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Morristown National Historical Park Jack-in-the-Pulpit Deer Exclosures Summary

Introduction

In conjunction with Linda Rohleder, PhD candidate at Rutgers University, the New Jersey Department of Environmental Protection, Division of Fish and Wildlife began efforts to collect information at deer exclosures located throughout New Jersey in 2008. Exclosures that did not have ornamental or native vegetation planted, and did not have invasive exotic vegetation removed were chosen. Twenty-seven deer exclosures were utilized. Information on the number of species present inside and outside deer exclosures and plant height was obtained. The Floristic Quality Assessment Index and the Plant Stewardship Index were calculated from the plant species present. The Shannon Index of Diversity was obtained using the percent cover by species. The height and density of vegetation inside and outside of the deer exclosure was compared.

Study Area

The Morristown National Historical Park is comprised of 1,697.55 acres located in Morris County. The Park contains four separate units, each of which is associated with the Revolutionary War winter encampments of the Continental Army. The vegetation inside and outside eight exclosures located in the Jockey Hollow Encampment Area in Harding Township were sampled in May and June 2008. Four 10'x10' exclosures were constructed in 1997 to evaluate the effect of deer herbivory on Jack-in-the-Pulpit. This report summarizes the difference in vegetation inside and outside three of these exclosures, combined. The three exclosures are located at 40.76931 -074.52840, 40.76937 -074.52800, and 40.76936 -074.52905.

Methods

One randomly located, one-meter² study plot was established outside each of the three exclosures, and one study plot was established inside each of the three exclosures in May 2008. Percent cover, by species was recorded for each one-meter² study plot. From the center point of each exclosure, and in the corresponding area outside the exclosure, the height of vegetation within a 2-meter radius was recorded. The density of vegetation was recorded inside and outside the exclosures using a density board. The density board was used to determine the percent cover at 20-centimeter heights from a distance of two meters, in eight directions.

All New Jersey and Pennsylvania plants have been catalogued and assigned a number, the Coefficient of Conservatism (CC), from zero to ten by local experts and botanists. Zero represents the most generalist species, tolerant of disturbance and includes invasive or introduced nonnative species. Ten represents the most conservative species and

includes many rare and endangered state-listed native plants that require special habitats. The Floristic Quality Assessment Index (FQAI) is calculated using the CC for only those plants native to New Jersey, while the Plant Stewardship Index (PSI) is calculated using the CCs of both native and non-native plants. The naturalness of the total plant community is calculated by adding in all non-native species and giving them a C value of 0. Thus Total Mean C can be computed, and the PSI value is calculated by multiplying the Total Mean C by the square-root of N, where N is native species richness. The FQAI of an area is computed by multiplying the Native Mean C by the square-root of N, where N is the native species richness. The PSI, FQAI, and Native Mean C were calculated using the PSI calculator found at the Bowman's Hill Wildlife Preserve web site at www.bhwp.org/db/index.php. The mean Coefficient (mean C) for native plants is used as a non-weighted indication of floristic quality. It is not dependent on the size of the area inventoried and can be used for comparing sites of different sizes.

Results

No one species covered more than 30% of any of the one-meter² study plots either inside or outside the enclosure. Jack-in-the-Pulpits were not more prevalent inside the enclosures than outside, nor were they taller inside the enclosure than outside.

Study plots located inside the enclosures combined had a Plant Stewardship Index (PSI) of 4.47 and Floristic Quality Assessment Index (FQAI) of 5.37. The PSI and FQAI differed because invasive exotic species were found in the study plots. Study plots located outside the enclosures combined had a PSI of 1.50 and a FQAI of 3.00. Eight species of plants were found in the three study plots inside the enclosure and two species were found in the one-meter² study plots outside the enclosure.

The native mean C for the one-meter² plots located inside the enclosure was 2.40. The native mean C for the one-meter² plots located outside the enclosure was 3.00.

The percent cover of plots located outside the enclosure averaged 19%, while the percent cover of plots located inside the enclosure averaged 26%.

From the center point of each enclosure and in the corresponding study areas outside the enclosures, the height of vegetation within a 2-meter radius was recorded. The heights of *Parthenocissus quinquefolia*, *Fraxinus pennsylvanica*, and *Prunus serotina* inside the enclosures exceeded the heights of the same species outside the enclosures.

Within the 2-meter radius circles, located inside the enclosures, *Rubus occidentalis*, *Acer rubrum*, *Fagus grandifolia*, *Lindera benzoin*, *Amelanchier canadensis*, *Ulmus americana*, *Quercus rubra*, *Athyrium filix-femina*, and *Carex* sp. were found, but were not found in any of the 2-meter radius circles located outside the enclosure.

The density of vegetation was recorded from the center point of each enclosure and corresponding areas outside the enclosures. A density board was used to record the

percent cover at 20-centimeter(cm) heights from a distance of two meters, in eight directions. The density of vegetation was greater inside the exclosures at all height classes except the 20-40cm height class.

Shannon's diversity index (H) was used to examine abundance and evenness of species in the interior plots versus the exterior plots (calculator can be found at <http://math.hws.edu/javamath/ryan/DiversityTest.html>). The diversity index takes into account both the number of species and their proportions. A higher value indicates higher diversity. The diversity index of plots located inside the exclosures is 2.46, while the diversity index of plots located outside the exclosure is 0.93. Evenness (H/Hmax) indicates the extent to which species are represented in approximately equal proportions. A value closer to 1 would indicate more equitable distribution. The evenness of vegetation species located in plots outside the exclosure is 0.93 and the evenness of vegetation species located in plots inside the exclosure is 0.82.

The soil moisture differed slightly, with the outside study plots located on slightly drier soil. The soil moisture averaged 18.7 % outside the exclosures and the soil moisture averaged 20.3% inside the exclosures.

Summary

The diversity of vegetation was found to be much greater inside the Jack-in-the-pulpit deer exclosures than outside, after excluding deer for eleven years. The PSI and FQAI were significantly higher inside the deer exclosures (4.47 and 5.37) than outside (1.50 and 3.00). The percent cover was higher inside the deer exclosure (26%) than outside (19%).

A list of plant species identified inside and outside the exclosure is found in Appendix A.

A complete summary of results from the 27 deer exclosures, in New Jersey where species abundance, diversity, and density by height was obtained will be completed in 2009. These results will be correlated with deer population estimates. A copy of this PhD thesis written by Linda Rohleder will be provided to the National Park Service.



Appendix A.

Vegetation Species Found Outside Deer Exclosure in one-meter² plots and in 2-meter radius circles

<i>Arisaema triphyllum</i>	Jack-in-the-pulpit
<i>Allium vineale</i>	Field garlic
<i>Berberis thunbergii</i>	Japanese barberry
<i>Celastrus orbiculatus</i>	Oriental bittersweet
<i>Fraxinus pennsylvanica</i>	Green ash
<i>Liriodendron tulipifera</i>	Tuliptree
<i>Nyssa sylvatica</i>	Black gum
<i>Parthenocissus quinquefolia</i>	Virginia creeper
<i>Prunus serotina</i>	Wild black cherry
<i>Rubus phoenicolasius</i>	Wineberry
<i>Thelypteris noveboracensis</i>	New York fern

Vegetation Species Found Inside Deer Exclosures in one-meter² plots and in 2-meter radius circles

<i>Acer rubrum</i>	Red maple
<i>Amelanchier canadensis</i>	Shadbush
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit
<i>Athyrium filix-femina</i>	Lady fern
<i>Carex</i> sp.	Sedge sp.
<i>Celastrus orbiculatus</i>	Asiatic bittersweet
<i>Fagus grandifolia</i>	American beech
<i>Fraxinus pennsylvanica</i>	Green ash
<i>Lindera benzoin</i>	Spicebush
<i>Nyssa sylvatica</i>	Black gum
<i>Parthenocissus quinquefolia</i>	Virginia creeper
<i>Prunus serotina</i>	Wild black cherry
<i>Quercus rubra</i>	Northern red oak
<i>Rubus occidentalis</i>	Black raspberry
<i>Ulmus americana</i>	American elm