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Fort Collins, Colorado

White-tailed Deer Monitoring at Pea Ridge National Military Park, Arkansas: 2007 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2007/026
NPS D-50

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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March 2007

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Please cite this publication as:

Cribbs, J.T. and D.G. Peitz. 2007. White-tailed Deer Monitoring at Pea Ridge National Military Park, Arkansas: 2007 Status Report. Natural Resource Technical Report NPS/HTLN/NRTR—2007/026. National Park Service, Fort Collins, Colorado.

NPS D-50, March 2007

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Executive Summary

White-tailed deer monitoring was initiated as a pilot study at Pea Ridge National Military Park, Arkansas in winter 2005. Overall, the index of deer density has declined 65.8 % over the past three years. The index of deer density has declined an estimated 56.46% during the past year. Several deer remains where observed by HTLN staff while at the park during the 2007 survey. Employees of PERI also commented on seeing deer remains regularly, and that a deceased deer was removed from a spring on the park. It appears that during the late summer or early fall of 2006, deer on the park succumbed to a disease. Most likely an outbreak of hemorrhagic disease (http://www.uga.edu/scwds/, 2006). No reports of hemorrhagic disease were reported in Benton county, however, seven cases were reported in two adjacent counties, Washington and Madison (Gray, 2007). With the current decline the deer population on the park is approaching normal densities, however further declines in the population are possible.

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 Pea Ridge National Military Park, 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 the 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 an area visible at night with spotlights along the main tour road that makes a 10.17 km loop through the center of the park. This permanent sampling route was chosen from all existing roads and trails within a park, including service roads because it is easily traversed and passes through all major habitats found on the park. 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 park. 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 park 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 park resources throughout the following year.

Surveys were conducted from a survey vehicle moving no more then 16 km / hr using two 1,000,000 candlepower spotlights. 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 January 22, 23 and 24. Based on year one data (2005), it was observed 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 made each survey night.

Visibility Estimates

During the third 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 survey 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 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 (120.12 ha or 6.9 % of the park, Figure 1). The visibility estimate changed very little between years, 7%, indicating vegetation structure,

especially in grassland areas, was similar between years. 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.

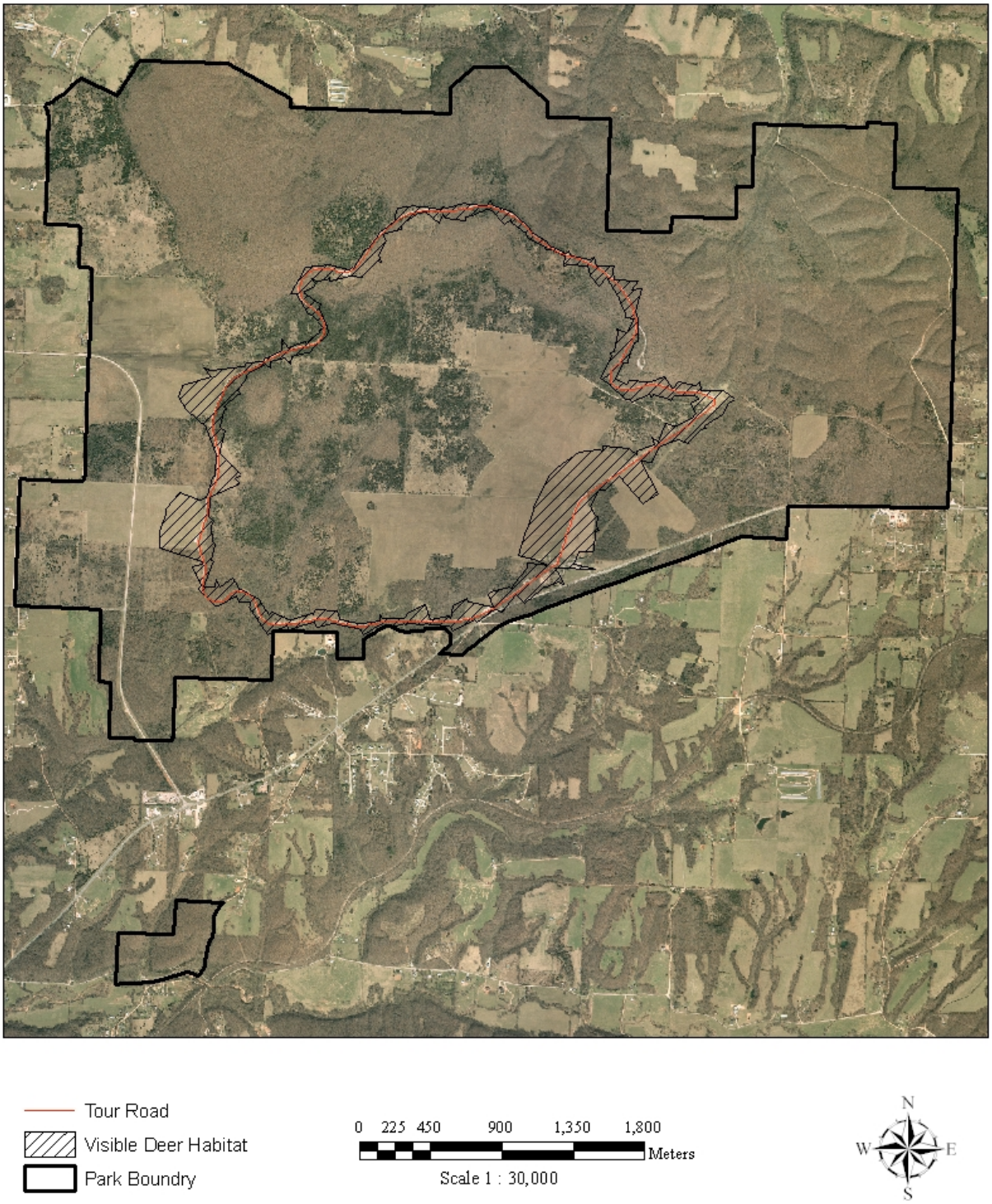

Figure 1. Route showing the area visible during white-tailed deer surveys on Pea Ridge National Military Park, Arkansas during 2007.

Results

Surveys for 2007 resulted in an average index of deer density of 14.43 (std. dev. $\pm$ 6.25) individuals / km^2 in the survey area of Pea Ridge National Military Park, representing a decline in the estimated index of deer density of 56.46% from 2006 levels (Figure 2). Based on each nights survey results values ranged from 8.32 to 20.81 individuals / km^2 in 2007. During the survey nights 10, 17, and 25 deer were seen respectively. The area visible from the survey route was determined to be 120.12 ha (Figure 3), or 6.9 % of the main unit of the park.

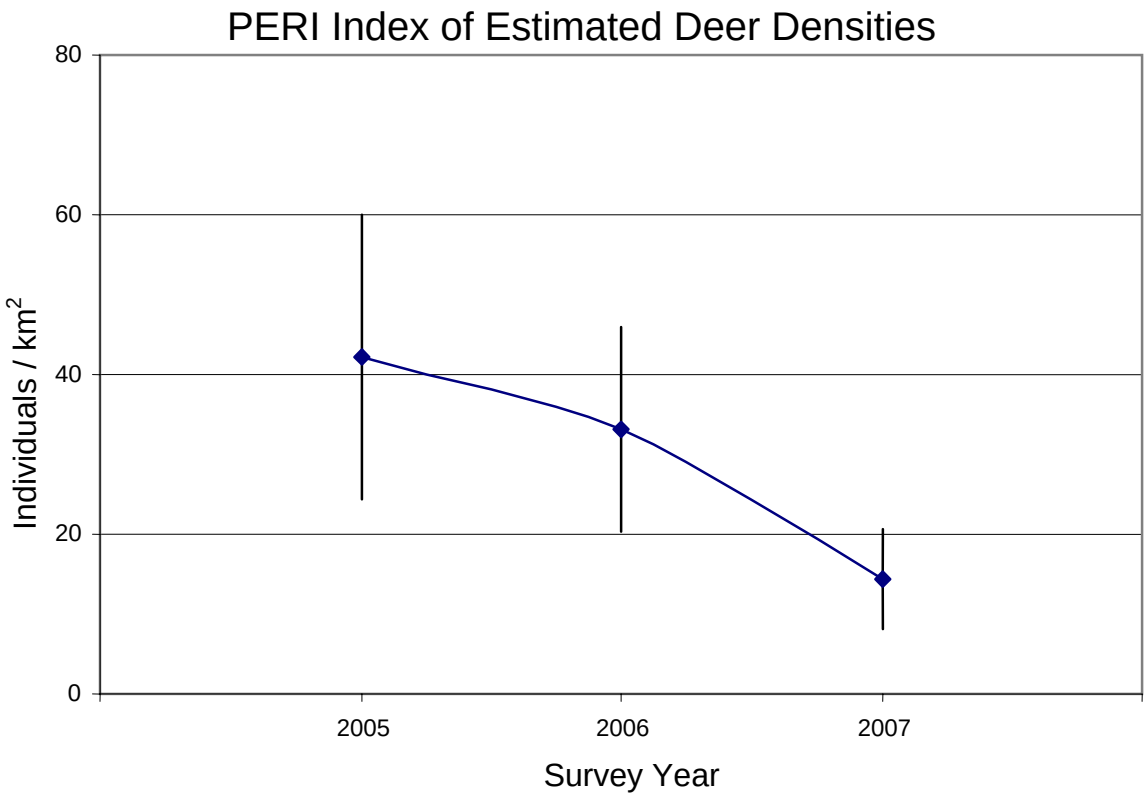

Figure 2. Index of white-tailed deer density estimates on Pea Ridge National Military Park, Arkansas during all survey years. Standard deviation is show with error bars.

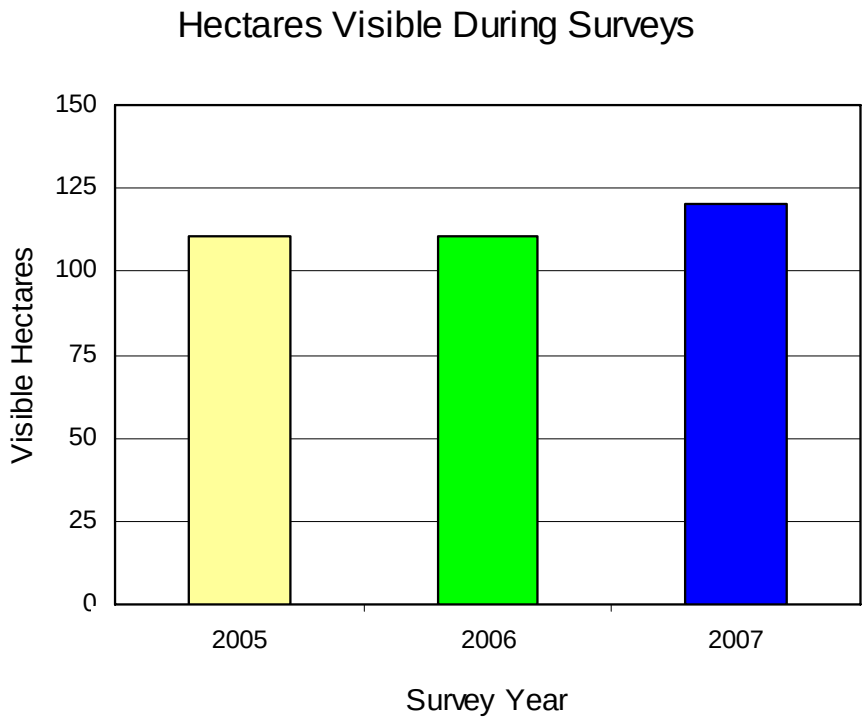

Figure 3. Visible area observed during each survey year on Pea Ridge National Military Park, Arkansas.

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.state.ar.us/deer/index.html, 2006). As far back as 1988, deer densities were already averaging over 12 individuals / km^2 in the northwestern part of the state (http://www.uga.edu/scwds/, 2006). Today, higher deer densities in areas of suitable habitat or areas where populations grow without the pressures of predators and hunting are expected. Densities observed in the fragmented and un-hunted habitat of the survey area on Pea Ridge National Military Park are consistent with expectations: (http://www.agfc.com/pdfs/species_management_plans/deer_mgmt_plan_99.pdf, 1999).

Deer such as those on Pea Ridge National Military Park are vulnerable to over population, disease or starvation in the absence of natural predators and hunting. During the fall of 2006, deer on the park very likely succumbed to hemorrhagic disease (http://www.uga.edu/scwds/, 2006), which may account for a decline in the population. Climate most likely played no role in the lower index of deer densities. During 2006 observed climatic conditions near the park varied little from the 30 year average, indicating that forage or mast production was not restricted due to climate. Precipitation during 2006 was lower than the 30 year average (5.22 cm) and the average temperature was 1.05º C higher than the 30 year average (http://ag3.agebb.missouri.edu/npsdata/, 2007).

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 and other deer activities as well (Healy 1997). Studies have also shown that deer can have a negative effect on developing forestland and the may be a key impediment to forest restoration projects (Crouch and Paulson 1968). Lower deer populations will likely be beneficial to the park for resource protection reasons.

Implementation of a deer monitoring program on Pea Ridge National Military Park yielded important results by documenting a possible disease related decline 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 park. White-tailed deer densities have decreased an estimated 65.79 % since monitoring began in 2005. The decline may not be as high as 65.79% but it has defiantly declined during the past three years.

Acknowledgements

We would like to thank the staff at Pea Ridge National Military Park for making this monitoring possible. We would especially like to thank Kevin Eads, Richie Nigro, Nolan Moore and Curtis Tilghman for their interest and assistance with conducting deer surveys.

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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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NPS D-50, March 2007

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