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White-tailed Deer Monitoring at Arkansas Post National Memorial, Arkansas: 2005-2006 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2006/014
NPS D-45

ON THE COVER
White-tailed deer (*Odocoileus virginianus*)
Grayscale 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. Deer population densities averaged 82.98 (std. dev. $\pm$ 12.36) individuals / km^2 in the survey area of the memorial during the first year of monitoring. During the second year (2006) of monitoring, deer densities averaged 34.05 (std. dev. $\pm$ 14.02) individuals / km^2 in the survey area, representing a decline of 58.96 % from the previous year. High deer numbers on the memorial may have made them vulnerable to disease and starvation. During the fall of 2005, deer on the memorial could have succumbed to one of the reoccurring outbreaks of hemorrhagic disease seen in the Southeastern United States, resulting in the loss of over half the population in the study area (http://www.uga.edu/scwds/, 2006). Deer density in 2005 may have been higher than 2006 due to more favorable climatic conditions or habitat on the memorial and would have declined without a disease outbreak. In years when forage or mast production is restricted due to climatic conditions, starvation becomes a greater population control. With deer densities still relatively high, further declines in the population should be expected. Our first two years of monitoring deer on the memorial demonstrated the importance of annual population monitoring in identifying changes in the population.

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 first two years 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 a 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 included all deer within the boundaries of the main unit of the memorial at the time surveys were being conducted (although the sample frame was limited to the road corridor). These are the deer that most impact herd size and memorial resource throughout the following 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 < 20 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.

During our monitoring, we attempted to conduct three replicates each survey night. Survey nights were March 28th, 29th and 30th, 2005 and January 3rd, 4th and 5th, 2006. Surveys commenced one hour after official sunset and each hour thereafter until all three surveys were completed.

Visibility Estimates

During the second year of monitoring, every 10th 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 surveys was completed. The starting point was staggered within the first 10th mile of the survey route each night in an attempt to get a more robust picture of how much area was being surveyed along the route. Using GIS technologies, perpendicular distances were plotted on a map, a polygon was created and the survey area determined. Visibility estimates were not taken during the first year of monitoring.

Data Analysis

Population densities were calculated using the survey area determined during year two of monitoring (31.20 ha or 25.72 % of the terrestrial lands of the main unit of the memorial, Figure 1). Vegetation structure, especially in grassland areas, was similar between years. Count data from each replicate (n = 9 in 2005 and n = 8 in 2006) were used in the calculation of deer population densities. For 2005, deer observed at a distance greater than 250 m were excluded from the count data. Deer observed at this distance were beyond the survey area determined during the second year of monitoring and if included in the calculation of population density would skew them upward. By only using observations from the 2006 survey area, density estimates are comparable between years. In the future, the survey area will be determined each year, and by definition will include all deer observations. An estimate of the average annual population density and standard deviation was determined from the replicates for that year. The range in population densities each year was determined from replicate values as well. The percent change in annual deer densities were calculated and reported.

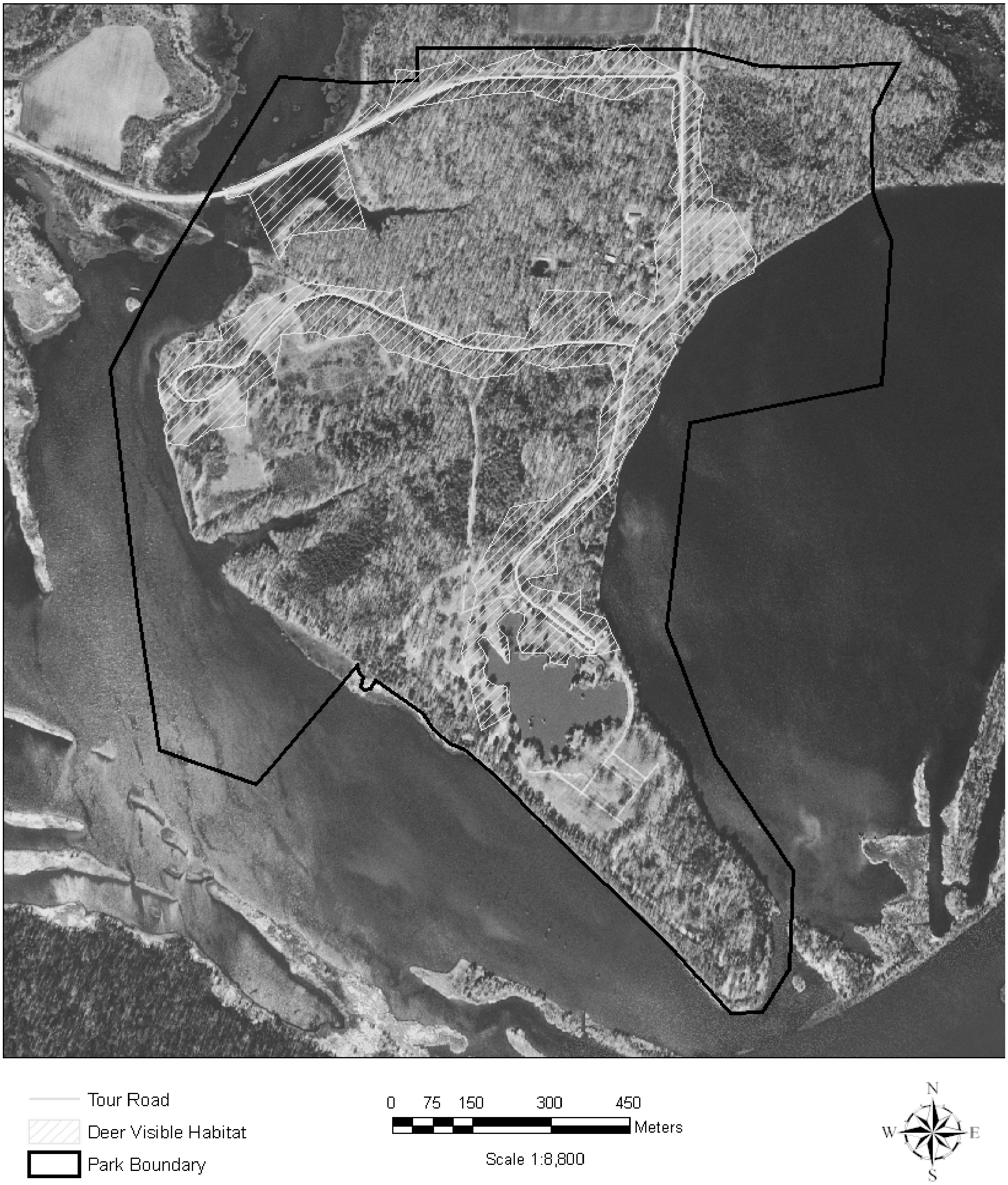

Figure 1. Route showing the area visible during white-tailed deer surveys on Arkansas Post National Memorial, Arkansas during 2005-2006.

Results

White-tailed deer population densities averaged 82.98 (std. dev. $\pm$ 12.36) individuals / km^2 in the survey area of Arkansas Post National Memorial the first year of monitoring (2005). Densities ranged from 60.90 to 99.36 individuals / km^2. During the second year (2006) of monitoring, white-tailed deer densities averaged 34.05 (std. dev. $\pm$ 14.02) individuals / km^2 in the survey area, representing a decline of 58.96 % from the previous year. Densities ranged from 19.23 to 51.28 individuals / km^2.

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 (http://www.agfc.com.pdf/deer_mgt_plan_99.pdf, 1999, http://www.agfc.state.ar.us/deer/index.html, 2006). 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, deer densities higher than that in areas of suitable habitat or in areas were populations grow without the pressures of predators and hunting are expected (http://www.agfc.com.pdf/deer_mgt_plan_99.pdf, 1999). Densities observed in the fragmented and un-hunted habitat of Arkansas Post National Memorial are very much in line with that which is expected (http://www.agfc.com.pdf/deer_mgt_plan_99.pdf, 1999).

Deer such as those at Arkansas Post National Memorial may become vulnerable to over population, disease and starvation in the absence of natural predators and hunting. During the fall of 2005, deer on the memorial may have succumbed to hemorrhagic disease (http://www.uga.edu/scwds/, 2006), which may account for the loss of almost 59 % of the population. Deer densities observed may be high due to favorable climatic conditions or habitat on the memorial and may decline further with or without a disease outbreak. In years when forage or mast production is restricted due to climatic conditions, starvation becomes a greater population control. In one study in Pennsylvania, researchers were unable to maintain deer densities at 32 individuals / km^2 for a 10-year period because of starvation mortality (deCalesta 1994). However, maximum densities of 25 individuals / km^2 where obtained in this study.

One problem with high deer numbers is that they over-browse vegetation causing a shift in species assemblages, reduced plant diversity on a local level and changes in the functioning of plant communities (Alverson et al. 1988, Mladenoff and Stearns 1993). Rare and sensitive plant species may be influenced by foraging or other deer activities as well (Healy 1997). Studies have also shown that deer can have a negative effect on developing forestland and they may be a key impediment to forest restoration projects (Crouch and Paulson 1968). Implementation of a deer monitoring program on Arkansas Post National Memorial yielded important results by documenting a possible disease related decline in the population. Our first two years of monitoring also demonstrated the importance of annual population monitoring in identifying changes in the deer population of the memorial.

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Literature Cited

Alverson, W.S., D.W. Waller, and S.L. Solheim. 1988. Forests too deer: edge effects in northern Wisconsin. Conservation Biology **2**:348-358.

http://www.agfc.com.pdf/deer_mgt_plan_99.pdf. 1999. Arkansas Game and Fish Commission web site. Arkansas Game and Fish Commission, Little Rock.

http://www.agfc.state.ar.us/deer/index.html. 2006. Arkansas Game and Fish Commission web site. Arkansas Game and Fish Commission, Little Rock.

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.

deCalesta, D.S. 1994. Impact of white-tailed deer on songbirds within managed forests in Pennsylvania. Journal of Wildlife Management **58**:711-718.

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

Healy, W.M. 1997. Influence of deer on the development of forest structure and composition in central Massachusetts. Pages 249-266. *in* W.J. McShea, H.B. Underwood and J.H. Rappole, editors. The science of overabundance: deer ecology and population management. Smithsonian Institute Press, Washington, D.C., USA.

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.

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.

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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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