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Sharpshooting suburban white-tailed deer reduces deer–vehicle collisions

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Abstract: Too many deer–vehicle collisions (DVCs) are one of the primary reasons local governments implement lethal deer management programs. However, there are limited data to demonstrate that a reduction in deer (*Odocoileus* spp.) densities will result in a decline in DVCs. We conducted sharpshooting programs in 3 suburban communities to reduce deer numbers and to address rising DVCs. Annual or periodic population estimates were conducted using both helicopter snow counts and aerial infrared counts to assess population trends. Management efforts were conducted from 3 to 7 years. Local deer herds were reduced by 54%, 72%, and 76%, with resulting reductions in DVCs of 49%, 75%, and 78%, respectively. These projects clearly demonstrate that a reduction in local deer densities using lethal methods can significantly reduce DVCs.

Key words: deer–vehicle collisions, human–wildlife conflict, *Odocoileus virginianus*, sharpshooting, suburban, white-tailed deer, wildlife damage management

Deer–vehicle collisions (DVCs) and their related public safety concerns are one of the most significant conflicts that arise when white-tailed deer (*Odocoileus virginianus*) become abundant in urban and suburban environments (Ng et al. 2008). Conover et al. (1995) estimated that there are >1 million DVCs in the United States annually, and >200 human deaths are attributed to these events.

It has been demonstrated that DVCs increase as local deer populations increase (Hygnstrom and VerCauteren 1999, Etter et al. 2000, Hussain et al. 2007, Grovenburg et al. 2008, Rutberg and Naugle 2008). One could logically conclude that a reduction in deer abundance would lead to a decline in DVCs (Mastro et al. 2008). The only way to reduce deer numbers efficiently and effectively is through the removal of deer from a local population (DeNicola et al. 2000, Rutberg et al. 2004). In most states, live-trapping and relocating deer is not an option because of high costs, disease transmission risks (e.g., chronic wasting disease), unavailability of suitable release sites, and concerns over stress to captured deer. Furthermore, most relocated deer do not survive a year in their new environs (Conover 2002). Therefore, only lethal management options (i.e., hunting, sharpshooting, and live capture followed by euthanasia) can potentially reduce deer densities in the short term.

There is often considerable controversy associated with discussions about how to address conflicts associated with an abundance of deer (Storm et al. 2007). Our experience is that elevated numbers of DVCs are often the only conflict that local politicians feel comfortable using to justify the authorization of lethal deer management options. However, no one has demonstrated a clear correlation between reductions in deer densities and a reduction in DVCs. Therefore, our objective was to examine if the implementation of a sharpshooting management program reduced the number of DVCs in 3 suburban counties.

Study areas

We implemented sharpshooting management projects in Iowa City, Iowa; Princeton, New Jersey; and Solon, Ohio. Management efforts were conducted in Iowa City during January 2000, December 2000–January 2001, and December 2001–January 2002. We implemented the sharpshooting program in Princeton during February–March 2001, January–February 2002, February–March 2003, January–February 2004, January 2005, and February 2006. We culled deer in Solon during February–March 2005 and January–March 2006.

Management activities were focused in a 15.5 km^2 area in Iowa City, all of Princeton Township (36.3 km^2), and all of Solon (51.8 km^2). These communities were typical suburban developments that were composed of a matrix of suburban and commercial development, with intermingled small agricultural plots and undeveloped open spaces. Public safety concerns

Anthony DeNicola sharpshooting deer.

over increasing DVCs was the reason elected officials approved the use of sharpshooting to reduce the local deer herds.

Methods

We used sharpshooting techniques to kill deer (DeNicola et al. 1997). We selected bait sites throughout the area of operation before beginning sharpshooting efforts in order to maximize the efficiency and safety of removal efforts. We would attempt to have a minimum of 2 bait sites per km^2. Whole kernel corn was placed on the ground 3 weeks in advance of shooting efforts at select shooting locations. We would place approximately 0.5 to 1 kg of corn per deer daily at each site. Sharpshooting sites were accessed from a vehicle or from a tree stand, during the daytime and after dark. Human safety was ensured by shooting only when there was a known earthen backstop created through the shooter's relative elevation (e.g., tree stand) or topography. Deer were shot only when circumstances were safe (i.e., with no humans in the removal zone). To prevent educating deer to the procedure, we shot when fewer than 9 deer were present. Although we shot deer on a first opportunity basis, when possible antlerless deer were prioritized.

Population estimates were derived using helicopter counts over snow following methods described in Beringer et al. (1998) in Princeton (February 2002). Biologists from the Iowa Department of Natural Resources conducted less systematic helicopter counts over snow in Iowa City (1999–2002). These counts were done by the same personnel using the methods annually. Therefore, the Iowa City counts were minimum estimates and were not adjusted for detection rates. Aerial infrared (IR) censusing techniques (Naugle et al. 1996) were used over the entire management area in Princeton (December 2004) and Solon (March 2004, December 2005) to estimate population size. All IR counts were conducted by Davis Aviation (Kent, Oh.). Infrared counts were conducted using a single-engine Cessna 182 with a fuselage-mounted, high-resolution Mitsubishi M-600 thermal imager. Transects were designed at 100-m intervals and flown at 500 m above ground. At this elevation 100% coverage was achieved and verified with Global Positioning System (GPS) moving map software. Flights were conducted after 2200 hours to ensure adequate ground cooling and good thermal contrast. The thermal imager output was routed through a video encoder-decoder and recorded on digital videotape for later review. Count data in Princeton and Solon were complemented by conducting simple population projections based on observed demographics (DeNicola 2008). We assumed that 60% of the populations were female, 33% of females were fawns, and recruitment rates were 1:1 (doe:fawn ratio). We then included approximations of non-culling mortality (i.e., DVC and hunter harvest data, when available, and approximate mortality rates for urban deer from the literature (Etter et al. 2002). Immigration and emigration were assumed to be equal.

DVCs were tallied using police reports in Iowa City and a combination of police reports and road-kill collection records (i.e., location of carcasses removed from the roadway) of animal control officers in Princeton and Solon. Data collection methods were consistent among years at all locations. Using Microsoft Excel, we conducted linear regression analyses comparing recorded DVCs to estimated deer densities.

Results

During 49 days over 3 years of sharpshooting at the Iowa City site, we removed 950 deer, with a culling rate of 19.3 deer per day. We culled 1,455 deer during 118 days from Princeton (12.3 deer/day) during a 6-year period. We spent 77 days sharpshooting during 2005 and 2006 to remove 1,002 deer from Solon (13.0 deer/day). At all communities, we removed more deer and at a higher culling rate per day the first year we started sharpshooting than in subsequent years (Table 1).

Following the implementation of sharpshooting program, deer numbers and the annual number of DVCs were reduced from 49% to 78% in the study sites (Table 2). The highest percentage reduction (78%) occurred in Iowa City where the deer density was reduced by 76%. Reductions in deer densities and DVCs remained suppressed during the entire period of the sharpshooting program and did not rebound in later years (Table 3). There was a direct correlation between annual deer population and DVCs in all study sites (Iowa City, $r^2 = 0.72$, $F = 5.0$, $df = 1, 2$; $P > 0.05$; Princeton, $r^2 = 0.98$, $F = 203.5$, $df = 1, 5$; $P < 0.05$; Solon, $r^2 = 0.99$, $F = 85.1$, $df = 1, 1$; $P > 0.05$; Figure 1).

Discussion

DVCs become more frequent with an increase in deer densities (Etter et al. 2000, Mastro et al. 2008). However, our study is the only one we are aware of that demonstrates that reducing local deer densities through a culling program reduces DVCs (Table 2). Although this relationship is quite intuitive, it is important to demonstrate it because most lethal management programs of suburban deer are motivated by the desire to protect citizens from the cost and danger of injury from DVCs. In our 3 study sites, we found no indication that there was any significant level of immigration of deer into the communities from outside areas or emigration out of the communities. Instead, deer density trends could be predicted by accounting for harvest numbers, recruitment rates, and natural mortality occurring within the community. This further supports the observations by McNulty et al. (1997) of local deer management effects on deer movements.

In this study we also found that the percentage of the deer population killed annually in DVCs consistently ranged from 13% to 20% (Figure 1). Solon had the lowest percentage of the deer population killed by vehicles each year (13.2%), and Princeton had the highest (20.7%). Anecdotal observations of high traffic volumes on narrow roads with low lateral visibility in Princeton may explain why deer are more vulnerable to DVCs there than in Iowa City or Solon.

Even though a management method may be proven effective, the relative implementation

Table 1. Number of days sharpshooting was conducted and deer shot and removed from 3 suburban communities during different winters (a winter may include December of the prior year).

Location	Winter	Days of effort	Number deer killed	Number deer killed/day
Iowa City, Ia.	2000	10	360	36.0
	2001	21	340	16.2
	2002	18	250	13.8
Princeton, N.J.	2001	15	322	21.5
	2002	27	303	11.2
	2003	21	280	13.3
	2004	27	276	10.2
	2005	13	124	9.5
	2006	15	150	10.0
Solon, Oh.	2005	37	602	16.3
	2006	40	400	10.0

Table 2. Number of deer and annual DVCs, both before (pre-cull) and after (post-cull) implementation of a deer sharpshooting program within 3 suburban communities.

Site location	Winter culling period	No. deer pre-cull	No. DVCs pre-cull	No. deer post-cull	No. DVCs post-cull	% pop. decline	% DVC decline
Iowa City, Ia.	2000–2002	371	63	91	14	76	78
Princeton, N.J.	2001–2006	1600	342	450	85	72	75
Solon, Oh.	2005–2006	1400	171	650	88	54	49

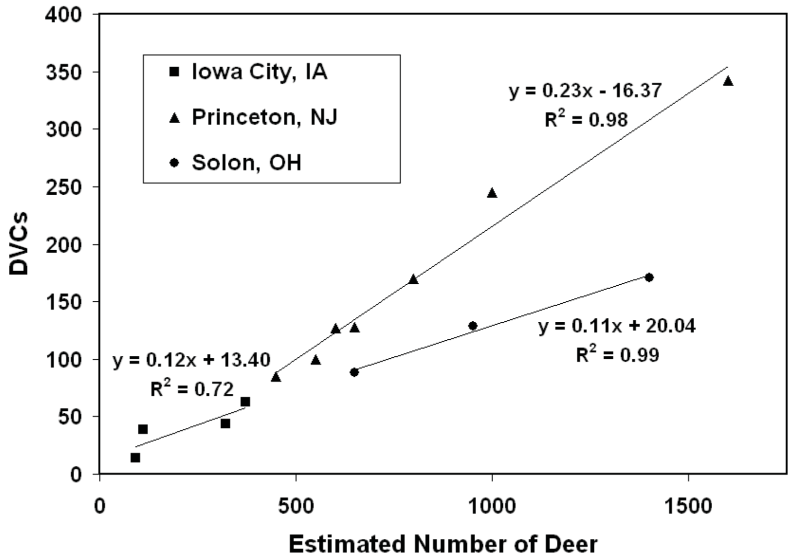

Figure 1. Linear regression analysis of deer population size and annual number of DVCs in Iowa City, Iowa, 1999–2002, Princeton, New Jersey, 2000–2006, and Solon, Ohio, 2004–2006.

Table 3. Annual changes in the density of deer and recorded DVCs for 3 suburban communities prior to (pre-cull) and after implementation of sharpshooting program to cull deer (data marked with an asterisk [*] were collected pre-cull).

	1999	2000	2001	2002	2003	2004	2005	2006
Iowa City, Ia. (15.5 km^2)								
Deer/km^2	23.9*	20.6	7.1	5.9				
DVCs/km^2	4.1*	2.8	2.5	0.9				
Princeton, N.J. (36.3 km^2)								
Deer/km^2		44.1*	27.5	22.0	17.9	16.5	15.2	12.4
DVCs/km^2		9.4*	6.7	4.7	3.5	3.5	2.8	2.3
Solon, Oh. (51.8 km^2)								
Deer/km^2						27.0*	18.3	12.5
DVCs/km^2						3.3*	2.5	1.7

cost-to-benefit ratio must be considered before it can be determined to be a practical solution. For example, culling costs would be balanced by savings from preventing damage to a vehicle involved in a DVC when the cost to cull a deer equals $354, based on data from the Princeton site (DeNicola, unpublished data). Moreover, money saved by averting accidents does not include cost benefits associated with a reduction in human injuries and fatalities associated with DVCs (Bissonette et al. 2008). Additional benefits of reducing deer densities include a reduction in landscape damage (Ward 2000, DeNicola et al. 2000), reduced numbers of black-legged ticks (*Ixodes scapularis*) and associated cases of Lyme disease (Stafford et al. 2003), and reduced ecological damage to forested areas (Kelty and Nyland 1983, Kittredge et al. 1992, Conover 1997).

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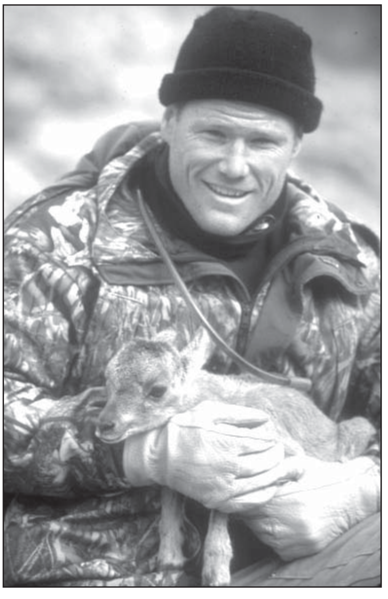

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