



Deer Enclosures

Introduction

The Big Meadows Area (BMA) is a great place to observe wildlife. 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, a decreased regeneration of woody plants, and decreased cover of palatable plant species (e.g. lilies).

Management Needs

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.



Current Procedures

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 & wildlife programs at Shenandoah National Park (funded by a Natural Resources Preservation Program (NRPP) Regional Block Grant) identified sites for seven deer enclosures 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 a ~15 x 15 m four-sided deer enclosure at each site. In August of 2008 after the enclosures had been in place for two years, transects and plots (half inside the enclosure, half outside the enclosure) were resampled.



A tall flowering Canada burnet protected from deer browse inside the enclosure.



Deer Exclosures (continued...)

What We Have Learned

Canada burnet (*Sanguisorba canadensis*) was one of the target rare plant species at these sites. 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! 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 ($p < 0.01$, mean \pm 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 ($p < 0.01$), and the area covered by these plants was greater inside the exclosure ($p < 0.01$) 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. 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 ($p < 0.01$, mean \pm 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.

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 viminum*), 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.



Blue-flag iris. One of the rare plants within the exclosures that is monitored.

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.

Horsley, S.B., Stout, S.L., and DeCalesta, D.S. 2003. White-tailed deer impact on the vegetation dynamics of a northern hardwood forest. *Ecological Applications*, 13(1):98-118.

Ludwig, J., Fleming, G., Pague, C., and Rawinski, T. 1993. A Natural Heritage Inventory of Shenandoah National Park (Natural Heritage Technical Report #93-5), February 1993. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia.



Linear-leaved willow herb. One of the rare plants within the exclosures that is monitored.