implementing Revisions to Forest Monitoring Program

By Wendy Cass

The summer of 2004 marked the second season for implementing a revised plot installation and vegetation sampling protocol for the park's long-term forest vegetation monitoring program. At this time, 57 plots or 35% of sites to be included in the final program have been installed and sampled. Work also continued on the programs written protocol. The document remains in draft form because of additional work to be done on the figures and appendices. However, the methods for plot installation and sampling amidst a myriad of unpredictable field situations, have stabilized and been documented.

2005 is the beginning of a new program structure for the SHEN natural resources monitoring program. In an effort to save money, the program is moving to a rotation system where vegetation and animal monitoring projects will alternate active years. Even though each program will only be active in one out of every two years, the vegetation crews will contain a greater percentage of higher graded employees and approximately 30% more people. The larger crew size and higher experience level of the crew, will allow more work to be done in the active year of each program than could previously have been done in a single year.

Biotechs identify forest herbs while sampling the vegetation in a long-term forest monitoring plot.

The vegetation monitoring program will be active in 2005 and will concentrate heavily on the installation and sampling of as many additional forest vegetation monitoring plots as possible. We anticipate having two crews, each composed of three to four technicians or volunteers, who will collectively install at least 70 additional monitoring plots.

Wendy Cass is a Botanist.

Habitat Modeling Completed for Plants of Economic Importance

By Wendy Cass

Habitat models provide an efficient way to predict where plants are likely to be found without having to field survey the entire area of interest looking for the target species. These models are formed by combining remote sensing information and environmental variables such as slope, aspect, landform, and geology, with knowledge of where the target species is known to exist. The model can then be used to generate a map that displays the degree of habitat suitability for the target species within an area.

In 2002 and 2003, the Shenandoah National Park (SHEN) vegetation monitoring program assisted with a project to predict the distributions of plants of economic importance using a habitat model and field data. The target species were selected in conjunction with criminal investigators from the park's Ranger Activities Division, and included American ginseng (*Panax quinquefolia*), black cohosh (*Cimicifuga racemosa*), and bloodroot (*Sanguinaria canadensis*).

American ginseng (*Panax quinquefolia*)

The work at SHEN was part of a larger project funded by the Natural Resources Preservation Program to model the distributions of the target species in three National Park Service (NPS) units (SHEN, Blue Ridge Parkway and Great Smoky Mountains National Park). The project used a predictive habitat model originally developed by Frank van Manen of the U.S. Geological Survey Biological Resources Division (USGS-BRD) for use in the Smokies. As part of the project, the Great Smoky Mountains National Park habitat model was adapted by John Young of the USGS - BRD and Frank van Manen for use in the Blue Ridge Parkway and Shenandoah.

Once adapted to SHEN, the predictive model was used to generate maps of the park showing predicted habitat for the target species. In the summers of 2002 and 2003, NPS biological science technicians visited 191 points randomly located within areas predicted to have a high probability of containing the species of interest. A map verification plot was located at each of these field points. The verification plots had an area of 900m^2 and were designed to contain the same amount of area as is represented by one map pixel – the finest level of resolution within the map. At each verification point, technicians collected data on habitat characteristics and the presence of target species. Data from 2002 were used to refine the habitat model and generate new maps and verification points for the 2003 field season.

Black cohosh (*Cimicifuga racemosa*)

Data analysis summarized in a final report by the USGS (Young et al. 2003) found that model validation plots from 2003 contained at least one of the target species (American ginseng, black cohosh, bloodroot) 89% of the time. The model was most accurate in the prediction of black cohosh and was able to predict the presence of cohosh 80.9% of the time. The model was least accurate for ginseng, yet was still able to correctly predict the presence of ginseng 47.5% of the time. In addition, the project revealed that ginseng was 11.2 times more likely to be found when using the model compared to searching for ginseng without the model. Black cohosh and bloodroot were 6.8 and 3.3 times, respectively, more likely to be found using the model than without (Young et al. 2003).

Bloodroot (*Sanguinaria candadensis*)

The completed model was used to generate a final set of maps that predict the degree of habitat suitability for each target species. These maps are now available to assist with monitoring and protection efforts by natural resource and law enforcement personnel working to protect ginseng, bloodroot, and black cohosh throughout the park.

References

Young, J.A., F.T. van Manen, and C.A. Thatcher. 2003. Habitat modeling for protection of illegally harvested plants in National Parks of the Blue Ridge Mountains. National Park Service Report. U.S. Geological Survey.

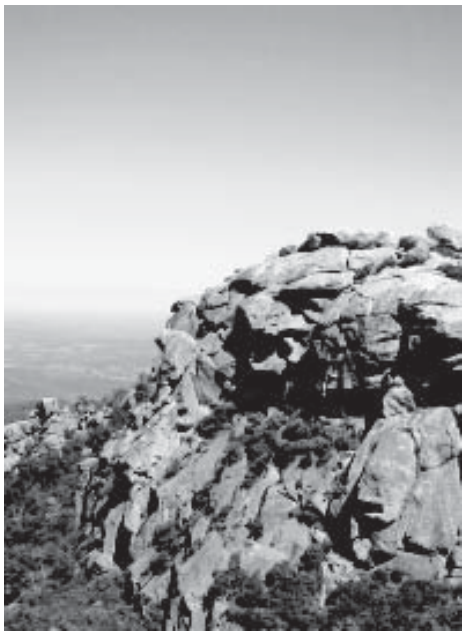
Wendy Cass is a Botanist.

Cliff Management Project to Start in 2005

By Wendy Cass

Rock outcrops and cliffs are some of the most visited areas in Shenandoah National Park (SHEN), and are sought out by picnickers, hikers, climbers, and other recreationists alike for their spectacular views and recreational opportunities. Because of their location and environmental characteristics, outcrop and cliff areas support unusual and delicate plant and animal communities. These communities typically occur on thin soil, or in lichen dominated environments and are extremely sensitive to trampling and other human activities. The Virginia Department of Conservation and Recreation (VA DCR) began expressing its concern to SHEN about the degradation of high elevation areas in 1993 with a preliminary assessment of rare plant communities and their associated plant and animal species. In response to these concerns, and continued evidence of progressive degradation of cliff and outcrop areas, park staff worked together to apply for funding to address the problem.

The grant application was successful and fiscal year 2005 marks the start of the long-awaited Cliff Management project. The project is funded by the Natural Resources Preservation Program (NRPP) and will run from 2005 through 2007 at a cost of $521K. Project coordinators, Wendy Cass and Steve Bair, will be working closely with cooperators from the Virginia Department of Conservation and Recreation, Virginia Tech, and U.S. Geological Survey Biological Resources Division for the duration of the project.



The project will begin by mapping cliff and outcrop areas throughout the park. Approximately 50 of these areas will then be selected for further study, and surveyed for geological, botanical, and zoological resources. Social science and visitor use assessments will be done on a subset of cliff areas to examine the intensity, impacts, and distribution of cliff visitation. Additionally, visitor education and the production of cliff-related trailhead displays will be integrated into the project to increase awareness of cliff area value and sensitivity. The project will culminate in the production of an interdisciplinary cliff management plan to guide recreational activities and cliff protection measures in the future.

Wendy Cass is a Botanist.

National Park Service
U.S. Department of the Interior

Shenandoah National Park lies astride a beautiful section of the Blue Ridge, which forms the eastern rampart of the Appalachian Mountains between Pennsylvania and Georgia. In the valley to the west is the Shenandoah River, from which the park get its name, and between the north and south forks of the river is Massanutten, a 40-mile-long mountain. To the east is the rolling Piedmont country. Providing vistas of the spectacular landscape is Skyline Drive, a winding road that runs along the Blue Ridge through the length of the park.

Address
Shenandoah National Park
3655 Highway 211 East
Luray, Virginia 22835

The National Park Service cares for the special places saved by the American people so that all may experience our heritage.

New Vegetation Map to be Completed in 2005

By Wendy Cass

Just about anyone who has been to Shenandoah National Park (SHEN) is familiar with the Skyline Drive, overlooks, and developed areas. Others have ranged further afield and enjoyed the many streams, trails, campsites, shelters, and cultural relicts found throughout the backcountry. All of these features are fairly easy to envision and place on a map, but what fills the rest of the space between the park boundaries? Most of it is filled with plants, or to be more accurate, plant communities. A plant community is generally defined as groups of plant species growing together in a suitable habitat.

A Virginia Department of Conservation and Recreation field botanist and NPS technician travel through a robust population of interrupted ferns (*Osmunda claytoniana*) on their way to a vegetation sampling plot.

Some management benefits to understanding the composition and distribution of park plant communities include: (1) an improved ability to understand and predict fire behavior, (2) a greater ability to predict the susceptibility of the park to non-native insect pests and environmental pollutants, (3) information about where to send visitors seeking a particular experience or resource of interest, and (4) improved knowledge about available wildlife food sources and habitat. At the core of these and other benefits is the fact that vegetation mapping "fills in the gaps on the map". In doing this, it helps in understanding the full scope, components and characteristics of the natural system being preserved.

SHEN currently has an 18 year old vegetation map that divides the park into eight forest cover types based on tree canopy composition (Red Oak, Cove Hardwood, Yellow Poplar, etc.). Despite the broad mapping categories, this vegetation map had been extensively used by resource management staff to plan and complete projects.

Even though vegetation appears consistent over the short-term, it is not static. Vegetation communities can change in response to many things including succession, disturbances, and changing environmental conditions. For this reason, vegetation maps need to be periodically re-done so that they accurately reflect the vegetation composition in the field. The vegetation of SHEN has undergone some extreme changes in the last 18 years in response to disturbances such as the gypsy moth, hemlock woolly adelgid, and storms. These changes prompted natural resources staff to seek funding in 1999 to replace the old vegetation map.

The park's new vegetation map has been in process since 2001, and has cost $295,000 provided by a grant from the NPS Natural Resources Preservation Program (NRPP). The new map was developed largely through the efforts of John Young of the U.S. Geological Survey Biological Resources Division, and Gary Fleming of the Virginia Department of Conservation and Recreation, Natural Heritage Program. Young led the effort to compile and analyze remote sensing data from multi-spectral satellite imagery and aerial photos, to assess the distribution of vegetation communities in SHEN in relation to ecological units defined by terrain and landscape structure. Fleming coordinated field vegetation plot sampling, and vegetation community classification work using multivariate ordination techniques.

In the end, 34 vegetation communities were identified and mapped to a resolution of 15 meters. These communities have each been described within the National Vegetation Classification System to the Association level, and compiled into a field plant community identification key. The final vegetation map will be delivered in early 2005 and will include grid and polygon digital data showing plant communities throughout the park.

A vegetation mapping crew records vegetation composition and cover in a thickly vegetated sampling plot.

Wendy Cass is a Botanist.

Big Meadows Area Deer Population Trends Over the Last Five Years

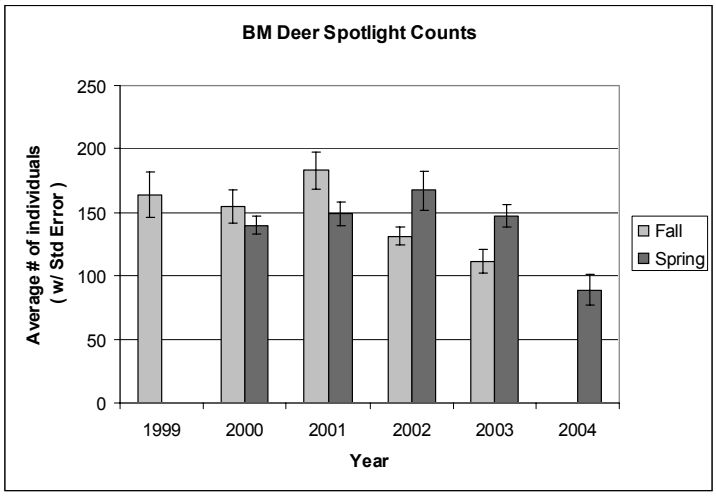
By Rolf Gubler

Since fall 1999, Natural and Cultural Resources (NCR) staff has conducted nighttime spotlight counts of deer in the Big Meadows Area. The purpose of this survey is to show long-term trends in relative deer densities in the Big Meadows Area (BMA). Big Meadows deer densities have likely exceeded biological carrying capacity for 20 or more years as evidenced by visible effects in the landscape. Visible effects include: defined browse lines, loss of native herbaceous ground cover, diminished woody regeneration, loss of ground-nesting songbird habitat, and an abundance of non-preferred plant species dominating the landscape. Lack of hunting and predation on the deer population plus ongoing maintenance of grassy openings, contribute to high relative deer densities in the BMA.

The BMA includes ideal deer habitat - a combination of meadow, mature forest, forest edge, old orchard, dense cover, and permanent water. For these reasons, the BMA can support more deer than a contiguous mature forest setting. However, at densities of roughly 200 deer per square mile (see graph) they run a much higher risk of disease outbreak, parasites, and winter die-offs (from starvation). Additionally, these deer are having an incredible amount of sustained grazing and browsing impact on the BMA (since each deer consumes 4-6 pounds of vegetation per 100 pounds of body weight/day).

Results

- Fall nighttime spotlight counts from 1999-2003 have yielded an average of 212 deer per square mile (n=49) in the BMA.
- Spring nighttime spotlight counts taken from 2000-2004 have yielded an average of 200 deer per square mile (n=33).
- Fall nighttime counts from 1999-2003 have yielded relative deer densities ranging from 103-451 deer per square mile.
- Spring nighttime counts from 2000-2004 have yielded relative deer densities ranging from 76-331 deer per square mile.



This graph depicts the average number of deer/night in a 0.70 square mile survey area at BMA.

Emerging Trends

The graph above shows a 5-year downward trend in relative deer densities in the BMA. However, given the cyclical nature of herbivore populations, this may turn out to be a typical down-turn in relative deer density. It will be interesting to see if BMA deer densities climb back up to 1999-2001 levels in future years.

Comparing fall spotlight counts to spring counts, habitat usage generally drops off in spring in all areas except the Meadow. New growth of grasses and forbs plus less severe weather in spring (vs. fall), probably attribute to this difference.

The Meadow has seen notable fluctuations in fall usage from year to year. Fall Meadow usage has fluctuated from 21 deer/night in 1999, to 10 deer/night in 2000, to 29 deer/night in fall 2001, to 36 deer/night in 2002, and 13 deer/night in 2003. The apparent drop in usage of the Meadow may have been due to the bush-hogging that took place in October 2000. Bush-hogging in fall reduces available food and cover in the Meadow for deer.

Future Research

Spotlight surveys give a good indication of relative deer density and population trends in the BMA. For comprehensive population parameters, a population dynamics study is needed. For this reason, Natural and Cultural Resources staff has been working with Virginia Tech Researcher (Dr. Mike Vaughn) on a Fee Demonstration proposal for an in-depth deer study in the Big Meadows Area and the Loft Mountain Area. The goal of this proposed study will be to focus on population dynamics and conduct a demographic analysis of deer in these two areas of Shenandoah National Park. The study would focus on determining deer densities, mortality rates, survival rates, recruitment rates, dispersal rates, herd health, and seasonal movement patterns. This study would be combined with a study to monitor the effects of sustained deer browsing on Big Meadows vegetation and rare plants (by constructing deer

exclosures). Ultimately, this would help to document the impact on vegetative communities and determine biological carrying capacity.

The results of a Population Dynamics Study are essential if protecting the rare plant communities*, floral diversity, songbird habitat, woody regeneration and vulnerable landscape features in the BMA is wanted. This information will help in understanding the dynamics of the Big Meadows deer herd and help to build a foundation for developing future management recommendations and options.

White-tailed deer in Big Meadows. Photograph by John Mitchell. NPS Photo.

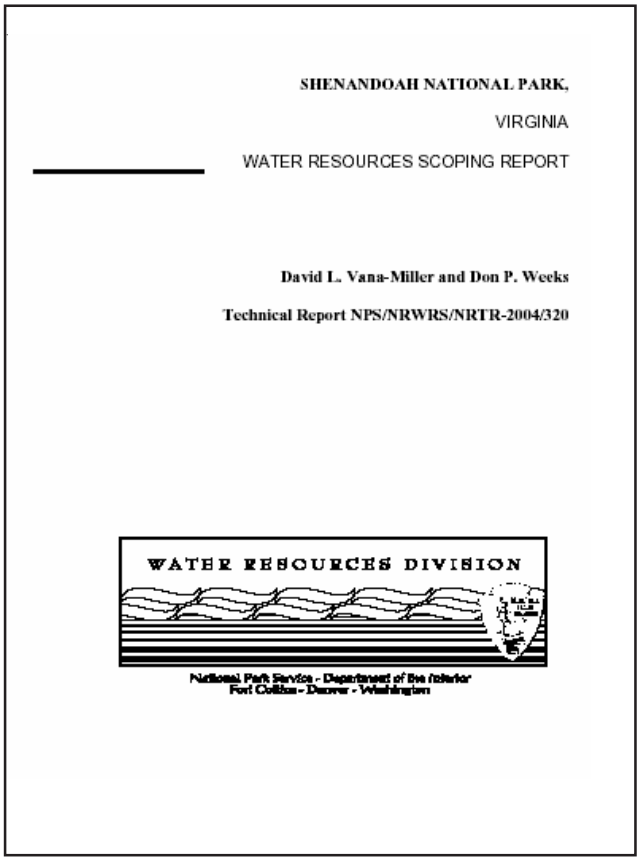
* Big Meadows contains 18% of the park's State rare plant species (Report of the Virginia Department of Conservation & Recreation, Division of Natural Heritage).

Rolf Gubler is a Biologist.

Water Resources Scoping Report

By Shane Spitzer

In August 2004, the final publication of the Water Resources Scoping Report for Shenandoah National Park was completed. The Water Resources Scoping Report provides an overview of state and federal water-related legislation, summarizes the ecological setting and hydrologic environment of the park, identifies significant water related issues and information needs, and presents recommendations for management consideration. The report is a culmination of almost two years of effort by the Water Resources Division and park staff. Input was solicited from federal, state, and local agencies as well as the private sector. The report concludes by identifying the following as high priority water resources issues needing attention:



- Inventory and classify wetland attributes
- Re-evaluate existing water-based monitoring programs
- Restore streams impacted by acidic deposition
- Research impacts of changing chemical composition of streams on aquatic biota
- Inventory impacts on water quality
- Research mercury deposition and impacts

For more information, the report can be found at: http://www.nature.nps.gov/water/Scoping_Reports/shenandoah%20screen.pdf

Shane Spitzer is a Physical Scientist.

Physical Sciences Project Updates

By Shane Spitzer

Project Title: Assessment of the Hydrology of the Sensitive Wetland System at Big Meadows, Shenandoah National Park

This project seeks to characterize the hydrology of Big Meadows by collecting new data on groundwater flow, analyzing these data, and synthesizing the data through the use of models. The project is being done through a cooperative agreement with the University of Virginia and is funded through the Natural Resource Preservation Program.

The shallow aquifer underlying the large meadow adjacent to the visitor center at Big Meadows is the focus of this study at least through FY05. Last summer two shallow monitoring wells were placed near the middle of the Meadow approximately 200 meters apart. They both reached depths of about 2.5 meters, which was a meter below the water table at the time of emplacement in June. Pressure transducers were suspended in both wells, continually recording water levels at 15 minute intervals. Two more wells were established; then the presence of abundant cobbles, which occur as float in the soil throughout most of the Meadow, made normal construction of the remainder of the wells impossible. A permit amendment was obtained to allow a larger diameter hole for easier emplacement of well piping. Because of this, an archeological survey was then required at each site. Throughout September, Carol Nash and her team of archeologists from James Madison University examined material that was dug from 12 additional sites. Currently 16 well locations have been completed and are being monitored.

Plans for this year include continued monitoring of wells already installed, a groundwater pump test using one of the water supply wells, and preparation of a thesis by Lars Nelson from the University of Virginia.

Project Title: Integrated Climatic Database for the Shenandoah National Park

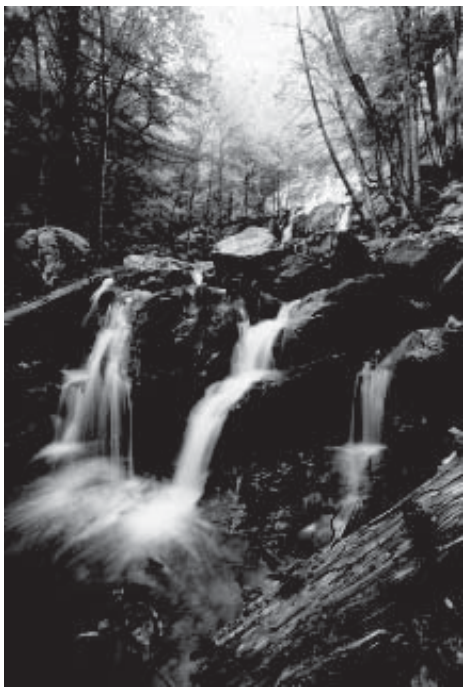
The purpose of the Shenandoah Climate Database Development project is to inventory, assess, and assemble historical climate data from myriad sources in a useful, accessible, and clean database, with subsequent assessments regarding the suitability of various systems for creating a continuous, high-quality data stream into this database. This database will be operational, with interactive querying capability. The project is being done through a cooperative agreement with the University of Virginia and is funded by Regional Science funding.

Pursuant to this purpose, the project has begun with a broad-based review of available data sources for the park, both past and present. No final determination has been made regarding the selection of datasets and data sources to include in the database. This is partly contingent upon the response of varying parties, including the National Weather Service, to queries regarding the archival of past data.

The development of the database has begun and population of the database will continue through the first quarter of 2005. Final completion date for the project is July 2005.

Project Title: Identification of Native Brook Trout Stream That Are Impaired by Acidification

The purpose of this project was to obtain 12 monthly field pH measurements from 20 of Virginia's most acidic native brook trout streams. Six of these streams were located within the park. Sampling took place from October 2003 to September 2004. Data are currently being quality assured and analyzed. The results of this project will lead to additional streams being listed as impaired by the Virginia Department of Environmental Quality and will be reported in the next revision of Virginia's Clean Water Act Section 303(d) listing. This project is being done by the University of Virginia and is funded by the Virginia Water Resources Research Center.

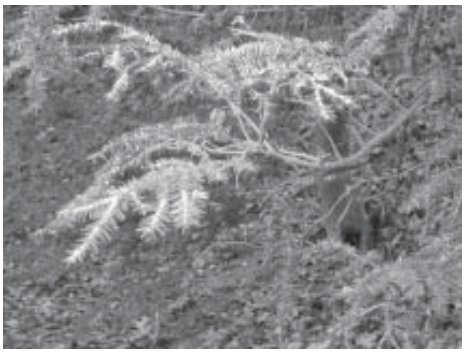


Shane Spitzer is a Physical Scientist.

Hemlock Woolly Adelgid Update

By Mary Willeford Bair

Hemlock woolly adelgid (*Adelges tsugae*) continues to threaten hemlocks in Shenandoah National Park. First discovered in the park during the fall of 1988, they are now wide-spread throughout. Few hemlocks have escaped colonization by this serious forest pest. Heavy infestations of hemlock woolly adelgid on eastern hemlock trees have progressively led to crown health decline and tree mortality which threatens to eliminate all eastern hemlock stands in Shenandoah National Park.



Hemlock woolly adelgid infestation on hemlock branches.

In 1990, park staff established six monitoring sites within hemlock areas in accordance with established protocols for forest vegetation monitoring (Smith and Tolbert, 1990) under the auspices of the park's Long Ecological Monitoring Program. Locations of sites are Thornton River in the north district; Pass Run, Whiteoak Canyon, Limberlost, Rapidan Camp in the central district; and North Moorman's River in the south district. Crown health data collected in recent years was compared to baseline data collected the first year. The percentage of dead trees within monitored stands has significantly increased.

RESULTS

Comparisons between tree crown health data from 1990/1991 to 2004 show a dramatic shift of trees exhibiting excellent crown health (crowns with 90-100% foliage intact) to ones exhibiting poor crown health (1-49% foliage intact) or that are dead. By 2004, adelgid-attributed mortality had increased from an initial 8% to 93%. Additionally, moderate-poor canopies comprised less than 10% and excellent canopies were nonexistent in 2004 (Figure 1).

DISCUSSION

Although the small sample size and the site selection technique do not allow us to draw comprehensive conclusions about parkwide hemlock health, data from the sites provide a snapshot of crown health in dense, untreated hemlock stands. A revised sampling scheme was implemented in 1999. This new sampling design allows conclusions to be drawn about hemlock crown health on a parkwide basis but the data has yet to be analyzed. Despite this lack of analysis, it is clear that hemlock woolly adelgid has caused significant decline in hemlock crown health and tree mortality has increased parkwide.

Without intervention, there is a very real possibility that this insect pest could directly or indirectly eliminate eastern hemlocks from Shenandoah's ecosystem. Efforts to extend the lives of

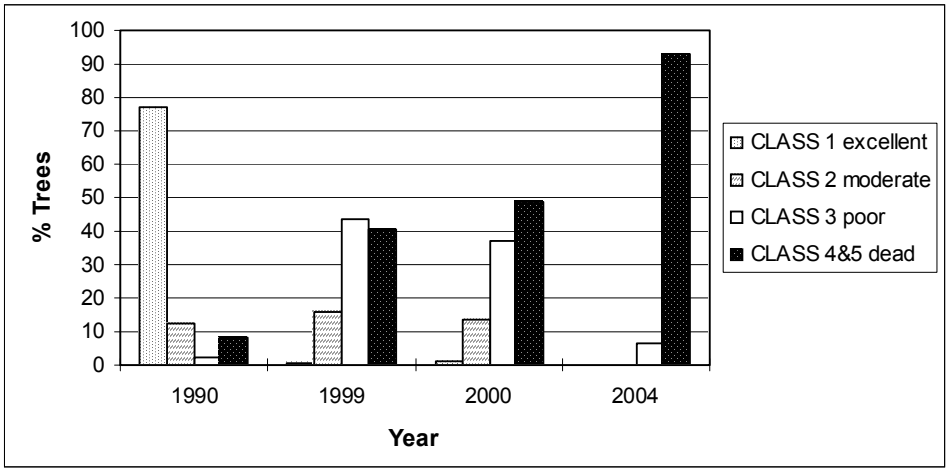


Figure 1. Comparison of crown health by year. Crown class is based on the percentage of foliage intact: Class 1: 90-100%; Class 2: 50-89%; Class 3: 1-49%; and Class 4 & 5: dead.

our remaining healthy hemlocks continue. Adelgid suppression in 2005 will be accomplished through insecticidal soap spraying and by soil treatments of Merit[R]. The systemic pesticide Merit[R] (Imidacloprid) remains at effective levels to adelgids for over a year. The battle to save a lasting remnant of Shenandoah's hemlock gene pool for future generations continues.

Hemlock mortality viewed from Hemlock Springs Overlook.

References

Smith, D.W., and J.L. Tolbert. 1990. Shenandoah National Park Long-Term Ecological Monitoring System, Section II, Forest Component User Manual, 1st Edition. Virginia Polytechnic Institute and State University, Blacksburg, VA. (with revisions by Wendy Cass, 1999).

Mary Willeford Bair is a Biological Science Technician.

Shenandoah National Park Begins Sudden Oak Death Surveys

By Mary Willeford Bair

A new exotic pest may be on its way to Shenandoah. The pathogen (*Phytophthora ramorum*) that causes Sudden Oak Death (SOD) has been prevalent along the western coast of the United States for some time. Unfortunately, contaminated nursery stock from the west coast was accidentally shipped to the eastern states. Many of these plants were subsequently sold and planted before it was discovered that they harbored SOD. Due to the concern for the possible spread of this disease and potential impact on eastern forests, the National Park Service Washington Office provided a modest amount of funding to conduct preliminary detection surveys in Shenandoah National Park. Samples of plant species known to be susceptible to SOD were collected at 15 parkwide sites during 2004. All 133 samples were negative for the presence of the pathogen responsible for SOD infections.

Mary Willeford Bair is a Biological Science Technician.

PowerPoint: Tips and Tricks for Keeping Presentations Small

By Alan Williams

More and more people now use PowerPoint instead of a slide projector to give presentations. PowerPoint has allowed presenters to add many more options, such as text, custom transitions, and graphical animations to their 'slide' programs. Though the days of a slide being in backwards or out of focus may have passed, there are always new challenges with the new technologies. Common problems people have with PowerPoint are large file sizes and consequently slow loading presentations. This article will point out a few tips and tricks for slimming down and speeding up your PowerPoint.

Typically, users who are showing multiple digital pictures in their presentation run into the problem of the PowerPoint file getting quite large. Logically as images are added to the presentation, the PowerPoint file must grow to store that digital information, but the question is, Why do some digital pictures seem to add more than what might be expected? This often has to do with the resolution of the original picture and how it was brought into PowerPoint. So how can you keep you PowerPoint files from getting too big?

Getting Pictures In

There are a few different methods for getting images into your presentation. In PowerPoint 2002, the simplest method for getting an image file uses the Menu items: Insert> Picture>From File (Figure 1). However it is also possible to cut and paste images from other computer programs into PowerPoint. If you use this method it is advisable to use the Edit> Paste Special> "Picture" option (Figure 2) to minimize links to other programs that tend to 'bloat' the size of the PowerPoint file.

Picture Resolution

High resolution pictures from scanners or digital cameras add unnecessary size for the majority of PowerPoint presentations which are

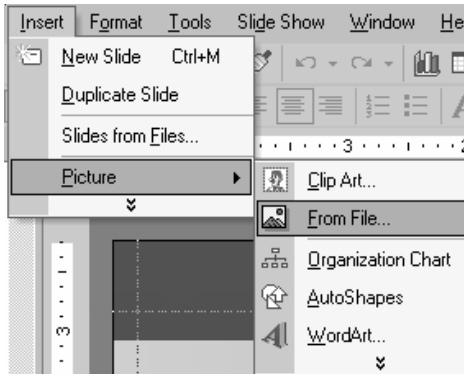


Figure 1

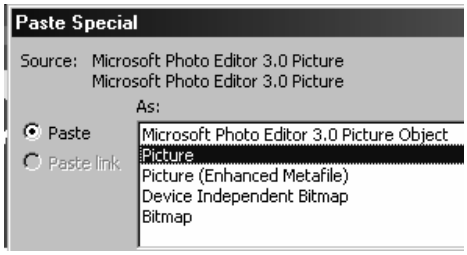


Figure 2

shown using an LCD projector or a computer screen. This is because most high quality computer displays are set at 1000 pixels wide by 750 pixels high while many scanners or digital cameras are set to produce images with much higher resolution (For more information see Reference). The extra pixels are not shown, therefore are wasted. In previous versions of PowerPoint, to keep these wasted pixels from adding size to your file, you needed to resize or make low resolution versions of the large images before bringing them in. In PowerPoint 2002, there is a new "Compress Pictures" feature that will do the resizing for you (before trying this feature Save your presentation).

To use this feature, select an image in your PowerPoint presentation and then right-click and go to "Format Picture". On the "Picture" tab press the "Compress" button. You can also get to this feature by looking for a new button on the "Picture" tool bar (Figure 3). If you don't see the Picture tool bar go to Menu> View> Toolbars> Picture. You should then get the "Compress Picture" screen (Figure 4)

Figure 3

asking you how to proceed. If you want to get the smallest file sizes possible then choose: Apply to> All Pictures in Document, Change Resolution> Web/Screen, and Check both of the Options> Compress pictures & Delete cropped areas from pictures.

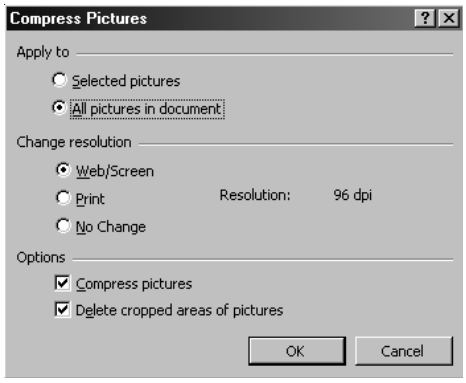


Figure 4

Then do a Menu> File> Save As... to a new file name. You should then be able to use the Windows Explorer to compare the file sizes between the original and compressed pictures in PowerPoint. In some cases you may want to keep the primary version of your PowerPoint uncompressed in order to print out high quality handouts, but then make a compressed version for your presentation or for sharing with other users. Experiment with this feature to see how it can best work for you.

References

1) http://www.powerpoint backgrounds.com/powerpointgraphics.htm
2) http://www.ipaw.org/pp.htm
3) http://www.bitbetter.com/powertips.htm
4) http://www.microsoft.com/office/previous/xp/tips/powerpoint.asp

Alan Williams is a Ecologist.

New Permanent Employee -- Liz Garcia

By Liz Garcia

It's great to finally be a permanent part of Shenandoah National Park. I started my career with the National Park Service at Shenandoah as a Student Conservation Associate in 2000. I had worked with resource management personnel monitoring peregrine falcons and updating the backcountry signs and campsite inventory. In 2001, I become a seasonal Biological Science Technician working with Backcountry and Wilderness. The next season I worked as a Fire Effects Monitor and had my first chance to fight forest fires both in the east and out west. In 2003 and 2004, I worked seasonally with resource management again. In addition to managing the peregrine falcon hacksite and working on the Hogcamp Branch Stream Restoration project, I also picked up numerous forest health projects. I am now a part-time Physical Science Technician.

In 2001, I received my Bachelor of Arts from Green Mountain College in Poultney Vermont, majoring in Environmental Studies with a minor in Adventure Recreation. I then went on to receive a Masters of Professional Studies in 2002 from the State University of New York (SUNY) - College of Environmental Studies and Forestry, located in Syracuse New York. There I mastered in Natural Resource and Recreation Management.

I am originally from Gloversville, New York. It's a small town about five miles south of the Adirondack State Park and an hour northwest of Albany. I am currently living in New Market with my husband Solim, who also works at Shenandoah National Park, and our beagle Buddy.

Liz Garcia is a Physical Science Technician.

New Employees to Share Duties in Natural Resources

By James Åkerson

Two new term Biological Science Technicians were hired in February 2005. They are Jacob (Jake) Hughes and Nicholas (Nick) Fisichelli. They join David Demarest as a three-person roving team to conduct fieldwork in botany, exotic plant management, fisheries, and wildlife management.

Jake Hughes holds a Bachelor of Science in Biology from the University of Maryland - College Park. He has recent experience at Rock Creek Park in Washington, D.C., where he worked in exotic plant control as a term and temporary employee for three years. He led crews involved in exotic plant management and various other vegetation tasks. He also worked in horticulture at the U.S. National Arboretum in Washington, D.C. Jake will be the lead technician for the Park's exotic plant management program. He will also spend significant time with botany tasks. In his spare time, Mr. Hughes enjoys botanizing, fishing and playing the bass.

New term employees, Nick Fisichelli (left) and Jacob Hughes (right).

Nick Fisichelli holds a Bachelor of Science - Resource Ecology and Management from the University of Michigan. He was a temporary employee with the Natural Resources Branch at Shenandoah National Park beginning in 2003. During his first season, he surveyed the park boundary for invasive, exotic plant species. Prior to his arrival at Shenandoah, Mr. Fisichelli worked at Lassen Volcanic National Park and Oregon Caves National Monument in natural resource management and fire management. He will be the lead technician on the park's botanical programs. His primary projects include the installation and sampling of 160 long-term forest monitoring plots and the monitoring of rare plant populations and communities.

James Åkerson is a Supervisory Ecologist.

The purpose of the Shenandoah National Park Resource Management Newsletter is to convey information on Shenandoah's natural, cultural, and backcountry/wilderness resources, issues, and programs to park employees and the interested lay public. We will strive to present a mix of current activities, research and monitoring findings, and basic information about the park's resources in an informal publication on a annual basis. We welcome short articles meeting this purpose from both park staff and cooperators. Paper copies of the newsletter will be distributed to park employees and others upon request, and will be distributed with permission by the Shenandoah National Park Association to its members.

Editor
Debbie Sanders

Chief of Natural & Cultural Resources
Gary Somers

Comments? Write to:
Superintendent
Shenandoah National Park
3655 Highway 211 East
Luray, VA 22835

Editor's Note:
If you wish to be removed from this mailing list, please call Sharon Henry at (540) 999-3493.

National Park Service
U.S. Department of the Interior

Shenandoah National Park
3655 Highway 211 East
Luray, Virginia 22835