NEW YORK STATE OF OPPORTUNITY.

Department of Environmental Conservation

COMMUNITY DEER MANAGEMENT GUIDE

Division of Fish and Wildlife

2018

www.dec.ny.gov

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Introduction

White-tailed deer (*Odocoileus virginianus*) play vital roles in the natural and cultural environment of New York and are highly valued for their beauty and grace as well as the utilitarian benefits they provide. However, the abundance of deer in large parts of the state is causing increasing problems, particularly in suburban and urban areas. Common types of human-deer conflict include deer-vehicle collisions on roads, deer damage to landscaping plants, and an increase in diseases carried by ticks that feed on deer. High densities of deer also threaten the long-term viability of forest ecosystems.

Because deer are large, highly mobile animals, there is little that individual property owners in developed areas can do to reduce the deer-related problems they face. Enclosing a property in a fence that deer can't jump over can prevent landscaping damage, but it does nothing to reduce the risk of deer-vehicle collisions. Furthermore, such fences around yards have the effect of pushing the deer onto other properties, thus improving the situation for some residents at the cost of making it worse for others.

Reducing deer problems for community residents as a whole typically requires approaching deer management at a community level. That means making decisions as a community rather than as individuals and taking actions at a large enough geographic scale that they will affect deer throughout the community. This handbook was written to help people understand the deer problems they're experiencing and guide communities through the process of assessing the need for deer management, evaluating possible approaches, and planning a course of action. Community-based deer management is taking place across the country, and another good source of guidance along with information on the experiences of many other communities is the Community Deer Advisor website (deeradvisor.org) developed by Cornell University.


Photo by Bazartseren Boldgiv

Deer Biology and History in New York

Deer numbers in New York increased throughout the 20th century. People encounter deer on a daily basis now in places where they were formerly never seen. Many people who live in urban and suburban areas with high deer densities wonder whether the deer are there because they were displaced from habitat that was destroyed for development. Some people feel that calls for control of deer populations are a sign of intolerance and humans should simply learn to live with high deer densities. A consideration of history and ecology can shed light on these ideas.

Causes of deer overabundance

After rampant deforestation and unregulated hunting wiped out over 95% of the country's deer in the 19th century (McCabe and McCabe, 1984), management in the first half of the 20th century was aimed at increasing deer numbers. New York was highly successful in this effort, as were many other states. Deer have a high reproductive rate; females (does) can produce young at one year of age, and they average two offspring (fawns) per year. Both males (bucks) and females breed with multiple mates each year, so each buck can impregnate several does, and reproductive rates may not be diminished in populations with more females than males. If food is abundant and mortality is low, deer populations can double in size every two to three years.


Photo by Dick Thomas

White-tailed deer are considered a generalist species, which means they can thrive in a variety of habitats and eat a variety of foods. They are found in forested and brushy areas from the Northwest Territories in Canada all the way to South America. Primarily browsers and grazers, they eat both woody and herbaceous vegetation. They normally find the most to eat in edges, or transition zones between forest and more open habitat types, where there is an abundance of both kinds of food available. The current pattern of human land use is ideal for creating and sustaining high-density deer populations because open areas such as residential developments and agricultural fields are interspersed with forested areas, providing plentiful edge habitat as well as a variety of nutritious crops and ornamental plantings that supplement the natural food available to deer. Suburbs have been referred to as "deer factories" because they provide such good conditions for deer populations to grow.

DEER THRIVE IN SUBURBAN ENVIRONMENTS.

In fully functional ecosystems, populations would be controlled by a combination of interacting factors, including food supply, predation, disease and weather. This doesn't mean that population density would be stable; it's normal for animal populations to fluctuate due to variable

environmental conditions. High population densities would not be sustained across broad geographic areas, because mature forests don't provide enough suitable deer food to support such populations. However, fully functional forest ecosystems don't exist in New York. Even deer in large wild areas such as the Adirondacks are not living in an intact ecosystem, because wolves and mountain lions, historically their principal predators, have been eliminated. Bears, bobcats and coyotes do prey on deer, particularly fawns, but hunting by humans is currently the primary predatory force acting to control population levels in rural and remote areas. In more developed areas, local laws and landowner opinions have severely constrained hunting, and predators are scarce, so the majority of deer deaths are caused by collisions with vehicles. This relatively low mortality combined with abundant food has allowed suburban and urban deer populations to reach extraordinarily high levels. Even if the full suite of natural predators were to return to New York, significant reductions of deer populations in developed areas would not be expected, because wolves and mountain lions would avoid or not be tolerated in such areas.

Impacts of deer overabundance

By the middle of the last century, wildlife managers across the country recognized that deer populations in many areas, including parts of New York, were outstripping their food supply (Leopold et al., 1947; Severinghaus and Brown, 1956). In the 1940s, agricultural damage by deer was reported as a problem throughout the Southern Tier of the state (Severinghaus and Brown, 1956) and in Albany County (NYSDEC, 1944). In 1959, a law was passed allowing a January deer hunting season with shotguns in Westchester County. The text of that legislation described a "critical overabundance of deer" that was causing "severe damage" to agriculture as well as damage to home landscaping (1959 N.Y. Laws, Ch. 738). At the same time, the state wildlife biologists were noting that deer populations in the Catskills and central Adirondacks were larger than the natural food supply could support and were causing chronic habitat degradation, which, in the case of the Adirondacks, they believed had already been occurring for over 50 years at that point (Severinghaus and Brown, 1956).

Impacts on human activities

The deer-related problems that directly affect human activities are the ones that receive the most public attention. In recent decades, frequently mentioned concerns have included deer-vehicle collisions (DVCs) on roads, deer eating crops in agricultural areas and landscaping plants in residential areas, and the potential role of deer in the increase of tick-borne illnesses such as Lyme disease.

Based on insurance claims, State Farm estimates that there are over 70,000 DVCs annually in New York (data provided by State Farm Insurance®) and that nationally the average property-damage cost per collision is approximately $4,000. Losses are not limited to property; although the federal highway fatality database doesn't separate the statistics by species, 437 people were killed in the U.S. in 2015 in crashes caused by vehicles striking or attempting to avoid an animal, many of which were doubtless deer. Taking into account additional factors, a cost-benefit analysis estimated the average total cost of a DVC at more than $6600 (Huijser et al., 2009). DVCs thus can be estimated to cost the citizens of New York over $462 million per year.

In 2002, New York farmers estimated their deer-related crop damages at $59 million, and about one quarter of farmers indicated that deer damage was a significant factor affecting the profits of their farms (Brown et al., 2004). Lowered property values due to deer browsing of landscaping is a concern in some residential areas.

Many parts of New York are considered high-risk areas for human infection with Lyme disease (Diuk-Wasser et al., 2012), based on the density of infected black-legged ticks (*Ixodes scapularis*). Reducing deer populations to very low levels can reduce tick densities (Kugeler et al., 2015) and probably Lyme disease rates (Kilpatrick et al., 2014), because deer are the primary food source for adult female black-legged ticks. However, less drastic deer population reductions may not lower the chances of human Lyme infection (Jordan et al., 2007; Kugeler et al., 2015). Small mammals such as rodents and shrews, not deer, are the main tick hosts that pass on the Lyme-causing bacteria (*Borrelia burgdorferi*). Several other tick-borne diseases are less common but increasing in frequency. Deer are the principal hosts for the lone star tick (*Amblyomma americanum*), which can cause an allergy to the consumption of mammalian meat (Commins et al., 2011) as well as transmit ehrlichiosis and other diseases to humans (Childs and Paddock, 2003).

Impacts on forest ecosystems

There is a growing awareness of the ecological impacts of deer overabundance. Deer are altering forests across the state, perhaps permanently. Just as livestock can overgraze a range and reduce it to a barren wasteland, deer can over-browse a forest. Because mature canopy trees aren't affected, deer impacts on a forest may not be immediately evident, but they are profound and long-lasting. Browsing by deer at high densities reduces diversity in the forest understory (Horsley et al., 2003; Nuttle et al., 2014), enables invasive species to out-compete natives (Knight et al., 2009), and prevents seedlings of many species from growing into the next generation of trees (Tilghman, 1989), ultimately leading to fewer mature trees in a more open plant community with a different and less diverse species composition (White, 2012). In areas with long histories of high deer impacts, reducing deer population density or removing all deer may not be sufficient for plant diversity to recover (Nuttle et al., 2014; Royo et al., 2010; Webster et al., 2005), even as much as 20 years later. Some species are so thoroughly eliminated by deer that they may have to be planted if they are to be restored to such areas. Impacts on endemic species can be devastating. For example, evidence suggests that current deer population densities in eastern North America will result in the extinction in the wild of ginseng, a valuable medicinal herb, within the next century (McGraw and Furedi, 2005).

DEER IMPACTS ON FORESTS ARE PROFOUND AND LONG-LASTING.

The ecological changes brought about by deer also cascade through forest plant communities into wildlife communities, reducing the abundance and diversity of songbird species that use the intermediate levels of a forest (deCalesta, 1994). Furthermore, high-density deer populations interfere with habitat management efforts. Because browsing by deer counteracts the regenerative effects of natural forest disturbances such as fire (Nuttle et al., 2013), attempts to promote forest health through restoration of such disturbances and to increase populations of wildlife species that depend on young forest stands may fail unless deer populations are reduced. Regenerative processes are impaired in many parts of New York, particularly for tree species that are economically valuable (Shirer and Zimmerman, 2010). Even in the Adirondacks, where deer densities are lower than in much of the rest of the state, both direct and indirect impacts of deer browsing must be counteracted for a diverse forest to regrow (Behrend et al., 1970; Sage et al., 2003). Ecosystem impacts may be magnified in urban and suburban parks and natural areas, which provide important habitat for migrating birds and other wildlife but are often subjected to the highest deer densities.

Two forested parks in New York City. The photo on the left shows severe deer damage; the photo on the right shows a healthy understory. Photos by Ken Scarlatelli.

High-density populations can also harm the deer themselves by increasing competition for food and transmission of diseases and parasites. Deer in lower-density populations tend to be in better physical condition (Keyser et al., 2005), all else being equal, because there is more food available to them. Because they don't come in contact with as many other deer, they are less likely to be infected with parasites or diseases (Storm et al., 2013).

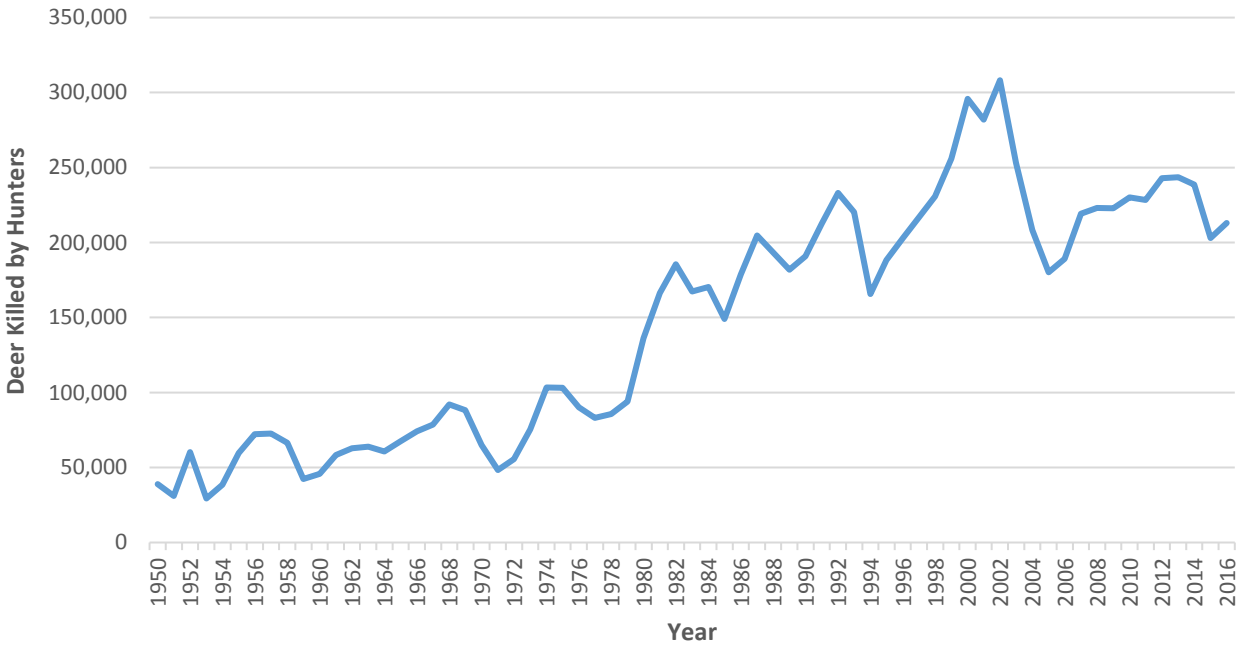
A browse line indicates that deer have eaten all the foliage growing within their reach. Photo by Tom Rawinski.

Deer Management in New York


Photo by Dan Aitchison

Deer population levels in most areas are managed with regulated recreational hunting. For the past twenty-five years, target population levels in New York have been set primarily through a public input process. Because public awareness of the issues surrounding high-density populations has remained low until quite recently, changes in those target levels have often not adequately reflected deer impacts on habitat, or even on people. The Department of Environmental Conservation (DEC) is implementing a new process in 2018 for setting population goals, taking into account both social and ecological impacts of deer.

Increasing the mortality rate of does is the key to controlling deer populations, so DEC increases the number of Deer Management Permits (DMPs), also known as antlerless deer tags or doe tags, made available to hunters in areas where populations are above target levels. In some parts of the state there has been virtually unlimited availability of DMPs in recent years, but even so, the desired harvest levels are not being achieved. DEC is working to find ways to increase the effectiveness of population management strategies in these areas.



This graph shows the estimated annual deer harvest in New York, providing an indication of how dramatically the statewide deer population has grown over the past 40 years.

The highest deer densities in the state can be found in urban and suburban areas, and many communities are experiencing severe impacts. Due to local firearms ordinances and restrictions by landowners there is typically little land accessible to recreational hunters in developed areas, so localized strategies developed and applied at the community level are usually necessary for

effective deer management. Many communities are finding ways to address their problems with overabundant deer, but it's important to recognize at the outset that it's a complicated process requiring a long-term commitment. Steps that are taken to reduce deer populations must be maintained, or the problems will quickly return.

Communities, individual landowners, or groups of landowners experiencing negative impacts from deer can pursue intensive population reduction on their land or within their boundaries through two special permit programs:

- The Deer Management Assistance Program (DMAP) provides antlerless deer harvest tags that a landowner, organization or municipality can distribute to licensed hunters for use on specific parcels of land. The hunters can use the tags on those properties during deer hunting seasons in addition to the tags they receive with their licenses.
- Deer Damage Permits (DDPs) allow taking of deer outside of hunting seasons under certain conditions, and may allow the use of specialized techniques to increase success. These permits are issued in situations where adequate population control and damage reduction cannot be achieved through hunting, even with DMAP.

There is no fee associated with either of these programs.

Unless individual properties are very large, community-level action rather than individual landowner action is probably necessary for effective reduction of impacts. Municipalities are required to submit a deer management plan with a DDP application (downloadable from website) but not with a DMAP application (downloadable from website). Before any such application is prepared by a municipality, there should be a thorough community-wide decision-making and planning process so that the problem the community is trying to solve can be identified, all available management strategies can be considered, and community members can select the best approach together.

Photo by Dick Thomas

Community Deer Management Planning

A community that is considering deer management should begin with information-gathering, education and outreach. Community leaders should educate themselves and other community residents about deer biology, the ecological and social impacts deer are causing in their area, and possible methods for reducing those impacts. This provides the foundation for an informed decision-making process. To aid in these efforts, DEC biologists can provide information, advice and resources and give presentations at public meetings convened to discuss deer issues. In addition, the Community Deer Advisor website (deeradvisor.org), which provides recommended best practices, examples from other communities, and a suite of valuable resources, can serve as a guide through the entire planning process.

Important Steps in the Planning Process

- Educate community members about deer biology and impacts.
- Determine whether most community members want deer impacts to be addressed.
- Develop a transparent and inclusive decision-making process.
- If the community wants deer impacts addressed, identify objectives (not methods) for impact reduction.
- Educate community members about methods for reducing impacts.
- Assess community preferences for methods and select methods to implement.
- Develop a written management plan and share it with community members.
- Collect data on pre-management impact levels so that progress toward objectives can be tracked.
- Apply for any necessary permits.
- Begin management actions.

One of the initial steps is often to conduct a survey of community residents. This can be an efficient way to learn about the type and severity of deer-related impacts being experienced, locations in the community where problems are most severe, and opinions on whether some community-level action should be taken to reduce these problems. It's best not to include questions in the survey about specific types of action that might be taken, as they would only be a distraction. The goal at this point is simply to define the issue and assess the need for action.

Often a committee is formed to lead the information-gathering, decision-making and planning efforts. Municipal leaders should ensure that a variety of perspectives are represented on the committee and that extensive outreach takes place to involve all segments of the community in the planning process. Whatever decisions are reached, it's unlikely that everyone in the community will agree with them, but everyone should be able to agree that the decision-making process was valid and that the decisions are supported by the majority of the community. Committee members should therefore be dedicated to conducting an inclusive and respectful process that allows all opinions to be heard and considered.

If public opinion data indicate that most people feel deer problems aren't so bad that the community should take action, the process is likely to stop at this point,

although education efforts may continue. Periodic re-surveying of residents is useful to identify any change in public sentiment over time.

If most of the community feels some action is warranted, the next step is to set measurable objectives. These objectives will guide management decisions, so they should be defined before any consideration of management methods takes place. Objectives should be based on the impacts that have been identified by the community, rather than deer numbers or densities. The focus needs to be on the problems the deer are causing, because that's the only way to know whether things are improving. For example, objectives might be to reduce deer-vehicle collisions to a certain number per year, to reduce to a certain level the number of landscaping plants that residents report killed by deer, or to allow a certain percentage of tree seedlings in forest patches to survive.

Progress toward objectives can be tracked by monitoring the chosen impact measures. Impact monitoring methods should be identified during the planning process. Ideally, data collection on impacts will start before management actions are implemented so that the initial conditions can be documented as a baseline. This will make it possible to measure the effect of management activities on impact levels, and can also help identify target levels to use as objectives.

There is a common misconception that it's necessary to count the deer in the community. In actuality, knowing the number or density of deer in the community is not necessary or even useful, except possibly in coming up with cost estimates for some management actions. By definition, the problem is the impacts the deer are causing, not the deer themselves, so knowing the severity of impacts is all that's necessary to make decisions about whether to take action. Similarly, there would be no clear way to set a target population number as a management objective, because a multitude of variable factors determine the number of deer that can sustainably live in an area, and every location is different. Finally, it's very difficult to get an accurate count of deer, particularly in urban areas. Communities that try it typically end up spending a lot of time and money and often obtain confusing, possibly meaningless numbers.

MONITORING DEER-RELATED IMPACTS IS NECESSARY FOR EVALUATING PROGRAM SUCCESS.

After objectives have been clearly defined, the process of selecting methods for attaining those objectives begins. The experiences of other communities (Doerr et al., 2001; Hygnstrom et al., 2011; Kilpatrick et al., 2010; Kilpatrick and Walter, 1999; Rudolph et al., 2011; Stewart et al., 2013; Wiggers, 2011) can be tremendously helpful in developing management strategies and evaluating the pros and cons of various courses of action. Some communities that provide detailed information online regarding their deer management programs include: Cayuga Heights, NY; Trumansburg, NY; Southold, NY; Hopewell Township, NJ; East Goshen Township, PA; Mt. Lebanon, PA; Howard County, MD; Baltimore County, MD; Burnsville, MN. Others are described as case studies in the community-based deer management guide published by Cornell University (Decker et al., 2004). Communities should consider reaching out to neighboring communities and public land managers to promote cooperation and coordination as they develop their deer management plans. Simultaneous action over a larger area will tend to increase the success of each program. Before carrying out or funding deer management activities, municipal governments should consult their legal counsel regarding any obligations they may have under the State Environmental Quality Review Act.

Choosing which actions to implement is the most difficult and time-consuming part of the planning process for many communities. DEC staff can help by providing information on deer biology and management options. Bringing in a trained facilitator to guide discussions may also be useful and even necessary. Deer management can become a contentious and controversial issue, as community members may have widely varying perspectives on deer and be passionate about their opinions and priorities. County Cornell Cooperative Extension offices, universities and government agencies may all have skilled facilitators among their staff, and professional facilitators can be found online.

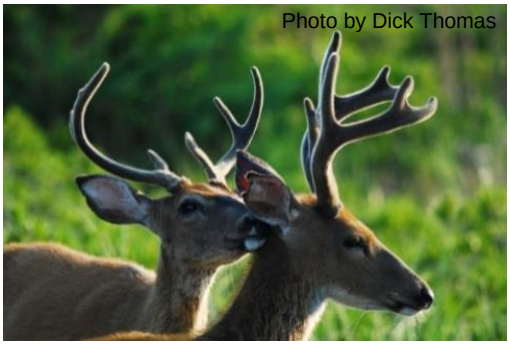


Photo by Dick Thomas

It's important to thoroughly publicize planning efforts to ensure that all members of the community have an opportunity to participate and voice their perspectives. Insufficient outreach increases the likelihood of negative backlash from groups or individuals who disagree with a plan that was formulated without their participation. An inclusive process provides valuable information to community leaders on deer impacts and stakeholder opinions, allows stakeholders to increase mutual understanding by educating each other on their differing perspectives, and establishes a strong foundation for defending deer management decisions and actions in the event of a subsequent challenge. A high level of communication and transparency should be maintained throughout program implementation, to keep community members informed and engaged.

Because deer management is a long-term undertaking, periodic evaluation of the program is an important component. Evaluations should incorporate as much diversity of stakeholder participation as did the initial planning process. Progress toward the program goals should be assessed and a determination made on whether modifications to the program are needed. Such modifications may be stimulated by lessons learned during program implementation, data gathered through monitoring, technological advancements, shifts in community priorities, or other causes.

In most cases programs run more smoothly after the first year or two, as residents become accustomed to the management activities and begin to see results. However, controversy can still resurface, and if periodic evaluations and modifications are not conducted, over time the program may become out of sync with the community's needs and desires. Because a deer management program should outlast the tenure of the people making decisions when the program is initiated, it is valuable to have a written management plan. Such a plan provides an opportunity for the community to document their decision-making process and reasoning and establish guidance for future decisions.

Management plan structure

The purpose of a management plan is to present the problem to be solved, the desired results of management, and the proposed approach. Any community that applies to DEC for a DDP is required to submit a management plan. The plan should not be an extensive review of deer ecology and management; it should simply outline the need and strategy for addressing deer impacts in the community. Structurally, a concise management plan consists of three basic sections: an introduction or background, a list of management objectives, and a description of the methods that will be used to achieve those objectives and evaluate success. The plan

should not focus solely on aspects of management that are meant to reduce deer abundance; it should include all ways in which the community intends to address deer-related impacts (e.g. public education efforts, installation of road-crossing structures for wildlife, fencing of sensitive plant communities) so that individual activities can be considered in an integrated context.

The introductory section should describe the situation that has created a need for management action. This should include a discussion of what is known about the local deer population and its impacts, followed by an explanation of why a DDP is needed to address those impacts. If any actions were undertaken previously to address the impacts, those actions and their outcomes should be described. Planners may also wish to include in this section a description of the process through which the plan was developed and a list of people who participated or contributed. This type of process documentation may help facilitate aspects of community review and plan implementation.

The objectives should relate directly to the impacts that were identified in the introduction. General goals that are more broadly stated may also be included in this section, but only to provide context for the specific, measurable objectives that are the focus of the plan. Objectives should be defined such that it will be possible to determine clearly whether they have been attained. “Reduce deer-vehicle collisions in the Village to fewer than ten per year” is an appropriately defined objective; “Reduce deer-vehicle collisions” is not.

The methods section should cover two separate categories of methods: those designed to reduce deer-related impacts and those designed to monitor deer-related impacts. All impact reduction approaches to be used, including education and activities aimed at modifying human behavior, should be described. A justification, or explanation of why that particular technique was chosen, should be included for each method. Planners may wish to include discussions of methods that were proposed or considered but not selected, so that the decision process is transparent and thoroughly documented. If lethal methods are going to be used, the system by which venison will be distributed for utilization should also be described. With respect to monitoring, at least one method should be included for each impact for which an objective has been defined. If baseline data have been collected before plan submission, they should be provided with the plan.

A map should be provided that shows the locations of all field-based activities proposed in the plan (e.g. stretches of road where traffic control efforts will be implemented or DVCs will be monitored, properties where bait-and-shoot sites will be located, forest stands where ecological impact indicators will be measured). If there are concerns about the possible public release of sensitive information, alternate arrangements can be made with DEC.

The plan should be detailed and specific, but not rigid. An adaptive management approach should be used, meaning that the situation should be reassessed periodically to determine whether changes should be made to methods or objectives. The plan should specify how these reassessments will be conducted and how often they will occur.

Photo by Paul Curtis

Management Tools

Actions a community can take to reduce deer-related impacts fall into two broad categories: those that reduce residents' vulnerability to the negative effects of deer, and those that reduce deer populations. Communities should pursue both approaches to maximize the likelihood of success and engage all residents in the impact reduction effort.

Reducing vulnerability to deer impacts

Deer feeding

Feeding wild deer is illegal in New York, but some residents are reluctant to obey the prohibition. They mistakenly believe that providing food will be helpful, or they simply enjoy seeing the deer on their property. However, deer feeding contributes to unnatural concentrations of deer, which exacerbates deer-related impacts and increases the risk of disease transmission. It also alters deer behavior in ways that can create hazards for people and property. Over time, deer feeding will act to increase deer populations, leading to even greater impacts. Furthermore, deer can die from eating large quantities of high-calorie food, such as corn, in the winter, when their complex digestive system is set up to deal with lower-calorie natural forage.

Community residents should be educated on the problems deer feeding causes for the community, the ecosystem and the deer. Violations of state law and regulation can be reported to local Environmental Conservation Officers. Municipalities may wish to pass their own bans on deer feeding so that they can establish penalties and conduct enforcement.

Deer-vehicle collisions

There are several steps local governments and residents can take to reduce the risk of DVCs. Residents should be educated on deer behavior, the need to drive more slowly and be especially vigilant at dawn and dusk and during the rut (mating season), and the importance of watching for additional deer following when they see one crossing in front of them. A public-awareness campaign each fall as rut begins might be especially helpful.

Photo courtesy of New York City Dept. of Transportation

If municipal officials can identify areas or stretches of road where collisions are most common, they can install warning signs and lower the speed limits. Mobile lighted temporary warning signs that appear in the fall may be more effective than permanent signs. If there is tall vegetation close to the road, creating a wider mowed border to increase visibility may be helpful. Erecting deer fences along both sides of the road could be helpful, but only if there are some barriers to movement that would prevent the deer from simply going to the end of the fence and crossing there. An investment-intensive option that has been used successfully in other parts of the country is a wildlife underpass created by elevating the road in a problematic location and building fences to funnel deer and other animals safely under the road to the other side (Beckmann et al., 2010; McCollister and Van Manen, 2010). Because of the expense, this method is only likely to be used on sections of

road where collisions are very frequent or there are additional reasons to construct wildlife crossing structures. To minimize cost, underpasses can be created during regular road and culvert maintenance and repair activities.

Numerous products have been developed to help prevent DVCs, such as whistles on cars and reflectors along roadsides, but research has not shown any of them to be effective (Mastro et al., 2008).

Tick-borne disease

Until vaccines are available, individual vigilance is the best way to reduce the risk of contracting a tick-borne disease. Tucking pant legs into boots or socks can help keep ticks on the outside of clothing, and wearing light-colored clothes makes them easier to spot. Clothing that has been treated with permethrin can kill ticks before they have a chance to bite. An approach for those who want to avoid using pesticides is to inspect oneself frequently when outside and remove any ticks from clothes with duct tape or a lint roller (to permanently remove them from the environment). Head-to-toe inspections should be conducted after coming inside and removing clothes, and any embedded ticks should be removed using fine-tipped tweezers without squeezing the tick's body. Anyone who develops symptoms of a tick-borne disease after being bitten by a tick should contact their doctor and tell him or her about the tick bite and the symptoms. Community leaders should work to educate residents on techniques to reduce ticks in their yards, tick-bite prevention measures, tick removal methods, and disease symptoms.

Municipalities may consider using pesticides to decrease tick numbers. Applying pesticide to the ground or vegetation can provide effective short-term reduction of tick populations (Eisen and Dolan, 2016), but will also kill many other invertebrates. Combining multiple methods, including devices that treat small mammals with pesticide, can control tick populations while reducing pesticide use (Schulze et al., 2007; Williams et al., 2018). Treating deer with pesticide via devices called 4-Posters™ can control tick numbers under certain circumstances (Wong et al., 2017). 4-Posters™ are bait stations designed to attract deer and treat them with permethrin while they are eating the bait. Maintaining 4-Posters™ is expensive, and many communities that have tried them have abandoned their use because of the cost. The constant availability of extra food for deer and other animals can also lead to many negative consequences. Municipalities wishing to use 4-Posters™ must apply to DEC for deer feeding permits and implement deer population control programs to prevent some of these consequences.

Plant damage

Deer browsing can create problems in many different contexts, from ecological degradation to crop losses to ornamental plant damage. Information on various ways to reduce plant damage by deer is available from Cornell Cooperative Extension and many other sources. The only sure way to keep deer from eating plants is to enclose the plants in a sturdy fence that deer can't jump over, which usually means at least eight feet high. As an alternative to fencing the entire planted area, small cage-type enclosures can be placed over individual plants that are small enough, and netting can be draped over shrubbery. Such barriers of course have an aesthetic impact, and the cost and labor involved typically make them useful only for small areas with highly valued plants,

Photo by Paul Curtis

either cultivated or natural. Electric fencing may be cheaper for larger areas, but it requires substantial maintenance, poses a hazard to people and non-target animals, and is only temporarily effective because deer can learn to get past the fence without being shocked.

Most other possible methods for deterring deer from eating plants suffer from the same problem of temporary effectiveness. Various devices that are meant to scare deer with motion, sound, light, or spraying water have been developed, but over time the deer will get used to any of them and will no longer be scared away. There are also many types of chemical repellents that can be applied to plants and are meant to prevent browsing, due to their noxious taste or smell. They can be effective, but they must be reapplied frequently as rain washes them off and the plants produce new growth, and if deer density is high or the plants are highly desirable, they will not prevent deer from feeding on the plants.

Plants do vary in attractiveness to deer, and many homeowners take the approach of choosing less palatable species to plant in their landscaping. Of course, this isn't a strategy that can be used to reduce deer damage to vegetable gardens, crops, or natural ecosystems, but it can work for landscaping if there are ample alternative food sources available to the deer. Recommendations on deer-resistant planting are available from Cornell Cooperative Extension, along with many other sources. However, individual tastes vary, so even species that are considered generally unpalatable may still be eaten by specific deer, and if deer densities are high enough, virtually all plants will be vulnerable. Some non-native plants that are rarely eaten by deer are invasive in natural areas and will escape from gardens to create tremendous ecological problems, so care must be taken to avoid planting invasive species.

THE ONLY WAY TO REDUCE PLANT DAMAGE THROUGHOUT THE COMMUNITY IS TO REDUCE THE DEER POPULATION.

The final method for preventing damage to plants is hazing, which requires a DEC permit in New York. Hazing is active physical harassment of the deer, and it usually takes the form of shooting at them with non-lethal projectiles such as rubber buckshot or beanbag rounds. The other common type of hazing is chasing by a dog that is prevented from leaving the area it is protecting, for example by an underground electronic fence. These are labor-intensive techniques that require the hazer to be on watch constantly, and they are not likely to receive widespread use.

The most significant difficulty with reducing deer damage to plants by any of these methods is that only individuals will benefit, not the whole community. Any action that decreases one resident's likelihood of damage will increase the pressure on everyone else's plants. The only way to reduce plant damage throughout the community is to reduce the deer population.

Reducing deer populations

Lethal removal

For deer populations to be reduced, deer deaths must outnumber births. The white-tailed deer is a prey species that evolved under high predation levels, so its natural state includes a high

mortality rate. For a healthy deer population to remain stable, on average 30-40% of the animals must die each year (Matschke et al., 1984); otherwise the high reproductive rate will result in population growth. In undeveloped areas, most of this mortality occurs through predation of fawns, hunting of adults, and starvation during severe winters. In residential areas most deer deaths result from collisions with vehicles, and those don't usually occur at a high enough rate to offset reproduction.

Just as an understanding of reproductive characteristics can help clarify how deer overabundance develops, an understanding of the realities of deaths from natural sources such as predation, disease and starvation and from human-caused sources such as vehicle collisions and shooting can help clarify the ramifications of various courses of action and inaction by communities. Natural deaths of wild animals, including deer, typically involve suffering in the form of pain, fear, or both. Deer-vehicle collisions (DVCs) may result in a quick and painless death when they occur on high-speed highways, but on lower-speed roads they are more likely to cause considerable suffering followed by slow death or permanent crippling.

Photo licensed on Wikimedia Commons by John O'Neill-

Killing deer intentionally and humanely is the only reasonable way to increase the death rate in developed areas. This is best accomplished by shooting them in a vital organ. Deer that are shot in the brain with a powerful gun, the usual method of professional culling, die instantly. In hunting situations, the preferred target area is the lungs and/or heart, because they are less likely to be missed than the brain. Either a bullet or a broadhead-tipped arrow shot through those organs typically kills a deer within seconds, but the deer may run 50-100 yards in that time.

NATURAL DEATHS OF WILD ANIMALS TYPICALLY INVOLVE SUFFERING.

Public safety should be the highest priority in any deer population reduction effort. Guns and bows (including crossbows) can both be used safely in community deer management programs with appropriate controls. New York state law prohibits the shooting of guns within 500 feet of a house (without the owner's permission), school building or playground, public structure, or occupied farm structure, factory or church, whereas the corresponding distance (called a setback distance) for crossbows and vertical bows is 250 feet and 150 feet, respectively. Due to these shorter setback distances for archery equipment, bowhunting is by far the most common type of hunting in urban and suburban settings. With the ability to operate in areas as small as suburban yards, bowhunters can be active throughout more of the available habitat and potentially encounter more of the deer than if they were using guns.

Hunting

Bowhunting for deer is typically done from a tree stand: a platform attached to a tree 10-20 feet above the ground. Being elevated improves the hunter's ability to detect deer, reduces the likelihood that deer will detect the hunter, and most importantly, establishes a downward shot trajectory so that arrows never travel far from the shooter's location. This makes bowhunting extremely safe for the public and non-target animals. Most shots are taken at deer that are less than 20 yards away from the shooter, which means that he or she can very clearly and easily identify the target and the arrow is likely to be shot at a steep downward angle. If the arrow passes completely through the deer or misses, it will end up sticking into the ground within sight of the hunter. Bowhunting can and does safely occur simultaneously with other recreational land uses such as hiking, cross-country skiing, horseback riding and mountain biking.

Photo by Dan Aitchison

BOWHUNTING FROM A TREE STAND IS EXTREMELY SAFE FOR THE PUBLIC AND NON-TARGET ANIMALS.

Many municipalities have passed ordinances forbidding weapons discharge or hunting. Because DEC has authority over hunting in New York, local ordinances specifically limiting or prohibiting hunting are contrary to state law and legal precedent unless they only apply to land owned or managed by the municipality (Kalbaugh, 2015; M. Sanza, pers. comm.). Broad restrictions on weapons discharge in the name of public safety may or may not be valid under state law, depending on the history of the municipality and its original governance documents (M. Sanza, pers. comm.). Regardless, all of these types of ordinances can act to prevent hunting of overabundant deer populations on land where hunting could be conducted safely and in full compliance with state laws. Communities working to address deer impacts often find themselves hindered by their own ordinances, which they then must rescind, revise, or grant variances to.

Photo by Dan Aitchison

Allowing recreational hunters access to as much land as possible in a community is the simplest approach to deer population reduction. Many landowners, including municipalities, currently prohibit hunting on their land, and since hunting is the principal mechanism for deer population control in the absence of large predators, this practice allows populations to grow to unsustainable levels. In communities that are trying to reduce deer-related impacts, opening more private and public properties up to hunting and encouraging hunters to shoot as many does as they legally can will provide additional recreational opportunities for local hunters while benefiting the entire community. To increase the success of such an effort, communities may wish to conduct outreach to increase local non-hunters' understanding of hunting and the excellent safety record of New

York hunters and raise hunters' awareness of the negative impacts of overabundant deer and the importance of reducing populations.

If community residents are uncomfortable with the idea of simply opening up land to hunting under state regulations, a "controlled hunt" may be a way to address their concerns while still accomplishing population reduction through recreational hunting. A controlled hunt is just a way to formalize the authority that all landowners have to restrict how hunting occurs on their land. Individual property owners can choose whether they want their property to be included in a municipal controlled hunt. A set of rules is established that applies to all participating properties and places limits or requirements on hunting on those properties that are stricter than state law requirements. Appendix 1 contains detailed information on types of rules that are often used in controlled hunts. DEC staff can help municipalities identify structures for controlled hunts that balance community concerns and management needs. Some municipalities opt to run controlled hunts themselves, but others collaborate with a local sportsmen's organization. In this type of collaboration, the municipality and/or landowners set the rules for the hunt and the sportsmen's organization administers the hunt: managing the hunters, applying the rules, and serving as the communication conduit between landowners and hunters. Some ecological consultants also offer community deer hunt management as a commercial service.

Municipalities (and landowners) can increase the ability of hunters to reduce local deer population densities by enrolling in the Deer Management Assistance Program (DMAP), which provides an allotment of antlerless deer tags to be used during deer hunting seasons on designated lands within the municipality. The municipal applicant is

Recommendations from The Wildlife Society

The Northeast Section of The Wildlife Society recommends the following progression of actions that communities may implement to address deleterious impacts from overabundant deer. Actions progress from those that are more general to those that are more specialized.

1. Modify human behavior, which may include bans on deer feeding, changes in speed limits, or zoning considerations to limit or isolate deer habitat within community centers. Consider use of exclusion fences to protect high-value commercial or natural resource areas.

2. Address municipal projectile discharge ordinances and other local bylaws that may prevent regulated hunting by the public as otherwise authorized by state laws and regulations.

3. Identify lands within the community used by deer where management action may be targeted. The lands may include residential neighborhoods, parks and preserves, riparian areas, cemeteries, golf courses, industrial areas, or transportation corridors.

4. Implement controlled public hunts in defined areas within state-regulated hunting seasons and implement public safety limitations as needed.

5. Where needed, coordinate managed hunting using a participant selection process, safety and shooting proficiency test, and personal interviews, with preference to more skilled and cooperative hunters.

6. Facilitate access to private and public lands for managed hunts.

7. Train hunters in suburban deer hunting techniques.

8. Seek special provisions to make regulated hunting more effective, such as: use of crossbows, muzzle-suppressed firearms from elevated locations, use of bait, and increased antlerless permit allowance combined with incentives for additional permits for antlered deer.

9. Consider financial incentives to increase hunter effort such as equipment, butchering, or transportation cost reimbursement.

10. Employ professional sharpshooting where regulated hunting options have been insufficient to solve identified problems or are otherwise not feasible.

This list is not all-encompassing, and later options are not intended to replace early options; options can be pursued inclusively in sequential order. In any case, the specific management actions undertaken will be largely dictated by the current biological and social conditions in the affected community.

responsible for equitably distributing the tags to the hunters who will be hunting on those properties. This allows those hunters to shoot more does than they would be able to using just the tags they receive with their hunting licenses.

Culling

In many cases, even with DMAP, hunting may not increase the deer mortality rate enough to meet community goals for impact reduction. The next step for these communities is to pursue culling, which is the term for killing deer outside of a hunting framework. A DEC-issued Deer Damage Permit (DDP) is necessary for a culling program to occur, and such permits typically allow the use of methods that are not available to hunters, which is why culling is usually more effective for rapid population reduction than hunting is. For example, nearly all culling programs involve the use of bait to attract deer to locations where they can be shot safely and efficiently, and most of the shooting occurs at night, when deer are out searching for food and spotlights can be used to temporarily induce them to "freeze," providing a good opportunity for a shot. Culling usually occurs at a different time of year than hunting, for example in mid-winter, when deer have less natural food available and can be more easily attracted to bait.

DDPs can be issued to private individuals and representatives of businesses, municipalities and organizations. The permittee can designate agents who will do the shooting, and those agents can be volunteers, employees of the permittee, or wildlife control professionals. A cull that is conducted by volunteers is managed essentially the same way as a controlled hunt, except that training the volunteers in the most effective use of bait and lights may be a valuable step. Only a DEC-licensed Nuisance Wildlife Control Operator (NWCO) can be paid for the primary purpose of killing deer on a DDP. However, an employee whose primary duties are not removal of nuisance deer (e.g. property management, maintenance or security personnel) is not required to have a NWCO license to occasionally kill deer on a DDP. Licensed NWCOs can be hired specifically to conduct deer culls, and there are companies that specialize in nuisance deer removal in urban and suburban situations. The Wildlife Services branch of the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture can also be hired to conduct deer culls.

Culling by volunteers is most likely to be done with archery equipment, because of the ability to be quiet and unobtrusive and utilize small habitat patches throughout the community. Professionals often cull using rifles. They may have considerable experience selecting safe shooting zones in developed areas and typically also have specialized infrared equipment that enables them to detect people and other animals from a distance at night.

If there are only a few places in a community where deer can be safely shot, or if community members are unwilling to support methods that involve shooting, alternative approaches to population reduction will be necessary. Professionals can be hired to capture deer with traps, nets or anesthetic darts and then kill them with either a captive-bolt gun or injection of potassium chloride. However, there are several negative consequences of these methods. Trapping causes stress and possible injury for the deer, use of a captive bolt on a wild, unsedated animal is challenging for the operator, and use of chemicals renders the carcasses unsafe for consumption, so the meat is wasted.

If the deer have not been injected with anything, every effort should be made to ensure that the venison resulting from community hunts or culls gets eaten. Hunters who are given access to private land can promote positive relationships by offering to share meat with the landowners. In a controlled hunt or cull situation, the community may wish to require that some or all of the meat be donated to charity. There are organizations (e.g. Venison Donation Coalition, Farmers

& Hunters Feeding the Hungry) that get donated deer butchered and the meat distributed to food banks and other assistance agencies. This low-fat meat is a tremendous boon for needy community members. Some municipalities (e.g. Town of Southold) develop their own programs for collecting and distributing donated deer, and may opt to make the meat available to all residents. The locavore movement has increased interest nationwide in eating local wild game meat. No matter how venison is distributed, if firearms have been used the community should make sure recipients have information on how to avoid ingestion of lead from bullet fragments, and all shooters should be encouraged to use lead-free ammunition.

Fertility control

People who are disturbed by the idea of killing animals often wish to control deer populations by reducing the birth rate rather than increasing the death rate. Even with effective fertility control, this wouldn't be a good way to reduce impacts of deer because it would just keep populations from growing; it wouldn't directly reduce them. Deer can live to be 20 years old, so population reduction would happen slowly if at all, and without hunting or culling most deaths would be from vehicle collisions, which isn't a prudent or humane method of removing deer. Meanwhile, the negative social and ecological impacts of deer would continue at levels which were found to be unacceptable by the community when they decided to initiate deer management efforts.

REDUCING DEER NUMBERS BY SHOOTING IS MORE HUMANE THAN RELYING ON VEHICLE COLLISIONS.

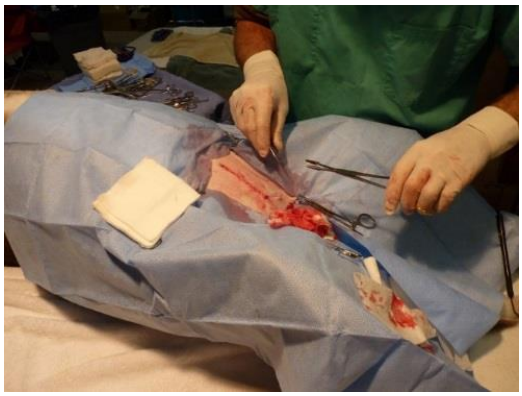
Currently, however, the lengthy delay in potential impact reduction is a secondary consideration, because effective fertility control on a population-wide scale has not been achieved except in small isolated populations in enclosures or on islands. The problem is that deer have such a high reproductive rate that a few fertile individuals can produce enough young to replace the small number of deer that die each year in urban and suburban settings. Wary individuals who are able to avoid capture and treatment, along with immigrants moving in from neighboring areas, provide more than enough reproductive capability to overwhelm fertility control efforts in the majority of cases (Merrill et al., 2006). Even on an island of less than 9 mi^2, a fertility control program that continued for 16 years was hampered by an inability to capture a high enough percentage of the deer, and meaningful population reductions only occurred in certain areas that provided the best access to the animals (Underwood, 2005; National Park Service, 2015).

Surgical sterilization is the most reliable way to render a deer infertile, and for does it can be accomplished by either ovariectomy or tubal ligation. The latter technique doesn't prevent ovulation, so sterilized does will still go into estrus and mate. Because they won't get pregnant, however, they will go through several estrous cycles each year, creating an extended rutting season. This could have a number of negative consequences, including more DVCs, increased stress and lower overwinter survival, and an increase in the local population due to bucks being attracted from neighboring areas (Boulanger et al., 2014). An ovariectomy program is not likely to have these consequences.


Photo by Paul Curtis

Immuno-contraception is the other fertility control method that is often suggested by those seeking alternatives to lethal population reduction. ZonaStat-D is a contraceptive agent for deer that has recently been approved at the federal level by the Environmental Protection Agency. It contains porcine zona pellucida (PZP), which prevents fertilization, not ovulation, so it has the same potential for negative consequences as tubal ligation. GonaCon™, a contraceptive agent developed by the U.S. Department of Agriculture, prevents does from going into estrus, but in field trials it seems to have a slightly lower success rate than PZP. Unlike surgical sterilization, immuno-contraception is neither effective on all treated animals nor a permanent treatment; does must be re-treated on a regular basis to maintain infertility. Contraceptive treatment can only be performed under a research permit in New York, because there are no contraceptive agents for deer commercially registered with the state and continued development is needed before they can be effective management tools.

All fertility control methods are extremely labor-intensive and expensive, because deer must be captured for treatment and virtually all does must be treated to prevent population growth. Capture, anesthesia and surgery also create stress and may result in injury or death of treated deer. If a community decides that these costs are acceptable to them and they wish to pursue fertility control in a small highly developed area where shooting deer doesn't seem feasible, they may receive a DEC permit to use surgical sterilization as part of a deer management program. However, because of the ineffectiveness of fertility control for reducing populations or impacts, lethal population reduction methods must also be used concurrently in nearby areas. The combination of a core sterilization area surrounded by a lethal control zone reduced the deer population in Cayuga Heights, New York by almost 40% in two years (P. Curtis, Cornell University, pers. comm.).



Other techniques

There are currently no other useful methods of reducing deer populations in developed areas. Reintroduction of large carnivores is not ecologically or socially feasible in areas with high human density and no large blocks of natural habitat. Trying to move a population of deer to another location is not a reasonable option, because capturing and relocating deer results in significant levels of stress, injury and mortality (Beringer et al., 2002), and also presents a risk of spreading disease.

Impact Monitoring

The principal considerations in the development of impact monitoring protocols are relevance and ease. Monitoring must provide data that are directly relevant to stated objectives and protocols must be easy to understand and apply. In many cases monitoring data may be collected by volunteers or non-specialist municipal employees, and over time there will probably be substantial turnover in the individuals collecting data, so accuracy and consistency will be maximized by simple, easy-to-use protocols.

Deer-vehicle collisions

DVCs are one of the principal impacts of concern to most communities. Lowering DVC frequency is therefore a goal of most community deer management plans. The relevant plan objective should include a numerical target, and it should specify the geographic area in which DVCs are to be tracked.

Data on DVCs are often compiled by municipal police or transportation departments. Tracking changes in DVC frequency can be complicated by the fact that different levels of government have responsibility for different roads. Village police, town highway personnel, and state Department of Transportation staff may all be removing deer carcasses from public roadways. Initial DVC frequency is often unknown and difficult to determine because there is no central repository for the data, different government agencies may treat information on DVCs differently, and many DVCs that don't incapacitate the vehicle or result in a carcass on the road are not reported to authorities.

During plan development one agency should be identified to take the lead on DVC monitoring, and someone within that agency should be designated as the contact for compiling DVC data. Each relevant agency should develop a process for detecting, recording and reporting to this person the DVCs that occur within their scope of responsibility. Community outreach efforts should include a plea for widespread participation in reporting DVCs. A hotline number or dedicated e-mail address could be set up to facilitate reporting by the public, or they could be asked to report all DVCs, no matter how trivial, to the police. If there is concern about relying on the accuracy and consistency of citizen-reported information, data collection could be restricted to those collisions that result in a deer carcass on the roadway and can therefore be verified by agency personnel. Although some DVCs will not be counted with that approach, as long as the method remains consistent over time it will accurately show changes in deer impact levels.

Ecological damage

There is increasing awareness of and concern about the impacts of deer on biodiversity in forested parks, urban greenspaces and ecological preserves. Many communities have a goal of reducing ecological damage, but identifying or developing a monitoring protocol that adequately measures deer impact without requiring scientific training to implement can be a challenge. The basic concept is simple: as population reduction measures are carried out, declining deer density should result in increased growth and survival of plants that deer like to eat. However, identifying which plants those are requires knowledge and training. This is the biggest hurdle to overcome for communities wishing to monitor ecological damage. Because deer browsing of

native plants can lead to increased growth of invasive species, distinguishing native species from invasives is critical. Furthermore, data collection methods must be standardized and consistent to ensure accurate detection of changes over time. Among other things, this usually means marking permanent plots so that the same sites will be evaluated each year (or whatever the data collection interval is).

DEC has worked with the Cornell University Department of Natural Resources and the State University of New York College of Environmental Science and Forestry to develop a monitoring protocol called Assessing Vegetation Impacts from Deer, or AVID. It focuses on specific wildflower and tree species that are eaten by deer in New York and includes a guide to identifying those species. The AVID protocol, which is available online and via mobile app, also includes instructions on identifying good monitoring sites. For this monitoring method, at least 6 permanent plots of 113 ft^2 each are measured out and marked in each forest patch or stand to be monitored. Data collection involves counting and measuring the height of individuals of the selected species in those plots. Each plant measured is marked with a tag so that it can be found and measured in subsequent years. The smartphone app provides paperless data collection and easy access to the species identification information in the field.

AVID ASSESSING VEGETATION IMPACTS FROM DEER

http://aviddeer.com

MONITORING METHODS MUST BE CONSISTENT OVER TIME TO SHOW CHANGES IN IMPACTS.

A similar method that was recently developed by a forest ecologist with the U.S. Forest Service is being implemented at various locations around the Northeast. It involves establishing plots of 1075 ft^2, selecting one or more species of interest in each plot, counting or estimating the number of individuals of each focal species in the plot, and measuring the heights of the ten tallest seedlings under 4 feet tall (if the species is a tree or shrub) or the ten tallest individuals (if the species is a wildlflower). For wildflowers, the number of individuals in flower or fruit is also recorded. In this method, the tallest individuals are measured each year, so marking specific plants is not required.

A different type of approach that has been used in New York and neighboring states is to plant red oak (*Quercus rubra*) seedlings each year and count the number that have been browsed by deer after a certain period of time (Blossey et al., 2017). This eliminates the need to learn to identify species, but requires identifying forest sites where red oak can grow, purchasing seedlings annually (or whatever the data collection interval is), and planting the seedlings properly so they survive the process. Other tree species could be used instead of or in addition to red oak. This method may be particularly useful in places where deer impacts are so severe that native wildflowers and tree seedlings are essentially absent from forest understories.

Photo courtesy of Cornell University

Simpler methods that involve just counting tree seedlings in plots or estimating the percentage of a vertical board that is

visually obscured by plant growth when viewed from a specific distance are less time-consuming and may require less training, but field personnel still need to be able to distinguish exotic species from natives. Otherwise, growth of invasive species could be misinterpreted as recovery of forest health.

Appendix 2 contains protocols or links to protocols for the methods mentioned here.

Cultivated plant damage

One of the primary deer-related problems experienced by landowners is damage to gardens, landscaping or crops. This can result in considerable financial loss and an inability to use land for desired purposes. Monitoring this type of damage can be complicated by changes in landowner behavior, such as planting different species, fencing, or using repellents. Relying on landowner reports of the extent or severity of damage, in addition to these potential complications, raises the possibility that perceptions of damage may change at a different rate from actual damage. For example, after a deer population reduction program has begun, optimism, relief or wishful thinking may lead landowners to perceive less damage in their gardens even before deer browsing has decreased.

Taking an experimental approach to monitoring this impact should result in more reliable data. For example, potted plants of a species that is frequently eaten by deer can be purchased and distributed to homeowners throughout the community each spring. Participating homeowners must commit to placing this plant in their yards, caring for it appropriately, and measuring its height or counting its leaves on a regular (daily or weekly) basis during the growing season. The data should be reported to a designated community official who will compile them and look for trends over time. The intensity of deer browsing in the community will determine what data points might be most useful for comparison. For example, if browsing is very heavy, the percentage of plants that still have any leaves remaining two weeks after placement might be the value chosen for between-year comparisons. In a community with lighter levels of browsing, a value such as the average height of the plants two months after placement might be a more informative indicator.


Photo by Dick Thomas

On the other hand, if residents' satisfaction or perception of damage level is considered an adequate indicator of program success, mail or internet-based surveying can be a relatively simple assessment method.

Tick-borne disease

Although tick-borne disease, particularly Lyme disease, is a major concern throughout much of New York and is often cited as a principal impetus for initiating a community deer management program, it is a difficult index to monitor for evaluating the success of the program. There are several reasons for this: in many cases deer population reduction is not likely to reduce Lyme disease incidence (Jordan et al., 2007; Kugeler et al., 2015), measuring tick abundance and testing ticks for the presence of the Lyme-causing bacteria is expensive, and other methods for

estimating Lyme prevalence may not provide reliable data. Rates of human infection can be estimated from public health records, but a decrease in those rates may be a result of improved tick bite prevention practices, which should be a focus of the education component of the community's program. The other tick-borne diseases are less common and less well studied than Lyme and therefore would be even harder to use as indicators. A community that wishes to pursue tick testing should contract someone with expertise in tick-borne disease.

Measuring tick abundance without testing to determine Lyme infection rates doesn't provide an accurate indication of disease risk. However, communities interested in just monitoring tick abundance can find descriptions of various methods online.

Tick-covered sampling cloth. Photo by Moses Cucura.

Conclusion

Deer overabundance is a challenging issue for communities to confront, but many have succeeding in developing management programs that have decreased their deer-related problems. The Community Deer Advisor website (deeradvisor.org) provides detailed examples that should be very useful for any community searching for an effective solution. DEC can offer information and advice specifically tailored for communities in New York.

Due to the nature of biological systems, reducing deer populations is necessary for long-term impact reduction on a community-wide scale. A review of the examples on the Deer Advisor site demonstrates that successful programs include hunting, culling, or both. Continued research on fertility control methods may produce additional useful options in the future. All deer impact management methods have to be continued and/or repeated year after year.

To maintain community support and justify municipal expenditures, monitoring is an important component of every deer management program. Monitoring the deer-related impacts of concern to the community is the only way to establish whether the program has successfully addressed those impacts.

Photo by Dick Thomas

Frequently Asked Questions

Isn't "deer overabundance" just a matter of perception? Aren't the deer living in our neighborhoods because development has crowded them out of the places where they used to live?

Actually, white-tailed deer do better in the suburbs than they do in more wild places. They have become so abundant in many developed areas because their reproductive and survival rates are both very high in those areas. High deer densities have serious ecological and public safety consequences, but people differ in their willingness to tolerate those impacts, which can affect a community's perception of overabundance.

What happens if we don't manage the deer? Won't they come into balance with the environment?

Deer are prey animals that in a "balanced" state have a high level of mortality from predators. Without that high mortality, the population will continue to grow until there isn't enough food available to support them and death by starvation becomes a significant factor. Long before that point, high rates of vehicle collisions and severe damage to landscaping and natural ecosystems make it clear to most people that letting the population continue to grow is bad for the deer, the environment, and the community.

Why not bring back natural predators and let nature take its course?

People would probably be less willing to tolerate large predators like wolves and mountain lions in their neighborhoods than deer. Also, those predators would not be as willing to live in developed areas as deer are. Research has shown that in states where mountain lion populations have recently become established, deer-vehicle collision rates dropped in rural areas but not urban areas.

We don't want to hurt the deer; why can't we just move them somewhere else?

Translocation, or moving deer, can't really be considered a humane procedure. Deer are very susceptible to capture stress, and research has shown that a high percentage of translocated deer die of stress-related causes shortly after release. In addition, moving deer increases the risk of spreading disease.

Will reducing the deer population cause the remaining deer to have more offspring to compensate?

Deer in urban and suburban areas are typically reproducing at or near maximum rates because they have access to plenty of food. A jump in reproduction would only occur in a situation where lack of food had led to malnutrition and lowering deer numbers allowed the remaining deer to regain health. But even in that situation, the increased reproduction would be mathematically outweighed by the deer removed, so the population would still decrease.

If we start population control, is there a chance we won't have deer anymore?

Not unless there's a severe disease epidemic. Community deer management activities are not capable of wiping out a deer population under modern laws and land-use patterns, nor is that ever the intent.

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APPENDIX 1. Controlled Hunt Structure

Controlled hunts occur within the normal hunting seasons and provide a mutually beneficial formal arrangement between hunters and landowners. DEC staff can help communities identify suitable controlled hunt structures and provide guidance for successful and safe implementation. As part of organizing such a hunt, it may be helpful to provide training to hunters on the special nature of urban/suburban hunts and ways to facilitate positive interactions with non-hunters.

A common barrier to hunting in urban and suburban areas is discharge ordinances. Many municipalities have passed ordinances prohibiting weapons discharge. To allow a controlled hunt to occur, such municipalities can issue a special permit or temporary waiver for the time period and location of the hunt if they are unwilling to rescind the ordinance.

What makes a controlled hunt possible is that landowners always have the right to impose rules on hunters they allow on their land, narrowing the boundaries of what is permitted more than the restrictions imposed by laws. In a community hunt, all participating landowners agree to a common set of rules. This ensures that both landowners and hunters know what to expect and allows all parties to feel comfortable with the hunt. Following are many of the aspects of hunting that are often subject to limitation in controlled hunts:

Hunter characteristics

Number of hunters – Because urban/suburban hunts typically take place in highly developed areas with relatively small properties, the number and distribution of hunters is usually tightly regulated. Hunt coordinators or landowners will specify how many hunters are allowed to hunt on a particular property and may schedule different hunters at different times to maximize effectiveness and efficiency.

Experience – Landowners may feel more comfortable with established hunters who have many years of hunting experience and have encountered and dealt with a wide variety of situations.

Proficiency – There is usually a shooting accuracy and consistency requirement for participating hunters. The municipality or a local sportsmen's club may administer a shooting test and set the qualification level. Hunters may be required to re-qualify each year that they wish to participate.

Performance – A hunt coordinator may compile data on time spent hunting, number of shots taken, number of deer killed, and number of arrows or wounded deer unrecovered. Hunters who don't devote enough time, don't kill enough deer, or display problems with accuracy may be removed from the program. In smaller or less formal hunts, landowners may just require that hunters kill a certain number of deer on their property each year or they will be replaced. In all cases, a landowner who is dissatisfied or uncomfortable for any reason can at any time rescind permission for a given hunter to use his/her property or remove his/her property from the program entirely.

Record – Hunters may be required to pass a criminal background check.

Monitoring

Identification – Hunt coordinators may provide ID cards or armbands for participating hunters. Landowners may request the contact information and vehicle license plate number of hunters using their property. Permits and ID tags may be provided for vehicles and tree stands.

Notification – Communication is an extremely important aspect of conducting hunts in developed areas, and there are many types of notification that may be required. There may be a hunt coordinator who receives notifications from hunters whenever they enter the field, shoot a deer, recover a deer and leave the field. In some cases, the local police department may wish to receive these notifications as well. Especially for a hunt focused on one property, like a park, there may be a centralized check-in/check-out location. A hunt coordinator or individual hunters may notify landowners whenever a hunter enters or leaves their property or shoots a deer on their property. Landowners should always be notified if a hunter loses an arrow on their property or is unable to recover a shot deer. To ensure accountability, hunters may be required to label all arrows with their names or assigned numbers.

Hunt details

Day and time – Hunting may be allowed only on certain days of the week and at certain times of day. Landowners may choose times when hunting activities are less likely to conflict with their use of their land.

Equipment – The types of hunting implement that are allowed may be specified. Due to safety considerations and discharge setback law, most hunting in urban and suburban areas is accomplished with archery equipment (typically compound bows and/or crossbows), but it may be possible to use firearms in larger green spaces such as parks. Safety equipment may be specified as well, such as with a requirement that all hunters wear full-body harnesses in tree stands.

Location – For hunts in parks, hunters may be prohibited from hunting within a certain distance of trails. Landowners may approve specific locations for tree stands or ground blinds and require that hunters only shoot from those locations. In many urban/suburban hunts, shooting is only allowed from tree stands to ensure that arrows have a downward trajectory and hit the ground within a short distance. The minimum height of tree stands may be specified. Landowners may also specify where hunters are permitted to park and what route hunters may use to enter their property.

Direction – In some cases, a landowner who is concerned about the proximity of a shooting location to other activities may wish to specify that a hunter is only allowed to shoot in a certain direction. Particularly if ground blinds are used, hunt coordinators may establish safe shooting directions for each location. Hunters who wish to cut branches or brush to clear shooting lanes should always obtain landowner permission first.

Distance – Hunters may be required to only take shots at deer that are closer than a certain distance.

Visibility – There may be a requirement to avoid shooting when a person is within sight or within a certain distance of the shooting location. There may be a requirement to cover deer carcasses completely when transporting them by vehicle.

Deer sex – Since deer population reduction is typically a principal goal, doe harvest is strongly emphasized in urban/suburban hunts. In some cases, only does are to be shot. In other cases, hunters may be allowed to shoot a buck after shooting a certain number of does.

Field dressing – Landowners may require hunters to remove all entrails from their property after field dressing a deer, or remove the carcass whole and dress it at another location.

Other

Venison disposition – Most of the venison is usually donated to local food banks. Landowners or municipalities may defray the butchering costs. A venison allocation system may be established to ensure that hunters, landowners and food banks all receive a predetermined share. To eliminate the risk of lead contamination of meat, the use of lead-free ammunition may be required. If lead ammunition is allowed, the potential for meat contamination should be carefully evaluated and communicated to recipients.

Conflict resolution – A procedure may be agreed upon for bringing any dissatisfaction or conflict between participants to a third party such as a hunt coordinator. This may permit many issues to be resolved while avoiding confrontation.

In addition to the rules established by the community, there should be a clear understanding that all federal, state and local laws, regulations and ordinances must be followed. Relevant New York State laws that all stakeholders should be made aware of include:

Discharge setbacks - Shooting a firearm within 500 feet, a crossbow within 250 feet, or a vertical bow within 150 feet of a school, playground, public structure, or occupied factory, church or farm building is prohibited. Shooting within those distances of a dwelling is prohibited unless the shooter owns or leases the building or has the owner's permission. With permission, it is legal to shoot even from within or on a dwelling. Where properties are fairly small, options for potential shooting locations will be expanded if neighboring homeowners grant permission for shooting within discharge setback distances.

Trespass – It is illegal to be on someone else's land without permission. Having shot a deer that then moved across a property boundary does not change this. Landowner permission must be obtained before a hunter can cross property lines to follow a wounded deer or recover a deer carcass. Landowners are not required to grant such permission. Hunters should seek all permissions they anticipate needing well in advance, and plan their shooting locations to avoid the likelihood that a shot deer will cross onto land where they have not been granted permission.

Interference – It is illegal to interfere with someone who is hunting lawfully and attempt to prevent them from killing game. Hunters should avoid confrontation, but should call 911 or DEC Dispatch if someone is interfering with their hunting.

Liability – The New York State General Obligations Law protects landowners from liability for non-paying recreationists hunting on their property. Participating hunters or a hunter organization coordinating a controlled hunt may wish to obtain liability insurance.

Sale of meat – Venison from wild deer cannot be sold.

If a Deer Damage Permit is obtained from DEC, a cull using volunteer shooters can be operated using a very similar structure and set of rules to a controlled hunt. The principal differences are that the permit allows deer to be shot outside of hunting seasons, hunting bag limits don't apply, and baiting and shooting at night with lights can be used to increase success. There must be a coordinator who is responsible for supervising the volunteers and ensuring that the terms of the permit are adhered to. The coordinator will probably need to provide training on the most effective use of bait and lights.

It's important to remember that even a well-run hunt with dedicated hunters won't effectively reduce a population if the hunters don't have access to the land holding most of the deer, so achieving adequate landowner participation is the key to a successful program.

APPENDIX 2. Ecological Monitoring Methods

Numerous options exist for communities to monitor ecological impacts of deer, though methodologies vary in complexity and effort necessary. DEC has partnered with research universities to develop the AVID protocol as a technique for the public and professionals to monitor deer impacts. Data collected through AVID, in addition to informing community deer management efforts, will be used by DEC deer managers to assess trends in deer impacts across the state. However, some communities may find alternative techniques to be helpful.

AVID

The Assessing Vegetation Impacts from Deer (AVID) protocol, developed by the Cornell University Department of Natural Resources, the State University of New York College of Environmental Science and Forestry, and DEC, can be found online at aviddeer.com. Training sessions are held periodically at various locations for people who want hands-on instruction.

AVID is a method for volunteers, foresters, landowners and others to monitor deer impacts on forests. It focuses on specific wildflower and tree species that are eaten by deer in New York. The AVID website and mobile app guide users through laying out monitoring plots, plant identification, and data collection. Within the plots, individual plants of the focal species are counted, marked and measured. Measuring these same individuals each year will show whether browsing pressure from deer is changing over time and may help communities, landowners, and managers make decisions on appropriate changes in deer abundance.

Ten tallest

The ten-tallest protocol uses the height of seedlings and/or wildflowers as indicators of forest health and browse impact. It involves laying out plots and then finding the tallest individuals of the focal species in the plots each year. Detailed instructions are being developed for publication, and in the interim may be obtained from protocol author Tom Rawinski, a U.S. Forest Service forest ecologist, at trawinski@fs.fed.us.

Seedling count

Background – A forest with overabundant deer will have very few tree seedlings that survive their first season of growth. As deer density is reduced, more seedlings will be able to survive. Once a seedling reaches 6' tall, deer shouldn't be able to reach the top, so deer browsing should no longer prevent it from growing.

Materials needed –

- Measuring tape.
- Marking materials such as posts or stakes to set plot corners.
- Compass to help you construct rectangular plots.
- GPS unit to record locations.
- String

Plot design – At least ten rectangular 6'x18' plots should be established. Strive to have enough plots to capture whatever variability there is in local forests. Avoid extremely rocky areas, steep slopes, and areas where the foliage is so dense that virtually no sunlight reaches the forest floor in the summer. If possible, plots should be at least 50 yards apart and at least 50 yards from any forest edge or manmade structure. Permanently mark the corners of the plots with posts or stakes. Record GPS coordinates of each plot to make it easier to find in future years.

Data collection – At the same time each year, count the native tree seedlings that are between 1' and 6' tall in each plot. The shape of the plots should make it possible for one person to make a single survey pass down the length of the plot tallying seedlings without losing track of which ones have been counted. Before starting a survey, lay out string along the two long sides of the plot so you can tell what's in and what's out. When you're done, pick up the string and take it to the next plot.

Evaluation – Natural ecosystems are too variable for there to be hard and fast rules about what densities are necessary for adequate regeneration, but as a rough lower limit guideline, an average count below five seedlings per plot (equating to approximately 2000 seedlings/acre or 5000 seedlings/hectare) would probably be cause for concern. Some forests in New York have more than four times that density of seedlings (>20,000 seedlings/hectare).

The species that are present should also be taken into consideration when assessing these results. If most of the seedlings are species that deer don't like to eat, like American beech (*Fagus grandifolia*) and eastern white pine (*Pinus strobus*), even though there are mature trees of other species around, that may indicate that deer browsing pressure is too high to allow the other species to grow.

Sentinel seedlings

Background – This method involves planting red oak (*Quercus rubra*) seedlings in upland forest areas and measuring the percentage of plants that have been browsed by deer after six months. Red oak is a common species in eastern North America. Green ash (*Fraxinus pennsylvanica*) can be substituted in wetland areas. Planting seedlings allows the assessment of deer browsing pressure without the need to find sites that have an adequate number of suitable plants growing naturally.

Materials needed –

- 1'-3'-tall red oak seedlings. Look for a nursery that offers bulk discounts.
- Measuring tape.
- Marking materials such as flagging, tree tags and stakes to help you find the seedlings.
- Planting tool such as a garden trowel or spade.
- GPS unit to record locations.

Sample size – To obtain accurate results, it's best to have at least 10 sites with 10 seedlings at each site.

Site selection – Avoid extremely rocky areas, steep slopes, young forests without mature trees, and dense conifer stands. If possible, sites should be at least 100 yards apart and at least 50 yards from any forest edge or manmade structure. The same sites should be used on each planting occasion. If there are surviving seedlings from the previous planting, they should be removed so they don't affect how attractive the site is to deer.

Timing – Plant seedlings in early winter (November - December) while they are dormant. Data collection should take place six months later. This covers the winter-spring time period when deer tend to do the most browsing on woody plants because there is little else available.

Planting – Plant seedlings at least 3' apart in a systematic pattern. Mark individual seedlings in an unobtrusive but durable manner, such as with a tree tag attached to a stake sunk in the ground 1' north of each seedling. Marking is necessary because if a seedling has been browsed, spotting it or identifying where it was can be difficult. Markers that are more visible might attract the attention of deer, because deer are curious enough to investigate things that look different. Record GPS coordinates for the site. Tie flagging around several trees at the edges of the site to make it easier to find in future years.

Data collection – Data interpretation can be improved if you count the number of leaf bud clusters on each seedling immediately after planting. Assuming you have a method of numbering the seedlings so you can match up the data, when you return in six months to look for leaves you will have a better idea of whether what you see shows browsing. Deer most commonly tear off leaves or parts of leaves. A stem torn by a deer will have a rough, jagged, frayed-looking end. In contrast, rabbit or rodent browsing usually results in a stem end with a clean-looking cut at about a 45º angle, because they bite it through rather than tearing.

Evaluation – Deer damage on more than 10% of the seedlings probably indicates that browsing pressure is too high to allow the forest to regenerate itself.