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Fort Collins, Colorado

White-tailed Deer Monitoring at Arkansas Post National Memorial, Arkansas: 2007 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2007/025
NPS D-44

ON THE COVER
White-tailed deer (*Odocoileus virginianus*)
Photo from The Heartland Inventory and Monitoring Network and Prairie Cluster Prototype Monitoring Program files.

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Executive Summary

White-tailed deer monitoring was initiated as a pilot study at Arkansas Post National Memorial, Arkansas in winter 2005. Overall, the index of deer density has declined 92.1 % over the past three years. The index of deer population density has declined an estimated 80.8 % during the past year. The smaller deer herd may be the result of hunting pressures or practices north of the park. Forage or mast production was most likely not a limiting factor. Climatic conditions during 2006 were very similar to the 30 year average, so it is very unlikely that climatic conditions significantly impacted forage production.

Introduction

Since European settlement, white-tailed deer (*Odocoileus virginianus*) populations in North America have experienced enormous changes in size and distribution. Once abundant, deer numbers declined to near extinction by the early 1900s. Clearing of forested lands and unrestricted hunting contributed heavily to the decline of this species (Stoll and Donohoe 1973, Dennis 1983). Declines in deer numbers were especially prevalent in the East and Midwest sections of the country where much of the land was converted for row-crop farming.

Regulated white-tailed deer hunting and extermination of most of their natural predators has led to unprecedented population growth throughout their range. With natural deer habitat severely reduced, row-crop agriculture and other agriculture practices provide artificial food sources that deer utilize. The ability of white-tailed deer to adapt to human disturbance has also aided in the recovery of this species. Urban sprawl benefits deer by fragmenting continuous blocks of forested lands into small sections with increased edge habitat, which is favored by deer and rarely available for hunting. Therefore, deer experience high rates of population growth as long as food is available in these small blocks of patchy habitat. Grass and forb production is greater in these areas as is mast production by oaks, hickories and other trees when compared to larger blocks of forested land (Peitz et al. 2001). Urban sprawl also redistributes deer by eliminating habitat in one area, thereby concentrating deer in available habitat in another (Shafer-Nolan 1997).

Deer become vulnerable to overpopulation, disease and starvation in the absence of natural predators and hunting. When deer occur in high densities, diseases are transmitted more readily. In years when forage or mast production is restricted due to climatic conditions, starvation or poor herd health can occur. Deer browsing from high-density herds also has a negative affect on vegetation of an area. Research has shown that high deer populations contribute to over-browsing of vegetation, which leads to plant mortality, decreased plant reproduction and may tend to favor less preferred exotic species (McShea and Rappole 1997). This shift in species assemblages can reduce plant diversity at a local level and cause changes in the functioning of prairie and woodland communities. Deer foraging may influence rare and sensitive plant species negatively. However, the influence of deer on the status of most rare and sensitive plant species is largely unknown. Many studies have shown that deer can have a negative effect on developing forestland (Crouch and Paulson 1968, Horsely and Marquis 1983, Marquis 1981). Browsing on young tree seedlings causes stunted growth as well as mortality (Michael 1992,

Mladenoff and Stearns 1993). Research has shown that in some situations damage from deer as well as mice and rabbits may be a key impediment to forest restoration projects (Crouch and Paulson 1968, Strole and Anderson 1992).

White-tailed deer are often viewed as an important component of park ecosystems. Deer have a tremendous following among the public and many parks provide information on the status of deer through their interpretive programs. However, this information is generally anecdotal in nature. White-tailed deer can present a safety hazard to motorist and park visitors when populations are high. High deer numbers increase the number of vehicle-deer collisions and the resulting property damage and personal injuries. In some cases, vehicle-deer collisions can result in the loss of human life. Deer also disperse ticks, which may carry Lyme disease (Connelly et al. 1987). Lyme disease is a debilitating immune system disease transmitted to humans by the bite of ticks. Ticks carrying other human transmittable diseases such as Rocky Mountain Spotted Fever and Ehrlichiosis may be spread by deer as well. Information on the status and trends in deer population size helps park managers determine if control measures are necessary in order to protect other park resources and improve visitor safety.

It is against a backdrop of urban sprawl, altered ecosystems and concerns over visitor safety on Park Service lands that we proposed monitoring white-tailed deer populations to assess their status and trends. Long-term trends in deer abundance provide one measure for assessing their potential as a problem for a park. Documenting long-term patterns in deer numbers allows one to evaluate correlations with changes in vegetation (e.g., through restoration of the cultural landscape). With this information, resource managers can more effectively identify and potentially mitigate damage caused to vegetation communities and endangered plant populations by deer. Monitoring data also helps managers assess safety risk from collisions and disease transmission. Long-term monitoring of deer numbers is critical in evaluating any population control measures a park may implement.

Objectives

The primary objectives for monitoring white-tailed deer populations at Arkansas Post National Memorial, Arkansas are:

- Determine annual changes in white-tailed deer numbers.
  Justification. *Significant annual changes in deer numbers may signal the presence of illegal deer harvest, disease or other acute factors of concern for park management.*
- Determine long-term trends in white-tailed deer numbers.
  Justification. *Understanding decadal trends in deer number will help park management determine if measures need to be taken to maintain herd health, minimize vegetation damage within a park or damage to surrounding private properties.*

This report summarizes survey results for the third year of monitoring.

Methods

Study Area

Deer surveys were limited to the area visible at night with spotlights along 3.42 km of the main tour roads of the memorial. This permanent sampling route was chosen from all existing roads and trails within the memorial, including service roads because it is easily traversed and passes through all major habitats found on the memorial. It is also important for long-term monitoring that the survey route is an all-weather route so that it will be passable shortly following inclement weather. Counting deer along this road corridor will yield an index of relative deer abundance, which correlates with the absolute abundance of deer on the memorial. Our index of relative deer abundance will allow detection of general increases or decreases in the actual population over time.

White-tailed Deer Survey Methods

Sampling was limited to winter months, before spring vegetation emerged (January through mid March). Therefore, the target population includes all deer within the boundaries of the main unit of the memorial at the time surveys were conducted (although the sample frame was limited to the road corridor). These are the deer that most impact herd size and memorial resources throughout the year.

Surveys were conducted from a survey vehicle moving no more then 16 km / hr, using two 1,000,000 candlepower spotlight. All deer seen along the survey route were counted and their location recorded using GPS technologies. Deer observations were made by two observers seated on the left and on the right side of the vehicle. Distances from the stopped survey vehicle to all deer were determined by a rangefinder or, for deer < 10 m from the vehicle, by visual estimates. Deer were usually observed in groups, in which case distance was taken or estimated to the center most deer in the group. In order to map locations of deer, the direction and angle of all deer or deer groups from the survey vehicle were recorded as well.

Survey nights were February 20, 21 and 22. Based on the first two years of data, it was determined that the highest number of deer counted each night occurred during the first replicates. Therefore, only one replicate starting one hour after official sunset was planned each survey night in 2007. However, due to low numbers of deer observed the first two survey nights, the survey on February 22 was postponed until three hours past official sunset in an effort to get a more robust survey result. Deer counts increased during the later survey, but it was still less than previous years.

Visibility Estimates

At every 10^{th} mile along the survey route we recorded perpendicular distances from the survey vehicle to the point beyond which deer would not be visible. The perpendicular measures were marked using GPS technologies. Visibility estimates were taken each survey night after the survey was completed. The starting point was staggered within the first 10^{th} mile of the survey route each night in an attempt to get a more robust picture of how much area was surveyed along the route. Using GIS technologies, perpendicular distances were plotted on a map, a polygon was created and the survey area determined.

Data Analysis

An index of relative density was calculated using the average deer count and survey area determined during each survey night in 2007 (38.24 ha or 31.5 % of the terrestrial lands of the main unit of the memorial, Figure 1). Vegetation structure in grassland areas was similar between years, visibility in the wooded sections of the park have slightly improved from previous years surveys. A mean index value of deer density and standard deviation were determined from the replicates for 2007. The percent change in annual deer densities were calculated and reported.

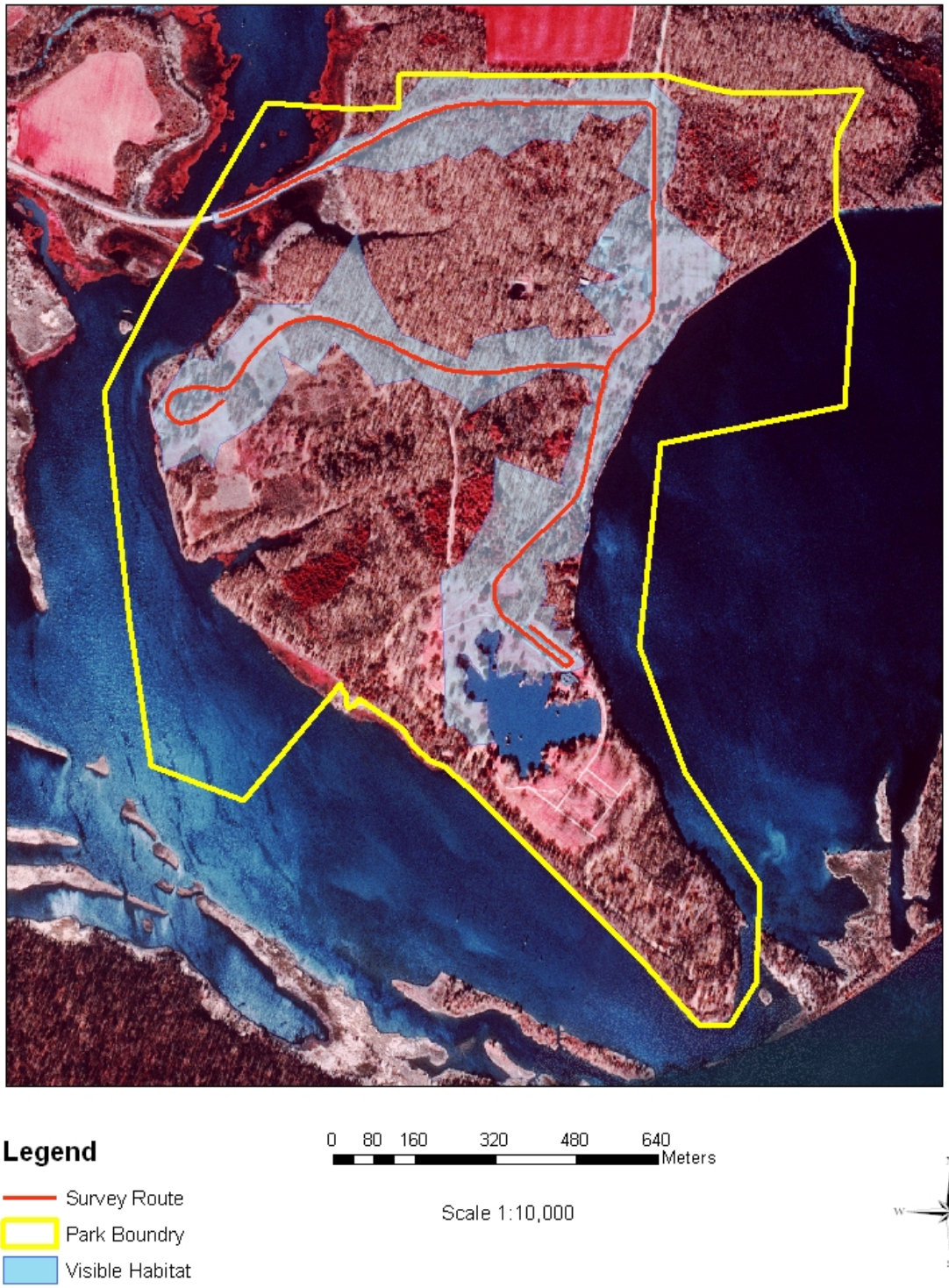

Figure 1. Route showing the area visible during white-tailed deer surveys on Arkansas Post National Memorial, Arkansas during 2007.

Results

The index of white-tailed deer population densities averaged 6.54 (std. dev. ± 9.25) individuals / km^2 in 2007 (Figure 2), representing a decline of 80.8 % from the previous years index on Arkansas Post National Memorial. The area visible from the survey route was determined to be 38.2 hectares (Figure 3), or 31.5% of the main unit's inhabitable land. During the survey nights 0, 5, and 14 deer were seen respectively. The last survey night was postponed until three hours after official sunset since so few deer were seen the first two nights. For this reason, the deer recorded during this count (14 deer) was not included in the estimated index of deer density.

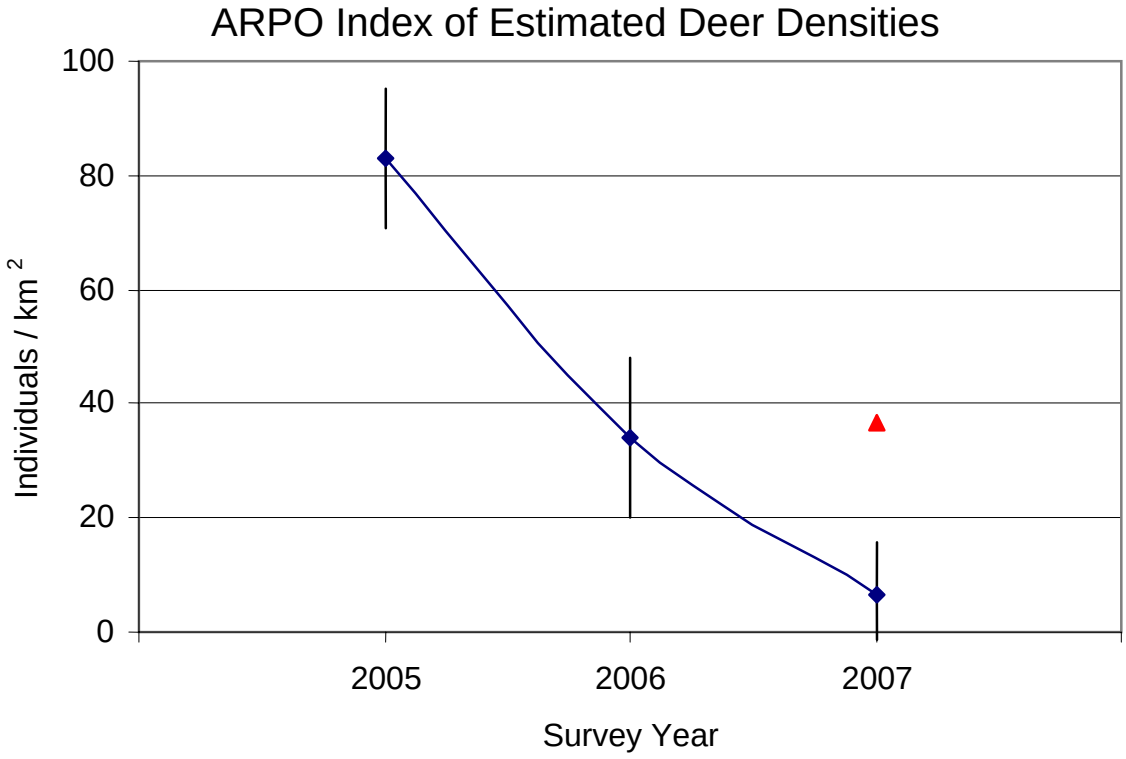

Figure 2. Index of white-tailed deer density estimates on Arkansas Post National Memorial, Arkansas during all survey years. ▲ Denotes the estimated index of deer density based on the count that occurred three hours past official sunset. Error bars show standard deviation.

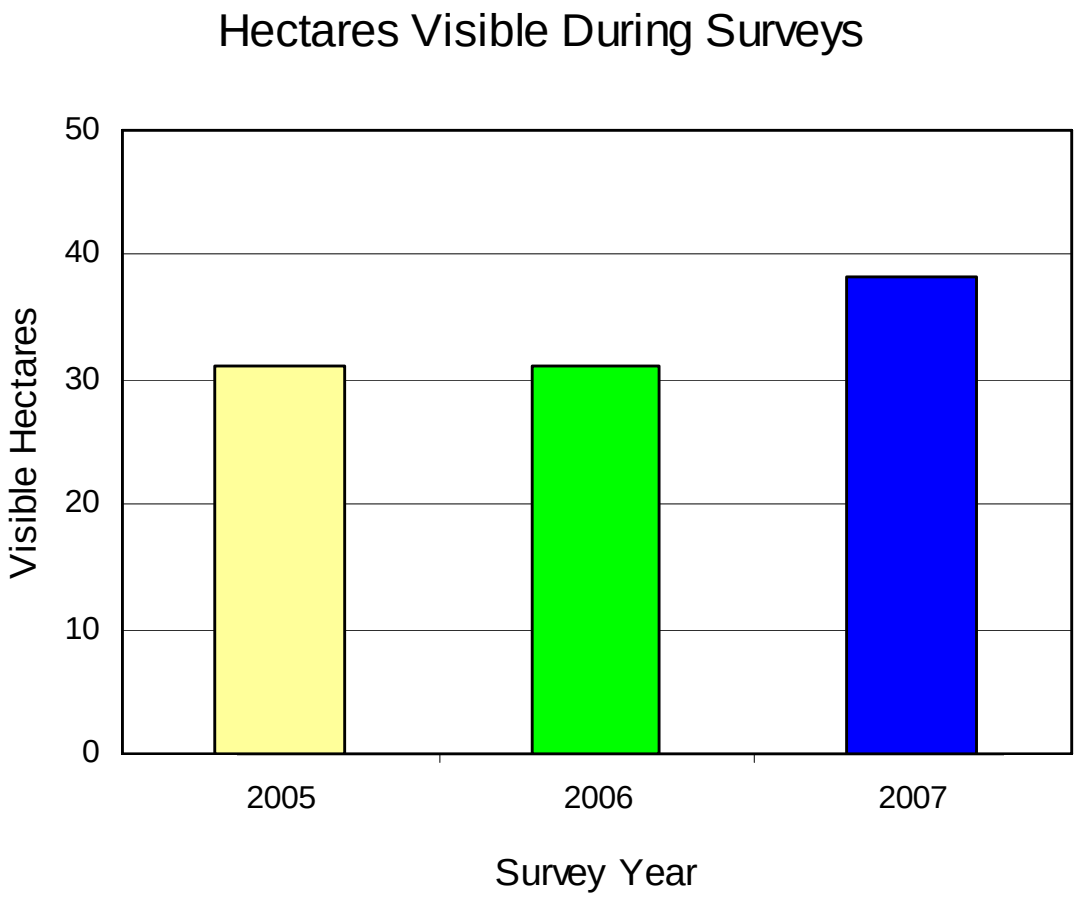

Figure 3. Area of the park that was visible during spotlight surveys during each survey year.

Discussion

White-tailed deer are extremely adaptable to human disturbance, which aided the species in recovering from near extirpation in Arkansas to today's herd, which exceeds 1,000,000 individuals during most years. As far back as 1988, deer densities were already averaging over 12 individuals / km^2 in the southeastern part of the state (http://www.uga.edu/scwds/, 2006). Today, higher deer densities in areas of suitable habitat or in areas where populations grow without the pressures of predators and hunting are expected. Densities observed in the fragmented and un-hunted habitat of Arkansas Post National Memorial are consistent with expectations: (http://www.agfc.com/pdfs/species_management_plans/deer_mgmt_plan_99.pdf, 1999). The index of deer density for the survey area in 2007 is probably higher than the 6.54 individuals / km^2 reported. The count from the third survey night was not included in the index since it was conducted at a different time of night. The single estimate from the third evening was X deer / km^2 Even though the true density of deer is thought to be higher than reported, we still believe the population on the park has decreased.

Deer densities at Arkansas Post National Memorial are most likely declining due to hunting practices or pressures outside of the park boundary. Arkansas deer have an average home-range

size of 404.7 hectares depending on habitat quality (Peterson, 2006). The main unit of Arkansas post has a land mass around 121.4 hectares, so deer movement off the park should be expected. Due to the low number of deer observed it is suspected that deer are moving off the preserve in the direction of deer feeders (located on private lands to the north) during the evening period. Also, during the survey two very small fawns were observed (estimated weight of 12 to 13 kg each) suggesting they were born late last fall instead of the usual May-June fawning period. The low numbers of deer observed compared to previous years, along with the small fawns present suggest two things. First, a large portion of bucks may have been removed from the population thus prolonging the breeding season throughout the year. Secondly, hunting on lands north of the park and methods to attract deer to that property may have reduced the number of deer in the park during the period of our monitoring.

Climatic conditions during 2006 varied little from the 30 year average. The average yearly precipitation for 2006 was less (8 cm) than the 30 year average. This was the second consecutive year that precipitation was less than the 30 year average. High and low average temperatures for 2006 were slightly elevated. However, these variations were minute (between 0.18º and 0.48º C) compared to the 30 year average. (http://ag3.agebb.missouri.edu/npsdata/, 2007)

Implementation of a deer monitoring program on Arkansas Post National Memorial yielded important results by documenting possible declines in the population. Our first three years of monitoring also demonstrated the importance of annual population monitoring in identifying changes in the deer population of the memorial. Future surveys need to be adjusted to improve the accuracy of deer counts on the memorial and account for activities outside the memorial that influence deer numbers if possible.

Acknowledgements

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Literature Cited

http://www.agfc.com/pdfs/species_management_plans/deer_mgmt_plan_99.pdf. 1999. Arkansas Game and Fish Commission web site. Arkansas Game and Fish Commission, Little Rock.

http://ag3.agebb.missouri.edu/npsdata/. 2007. Climate/Streamflow Data Archive. National Park Service.

Connelly, N. A., D. J. Decker, and S. Wear. 1987. Public tolerance of deer in a suburban environment: implications for management and control. Eastern Wildlife Damage Control Conference **3**:207-217.

Crouch, G.L., and N. R. Paulson. 1968. Effects of protection from deer on survival and growth of Douglas-fir seedlings. USDA Forest Service, Pacific Northwest Forest Range Experiment Station Reserve, Research Note 94.

Dennis, D. F. 1983. An analysis of Ohio's forest resources. USDA Forest Service, Northeast Research Station, Research Bulletin NE-75.

Horsely, S.B., and D.A. Marquis. 1983. Interference by weeds and deer with Allegheny hardwood reproduction. Canadian Journal of Forest Research **13**:61-69.

Marquis, D.A. 1981. Effect of deer browsing on timber production in Allegheny hardwood forests of northwestern Pennsylvania. USDA Forest Service Research Paper NE-475.

McShea, W.J., and J.H. Rappole. 1997 The science and politics of managing deer within a protected area. Wildlife Society Bulletin **25**:443-446.

Michael, E.D. 1992. Impact of deer browsing on regeneration of balsam fir in Canaan Valley, West Virginia. Northeastern Journal of Applied Forestry **9**:89-90.

Mladenoff, D.J., and F. Stearns. 1993. Eastern hemlock regeneration and deer browsing in the Northern Great Lakes region: a re-examination and model simulation. Conservation Biology **7**:889-900.

Peitz, D.G., M.G. Shelton, and P.A. Tappe. 2001. Forage production after thinning a natural loblolly pine-hardwood stand to different basal areas. Wildlife Society Bulletin **29**:687-705.

Peterson, Nicole. 2006. Managing a Successful Deer Herd. 2005 – 2006 Arkansas Game and Fish Commission Deer Season Summary. Arkansas Game and Fish Commission Report.

Shafer-Nolan, A. L. 1997. The science and politics of deer overabundance at Cuyahoga Valley National Recreation Area, Ohio. Wildlife Society Bulletin **25**:457-461.

http://www.uga.edu/scwds/. 2006. White-tailed deer population 1988. Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, University of Georgia, Athens.

Stoll, R. J., Jr., and R.W. Donohoe. 1973. White-tailed deer harvest management in Ohio. Ohio Department of Natural Resources, Division of Wildlife, In Service Document 73.

Strole, T.A., and R.C. Anderson. 1992. White-tailed deer browsing: species preferences and implications for central Illinois forests. Natural Areas Journal **12**:139-144.

The NPS has organized its parks with significant natural resources into 32 networks linked by geography and shared natural resource characteristics. HTLN is composed of 15 National Park Service (NPS) units in eight Midwestern states. These parks contain a wide variety of natural and cultural resources including sites focused on commemorating civil war battlefields, Native American heritage, westward expansion, and our U.S. Presidents. The Network is charged with creating inventories of its species and natural features as well as monitoring trends and issues in order to make sound management decisions. Critical inventories help park managers understand the natural resources in their care while monitoring programs help them understand meaningful change in natural systems and to respond accordingly. The Heartland Network helps to link natural and cultural resources by protecting the habitat of our history.

The I&M program bridges the gap between science and management with a third of its efforts aimed at making information accessible. Each network of parks, such as Heartland, has its own multi-disciplinary team of scientists, support personnel, and seasonal field technicians whose system of online databases and reports make information and research results available to all. Greater efficiency is achieved through shared staff and funding as these core groups of professionals augment work done by individual park staff. Through this type of integration and partnership, network parks are able to accomplish more than a single park could on its own.

The mission of the Heartland Network is to collaboratively develop and conduct scientifically credible inventories and long-term monitoring of park “vital signs” and to distribute this information for use by park staff, partners, and the public, thus enhancing understanding which leads to sound decision making in the preservation of natural resources and cultural history held in trust by the National Park Service.

www.nature.nps.gov/im/units/htln/

Heartland Network
Natural Resource Monitoring

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