National Park Service
U.S. Department of the Interior

National Capital Region
Washington, DC

National Capital Region Network 2006 Deer Monitoring Report

Natural Resource Report NPS/NCRN/NRTR—2007/033

ON THE COVER
Doe and Fawn at Great Falls, Maryland along the Chesapeake and Ohio Canal National Historical Park (CHOH)
Photograph by: Thomas Paradis, NCRN I&M Program

National Capital Region Network 2006 Deer Monitoring Report

Natural Resource Report NPS/NCR/NCRN/NRTR—2007/033

Scott Bates
National Park Service
Center for Urban Ecology
4598 McArthur Boulevard
Washington, DC 20007

July 2007

U.S. Department of the Interior
National Park Service
National Capital Regional Office
Washington, DC

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.

Natural Resource Reports are the designated medium for disseminating high priority, current natural resource management information with managerial application. The series targets a general, diverse audience, and may contain NPS policy considerations or address sensitive issues of management applicability. Examples of the diverse array of reports published in this series include vital signs monitoring plans; "how to" resource management papers; proceedings of resource management workshops or conferences; annual reports of resource programs or divisions of the Natural Resource Program Center; resource action plans; fact sheets; and regularly-published newsletters.

Views and conclusions in this report are those of the authors and do not necessarily reflect policies of the 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 National Capital Region I&M Network website (http://www.nature.nps.gov/im/units/ncrn/index.cfm) on the internet, or by sending a request to the address on the back cover.

Please cite this publication as:

Bates, Scott. E. 2007. National Capital Region Network 2006 Deer Monitoring Report. Natural Resource Technical Report NPS/NCRN/ NRTR—2007/033. National Park Service, Fort Collins, Colorado.

Comment [JPS1]: Is this supposed to be in bold type?

NPS D-72, July 2007

Contents

Figures

Page

Tables

INTRODUCTION

Distance surveys and pellet-group surveys to determine densities of white-tailed deer (*Odocoileus virginianus*) started in the fall of 2000 and spring 2001 within the National Capital Region (NCR). Distance surveys were conducted at ANTI, CATO, CHOH, GREE, GWMP, MANA, MONO, PRWI, and ROCR. Pellet-group surveys have been conducted at HAFE but were not done in 2006. These surveys are being conducted as part of a continuing effort to assess the deer population and its effect on NCR parks. Density data will be used in compiling deer management plans. This report summarizes the results of these surveys from their inception through the fall of 2006.

Methods

Field methods for collecting Distance data and analyzing the data followed NCR Distance Protocols described in the monitoring plan for the region (NPS 2005). All analyses were done at CUE. Spotlight data was entered into Distance software. Most parks were surveyed for at least three nights. Exceptions this year included GREE (4), ROCR (4), and MANA (1). Each night was treated as a replicate and the data were pooled for analysis. For the initial analysis, the detections were divided into 10-12 evenly-divided distance intervals. Intervals were expanded, narrowed, or dropped from the analysis to produce a smooth shoulder as the distance from the observer to the deer increased. Once a satisfactory shoulder was produced, four models were fit to the data (uniform, half-normal, hazard rate, and negative exponential). The three criteria used to choose the best fitted model were: 1) percent coefficient of variation (CV) less than 20; 2) the detection probability variation was less than 30%; 3) lowest Akaike's Information Criterion (AIC) score. Program Distance calculates all three measures.

Program TRENDS (Gerrodette 1987) was used to calculate the power of the test to detect a trend in the deer population. TRENDS is a software program that gives power estimates using appropriate tests. This is important since we want to be able to guard against not being able to detect a change in the population when it actually has occurred (a Type II statistical error). At a minimum we would like to be able to have an 80% chance to detect a 10% increase or decrease in the deer population. Wide variations in the number of deer groups encountered during the survey are the main reason why a survey would have low power.

The mean fall CV from Distance was used as an input into Dr. Underwood's Process and Power programs to account for temporal count (process variation) and sampling variation. Temporal count variation is high when there are wide variations in mean fall densities over time. Sampling variation is high when there are wide count variations within a survey year. Total CV was input into TRENDS. Other TREND parameters include: an exponential model (changes in deer

populations tend to be multiplicative rather than additive); a 2-tailed test because we are interested in decreases and increases in the population; an alpha level of 0.1; a 0.10 rate of change, and study duration (either 5 or 6 years depending on whether or not data was gathered during the fall of 2000).

SYSTAT PC was used to perform linear regression of the logarithm of the total population against time to check for significant population trends over time. A p-value of 0.01 was used instead of 0.05. The 0.05 level is typically used in scientific studies to guard against a Type I error (rejecting the null hypothesis when it is actually true – for our purpose, stating that there is a population trend when it does not exist). The p-value of a statistical significance test represents the probability of obtaining values of the test statistic that are equal to or greater in magnitude than the observed test statistic. A p-value close to zero signals that your null hypothesis is false and typically that a difference (trend) is very likely to exist. Large p-values closer to 1 imply that there is no detectable difference for the sample size used (no trend exists).

There is a statistical and biological reason for using 0.01 instead of 0.05. When repeated measurements over time are collected from the same area, the count data can be correlated from one year to the next (serial or positive autocorrelation). The use of 0.01 can mitigate positive autocorrelation (Hatfield et al. 1996).

The biological reason for using 0.01 is that it can take 5-10 years for vegetation recovery to occur after deer densities have been reduced to acceptable levels (Niewinski et al. 2006). A significant population decrease at a significance level of 0.01 would be more congruent with lower deer densities and vegetation recovery (but would not guarantee vegetation recovery when densities remain above acceptable levels).

Results

2006 REGIONAL DENSITIES

Figure 1 shows the 2006 fall densities for all parks. All parks except PRWI have deer densities that exceed 16 deer per square kilometer (40 deer per square mile). Densities above 40 deer per square mile indicate negative effects on other wildlife species; densities above 20 deer per square mile exert a negative effect on vegetation (Horsley et al. 2003). All NCR parks are above this density.

Comment [JPS2]: How many per square kilometer to impact vegetation

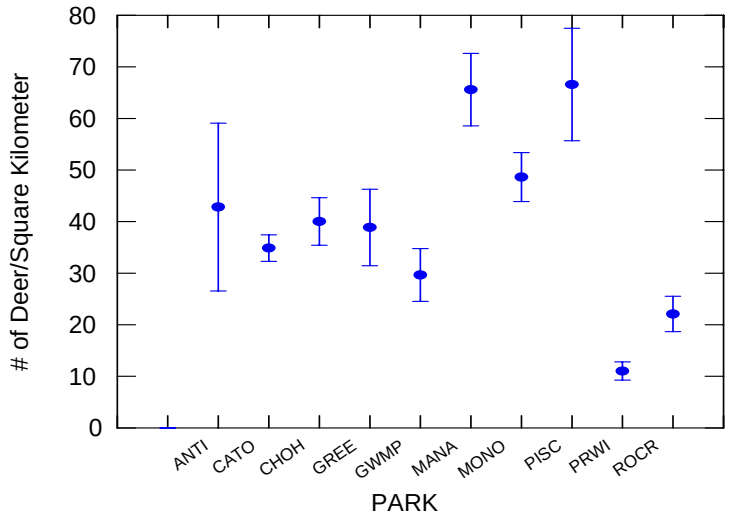

Figure 1. Fall 2006 deer densities at NCR parks. Blue dots indicate the mean; horizontal bars indicate the standard error of the mean. Bars that do not overlap indicate significant differences between parks.

SEX RATIO RESULTS

Table 2 contains buck:doe ratios from fall spotlight surveys. Buck:doe ratios of 1:4 or more may indicate an overpopulation situation (Miller and Marchinton 1995). MONO has exceeded this figure every year. CATO, CHOH, MANA, PISC, and PRWI have exceeded this figure in five out of six surveys. GWMP and ANTI have exceeded it in four out of six surveys.

Table 1. 2001-2006 buck:doe ratios.

PARK	2001	2002	2003	2004	2005	2006
ANTI	1:9.00	1:5..22	1:3.06	1:3.54	1:8.12	1:17.3
CATO	1:13.00	1:3.11	1:7.03	1:9.30	1:12.2	1:11.8
CHOH	1:5.40	1:3.40	1:6.00	1:6.57	1:6.60	1:6.58
GREE	1:3.61	1:3.47	1:8.00	1:2.76	1:9.00	1:3.31
GWMP	1:4.92	1:5.23	1:2.33	1:23.00	1:5.90	1:2.33
MANA	1:9.66	1:5.75	1:7.09	1:4.00	1:8.50	1:3.47
MONO	1:11.40	1:5.22	1:6.13	1:7.12	1:6.50	1:8.60
PISC	1:5.41	1:2.70	1:7.83	1:4.52	1:8.00	1:11.60
PRWI	1:4.76	1:6.16	1:7.50	1:4.40	1:1.91	1:5.26
ROCR	1:2.87	1:5.30	1:2.69	1:4.76	1:3.26	1:4.42

Fawn: doe ratios (Table 3) of 0.3:1 or less indicate populations under stress (Miller and Marchinton 1995) (not enough desirable food sources for does to produce twins). Results were similar to 2005-06: four parks were below 0.30 (CHOH, GWMP, MANA, and PRWI). GWMP and PRWI have been below 0.30 in five out of six years. ANTI, MONO, and PISC have exceeded 0.30 every year.

Table 2. 2001-2006 fawn:doe ratios.

PARK	2001	2002	2003	2004	2005	2006
ANTI	0.74	0.91	0.86	0.80	0.41	0.70
CATO	0.37	0.44	0.41	0.30	0.08	0.33
CHOH	0.13	0.17	0.56	0.52	0.10	0.11
GREE	0.25	0.22	0.63	0.46	0.56	0.58
GWMP	0.23	0.28	0.76	0.26	0.03	0.14
MANA	0.63	0.27	0.45	0.34	0.35	0.21
MONO	0.66	0.93	0.87	0.59	0.38	0.33
PISC	0.37	0.48	0.86	0.69	0.62	0.62
PRWI	0.16	0.19	0.38	0.00	0.08	0.07
ROCR	0.12	0.25	0.75	0.39	0.30	0.38

PARK RESULTS

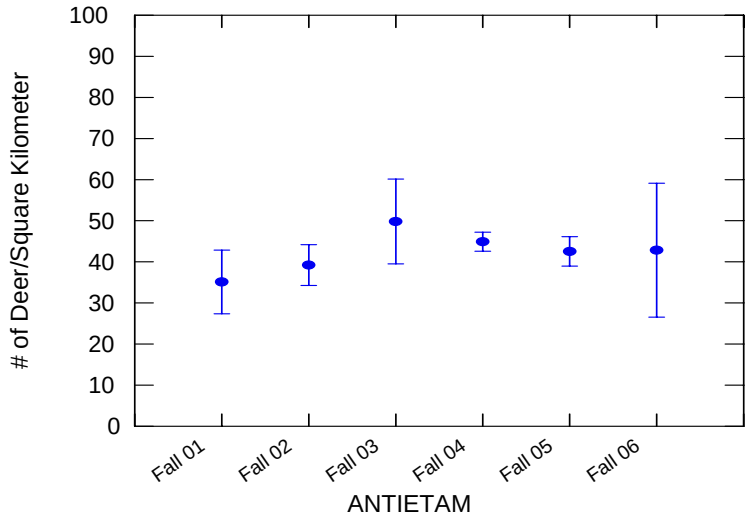

Figure 2. Antietam National Battlefield annual density data.

If bars overlap then there is no significant difference between years. The 2006 deer density was slightly higher than 2005. There was no significant population trend from 2001-2005 (Table 3). The park has achieved the goal of 80% power to detect a trend of ±10% (Table 3).

Table 3. Percent population change, linear regression f-ratio, p-value, and power to detect a ±10% trend.

PARK	% CHANGE[1]	F-RATIO[2]	P-VALUE	%POWER[3]
ANTI	22	1.07	0.35	90
CATO	-51	13.40	0.014*	100
CHOH	20	0.81	0.40	79
GREE	16	3.44	0.13	47
GWMP	-13	0.04	0.90	34
MANA	15	0.003	0.95	100
MONO	-18	0.19	0.68	100
PISC	55	1.37	0.30	82
PRWI	-29	11.28	-0.028*	25
ROCR	-7	0.07	0.87	60

1- First year density divided by last year density.
2- Linear regression test statistic.
3- Power to detect a ±10% trend with a goal of 80%.
*- Significant p-value at the 0.05 level.

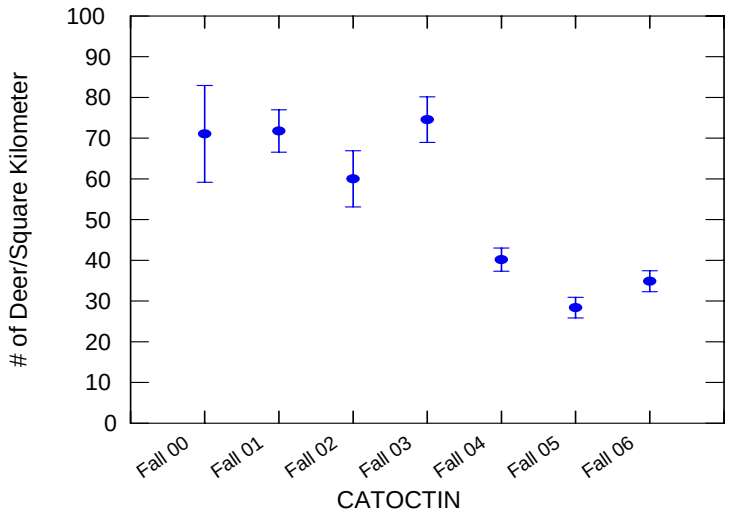

Figure 3. Catoctin Mountain Park annual deer density.

The mean fall density increased slightly in 2006. This was reflected in the fawn:doe ratio (Table 2). The decrease in the population during the period of study (2000-2006, Table 3) was not significant at the 0.01 level but is significant at the 0.05 level. Last year's report stated: *If the density remains under 37 deer/square kilometer (95/square mile) in 2006, the decrease in the population will be significant at the 0.01 level.* The density remained under 37 deer per square kilometer but was not significant at the 0.01 level. Again, this may be a possibility in 2007. The park has 100% power to detect a 1% trend so any trend at the 0.01 level cannot be dismissed.

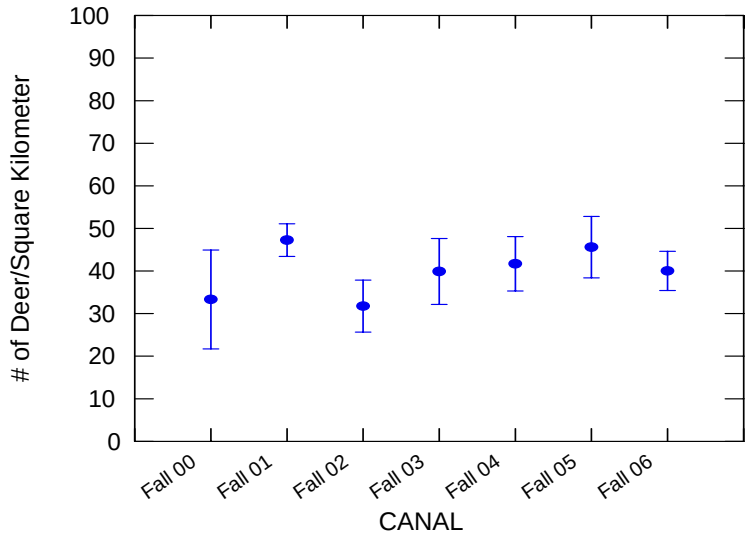

Figure 4. CHOH (Goldmine Tract) annual deer density.

The 2006 density at CHOH decreased slightly. Densities at C&O have been fairly stable when compared to other parks (a range of 16 between the lowest and highest densities). There was no significant population trend during the study period (2000-2006, Table 3). The park has 79% power to detect a ±10% trend and will reach 80% next year.

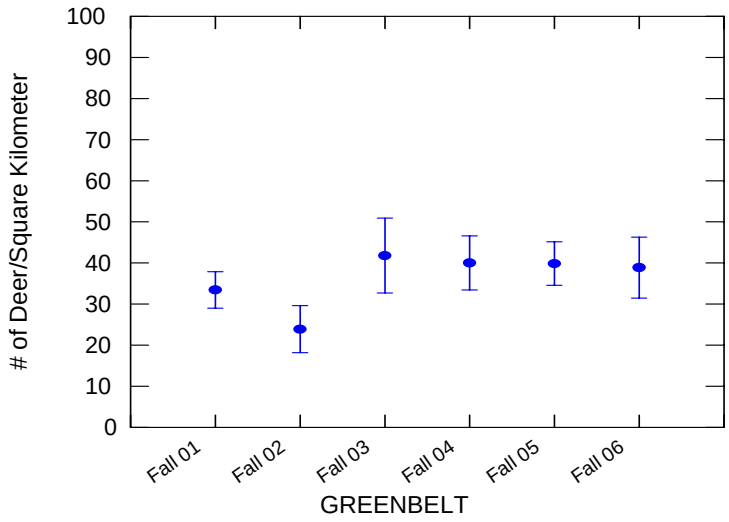

Figure 5. Greenbelt Park annual deer density.

There has not been any significant trend at Greenbelt during the study period (Table 3). The park has low power to detect a trend (Table 3). The initial temporal and sampling variation, along with the current high coefficient of variation of the survey, has increased the time to reach 80% power. It may take 6 more years of surveys before the park reaches 80% power to detect a trend with the current intensity of surveying.

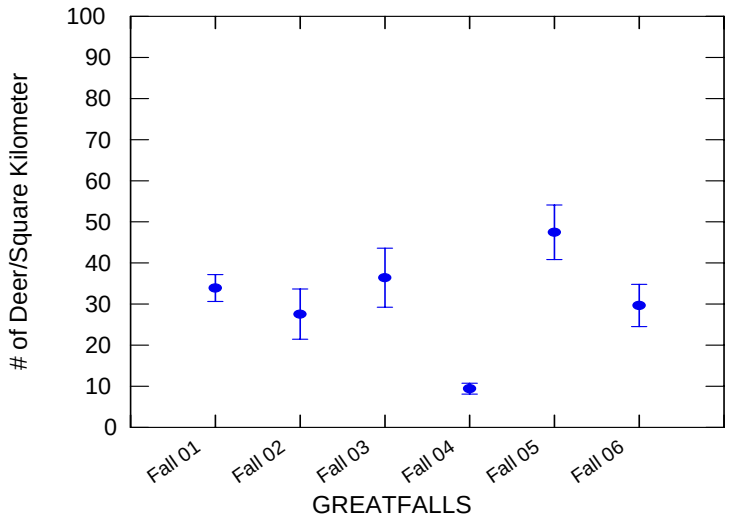

Figure 6. Great Falls annual deer density.

There was no significant trend in the deer population (Table 3). The park also has low power to detect a trend (Table 3). Year-to-year count variation was responsible for 87% of the total variation. This can be seen looking at the mean fall densities from 2001-2006 (33, 27, 36, 9, 47, and 29). It may take another 8 years of surveying before 80% power is achieved at the current level of survey intensity. The small size of the park facilitates easy movement by deer in and out of the park boundary and contributes heavily to the count variation.

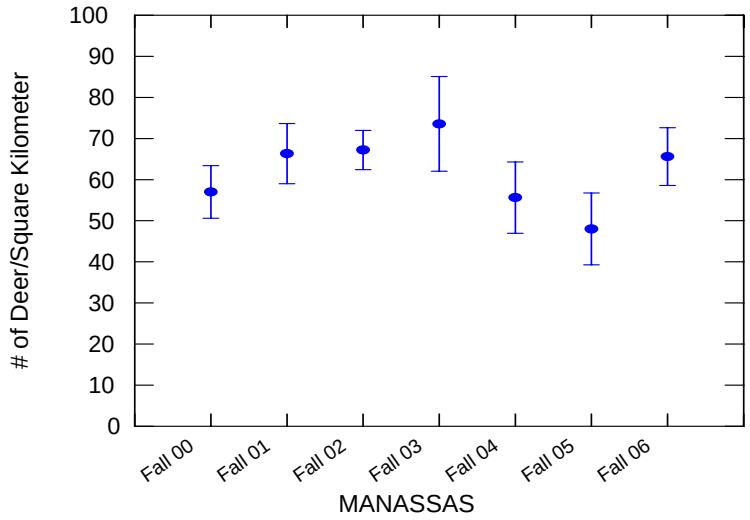

Figure 7. Manassas National Battlefield Park annual deer density.

Manassas had a moderate increase in 2006. It also had the second highest density of all NCR parks. No significant trend was detected during the study period (2000-2006, Table 3). MANA has achieved 100% power to detect a ±10% trend.

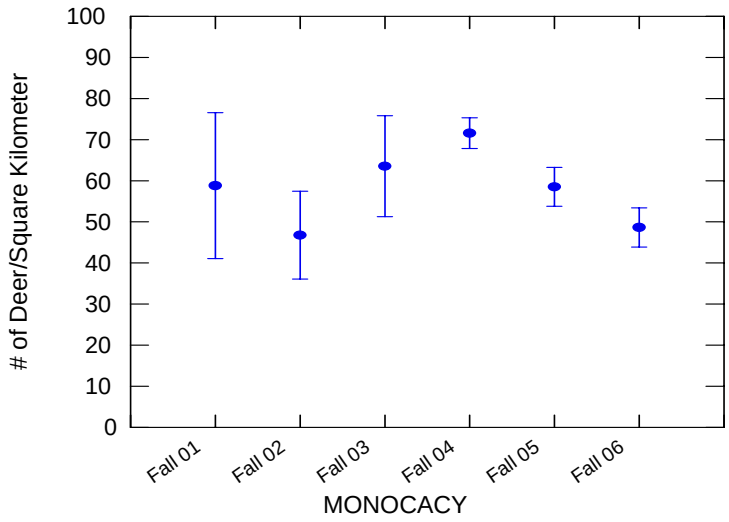

Figure 8. Monocacy National Battlefield annual deer density.

Monocacy's deer density decreased slightly from 2005. The park had the third highest density in the region in 2006 and continues its streak as one of the top 3 high-density parks in each year of the survey. There was no significant population trend during 2001-2006 (Table 3). The park has 100% power to detect a ±10% trend after the 2006 surveys.

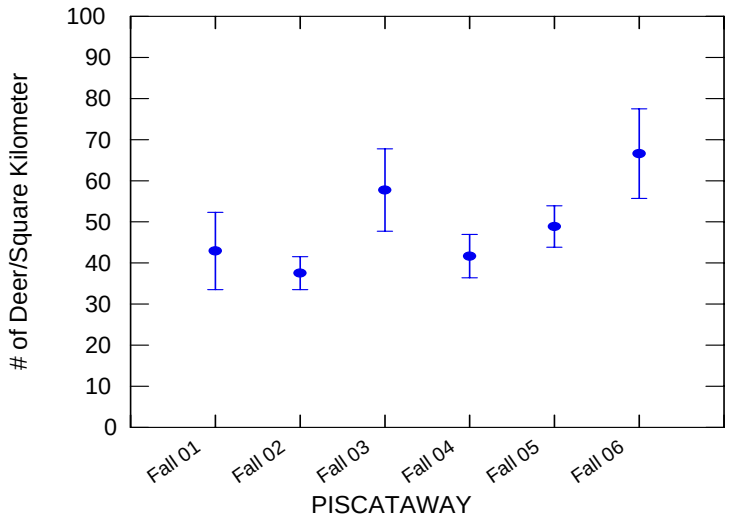

Figure 9. Piscataway Park annual deer density.

The deer density at Piscataway has increased nearly 60% since 2004. There was no significant population trend from 2001-2006. Power to detect a ±10% trend is now 82% (Table 3).

Comment [JPS3]: I don't understand this. If it is up 60% and a 10% trend can be detected, why is there no significant population trend?

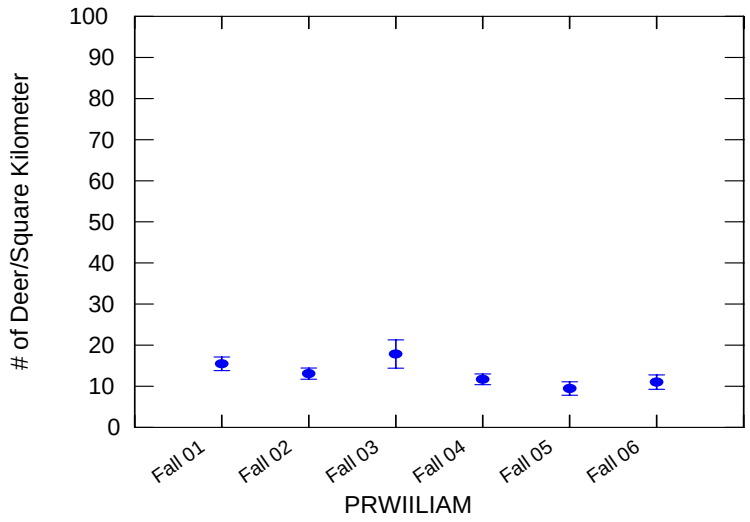

Figure 10. Prince William Forest Park annual deer density.

Density at Prince William increased slightly in 2006. With the exception of 2003, the deer population has been less than 16 deer/square kilometer (40 per square mile). A significant negative trend (-30% since 2001) exists at the 0.05 level. The minimum detectable trend is -22% (Table 3). If the significance level drops to 0.01 or less in 2007 then this negative trend can be assumed to be true. Sampling variation and year-to-year variation account equally for the total count variation. It may take another 10 years of surveying before the park reaches 80% power to detect a ±10% trend unless the number of surveys are increased. The high amount of variation in 2003 has kept the power to detect a trend quite low. Increasing the number of spotlight surveys to increase the power to detect a trend would be easier than using digital camera surveys. It would take 100 digital cameras to conduct an accurate deer density survey at the optimal density of one camera per 160 acres throughout the park.

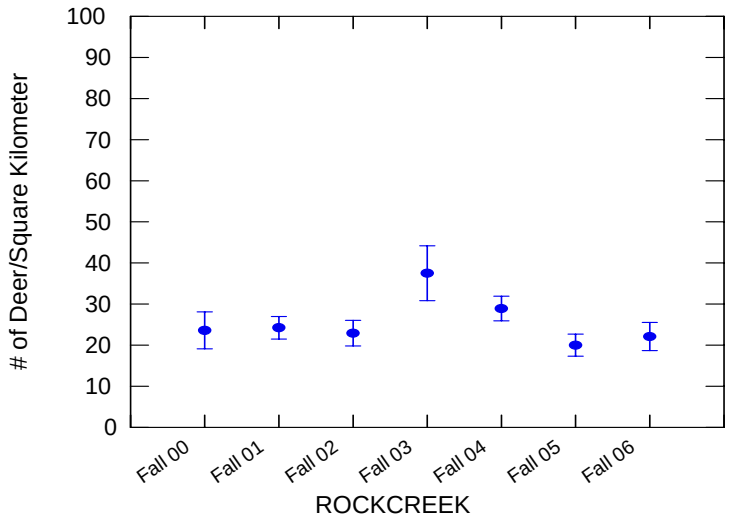

Figure 11. Rock Creek Park annual deer density data.

Rock Creek experienced a slight increase in 2006. There have been no significant trends in the population. The park will reach 80% power to detect a ±10% trend within the next 6 years.

Discussion

All parks had overabundant deer densities (over 20 per square mile or eight per square kilometer in forested areas) that would negatively affect native vegetation. All parks should be in the process of developing deer management plans.

No parks had any significant population trends at the 0.01 level. CATO and PRWI had significant negative trends at the 0.05 level. If CATO does achieve a significant downward trend at the 0.01 level, it will not have a positive impact on its forests. The deer density will remain four to five times higher than the acceptable density of 20 deer per square mile. There will also not be much biological meaning if PRWI reaches a significant negative trend next year. The deer population will remain at what is considered normal for eastern deciduous forests.

Five parks (CHOH, ROCR, PRWI, GREE, and GWMP) have not achieved 80% power to detect a ±10% trend. While CHOH and ROCR may reach this goal next year, GWMP, GREE, and PRWI require multiple years at the current level of surveys.

Results from GREE have been consistent over the last four years so that DISTANCE can continue to be used.

PRWI's acreage would require 100 remote digital cameras (one camera per 160 acres). The range of mean deer densities has been small (9-17 per square kilometer). It would be easier to increase the number of spotlight surveys.

GWMP may be too small a park to use DISTANCE or any other method. Densities have ranged from 9-47 deer per square kilometer over a six-year period. It may be more efficient to use remote digital cameras instead of spotlight surveys. Only five would be needed over two two-week periods.

Literature Cited

Gerrodette, T. 1987. A power analysis for detecting trends. Ecology 68:1364-1372.

Hatfield, J.S., W.R. Gould IV, B.A. Hoover, M.R. Fuller, and E.L. Lindquist. 1996. Detecting trends in raptor counts: power and Type I error rates of various statistical tests. Wildlife Society Bulletin 24(3): 505-516.

Horsley, S.B., S.L. Stout, and D.S. deCalesta. 2003. White-tailed deer impact on the vegetation dynamics of a northern hardwood forest. Ecological Applications 13(1):98-118.

McShea, W. J. 2005. The impacts of white-tailed deer foraging on agricultural and woodlots in the Chesapeake and Ohio Canal National Historical Site, Antietam National Battlefield Park, and Monocacy National Battlefield Park. Unpublished report. 16 p.

Miller, K.V. and R.L. Marchinton. 1995. Quality whitetails. Stackpole Books, Mechanicsville, PA. 322 pp.

Niewinski, A.T., T.W. Bowersox, and R. L. Laughlin. 2006. Vegetation status in selected woodlots at Gettysburg National Military Park pre and post white-tailed deer management. Technical Report NPS/NER/NRTR – 2006/037. USDI-NPS Northeast Region, Philadelphia, PA. 311 pp.

NPS. 2005. Monitoring plan for the National Capital Network of the National Park Service. Unpublished report. 225 pp.

Tilghman, N. 1989. Impacts of white-tailed deer on forest regeneration in northwestern Pennsylvania. Journal of Wildlife Management 53:524-532.

The U.S. Department of the Interior (DOI) is the nation's principal conservation agency, charged with the mission "*to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities."* More specifically, Interior protects America's treasures for future generations, provides access to our nation's natural and cultural heritage, offers recreation opportunities, honors its trust responsibilities to American Indians and Alaska Natives and its responsibilities to island communities, conducts scientific research, provides wise stewardship of energy and mineral resources, fosters sound use of land and water resources, and conserves and protects fish and wildlife. The work that we do affects the lives of millions of people; from the family taking a vacation in one of our national parks to the children studying in one of our Indian schools.

NPS D-72, July 2007

National Park Service
U.S. Department of the Interior

Center for Urban Ecology
4598 McArthur Boulevard, NW
Washington, DC 20007

www.nps.gov

EXPERIENCE YOUR AMERICA [T]