

**Population Analysis for White-tailed Deer
in the Village of Cayuga Heights, New York**

April 2014

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Introduction

During 2013-14, we continued monitoring deer movements, causes of mortality, and estimated deer abundance in the Village of Cayuga Heights. Knowing the abundance and distribution of white-tailed deer is important for making population management decisions, and estimates of population size before and after a management action is how the success of a management program is often judged (Lancia et al. 1994).

We again used camera-trapping to estimate deer population size in the Village. This method has provided reliable population estimates for big cats (Karanth and Nichols 1998) and free-ranging deer (Jacobsen et al. 1997, Koerth et al. 1997). Physical recapture of animals is not needed to get reliable data to use with capture-recapture models. Curtis et al. (2009) estimated abundance of suburban white-tailed deer herds using infra-red triggered cameras and the program NOREMARK (White 1996). Data gathered during earlier deer studies conducted in Cayuga Heights were used to validate this technique and models.

The capture and tagging of deer in the Village of Cayuga Heights during 2012 and 2013 provided a marked population of deer necessary for abundance estimation using mark-recapture analyses. Staff from White Buffalo, Inc., captured and sterilized 12 female deer during December 2013 (Table 1). One female deer (C14) was a recapture from deer trapping in 2012, and it was found that she still had one ovary intact, which was removed. One button buck was captured incidentally during 2013 and ear tagged (Table 2). By conducting a photo survey with infrared-triggered cameras in January 2014, soon after the deer tagging and sterilization was completed in December 2013, we were able to estimate herd size with good confidence in the results.

Methods

During 2014, the Village of Cayuga Heights (1.8 square miles) was again divided into 12 equally-sized sections by overlaying a grid of approximately 100-acre blocks over a map of the community. We made an effort to use most of the same properties and camera sites in both 2013 and 2014. Twelve infrared-triggered, digital cameras (Cuddeback, Non Typical, Inc., Green Bay, WI) were deployed over bait piles on properties with high probability of deer activity within each 100-acre block. It was intended that each camera would "capture" a large sample of the deer population for that block. In accordance with our NYSDEC permit, technicians were granted permission by each landowner before setting up the cameras and putting out bait for deer.

Camera sites were baited daily with approximately 14 pounds of dry, shelled corn for five days prior to the camera deployment on 17 January, 2014. Once the cameras were operating, the bait was increased to as much as 30 pounds per day at sites with higher deer activity and less than 14 pounds if there was bait left from the previous day. The cameras were set to run continuously for 24 hours per day, with a preset delay of five minutes between pictures. Every other day during the field survey, the memory cards in the cameras were changed so that technicians could confirm the cameras were functioning properly and download photos to a computer hard drive. On 24 January, 2014, the deer photo survey was completed, and cameras were removed. A sufficient number of pictures were taken in seven days ($n = 3,013$ photos with deer) with all 12 cameras functioning to run the statistical analysis for population estimation.

After the cameras were removed from the field, all the pictures containing deer were sorted by site and numbered. Each picture was then closely studied, and any legible ear tag number was recorded. We also recorded the total number of deer, the number of unmarked deer, and the number of unidentifiable marked deer for each photo. The number of bucks was recorded in each picture, but these data were not completely reliable, as some bucks had shed their antlers by early January. From these photographic data, the total number of times each identifiable, marked deer was observed was entered into the program NOREMARK (White 1996), along with the total number of unmarked deer, and the total number of marked deer expected to be alive and in the Village during the camera survey.

Results

The total number of marked deer that were identifiable in the pictures was 115 (Table 3). The maximum number of marked deer possibly in the Village of Cayuga Heights during the camera survey was 142 (Table 3; including 8 bucks and 27 unobserved tagged females). For deer that were not collared, and not moving with a radio-collared deer, it is impossible to know for certain if they were still alive and in the community (Table 7). Because of this uncertainty, we decided to run the computer analysis twice to get a minimum and maximum population estimate. The upper population bound included all the tagged deer possibly alive in the community ($n = 142$), whether the deer were observed or not in the camera survey. The lower population bound included only the tagged deer observed on camera and known to be alive during the survey ($n = 115$). There were five tagged female deer observed by White Buffalo, Inc., staff in December 2013 that did not appear in the January 2014 camera survey (Table 7).

Since deer capture and tagging were completed in December 2012, there have been 33 recorded deaths for marked deer (Tables 4 and 5). Twelve of the deer (36.4%) died as a result of deer vehicle collisions (Table 6). Fourteen deer (42.4%) were legally killed by hunters on Cornell University lands. Three deer (9.1%) died from other causes, and two of those were presumed to be from old age, as they were 13+ years old. One deer (3.0%) died shortly after release in 2012, and this animal was presumed to have succumbed from complications associated with either capture or surgery. It was not possible to determine the cause of death for three deer (9.1%) because their carcasses were too decomposed when found.

Deer population estimates generated by program NOREMARK were conducted in two ways. The first population estimate ($n = 143$) and associated 95% confidence interval (139-148) included all deer known to be alive (via photo confirmation) in the Village during the time of the survey in January 2014. The second population estimate ($n = 177$) and 95% confidence interval (168-186), included an additional 27 deer that may potentially be alive in the community (Table 7), but that did not appear on photographs during the camera survey. A reasonable estimate of deer abundance in Cayuga Heights based on these two analyses is the midpoint between the upper and lower values, 160 deer, or a density of approximately 89 deer per square mile. This is much lower than the total of 225 deer (125 deer per square mile) calculated in January 2013.

Based on our photo survey and discussions with A. DeNicola concerning untagged female deer observed while trapping, we believe there were few untagged, resident adult female

deer remaining in the community during early January 2014. It is impossible to know for certain the exact number of untagged, female deer in the Village, as it is sometimes difficult to distinguish button bucks from female deer. The photo survey indicated that there were likely two untagged adult female deer, and one female fawn, still residing in the Village during mid-January. There were also six untagged adult females, and four female fawns on the eastern edge of the Village (Hanshaw Road and Texas Lane areas) that were likely transient family groups which spend most of their time in the Town of Ithaca. If our estimate for untagged, resident female deer is correct ($n = 3$), then approximately 98% of the breeding female deer in the Village were tagged and surgically sterilized. It appears there will be continued immigration pressure from deer in the St. Catherine's Church area on the east side of the Village.

There were five tagged deer (C86, C88, C122, C141, and C143) observed by White Buffalo, Inc., staff in December 2013 that did not appear in any of the photos obtained from the infra-red triggered camera survey conducted during the January 17-24, 2014. Given the large number of pictures taken ($n = 3,013$ photos), these few unobserved deer did not influence the population estimate. Also, deer do occasionally enter or leave the Village. For example, deer C25 dispersed to Trumansburg Road near Cayuga Medical Center, and was not in the Village during the photo survey this winter.

After the camera survey was completed, seven tagged female deer were legally killed by archery hunters on Cornell University lands (Table 5; C56, C92, C105, C108, C125, C134, C135). Consequently, the current estimate of deer abundance in the Village should be 153 deer, or 85 deer per square mile. Although the combination of deer sterilization, and lethal removal of deer by deer-vehicle collisions and hunter harvest on Cornell lands, has clearly reduced deer abundance in the Village, these numbers are still well above recommended levels.

Discussion

It is clear that deer are overabundant in the Village of Cayuga Heights based on homeowner complaints, vehicle collisions, and plant damage. Most tagged deer from the Village were killed either in vehicle collisions (36.4%, $n = 12$; Table 6), or by archery hunters (42.4%, $n = 14$) on Cornell lands. As long as this mortality level continues to exceed immigration and births, the deer population in Cayuga Heights will decline. It will be extremely important to capture and sterilize any new or untagged female deer to maintain sterilization rates of 95% or

higher over time. Population reduction may be very slow, and it may take several years to reach goal population densities (approximately 15-20 deer per square mile). Much will depend on deer mortality and immigration rates in future years.

If additional lethal removal of adult female deer can be implemented, the population will decline much more rapidly. The Village Board should consider alternatives and potential modification of their SEQR documents to include other methods for reducing the deer population more quickly. Currently, the primary forms of deer removal in the community include deer-vehicle collisions and archery harvest of deer on Cornell lands. Deer-vehicle accidents have a high cost and pose safety risks for motorists. This is an inhumane way to manage a suburban deer herd. Professional, lethal control would be much more humane for the deer involved, and there is greater likelihood the deer would be fit for human consumption.

The recent changes (April 2014) in NYS Environmental Conservation Law allowing discharge of vertical bows and crossbows within 150 feet and 250 feet of occupied dwellings, respectively, could provide additional opportunities to remove deer from the community. The Village Board should consider how these law changes might impact deer management. This could provide for professional removal of deer from some locations in the Village using archery equipment.

Continued monitoring of the deer herd via a survey with infra-red triggered cameras will be critical to document the impacts of the program. It will be important to clearly show whether the deer herd continues to decline, and over what time frame significant differences are observed. It is clear from past deer-modeling studies (Merrill et. al. 2003, Merrill et. al. 2006) that immigration of female deer may significantly reduce the success of a deer sterilization program. Conversely, increasing mortality of female deer will enhance the likelihood of successful deer management efforts.

Recommendations

Based on the current population analysis and knowledge of deer behavior, we make the following recommendations:

1. During summer, the DPW crew should watch for spotted fawns, and note their locations. That should help us focus follow-up trapping efforts in areas where reproducing female

deer have established home ranges. If no spotted fawns are observed in the Village, this will affect potential deer trapping efforts in fall 2014.

2. Continue to record locations of dead, tagged deer. The Village Police and DPW staff have been very helpful in providing us with information concerning known deer mortalities. This will help us with future population estimation.
3. Consider follow-up deer trapping in fall and/or early winter. Trapping and sterilization efforts should focus on immigrant, untagged does, and female fawns. Whether trapping will be needed depends in immigration of female deer, and whether any spotted fawns are observed in summer 2014. Discussions should occur with A. DeNicola, P. Curtis, and DEC staff (S. Joule, DEC Region 7, Cortland) to plan for follow-up deer capture efforts and LCP renewal.
4. Consider a camera survey of deer in winter 2015. It will be important to monitor for any untagged female deer, and estimate deer abundance to determine the continued success of these research and management efforts. The deer camera survey should occur in the same time frame (January), using the same camera locations, as much as possible.
5. Evaluate the Potential Impacts of the New Discharge Distances for Bows. Additional deer mortality will be needed to lower deer abundance in a reasonable time frame. The Village Board should discuss and pursue additional management options with archery equipment to supplement the ongoing deer sterilization program.

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Table 1. Female deer captured, ear-tagged, and sterilized during December 2013 in Cayuga Heights, New York.

Tag#	Capture Date	Age @ capture	Radio Freq.	Treat 12	Capture Method	Capture Location	Comments
C14	12/2/2013	5.5		OV	Dart	223 Highgate	Recapture; one ovary was intact; w/MF
C137	12/2/2013	3.5		OV	Dart	Klinewood	w/MF
C138	12/3/2013	6.5		OV	Dart	Triphammer	
C139	12/3/2013	A	151.584	OV	Dart	Triphammer	w/140
C140	12/3/2013	0.5		OV	Dart	Triphammer	w/139
C141	12/4/2013	4.5	151.603	OV	Dart	Burleigh	w/adult doe and 2F
C142	12/4/2013	3.5		OV	Dart	N. Sunset	
C143	12/4/2013	3.5	151.422	OV	Dart	Kline/Wycoff	2 fawns - 1FF 1?
C144	12/4/2013	3.5		OV	Dart	Burleigh	2 fawns ó 1MF 1?
C145	12/5/2013	4.5		OV	Dart	Lexington	w/FF
C146	12/6/2013	4.5		OV	Dart	Pleasant Grove	w/FF
C147	12/6/2013	4.5		OV	Dart	Texas	w/C57
Total				12	Surgeries		

Table 2. Newly-marked male deer captured in Cayuga Heights, NY, during December 2013.

Tag#	Capture Date	Age @ capture	Radio Freq.	Treat 12	Capture Method	Capture Location	Comments
H32	12/3/2013	F		Male	Dart	Triphammer	

Table 3. Potential total marked deer alive in the Village of Cayuga Heights at the time of the photo survey, which was conducted during January 17 through January 24, 2013.

Marked female deer observed in the camera survey	107
Marked female deer not observed in the survey (with no mortality report)	27
Marked male deer observed in the camera survey	8
Potential total marked deer in the Village	142

Table 4. Known mortality of tagged deer ($n = 15$) in Cayuga Heights during December, 2012 through May 1, 2013.

Tag#	Capture Date	Age	Treatment	Capture Location	Alive?	Recovery Codes*	Recovery Date	Recovery Site
C13	12/2/2012	F	OV	223 Highgate	N	HH	1/30/2013	Cornell Hunting Zone M1
C21	12/3/2012	10+	OV	Winthrop	N	DVC	4/25/2013	2213 N Triphammer Rd.
C58	12/7/2012	5.5	OV	Berkshire/Highgate	N	DVC	2/4/2013	608 Cayuga Heights Rd. right along the edge
C82	12/9/2012	3.5	OV	Upland/Triphammer	N	DVC	2/26/2013	Route 13 hill
C94	12/11/2012	1.5	OV	Winthrop	N	ND	4/16/2013	Sandra Place Walkway west of NE School
C95	12/11/2012	1.5	OV	Winthrop	N	ND	3/24/2013	201 Christopher Lane
C116	12/13/2012	5.5	OV	Wyckoff/Cayuga Heights	N	CM	12/18/2012	Lakeview Cemetery
C119	12/13/2012	1.5	OV	Triphammer	N	HH	3/20/2013	Bluegrass Lane, north of Moakley House
C124	12/14/2012	2.5	OV	DPW	N	DVC	3/26/2013	Palmer Woods Creek near Triphammer Rd.
35	02/24/04	>3.5	2004 tubal ligation	336 N. Sunset	N	OC	01/22/13	508 Cayuga Heights Rd.
59	02/19/04	>4.5	2004 hysterectomy	109 N. Sunset	N	OC	02/27/13	Definitive location not provided
73	12/17/02	>3.5	2002 ovarectomy	1008 Hanshaw Road	N	DVC	4/12/2013	820 Hanshaw Rd.
H01	12/3/2012	F	Male	The Parkway	N	DVC	12/21/2012	The Parkway near Upland
H08	12/2/2012	2.5	Male	Lexington	N	DVC	2/17/2013	Along Route 13 north between Triphammer and Warren Roads.
H14	12/7/2012	F	Male	711 Triphammer	N	ND	4/2/2013	107 Sheldon Rd.

*HH= hunter harvest; DVC= deer-vehicle collision; ND= not possible to determine; CM= capture-related mortality; OC= other causes.

Table 5. Known mortality of tagged deer ($n = 18$) in Cayuga Heights during May 1, 2013 through April 1, 2014.

Tag#	Capture Date	Age	Treatment	Capture Location	Alive?	Recovery Codes*	Recovery Date	Recovery Site
131	12/12/2012	8+	OV	Iroquois/Parkway	N	OC	1/2/2014	301 Cayuga Heights Road
C04	12/2/2012	A	OV	403 Highgate	N	DVC	1/13/2014	In the median along Rte. 13 North
C23	12/3/2012	A	OV	327 The Parkway	N	DVC	7/29/2013	206 Hanshaw Road
C56	12/6/2012	4.5	OV	711 Triphammer	N	HH	3/7/2014	Palmer Woods
C62	12/7/2012	8.5	OV	Upland/Triphammer	N	DVC	7/26/2013	Route 13 by guardrail near Cayuga Heights Rd
C92	12/11/2012	1.5	OV	Winthrop	N	HH	1/14/2014	Corner of Warren Rd and Rte 13
C93	12/11/2012	1.5	OV	Lexington	N	HH	10/19/2013	In brush lot west of the Ithaca swim club on Uptown Rd
C105	12/12/2012	1.5	OV	711 Triphammer	N	HH	2/4/2014	On CU golf course NE of Hasbrouck Appartments
C108	12/12/2012	2.5	OV	711 Triphammer	N	HH	2/4/2014	On CU golf course NE of Hasbrouck Appartments
C109	12/12/2012	3.5	OV	Sheldon	N	DVC	11/21/2013	Corner of Ellis Hollow and Game Farm Roads
C115	12/13/2012	3.5	OV	Wychoff/Cayuga Heights	N	DVC	8/19/2013	Along Rte 13 near Ithaca High School
C125	12/14/2012	3.5	OV	DPW	N	HH	3/7/2014	Palmer Woods
C132	12/14/2012	2.5	OV	Pleasant Grove	N	HH	1/5/2014	Wood lot in NW part of CU golf course NE of Hasbrouck Apt
C134	12/15/2012	4.5	OV	Triphammer	N	HH	3/17/2014	Palmer Woods
C135	12/15/2012	4.5	OV	Triphammer	N	HH	3/17/2014	Palmer Woods
H05	12/5/2012	F	Male	1008 Hanshaw	N	HH	11/5/2013	off Rt. 13a near Coy Glenn Rd
H16	12/5/2012	F	Male	1008 Hanshaw	N	HH	11/18/2013	Corner Etna Rd and Pinkney Rd
H28	12/15/2012	F	Male	Triphammer	N	HH	12/13/2013	Along Stone Quarry Rd.

*HH= hunter harvest; DVC= deer-vehicle collision; ND= not possible to determine; CM= capture-related mortality; OC= other causes.

Table 6. Causes of deer mortality in Cayuga Heights during December, 2012, through April 1, 2014.

Cause of Death	Total	Percent
Deer vehicle mortality (DVC)	12	36.4%
Hunter harvested (HH)	14	42.4%
Other mortality causes (OC)	3	9.1%
Capture related mortality (CM)	1	3.0%
Not determinable mortality (ND)	3	9.1%

Total Known Deer Mortality (male and female) **33**

Table 7. Deer darted near the borders of Cayuga Heights ($n = 27$) that were not observed in the 2014 photo survey, not seen during the 2013 trapping effort by White Buffalo, Inc., and have no recorded mortality information. Without functioning radio-collars, it is difficult to determine if these deer are alive, or still residing in the Village.

Tag #	Capture location	Photo survey 2013	Observed December 2013	Photo survey 2014
C06	403 Highgate	Yes	No	No
C08	403 Highgate	Yes	No	No
C18	Winthrop	No	No	No
C33	Parkway/Comstock	No	No	No
C35	876 Highland	Yes	No	No
C37	876 Highland	Yes	No	No
C53	Texas	Yes	No	No
C54	Highgate	Yes	No	No
C64	876 Highland	Yes	No	No
C71	Lenox	Yes	No	No
C78	Comstock and Parkway	Yes	No	No
C79	South of W. Rem/Sunset	Yes	No	No
C86	506 Highland	Yes	Yes	No
C88	630 Highland	No	Yes	No
C96	Cayuga Heights	No	No	No
C97	Comstock	No	No	No
C98	Sheldon	Yes	No	No
C99	Parkway Place	Yes	No	No
C100	Parkway Place	Yes	No	No
C113	Wycoff/Cayuga Heights	Yes	No	No
C117	Wycoff/Cayuga Heights	No	No	No
C118	Cayuga Circle/Upland	Yes	No	No
C122	Lexington	No	Yes	No
C133	Lexington	No	No	No
C136	Triphammer	Yes	No	No
C141	Burleigh	NA, caught 12.2013	Yes	No
C143	Kline/Wycoff	NA, caught 12.2013	Yes	No