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White-tailed Deer Monitoring at Wilson's Creek National Battlefield, Missouri: 2005-2006 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2006/016
NPS D-80

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 Wilson's Creek National Battlefield, Missouri in winter 2005. Deer population densities averaged 55.47 (std. dev. $\pm$ 15.30) individuals / km^2 in the survey area of the battlefield during the first year of monitoring. During the second year (2006) of monitoring deer densities averaged 24.90 (std. dev. $\pm$ 5.56) individuals / km^2 in the survey area, representing a decline of 55.12 % from the previous year. High deer numbers on the battlefield in 2005 may have made them vulnerable to disease and starvation. During the fall of 2005, deer on the battlefield succumbed to hemorrhagic disease (Zeb Jordan, Missouri Department of Conservation, personal communication), resulting in the loss of over half the population in the study area. Deer density in 2005 may have been high due to favorable climatic conditions or habitat on the battlefield and would have declined without the outbreak of hemorrhagic disease. In years when forage or mast production is restricted due to climatic conditions, starvation becomes a greater population control. Our first two years of monitoring deer on the battlefield demonstrated the importance of annual 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. 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. Rare and sensitive plant species such as the Missouri bladderpod (*Lesquerella filiformis*) found on Wilson's Creek National Battlefield, Missouri may be influenced negatively by deer foraging. 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 Wilson's Creek National Battlefield, Missouri 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 an area visible at night with spotlights along the main tour road that makes a 7.90 km loop through the center of the battlefield. This permanent sampling route was selected from all existing roads and trails within the battlefield, including service roads, because it is easily traversed and passes through all major habitats found on the battlefield. 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 is correlated with the absolute abundance of deer on the battlefield. 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 battlefield 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 battlefield 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 counts 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 year one (2005) of our monitoring, three replicates were made each survey night. Survey nights were March 2nd, 3rd and 5th. Surveys commenced one hour after official sunset and each hour thereafter until all three surveys were completed. From year one data, it was observed that the highest number of deer counted each night occurred in the first replicates. Therefore, during our second year (2006) of monitoring, only one replicate starting one hour after official sunset was made each survey night. Survey nights during the second year of monitoring were January 11th, 12th and 13th.

Visibility Estimates

During the second year of monitoring, every 10th mile along the survey route we recorded perpendicular distances from the survey vehicle to a 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 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 (76.32 ha or 10.78 % of the battlefield, Figure 1). Vegetation structure, especially in grassland areas, was similar between years. Count data from the first replicate each night were used in the estimation 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 densities, would skew them upward. By using only 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, 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.

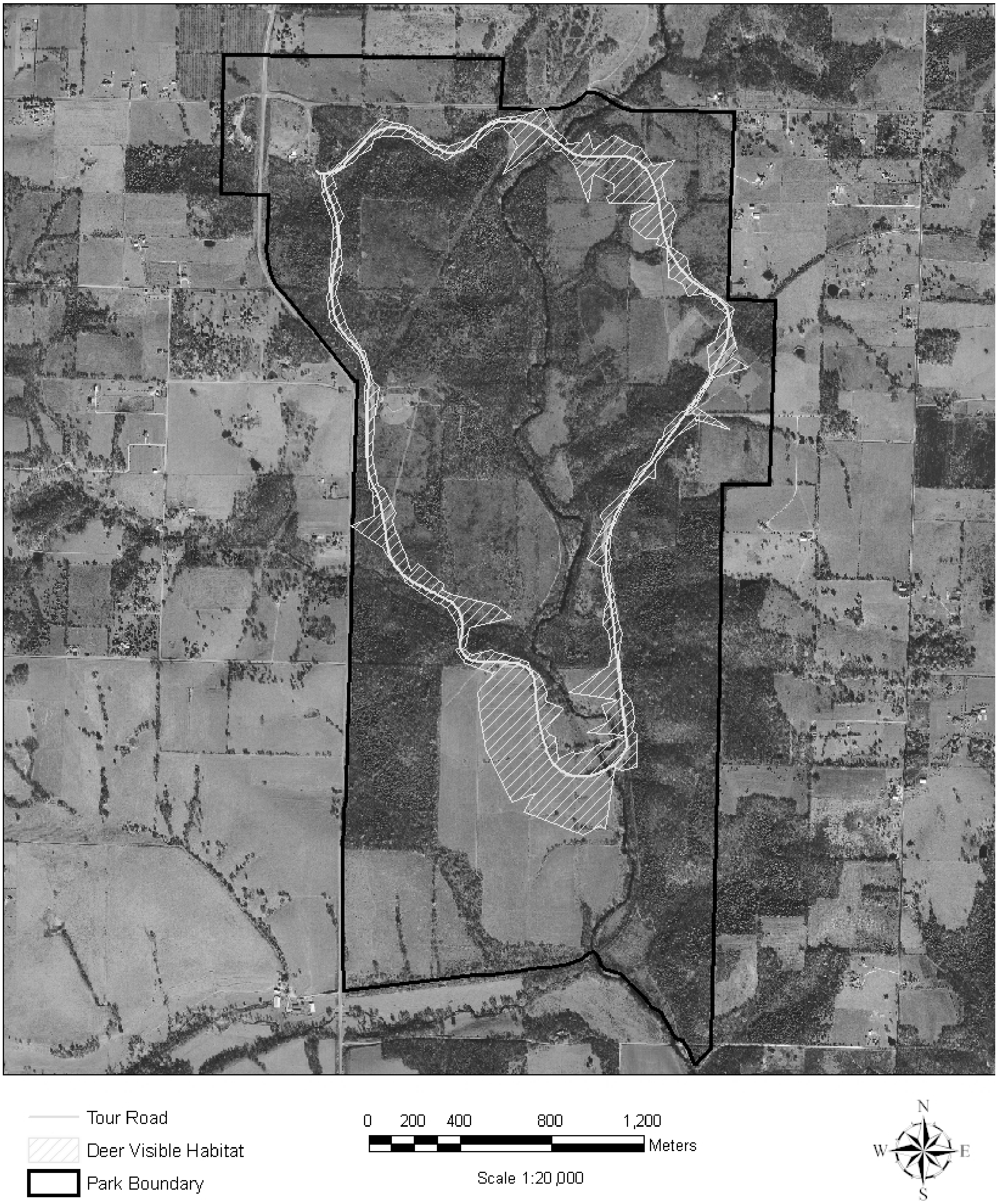

Figure 1. Route showing the area visible during white-tailed deer surveys on Wilson's Creek National Battlefield, Missouri during 2005-2006.

Results

White-tailed deer population densities averaged 55.47 (std. dev. $\pm$ 15.30) individuals / km^2 in the survey area of Wilson's Creek National Battlefield the first year of monitoring (2005). Densities ranged from 41.93 to 72.07 individuals / km^2. During the second year (2006) of monitoring, white-tailed deer densities averaged 24.90 (std. dev. $\pm$ 5.56) individuals / km^2 in the survey area, representing a decline of 55.12 % from the previous year. Densities ranged from 20.97 to 28.83 individuals / km^2.

Discussion

White-tailed deer are extremely adaptable to human disturbance which has aided the species in recovering from near extirpation in Missouri. Missouri had as few as 400 deer in the state in the 1930's (http//www.mdc.mo.gov/, 2006). Today the statewide deer herd is estimated near 1,000,000 individuals (http://www.mdc.mo.gov/areas/stlouis/wildlife/deer.htm, 2002). In the two counties in which Wilson's Creek National Battlefield is located (Greene and Christian), 3681 individuals were harvested in the 2004-2005 hunting season alone. As far back as 1988, deer densities averaged between 6 and 12 individuals / km^2 in the southwestern part of the state (http://www.uga.edu/scwds/, 2006). Deer densities can be expected to be much higher than that today (http://www.mdc.mo.gov/areas/stlouis/wildlife/deer.htm, 2002). Deer densities in urban areas are often much higher than 6 to 12 individuals / km^2 because populations grow without the pressures of predators and hunting. Urban sprawl benefits deer by fragmenting continuous blocks of forested lands into small sections with increased edge habitat favored by deer. In 2006, the deer densities observed in the fragmented habitat of the survey area of Wilson's Creek National Battlefield were very much in line with what would be expected, 15 to 30 individuals / km^2 (http://www.mdc.mo.gov/documents/areas/stlouis/deer_car.pdf, 2005). The average deer density observed in 2005 is considered high.

Deer such as those at Wilson's Creek National Battlefield may become vulnerable to over population, disease and starvation in the absence of natural predators or hunting. During the fall of 2005, deer on the battlefield succumbed to hemorrhagic disease (Zeb Jordan, Missouri Department of Conservation, personal communication) which may account for the loss of over half the population in the study area. Deer densities observed in 2005 may have been high due to favorable climatic conditions or habitat on the battlefield and may have declined without the outbreak of hemorrhagic disease. 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 were 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). Efforts to restore the cultural landscape of the battlefield to an oak savanna could be hampered during years of high deer numbers. Studies have 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 Wilson's Creek National Battlefield yielded important results by documenting a 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 battlefield.

Acknowledgements

We would like to thank the staff at Wilson's Creek National Battlefield for making this monitoring possible. We would like too especially thank all those who made us aware that a die-off in deer had taken place in the fall of 2005. We would also like to thank Weldon Young for his assistance with conducting deer surveys.

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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/

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Natural Resource Monitoring

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