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PRAIRIE RESEARCH INSTITUTE

Illinois Natural History Survey
1816 S. Oak Street
Champaign, IL 61820

# Deer in Urban Landscapes: History, Problems, and Management Approaches

Schauber, Eric. M.; Benson, T. J.; Sypreas, G.; Allen, Maximilian L.

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## Summary

This document summarizes the costs and benefits of various strategies for managing urban white-tailed deer (hereafter "deer"). Deer have reached high densities in many urban and suburban areas, leading to conflicts with people and negative effects on natural habitats and other wildlife. A range of options exists for managing abundant deer in human population centers, but all are costly and need to be continued over the long term to be successful. The most appropriate approach depends on the size of area to be managed, the number of deer living there, the budget, and feasibility and acceptability of lethal measures.


## History

Deer populations were sizable in North America prior to European settlement, estimated to total between 24 and 33 million. During the early 19th century, unregulated hunting eliminated deer from many areas (including most of Illinois) and greatly reduced deer populations in many others (McCabe and McCabe 1984).

Recovery of the species began with the Lacey Act of 1900, a federal law outlawing transport of illegally taken wildlife across state lines. By 1908, 41 states had created departments of conservation and begun passing state-level game laws that further aided deer population restoration. Conservation departments also aided recovery efforts by capturing and moving deer from areas with healthy populations to areas where deer were rare or absent (McCabe and McCabe 1984). Land clearing and hunting by settlers also reduced the natural predators that previously regulated deer populations (Crête 1999).

Photo: Michael Jeffords

These efforts to restore deer populations have been an overwhelming success. On one hand, this success has been important for conservation agencies and lauded by wildlife viewers and hunters. On the other hand, this success has also led to significant deer-human conflict in some regions (such as crop, garden, & landscaping damage, vehicle collisions, impacts to natural plant communities; VerCauteren and Hygnstrom 2011).

One of the primary tools used by state agencies to balance positive and negative aspects of deer is regulated public deer hunting. Public hunting has been effective in managing deer populations and providing recreational opportunities in many areas, especially in rural areas (Krausman et al. 1992, McDonald et al. 2007, Levine et al. 2012). However, public hunting is not always a feasible approach in areas with high human density.

With their high survival rates and little risk from predators in urban and suburban areas, unhunted deer populations can grow essentially unchecked. In such areas, deer populations have exceeded their biological and social carrying capacities (VerCauteren et al. 2011, Krausman et al. 2014), leading to negative consequences for ecosystems, people, and health of the deer themselves.

## Problems with Dense Deer Populations

### Economic damage

Dense populations of deer can have numerous negative economic consequences, including damage to agricultural crops, gardens, and landscaping plants. High deer density also has been shown to decrease the regeneration and harvest of valuable hardwood trees (Witmer and deCalesta 1992).

### Human health and safety

As many as 6 million deer-related vehicle accidents are reported in any given year. These collisions cause millions of dollars in vehicular damage each year as well as human injury and death (Bissonette et al. 2008). In Illinois, Cook County has the most deer-vehicle collisions annually, despite being the most urban county. High deer populations can have other indirect negative effects on humans, such as increased prevalence of diseases. Deer are known reservoirs (species that can harbor disease and sustain transmission) of numerous diseases that affect humans and domestic animals such as Lyme disease, COVID-19 (Hale et al. 2022), and bovine tuberculosis. Additionally, deer are affected by chronic wasting disease (similar to "mad cow" disease), of which transmission to humans has not been ruled out (Barria et al. 2018).

### Deer health

Deer in dense populations suffer reduced reproductive success and poor body condition (Ayotte et al. 2019; Simard et al. 2014), as well as potentially elevated transmission of diseases that can sicken and kill deer such as chronic wasting disease (Storm et al 2013).

### Health of natural areas

Excessive browsing by overabundant deer in natural areas reduces native plant diversity and habitat quality — critical components of ecosystem health (Urbanek et al. 2012, Anderson et al. 2017, Glennemeier et al. 2020). Because deer favor certain plant species, they can eliminate rare plants from natural areas, in favor of weedier more browse tolerant ones. For trees, this often stops regeneration of important fruit and nut producing trees, such as oaks. For wildflowers, this can mean that rare or high conservation value native flowering plants like orchids, lilies, and trilliums are quickly eliminated, while aggressive often non-native invaders proliferate (Miller et al 1992, Augustine and Frelich 1998, Rooney et al. 2009, Kalisz et al. 2014, Nuzzo et al. 2017, Averill et al. 2018). At extremely high densities, little if any vegetation remains within their reach, and thorny, often invasive, shrubs take over woodlands to the near exclusion of other vegetation, including key resources for pollinators (see "browse line" image below). These vegetation impacts reduce bird diversity (McShea and Rappole 2000), and high deer abundance has been linked to widespread declines of forest birds (Mills et al. 1991, Chollet and Martin 2013, Crystal-Ornelas et al. 2021).

"Browse line" within Forest Preserves of Cook County, from deer consuming nearly all woody foliage in reach.

Where deer are overabundant, Forest Preserves managers must go to great lengths to protect several nearly extinct plant species from deer browsing (Prairie Fringed Orchid)

## Management Approaches

### No action

While the easiest approach is taking no action, this strategy allows negative consequences of high deer density to worsen. This approach has the lowest direct costs, but the true costs of no action are large -- including the negative economic, ecological, and human health impacts associated with large deer populations (such as damage to crops and ornamental plants, degraded habitats, and collisions with vehicles).

### Feeding

Though it is against Illinois law, residents may be motivated to provide food to deer, particularly if they are in poor health. However, feeding deer makes the problems of an overabundant population worse, allowing it to remain at numbers that exceed what the habitat can support. Deer concentrated around unnatural food sources are also at high risk of transmitting diseases (Sorensen et al. 2014) and they can overbrowse vegetation near these concentrated spots (Cooper et al. 2006). Finally, providing non-natural food during winter can actually kill deer accustomed to natural food sources.

### Repellents

One approach for reducing negative consequences of abundant deer has been to apply chemicals to keep them away from agricultural fields, suburban gardens, and roadways.

Chemical repellents for agricultural crops and suburban gardens have shown some decreases in foraging of woody plants (Swihart et al. 1991, Melchiors and Leslie 1985), although other studies have not shown effectiveness (Milunas et al. 1994, Andelt at al. 1991). One study reported that use of chemical repellents along roadways in Europe could reduce deer-vehicle collisions by 26-43% (Bíl et al. 2018), but a later, larger study did not find any clear evidence of benefit (Bíl et al. 2020).

Despite some benefits, repellents must be applied widely and frequently to be effective, so cost could prevent this tactic from being a broad-scale solution to problems resulting from dense deer populations.

### Fertility control

One approach to slow, stop, or reverse the growth of deer populations is fertility control. Fertility can be controlled through surgical sterilization, hormonal contraception, or (most frequently) immunocontraception (tricking the immune system into preventing reproduction). These approaches have the advantage of being nonlethal, but they are expensive and difficult to implement. Fertility control often increases the lifespan of female deer, so stabilizing or shrinking deer populations requires that most females must fail to reproduce and even low levels of immigration can prevent population reduction from being achieved (Hobbs et al. 2000, Boulanger et al. 2012, Massei and Cowan 2014). Therefore, fertility control is most feasible and economical for isolated populations with relatively small total numbers of deer (<200 females treated, according to Rudolph et al. 2000).

Surgical sterilization has been attempted to control deer populations in Highland Park, Illinois, (Gilman et al. 2010) and in six other U.S. states (Boulanger and Curtis 2016, DeNicola and DeNicola 2021). It is physically invasive and expensive (>$1,000 per animal), so it is only feasible for small areas. Results indicate that deer abundance can be reduced if a large majority of females are sterilized, but deer immigrating from other populations can counteract that success.

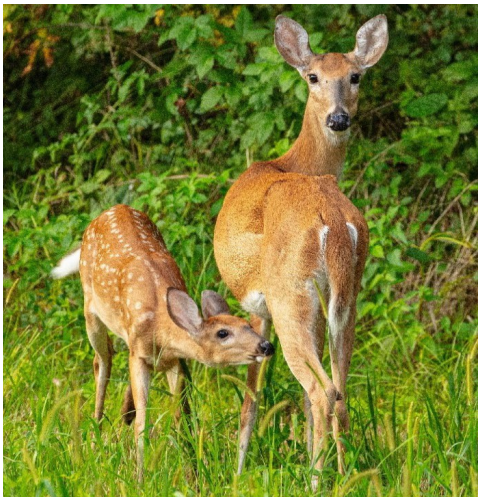

Photo: Michael Jeffords

Immunocontraception technologies have advanced, and their effectiveness has increased (Miller et al. 2013), but 2 or more treatments with repeated boosters are typically required for adequate fertility control. Reported costs per treated female deer range from $802 to $2078 (Rudolph et al. 2000, Walker et al. 2021).

For hormonal contraception, which is much less commonly used, there is also uncertainty about effects of treated deer on the food chain (Coffey and Johnson 1997) and potential legal liability of agencies for unanticipated side-effects to non-target species (e.g., scavengers and household pets; Warren et al. 1993).

**Capture and translocation (transport and release in new area)**

Another approach commonly argued for to deal with deer overpopulation in metropolitan areas, where lethal control methods are often unacceptable to many residents, is capture and translocation of large numbers of deer to more rural areas. While translocating deer may appear to be a nonlethal solution, multiple studies (reviewed in Massei et al. 2010) show that the method often results in high mortality, so it is not truly nonlethal.

Translocation is also costly and labor intensive and lack of cost-per-animal estimates from previous studies make budgeting difficult. The potential to spread diseases and ticks means moving and releasing deer is not permitted by most state wildlife agencies, including the Illinois Department of Natural Resources

**Lethal control: hunting**

Most deer populations are traditionally managed through programs that involve hunting. However, open public hunting can be problematic in urban and suburban areas for several reasons, including: safety concerns, conflicting social attitudes toward hunting, small property sizes, and projectile discharge ordinances. Another limitation with public hunting to control deer populations is that hunters prefer to harvest antlered (male) deer, though reducing antlerless deer (especially females) is integral to reducing deer populations (Enck et al. 2000). This issue has been addressed by some wildlife agencies by offering monetary incentives or "earn-a-buck" (hunters must harvest one or more antlerless deer before being able to take a buck).

In situations where open public hunting is not feasible, controlled hunts administered by state or local wildlife agencies are often used as a means to provide more oversight and lower risks. Controlled hunts can employ provisions that help reduce concerns and risks (real and perceived) of hunting in urban and suburban areas, such as limiting the time frame and spatial area of the hunt, stipulating whether antlered or antlerless deer can be taken, and restricting the type of weapon used.

Previous controlled hunts in some areas have attracted protests, and even physical interference, yet safety issues have not been reported and the method has been effective at reducing deer populations (Kilpatrick et al. 1997, Kilpatrick and Walter 1999). Controlled hunting in woodlands surrounded by human residential areas has been successful in substantially reducing both the deer population and Lyme disease rates (Kilpatrick et al. 2004). Cost per animal removed in controlled hunts is estimated between $160 - $622 per deer in the Northeastern U.S. (Sigmund and Bernier 1994, Deblinger et al. 1993, Connecticut Dep. Environ. Prot. 2007).

While firearm hunting is more efficient, archery hunting has been preferable in some areas due to discharge ordinances, restrictive hunting laws, and public perception about firearm safety (McAninch 1993, Kilpatrick et al. 2004).

**Lethal control: culling**

In some areas where hunting is not feasible, professionals have been employed to cull deer populations, typically by sharpshooting. Culling in various urban locations in the U.S. and elsewhere has had relatively high success rates at reducing deer populations and deer-vehicle collisions (Deblinger et al. 1993, DeNicola and Williams 2008, Drummond 1993, Etter et al. 2000, Jones and Witham 1993, Stradtmann et al. 1993, Ver Steeg et al. 1993).

Cost-benefit analysis has shown culling using sharpshooters is likely more cost-effective than using traditional controlled hunting (with monetary incentives to kill females). Cost per animal removed is estimated at $200-400 (White Buffalo Inc.). An added community benefit of culling is that meat from animals killed during these efforts can be donated to local food banks providing a benefit to the local community. For instance, deer culling within the Forest Preserves of Cook County provides an annual donation of over 10,000 pounds of meat to food banks. Despite the effectiveness, culling is often met with resistance due to state statutes, desire for hunting opportunities, and opposition to any lethal control approach.

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## Prepared by

**Eric M. Schauber, Ph.D.**
Illinois Natural History Survey Director, Principal Research Scientist, and Illinois State Biologist

**T.J. Benson, Ph.D.**
Principal Research Scientist, Wildlife Ecology

**Greg Spyreas, Ph.D.**
Associate Research Scientist, Botany

**Maximilian Allen, Ph.D.**
Assistant Research Scientist, Wildlife Ecology

**Prairie Research Institute**
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

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