National Park Service
U.S. Department of the Interior

Natural Resource Program Center

White-tailed Deer Monitoring at Pea Ridge National Military Park, Arkansas: 2008 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2008/104

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

White-tailed Deer Monitoring at Pea Ridge National Military Park, Arkansas: 2008 Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2008/104

J. Tyler Cribbs
National Park Service, The Heartland I&M Network and Prairie Cluster Prototype Monitoring Program
Wilson's Creek National Battlefield, 6424 West Farm Road 182, Republic, MO 65738

David G. Peitz
National Park Service, The Heartland I&M Network and Prairie Cluster Prototype Monitoring Program
Wilson's Creek National Battlefield, 6424 West Farm Road 182, Republic, MO 65738

April 2008

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

The Natural Resource Publication series addresses natural resource topics that are of interest and applicability to a broad readership in the National Park Service and to others in the management of natural resources, including the scientific community, the public, and the NPS conservation and environmental constituencies. Manuscripts are peer-reviewed to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and is designed and published in a professional manner.

The Natural Resource Technical Report series is used to disseminate the peer-reviewed results of scientific studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the National Park Service's mission. The reports provide contributors with a forum for displaying comprehensive data that are often deleted from journals because of page limitations. Current examples of such reports include the results of research that addresses natural resource management issues; natural resource inventory and monitoring activities; resource assessment reports; scientific literature reviews; and peer reviewed proceedings of technical workshops, conferences, or symposia.

Views, statements, findings, conclusions, recommendations and data in this report are solely those of the author(s) and do not necessarily reflect views and policies of the U.S. Department of the Interior, National Park Service. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the National Park Service.

Printed copies of reports in these series may be produced in a limited quantity and they are only available as long as the supply lasts. This report is also available from the Heartland I&M Network and NRPM websites (http://www.nature.nps.gov/im/units/HTLN and http://www.nature.nps.gov/publications/NRPM/index.cfm, respectively) on the internet, or by sending a request to the address on the back cover.

Please cite this publication as:

Cribbs, J.T. and D.G. Peitz. 2008. White-tailed Deer Monitoring at Pea Ridge National Military Park, Arkansas: 2008 Status Report. Natural Resource Technical Report NPS/HTLN/NRTR—2008/104. National Park Service, Fort Collins, Colorado.

NPS D-54, April 2008

Table of Contents

Figures

Page

Executive Summary

White-tailed deer were monitored on Pea Ridge National Military Park, Arkansas (PERI) using methods developed between 2005 and 2007. The index of deer density did not change significantly this year at Pea Ridge National Military Park. In previous years, the population was in decline from a possible outbreak of hemorrhagic disease. Our monitoring suggests this trend may have stopped in 2008. In 2007, disease was not reported in deer populations in and around the park, and by visual observations, deer appeared healthy during surveys. Overall, the index of deer density has declined an estimated 55.95 % since deer monitoring began at Pea Ridge National Military Park.

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 risks 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 fourth 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. 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 8th, 15th, 23rd, 29th and February 5th. Three spotlight counts were conducted each night. The first survey of each night started approximately one hour after official sunset with succeeding surveys occurring each hour thereafter.

Visibility Estimates

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. Following methods outlined in Peitz et al. (2007), visibility estimates were taken once following deer surveys on January 8. In a GIS, perpendicular distances were plotted on a map, along with any outlying deer locations (deer observations that occurred outside the estimated distance), to create a map of the survey area.

Data Analysis

Using nightly maximum count data and the survey area determined from visibility estimates (Figure 1), indexes of relative deer densities were calculated. Nightly results were used to estimate the average ($\pm$SD) annual deer population density index. The percent change in the annual index value was calculated and reported.

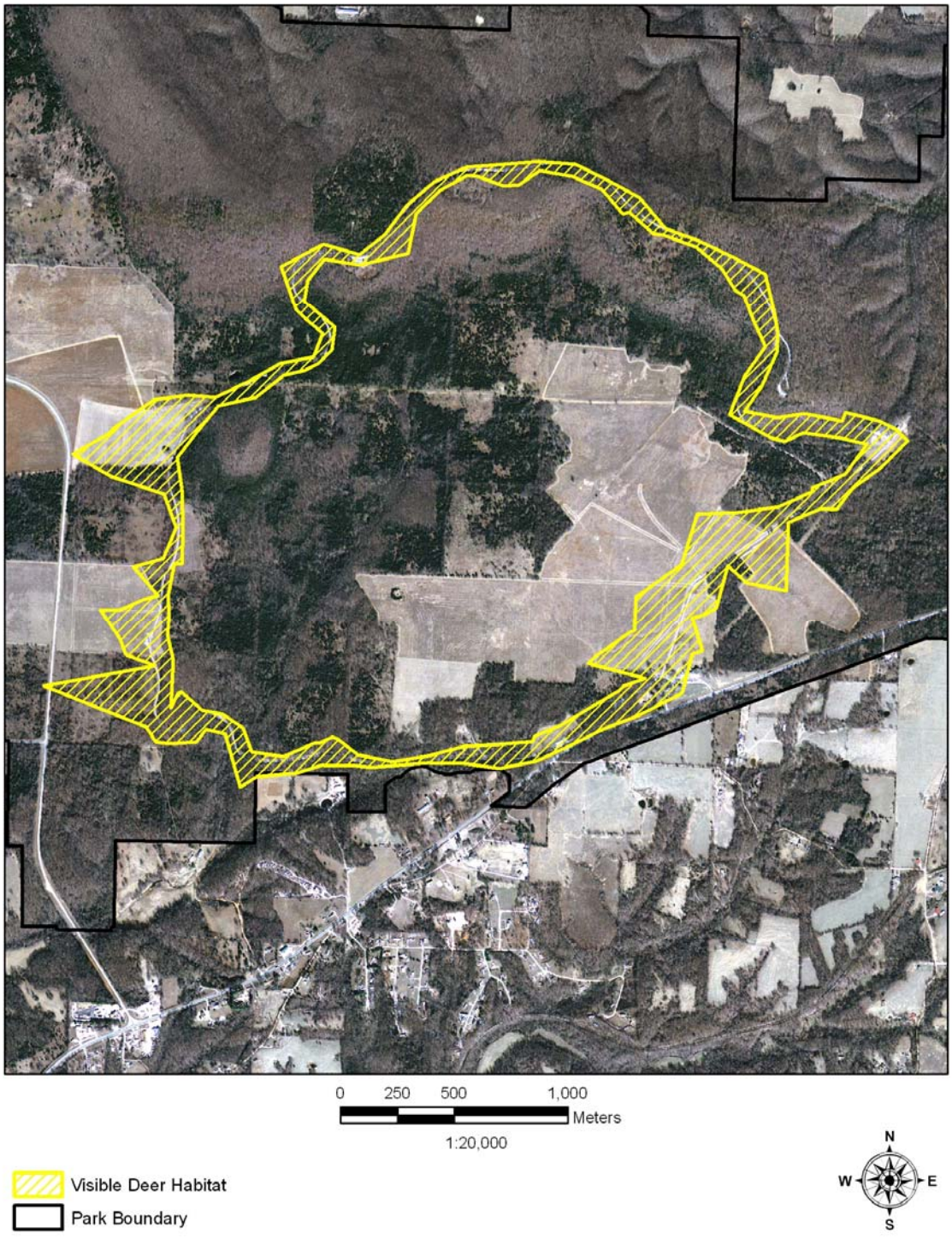

Figure 1. Route showing the area visible during white-tailed deer surveys on Pea Ridge National Military Park, Arkansas during 2008 survey.

Results

The index of relative white-tailed deer density averaged 18.58 (std. dev. ± 13.17) individuals / km^2 for the survey area of Pea Ridge National Military Park in 2008 (Figure 2). Values ranged from 5.70 to 38.30 individuals / km^2. This represents an increase in the mean index value of 28.76 % from the previous year. During the survey nights, a high of 7, 47, 16, 13 and 31 deer were seen respectively. The area visible from the survey route increased 2.16 % to 122.71 ha (Figure 3), or 7.1 % of the park (Figure 3).

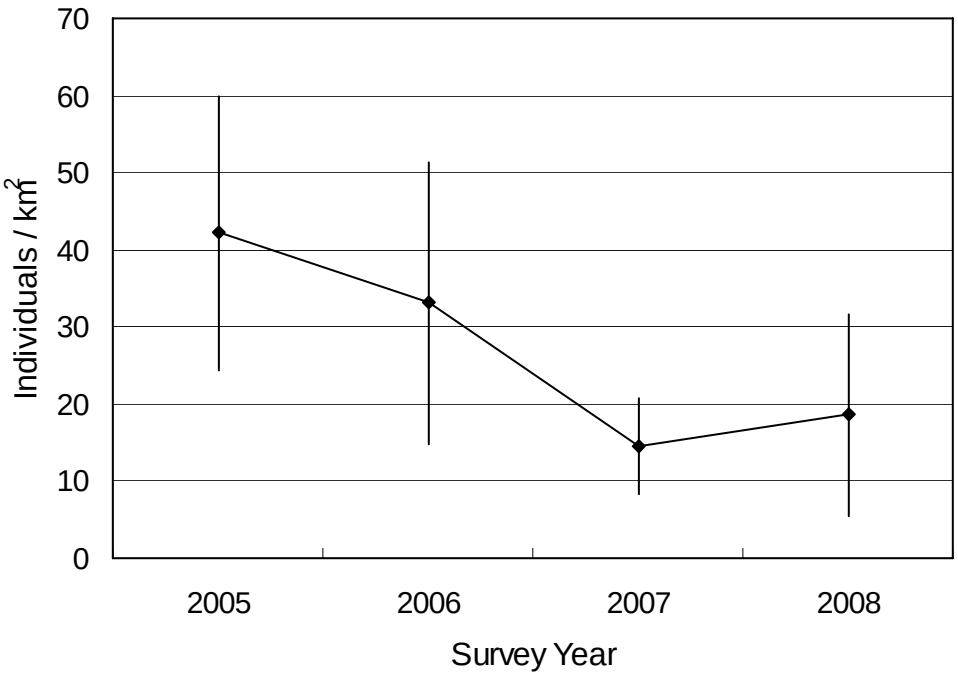

Figure 2. Average density index (± std. dev.) of white-tailed deer in the survey area of Pea Ridge National Military Park, Arkansas, 2005 – 2008.

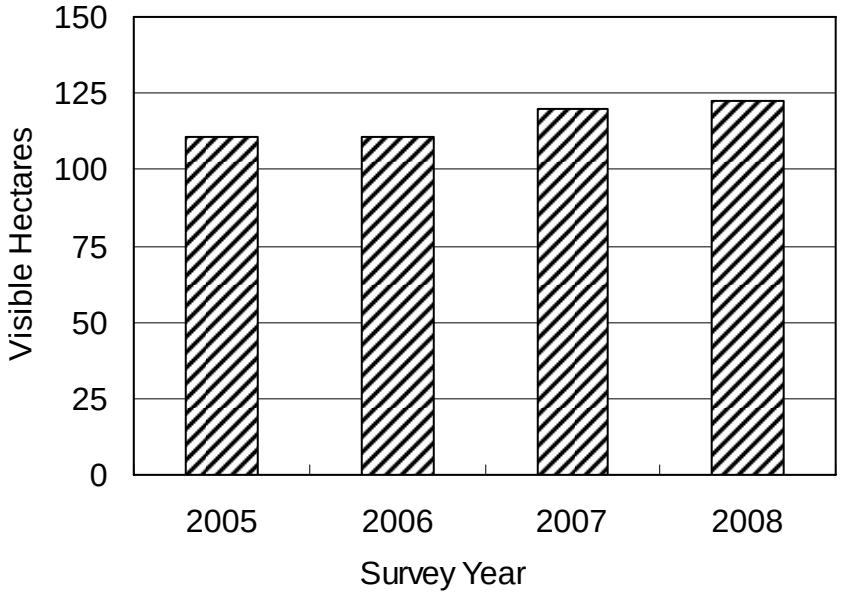

Figure 3. Area visible during white-tailed deer spotlight surveys (survey area) on Pea Ridge National Military Park, Arkansas, 2005 - 2008.

Discussion

The index of deer density for the survey area in 2008 has increased slightly compared to last year. The 2008 index of deer density ranged from a low of 5.7 individuals / km^2 and a high of 38.3 individuals / km^2. Due to the large variation in the standard error this years' count is not significantly different from the previous three years counts. However, the estimated deer density index increased 28.76 % over 2007, representing an increase of 4.15 individuals / km^2. This increase in deer numbers ended a declining trend since 2006. Hemorrhagic disease, believed to be the causative agent in previous years declining deer numbers, was not reported on or around the battlefield in 2007 (Cory Gray, 2008)

During the 2008 survey there were several influencing factors beyond our control that may have affected our monitoring. Specifically weather and after hour activity on the park during spotlight counts. Four out of five of our survey days had extreme temperature variations. Nightly declines of 31º to 45º F were observed as cold fronts moved into the area. On one occasion the temperature dropped by as much as 35º F in one hour a few hours before the spotlight count. Some other influences that possibly affected deer counts include dogs observed on the park during two different survey nights, and hunters tracking a wounded deer that had ran onto the park from adjacent private lands.

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.

According to Kevin Eads (resource manager) the largest number of deer in the morning are usually seen near the Elkhorn Tavern. In the evening, it appears that deer do not use this area. It is currently unknown why deer are not using the land surrounding the Elkhorn tavern during the evening.

Acknowledgements

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

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/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://www.agfc.state.ar.us/deer/index.html. 2006. 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.

Gray, Cory. 2008. Arkansas Game and Fish Commission. Personal communication.

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.

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

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS D-54, April 2008

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nps.gov

EXPERIENCE YOUR AMERICA ™