

Deer Management Options

Wherever deer are present on natural lands in southeastern Pennsylvania, there is a strong likelihood that the population is higher than the ecosystem can sustain without substantial losses of native plant and animal species, forest structural diversity, and advance tree regeneration and the proliferation of exotic (non-native) invasive plant species, black-legged ticks, and the bacterium that causes Lyme disease. That is because deer populations are no longer regulated as they were for millions of years, first by native predators and more recently by Native Americans hunting to supply their families with food. Year-round, geographically pervasive predation is the only force that has been demonstrated to be capable of limiting deer population numbers in most of our region, but all of their major predators are gone and will not be returning. Foods preferred by deer are so abundant across southeastern Pennsylvania that competition for food does not limit deer numbers, at least not until they are so plentiful that browsing has caused catastrophic changes to native ecosystems. Recreational hunting as it has been practiced since game laws were first instituted over a century ago is very different from predation or subsistence hunting. It does not regulate deer numbers at levels that allow native species diversity, forest structure, and advance tree regeneration to be sustained. However, the Pennsylvania Game Commission has been making changes to hunting regulations recently in recognition of the problems created by overabundant deer, expanding the hunters' "tool kit," extending hunting seasons, and allowing non-recreational culls in some circumstances. This has broadened landowners' options if they wish to reduce deer impacts on their natural lands.



Browsing by overabundant deer populations is the most significant factor in forest decline in Pennsylvania.

Landowners desiring more information on the deer issue in Pennsylvania are referred to *Managing White-tailed Deer in Forest Habitat From an Ecosystem Perspective: Pennsylvania Case Study*, which is available through Pennsylvania Audubon (<http://pa.audubon.org/>). This brochure is designed to help a land manager determine which option or options are most appropriate for his or her property.

No management

No deer management is an option if natural factors (predators, disease, famine) and human activities (hunting, car accidents) within the area are maintaining the deer population at a level that does not adversely affect important natural or cultural resources. Another basis for no management that

applies even where deer are overabundant and there is clear evidence of adverse ecosystem impacts is a landowner's belief that wild animals should not be harmed, perhaps coupled with the hope that nature or human ingenuity will eventually remedy the impacts without the need for lethal methods. In most situations in southeastern Pennsylvania, landowners with conservation priorities that include wildlife habitat, natural plant communities, or income from timber harvesting are likely to see those priorities compromised by the consequences of the no-management option.

An instructive example of the effects of the no-management approach is a 3,400-acre preserve north of Carlisle, Pennsylvania, managed by Natural Lands Trust. This property has suffered from extreme deer overabundance (densities over 100 per square mile) since the late 1960s when hunting was prohibited by the donor's will. The deer population has remained high—despite the total lack of understory vegetation—through the consumption of the annual mast crop (acorns, beech nuts, hickory nuts, etc. from the existing canopy trees), the few tree seedlings that are able to germinate, and agricultural crops on adjacent farm fields. As a result, the forest resembles a park with canopy trees and a carpet of Japanese stiltgrass spread and sustained by deer disturbance of the soil. Studies of forest gaps—the usual site of dense regeneration—by biologists at Dickinson College show a complete absence of tree seedlings. Computer models confirm the obvious: in the best case scenario, one without a major wind event or forest pathogen, the forest will gradually degrade into an impoverished savanna community with extremely low native species diversity as the current canopy trees decline and die.

Based on the current understanding of deer ecology and results on properties with high-density deer populations, failure to manage the deer population will make healthy natural forest communities unsustainable in southeastern Pennsylvania. The loss of native species diversity and structural variation in the understory will reduce habitat for local and migratory wildlife. A forest without a diverse understory lacks cover for ground-nesting birds such as ovenbird, worm-eating warbler, and Louisiana waterthrush and protected feeding and nesting areas for other forest-interior birds, including barred owl, Acadian flycatcher, wood thrush, cerulean warbler, northern parula, American redstart, Kentucky warbler, and

hooded warbler. A forest devoid of an understory also lacks shelter and moist conditions preferred by reptiles and amphibians, including salamanders, frogs, and turtles. The likely shift in plant dominance to exotic invasive species from natives, which are preferred browse for deer, will decrease food resources for insects (a key link in the food web sustaining larger animals), birds (the growth and survival of young birds, and often adults as well, depend on insects to supply fat and protein), and aquatic invertebrates in associated forest streams (they are largely unable to digest leaves of exotic plant species).

Without deer management, perpetuation of some semblance of natural forest communities would require the use of artificial regeneration (planted trees and tall shrubs) to regenerate the forest until the deer population collapses through disease or starvation. Trees and shrubs will need to be tall enough (>5 feet) when planted to escape browsing of terminal buds and be planted in numbers sufficient to maintain at least a 60% closed canopy under pressure from environmental stresses and pests and pathogens. The land manager will also need to accept the likely loss or severe degradation of the native herb layer.

Active management

Active methods to control deer overbrowsing can be grouped into two categories: those that restrict or deter deer access to desired vegetation and those that reduce the deer population within a tract of land. The current tools used to modify white-tailed deer behavior include barriers, repellents, and lethal removal. Two other approaches that are often talked about but are infeasible at present or are prohibited in the state are contraceptives and trap and transfer.

Barriers

Barriers physically restrict deer from interacting with vegetation in the treated area. Options under this method include tree shelters, netting, and deer enclosure fencing. Tree shelters and netting protect individual trees or shrubs; fencing excludes deer from all the vegetation in a specific area. Physical barriers have proven to be effective in protecting trees and shrubs in formal landscapes and forest vegetation although they can be expensive if used over a large area.

Tree shelters are useful to protect seedlings in open areas (estate areas, forest gaps, and edges) until they reach 6 feet in height and are above the maximum

browsing height of deer. However, their cost and maintenance requirements might limit their use by some landowners (financial assistance for planting and tree shelters may be available from the Pennsylvania Bureau of Forestry or the USDA Natural Resource Conservation Service). A 5-foot tree shelter with

support stake costs \$5 to \$6 depending on the quantity purchased. A per-acre cost at a 12-foot x 12-foot spacing will therefore run \$1,500–\$1,800, plus tree seedlings and installation. Tree shelters also require periodic monitoring and maintenance as they are attractive to deer as rubs and are sometimes targets of vandals.



David Seeckel

DEGRADED FOREST

There are no young trees to replace the old ones; no shrubs or low trees for birds to find food, nesting sites or cover; and no wildflowers to provide food or cover for ground-nesting birds and small mammals, or nectar for pollinators. Deer overbrowsing, along with stresses on hydrology and the impact of invasive species, can degrade a healthy forest community to the point where it becomes unsustainable.



David Seeckel

HEALTHY FOREST

How can you tell you're in a healthy forest? You can't see through it, at least in summer. Lush and three-dimensional, this forest is home to a complex, diverse community of life. It is the natural result of good stewardship. Deer may be present but at a density low enough that the forest can sustain itself. Water and nutrients are available in appropriate amounts, and exotic plants have not displaced the natives.



Cary Gimbert



Darrn Greff

Tree shelters are useful to protect seedlings in open areas (forest gaps and edges) until they reach six feet in height and are above normal browsing height by most deer.

Fencing holds more promise as a deer management tool, but it involves significant up-front expense and frequent monitoring to ensure the integrity of the fence. Deer fencing around significant areas of land are 8–12 feet high and constructed of box wire, plastic mesh, or electrified wire (shorter fencing can be effective if the enclosed area is very small or narrow, such as a vegetable garden). The Pennsylvania Bureau of Forestry uses two 4-foot sections (8-foot total height) of box wire fencing kept tight to the ground to protect tree regeneration following timber harvests. Bowman’s Hill Wildflower Preserve in Bucks County fenced 80 of its 100 acres with electrified wire in the early 1990s, effectively protecting its wildflower collection. Tyler Arboretum, near Media, Delaware County, in 2000 installed a 12-foot-tall, 2-mile-long deer fence around 105 acres of its collection at a cost of \$350,000 (including more than \$50,000 to provide vehicular access and a portion placed in the endowment for continuing maintenance). In addition to its high initial cost, fencing requires constant monitoring to quickly repair any breaks caused by

falling limbs or vandals and restricts not only deer movement, but also the movement of several other animal species. Cost estimates for large-scale fencing projects are currently on the low end about \$8–\$10 per running foot of fence and, depending on site characteristics and materials used, can range up to \$30 or more per running foot, including installation.

Costs and monitoring are complicated by internal roads, paths, or streams, requiring gates and stream crossing devices. One option that reduces the cost is to use temporary fencing, enclosing large (a quarter to half of the forested area) sections on a rotating basis to protect vital forest regeneration from deer browsing while maintaining accessibility to the rest of the forest for management and recreation. However, once advance tree regeneration is established and the fence is moved, the previously fenced areas are open to understory degradation again by deer browsing.

Fencing can also be used as an instructional and monitoring tool. Small (10 meter square) deer exclosures can be built at a relatively low cost (approximately \$300 per exclosure) to be monitored and compared to the existing forest. These study and demonstration areas provide a picture of the forest’s potential when browsing impacts from deer are removed. They also provide a feasible, more understandable, and far more useful barometer of deer overabundance than estimating deer density. The state of the forest within the exclosure can guide deer management outside.

Repellents

Repellents create unpleasant sensory experiences that discourage deer from physically interacting with vegetation in the treated area. Repellents include periodic loud sounds, bright lights, or foul-tasting foliar sprays, often with a base of capsaicin, the fiery alkaloid in chili peppers. Repellents can be effective in small areas where the goal is to reduce browsing damage to tolerable limits.

The main drawbacks to repellents are cost (approximately \$150 per acre, plus application) and their short-term effectiveness. Deer, particularly those in dense populations, quickly adapt to these tactics. The manager must be committed to continually monitoring application needs and experimenting with new products as deer adapt. Although foliar sprays may be useful for landscape and other special plantings, repellents are usually impractical for natural lands.

Contraceptives

Contraceptives to prevent pregnancy in deer have been tested and are a subject of ongoing research. The two major types of contraceptives are immunocontraceptives and hormonal contraceptives.

Immunocontraceptives “vaccinate” an animal against egg proteins. When an ovary releases an egg, the deer’s immune system views the egg as a foreign body and rejects it before it can implant itself within the uterus. Although very expensive and labor-intensive, immunocontraceptives have proven effective in arresting deer population growth under certain circumstances, such as on islands or within fenced parks or zoos where deer are confined to a relatively small area.

At present, the cheapest and most common method for administering immunocontraceptives is through the use of dart guns—close-range arms that are accurate to about 40 yards. Most population biologists feel that in order to stop herd growth in deer, they have to prevent pregnancy in 90% of the female population. Immunocontraceptives developed so far have to be readministered periodically to sustain sterility in each individual doe.

Hormonal contraceptives work primarily by preventing ovulation in does. The most effective method for administering this type of contraceptive is through subcutaneous implants. Although one treatment can be effective for multiple years there are logistical and health concerns associated with the use of hormonal contraceptives in natural areas on free-ranging deer (entering and leaving properties at will). The first is the need to immobilize each deer to apply the treatment, which is logistically difficult, very expensive, and stressful to the animal, often leading to self-injury or death. Potentially more problematic is the unknown consequences of introducing these hormones into the food supply.

Currently, there are no contraceptives for free-ranging deer that are approved by the FDA or any other governing body. Also, the effects of deer contraceptives on other animals (including humans) have not been studied. Because deer in southeastern Pennsylvania are free ranging, there is a high probability of human consumption of treated animals. It is even more likely that hormonal contraceptives will enter the food chain when treated deer die and are consumed by other animals, for instance, raccoons, opossums, foxes, coyotes, turkey vultures, crows, or

turtles. Introducing hormonal contraceptives into the environment and food chain could have unknown and far-reaching effects.

The use of contraceptives to manage the deer population on natural lands in southeastern Pennsylvania is not only prohibited by law, except as part of an established research program, but it is also infeasible at this time due to the high cost (over \$1,000 per doe annually for immunocontraceptives), the potential health risks of hormonal contraceptives, and the high mobility of the local deer herd. The fact that deer are free ranging throughout the region makes treating enough of the right animals almost impossible.

Trap and Transfer

Trapping or darting deer (requiring a permit from the Pennsylvania Game Commission) and moving them to another location is the most expensive, difficult, and ineffective deer control method. It is an option fraught with problems, the greatest of which is finding a location willing to accept more deer. This problem has become more difficult with the recent spread of chronic wasting disease (CWD) to nearby states (West Virginia and New York). Attracting well-fed deer into baited traps is the next challenge. Finally, survival rates of transported deer have been low. At present, the Pennsylvania Game Commission has a policy of issuing no permits for trapping and transferring deer.

Lethal Removal

Hunting is the most frequently used deer population reduction and maintenance method commonly available to landowners and land managers. Other lethal removal options, including deprivation permits for farmers and culls by sharpshooters are available, but tightly controlled by the Pennsylvania Game Commission. All lethal means of deer management focus on reducing the number of does by mainly targeting antlerless deer. Removing bucks has almost no effect on the year-to-year rate of population increase, decrease, or maintenance.

A controlled, recreational hunting program in most cases is the most practical deer management tool available in southeastern Pennsylvania at this time. However, scientific evidence is still lacking that it is fully effective over a broad range of situations for reducing impacts of deer to levels adequate for the restoration and maintenance of ecosystem health. The likelihood of success rests to a large degree on the level

of experience, skill, and dedication of the particular set of hunters who are the mainstay of the program.

There are several concerns surrounding the effective use of a deer-hunting program that should be considered by any land manager prior to implementation. The foremost issue is the safe use of firearms or archery in a region with a growing population and increasing use of natural lands. This is a particular concern in communities where natural lands are part of the common open space that is used by the local community. Any hunting program should be closely monitored by the land manager and controlled by restrictions that minimize the potential conflict between hunters and other users of the natural areas. These should include limitations on hunting areas and times, notification of appropriate persons when hunting is in progress, and an easy way to identify permitted hunters by other users. Most importantly, all hunters should be carefully screened for firearm proficiency and a history of ethical hunting practices. Any hunter who violates any program rule should be immediately removed from the program.

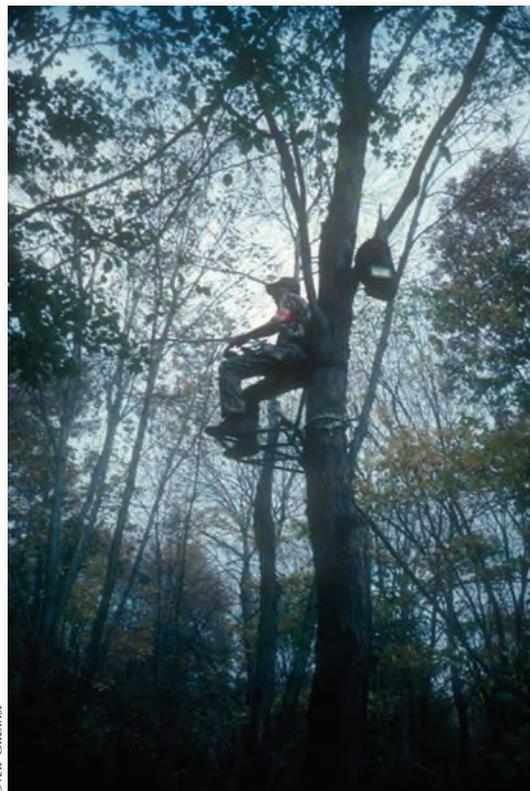
Ideally, hunting can lower the deer population to a level where only a few deer need to be removed each year to maintain the population at a level that allows healthy regeneration of the forest. Achieving this maintenance level is often complicated by ongoing suburban development in the surrounding landscape, which temporarily concentrates more deer on the remaining natural lands. If this is the case, it will probably require an extended period of more intense hunting, targeting mainly does, until the conversion of unprotected natural areas in the landscape to residential or other uses is complete. Perpetuating a maintenance level is also complicated by the fact that with a lower population, it may take hunters as much time to search out and remove a few deer as it now takes to remove a few dozen deer. The land manager will need to engage proficient, dedicated hunters to maintain the population at acceptable levels. Until additional options become available, recreational hunting will be the most widely used long-term method of keeping the population in check and allowing for limited forest regeneration until a point where populations stabilize in the surrounding area, which could be decades.

There are several potential alternatives and modifications within the lethal removal option that can be employed to reduce deer populations. The first

is the use of archery, particularly on small properties or properties with numerous residential structures on its borders. This would expand the hunting area (the safety zone for archery is 50 yards; firearms require a 150 yard safety zone) and extend the hunting time during the year by several weeks. An added benefit of allowing expanded access by hunters is that permitted hunters will monitor for unwarranted hunting while they are in the field.

In some situations, it is more efficient to engage a local hunting club to implement a deer population control program. They can handle all program administration, including proficiency tests, the scheduling of hunting times, and data collection on the separate harvest rates of does and bucks. The group should provide proof of insurance and be in close contact with the property landowner or manager to avoid conflicts with other activities in hunting areas.

Another alternative for expanding the number of deer harvested each year is enrollment in the



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A controlled hunting program is probably the most effective deer management tool available to landowners in southeastern Pennsylvania at this time.

Pennsylvania Game Commission’s Deer Management Assistance Program (DMAP). This program provides additional permit applications (coupons) to landowners that they can then give to hunters. One coupon is granted for every 5 acres of farmland and every 50 acres of other land cover (forest, meadow, successional). Additional permits above the standard formula are available if the landowner submits a management plan with their request. Unlike in past years, the landowner is no longer required to open their land to the general public.

A final option does not involve recreational hunting at all. It is the use of sharpshooters to remove deer. Under this option qualified professional sharpshooters are hired to euthanize a high quantity of deer within a property. This requires a special permit from the Pennsylvania Game Commission. The process is very rigorous and requires the landowner to make a convincing case that hunting within current game laws is not a viable option for managing the deer population at desired levels. However, this is probably the safest (removal is usually done at night using infrared sighting scopes, over isolated baiting stations located where shots are directed into the ground) and quietest (sharpshooters use rifle silencers) removal method and is the most effective option for reducing the deer population in the shortest time. The cash outlay is relatively high but the time demands on the land manager can be considerably lower than that required to run a controlled hunting program. The

venison is dressed and donated to charitable food banks or government-run institutions. Removal of other signs of the cull such as bloodied leaves may also be a part of the sharpshooters’ services. Culls must be performed annually, at least until ecosystem restoration is achieved. Once the deer population is reduced and overbrowsing impacts are alleviated, a controlled hunting program—if it is permissible or feasible—may be adequate to maintain the desired deer population density.

ESTIMATING DEER IMPACT

Monitoring vegetation indicators is a practical way to assess the effect of deer on forested areas. Vegetation can be assessed by two methods: (1) comparing the overall influence of deer browsing on existing vegetation to an established index or (2) quantitative sampling. The US Forest Service and Penn State University have developed a five-level deer impact index to visually assess the level of deer influence on forest health:

Deer Impact Index 1

Very low: No deer browse. Occurs only within a well-maintained deer enclosure.

Deer Impact Index 2

Low: Species composition and height of regeneration is determined mainly by available light, nutrients and seed source. There is a well-developed shrub

Summary of Active Deer Management Options

METHOD	COMMENTS	MOST APPROPRIATE APPLICATIONS
Tree Shelters	High cost and maintenance requirements	Converting small open areas to forest. Protecting landscape plantings.
Deer Fencing	Significant up-front cost, frequent monitoring	Establishing tree regeneration in overbrowsed forest areas. Creating demonstration areas. Protecting collections (arboretums).
Repellents	Impractical in natural areas	Protecting landscape plantings in small areas.
Contraceptives	High cost, permit/license	Maintaining populations in areas enclosed by fencing or isolated by significant natural boundaries (e.g., water, mountains).
Trap and Transfer	Expensive, difficult, transfer location, permit/license	Removing deer that are in an area that puts humans or themselves in immediate danger.
Lethal Removal	Currently most effective, safety concerns	Reducing and maintaining populations in areas large enough to provide appropriate safety zones.

layer and native wildflowers are abundant and grow to their full size.

Deer Impact Index 3

Moderate: Evidence of browsing is common with a greater reduction in height and abundance of the most-preferred species than of the least-preferred species.

Deer Impact Index 4

High: Preferred species are sparse or absent and all plants are nearly the same height as a result of browsing. Vegetation in the shrub layer is sparse except for the least-preferred species (e.g., spicebush, American beech, exotic invasive shrubs).

Deer Impact Index 5

Very high: A pronounced browse line is evident with virtually no vegetation below the browse line except for two rhizomatous fern species, hay-scented fern and New York fern or exotic invasive herbaceous species such as Japanese stiltgrass and garlic mustard.

The deer impact index is a qualitative measure; its utility for detecting change over intervals as short as one or two years is weak and its usefulness depends heavily on the level of experience and knowledge of the evaluator on food-plant preferences of deer, expected maximum sizes of various plant species under a variety of habitat conditions, and how to distinguish signs of deer browsing from plant damage caused by other animals and causes other than herbivory. Please note that these impact levels apply to later successional stages, particularly maturing, mature, and old-growth forests. Young forests (up to approximately 30 years old) typically have a dense canopy that prevents sunlight from reaching the forest floor. In this stage—called the pole or stem exclusion stage—the understory is largely free of shrubs and herbs due to heavy shade. As the forest matures and the canopy thins from the death of weaker trees, there is sufficient light to support a shrub layer on which deer can browse.

Quantitative sampling is more time-consuming but its interpretation involves less judgment and specialized expertise. A quantitative approach could include periodic surveys along a transect or cataloging vegetation change within fixed plots. The latter could be used in conjunction with the construction of deer exclosures.

Methods need to be scientifically rigorous if the results are to be sufficiently credible to serve as the basis for labor-intensive and potentially costly deer management procedures. For example, the protocol should include:

- random selection of areas to be sampled;
- sampled areas are large enough and sufficiently dispersed to include the variety of plant resources found within the property;
- sufficient replication and interspersions of treatments across the entire sampling area, for example, deer fencing, repellents, hunting; and
- sufficient number of samples to increase the likelihood of early detection of relatively subtle differences and to minimize the chances of confusing the effects of deer browsing with the effects of other factors that influence plant species composition.

The data gathered within sampling plots or along transects may include:

- percent cover of each plant species below 6 feet above ground surface (maximum height of deer browsing),
- number of seedlings and saplings of each tree species, and
- special measures of indicator species (forest-floor species known to be vulnerable to deer but somewhat tolerant of moderate levels of browsing, e.g., Canada mayflower, Indian cucumber-root, and several trillium species); measures may include height of tallest plant or length of longest leaf in the plot, and number of flowering/fruited individuals versus number of non-flowering/fruited individuals of each indicator species in the plot.

Excerpted from Natural Lands Trust's *Stewardship Handbook for Natural Areas in Southeastern Pennsylvania* (2008). For a more detailed discussion of deer management and information on stewardship of natural areas in general, please consult the *Stewardship Handbook*, available for free download or purchase at www.natlands.org/handbook.