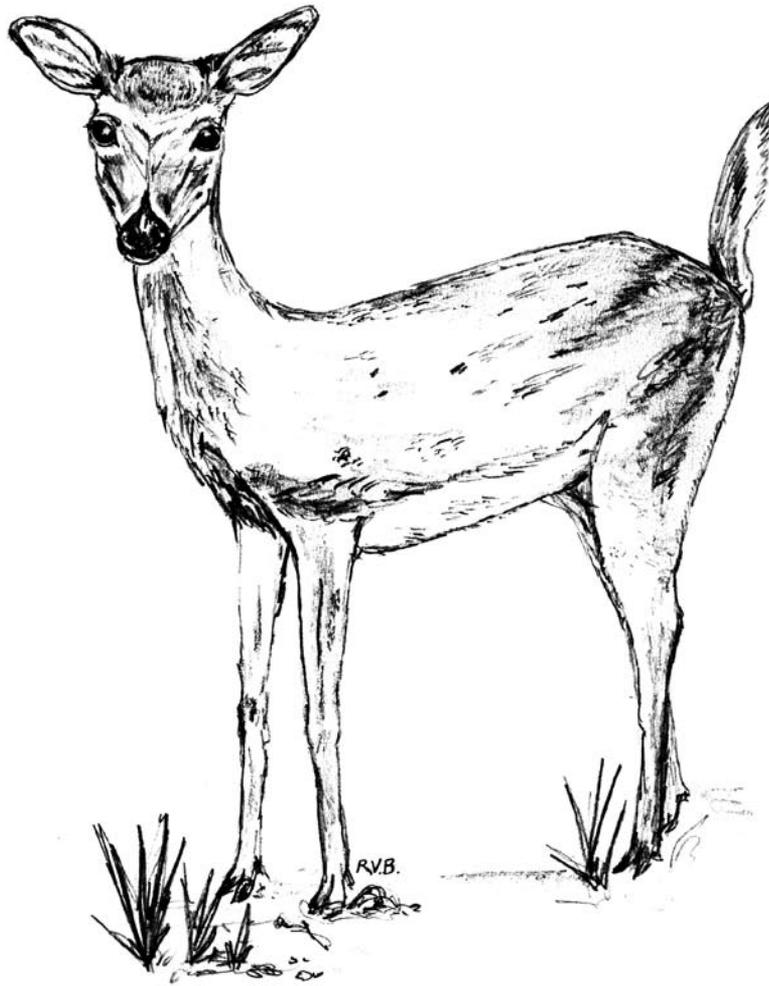


Managing **DEER** **Damage in Maryland**

Bulletin 354



Managing
Deer
Damage in Maryland

Jonathan Kays

Regional Extension Specialist—Natural Resources
Western Maryland Research and Education Center

For more information, refer to Maryland Cooperative Extension Fact
Sheet 655, "Resistance of Ornamentals to Deer Damage."

Table of Contents

Table 1. General Recommendations for Managing Deer Damage	iv
Introduction.	1
Integrated Pest Management.	2
Deer Pressure and Control Options.	3
Costs and Benefits of Control Methods	4
Altering Deer Habitat—Vegetation Management.	4
Managing Deer Habitat through Forest Stewardship	5
Scare Devices	8
Dogs Contained by Buried Electric Fencing	8
Ultrasonic Deer Devices.	9
Understanding How Repellents Work.	9
Applying a Commercial Repellent	10
Available Commercial Repellents	11
Noncommercial Repellents	11
Considerations for Choosing a Specific Repellent	12
Fencing.	14
Electrified Fencing.	16
Fence Maintenance and Effectiveness.	18
Permanent Nonelectric Deer Fences	18
Electric Permanent and Semipermanent Fencing.	20
Temporary Electric Deer Fences	22
Effectiveness of Temporary Electric Fences.	24
Tree Shelters.	25
Population Management.	25
Hunting	26
Developing a Hunting Program	26
Recruiting Effective Hunters	27
Hunting Strategies.	27
Crop Damage Permits	28
Suburban Deer Control	28
For Further Information and Additional Reading.	29
Scientific References.	32

Note:-When trade names are included, no discrimination against similar products is intended. Mention of trademarks in this publication does not constitute an endorsement by Maryland Cooperative Extension.

Table 1. General Recommendations for Managing Deer Damage for Different Land Uses.

Audience	Vegetation Management Pages 4–8	Repellents/ Scare Tactics Pages 8–14	Fencing Systems Pages 14–25	Management of Deer Population Pages 25–29
<i>Residential Homeowner</i>	<p>Plant trees, shrubs, annuals, and perennials less preferred by deer.</p> <p>Very ineffective in most areas due to moderate to high deer pressure.</p>	<p>Apply repellents and change products with every application. Only provides short-term protection and requires regular applications every 5-12 weeks.</p> <p>Repellents become less effective as more homeowners in the area use them. At some point deer will eat despite taste or smell.</p> <p>Leave dog outside all night contained by underground electric fencing system.</p>	<p>Use electric polywire/polytape fence to protect vegetable and flower gardens in growing season. Maintenance required.</p> <p>Install 8-ft. plastic or wire fence around back of yard to encourage deer to move on to other areas. Deer may become entangled in plastic fencing in some cases.</p> <p>Erect 8-ft. fence around the entire property perimeter.</p> <p>Install bird netting over shrubs in the winter or build cages around valuable shrubs and garden areas.</p> <p>Lobby community association or locales to allow use of electric fences or 8-ft. physical barriers if they are presently prohibited in local ordinances or covenants.</p>	<p>Contact political leaders to encourage hunting to reduce deer populations in nearby parks or other properties.</p> <p>Meet with your community association to encourage managed hunts.</p> <p>Contact MD DNR Wildlife Division for assistance with working with local communities to organize managed deer hunts.</p> <p>Use of deer contraception not a commercially available or practical option in suburban communities.</p>

Table 1. General Recommendations for Managing Deer Damage for Different Land Uses. (continued)

Audience	Vegetation Management Pages 4–8	Repellents/ Scare Tactics Pages 8–14	Fencing Systems Pages 14–25	Management of Deer Population Pages 25–29
<p><i>Forest Landowner (natural forest and forest plantation establishment)</i></p>	<p>Use forest management practices to create natural sources of deer browse and habitat. Contact a state forester for assistance. Must be balanced with adequate hunting pressure to keep population at carrying capacity.</p> <p>Leave slash from harvest operations distributed around site to discourage browsing of new growth by deer.</p>	<p>Use repellents on new forest plantings for 3-5 years or until they are out of deer's reach. Change repellents with each application. Not effective in areas with moderate to high deer pressure.</p> <p>Pairs of dogs contained within an electric fence to scare deer until vegetation above reach of deer. Unproven in this application.</p>	<p>Protect individual seedlings in plantations or in the natural forest with 4- or 5-ft. tree shelters.</p> <p>Install 8-ft. fence to physically keep deer out of new plantations, areas that have been recently harvested, or general forest areas. Protection for at least 5 years to allow regeneration to establish.</p>	<p>Forest landowners with a written forest stewardship plan or commercial agriculture operation with associated forestland can secure crop damage permits from MD DNR Wildlife Division to harvest doe deer.</p> <p>Develop a relationship with a local hunt club or hunters that requires harvesting of adequate numbers of doe deer, before buck deer are harvested.</p>
<p><i>Christmas Tree Grower</i></p>	<p>Use forest management practices on adjacent woodland to create natural sources of deer browse and habitat. Contact a state forester for assistance. Must be balanced with adequate hunting pressure to keep population at carrying capacity.</p> <p>Leave slash from harvest operations distributed around site to discourage browsing of new growth by deer</p>	<p>Use repellents to protect new seedlings until they are out of deer's reach. Change repellent with each application. Some repellents may have phytotoxic reaction and damage vegetation. Test for reaction. Requires regular applications that may not be cost-effective compared to fencing. Not effective in areas with moderate to high deer pressure.</p> <p>Pairs of dogs contained within electric fence unproven in this application but may be effective.</p>	<p>Install 8-ft. fence to physically keep deer out of new and existing plantations.</p> <p>Electric polywire/polytape fencing systems may be effective in some areas.</p> <p>Electric polywire/polytape fencing system installed in October can help to keep deer from browsing or rubbing trees prior to Christmas sale season.</p>	<p>Christmas tree plantation considered a commercial agriculture operation and owner can secure crop damage permits from MD DNR Wildlife Division to harvest doe deer.</p> <p>Develop a relationship with a local hunt club or hunters that requires harvesting of adequate numbers of doe deer, before buck deer are harvested. Hunting season may conflict with harvesting of trees or choose 'n cut operations so hunters must be able to work with needs of the landowner.</p>

Table 1. General Recommendations for Managing Deer Damage for Different Land Uses. (continued)

Audience	Vegetation Management Pages 4–8	Repellents/ Scare Tactics Pages 8–14	Fencing Systems Pages 14–25	Management of Deer Population Pages 25–29
<i>Commercial Row Crop, Livestock Farmer (soybeans, corn, hay)</i>	Clear out vegetation along field edges to reduce deer habitat and ease access by hunters. This may be in conflict with other wildlife habitat practices that encourage wildlife.	Repellents not cost-effective. Pairs of dogs contained within electric fence not practical. Use of propane cannons that are rotated around the property on a short-term basis may be effective. Neighbors may object to noise generated.	8-ft. fencing not cost-effective for most row crops. Electric polywire/polytape fencing may be effective for a few weeks during growing season around large fields.	Contact MD DNR Wildlife Division for crop damage permits to harvest doe deer and manage deer population. Develop a relationship with a local hunt club or hunters that requires harvesting of adequate numbers of doe deer, before buck deer are harvested.
<i>High-Value Agricultural Crop Farmer (nursery, orchard, vegetables, etc)</i>	Clear out vegetation along field edges to reduce deer habitat and ease access by hunters. This may be in conflict with other wildlife habitat practices that encourage wildlife.	Repellents not cost-effective. Pairs of dogs contained within electric fence very cost-effective. Application to vegetable production operations may be difficult. Use of propane cannons that are rotated around the property on a short-term basis may be effective. Neighbors may object to noise generated.	8-ft. fencing system very cost-effective and should be figured as a cost of doing business. Electric polywire/polytape fencing systems may be effective if used during critical times of ripening and before harvest.	Contact MD DNR Wildlife Division for crop damage permits to harvest doe deer and manage deer populations. Develop a relationship with a local hunt club or hunters that requires harvesting of adequate numbers of doe deer, before buck deer are harvested.

Table 1. General Recommendations for Managing Deer Damage for Different Land Uses. (continued)

Audience	Vegetation Management Pages 4–8	Repellents/ Scare Tactics Pages 8–14	Fencing Systems Pages 14–25	Management of Deer Population Pages 25–29
<p><i>County and City Parks, Golf Courses, Public Properties, Corporate Properties</i></p>	<p>Plant trees, shrubs, annuals, and perennials less preferred by deer. Very ineffective in most areas due to moderate to high deer pressure. Promoting the concept of planting less preferred species in a public property may give homeowners unrealistic expectations.</p>	<p>Apply repellents and change repellent with each application of products on an annual basis. Only provides short-term protection and requires regular applications. Not cost-effective over time compared to fencing. Pairs of dogs contained within electric fence may be very cost-effective in selected applications (i.e., ponds and selected areas). Additional benefits with controlling goose problems. Use of propane cannons that are rotated around the property on a short-term basis may be effective. Neighbors may object to noise generated.</p>	<p>8-ft. fencing systems to exclude deer very effective. Electric polywire/polytape fencing around small areas can be effective for growing season. Poor protection in dormant season.</p>	<p>Establish educational program including deer exclosures to educate employees, citizens, etc. about impact of deer on forest ecosystems, landscapes, vehicle collisions, Lyme disease, etc. Organize a county deer task force to assess the problem and effectiveness of different options. Contact Cooperative Extension or MD DNR Wildlife Division for more information. Contact political or organizational leaders to encourage hunting to reduce deer populations on affected properties. Contact MD DNR Wildlife Division for assistance with developing managed hunting programs.</p>

Go to www.naturalresources.umd.edu for more resources on managing wildlife damage.

Introduction

The white-tailed deer (*Odocoileus virginianus*) is of great economic and aesthetic importance to Maryland citizens. Every five years, the U.S. Fish and Wildlife Service conducts a nationwide survey of fishing, hunting, and other fish and wildlife recreational activities. The most recent 2002 survey documents that Maryland deer hunting generates positive benefits across the state. In 2001, 84,000 deer hunters spent more than 1.1 million days hunting deer with bow and firearms. These hunters spent \$82.3 million on equipment and supplies (up 105% over the last five years). When this initial spending is multiplied by the accumulative effect to the economy the total rises to \$156 million. Over \$4.1 million in Maryland sales tax is collected due to Maryland deer hunting and the deer hunting industry contributed to almost \$1.4 million in Maryland state income tax and \$6.4 million in federal income tax. The hunting industry itself employs 1,358 people.

The aesthetic and wildlife value of Maryland deer is not as easily quantified, but it is no less important to Maryland residents and vacationers. Surveys of residents by the Maryland Department of Natural Resources Wildlife Division indicate residents perceive deer in a positive manner. Ninety-five percent of Eastern Shore residents, 80 percent of western Maryland residents, and 75 percent of central Marylanders agree that deer are an important part of nature.

Rising Deer Populations

Despite their economic value and contribution to our quality of life, an overpopulation of deer can result in negative consequences, such as damaged crops, landscapes, and forests, and safety concerns due to deer vehicle collisions and Lyme disease. This usually occurs when the deer population exceeds the ability of the habitat to support them (known as "biological carrying capacity") or the ability to coexist with local human populations (known as "cultural carrying capacity"). Even with liberal hunting regulations, the deer population in Maryland has stayed at historically high levels. In 2001 the estimated

deer population was 240,000 deer, lower than the estimate of 249,000 deer that occurred in 1995.

Agricultural Crop Damage

Various surveys in the 1990s have documented statewide annual losses in Maryland of \$26.5 million for grain crops and \$11.5 million for high-value agricultural crops. There is some indication that aggressive hunting programs are resulting in lower losses of grain crops, which is a positive finding. Many farmers who produce corn, soybeans, and row crops are unable to justify the cost of protective fencing and other deer protection measures that are cost-effective for high-value agricultural crops. In many cases it becomes uneconomical to grow their crops due to high deer pressure and damage, which reduces profitability and may contribute to the sale of property for development. Producers of high-value agricultural crops such as nurseries, orchards, vineyards, etc., must include the cost of deer protection, typically fencing, as a business cost to assure a successful business operation.

Damage to residential landscapes from deer browsing is a major problem, but one that has been hard to quantify. A survey in Howard County found annual losses of \$4.8 million in residential and commercial landscapes for that county alone. It has become increasingly difficult to have a garden and landscape unless it is protected from deer.

Ecological Damage

In many of Maryland's forests, overbrowsing by large deer populations has eliminated understory vegetation and caused regeneration failure in recently harvested and planted woodlands. The use of expensive plastic tree shelters is necessary to regenerate hardwood forests. Deer are selective feeders, so many tree species that are favorites for browsing are unable to regenerate themselves. The loss of understory vegetation in forests results in a loss of wildlife habitat for forest birds and mammals, a number of plant species that deer favor over others, as well the loss of endangered plants that may have existed in the past. Overall, overbrowsing by deer has serious ecological consequences and results in a loss of biodiversity of plant and animal species.

Safety Issues

Overabundant deer populations have caused serious health and safety problems. According to the Centers for Disease Control and Prevention (CDC), Maryland was among the ten states with the highest number of reported Lyme disease cases in 2001. The current evidence is inconclusive as to whether lowering deer densities actually reduces the incidence of Lyme disease, however, deer serve an important part in the lifecycle of the black-legged tick (or “deer tick”) that carries the disease.

Deer vehicle collisions are a major safety and economic issue. The annual cost of deer vehicle collisions in Maryland is estimated at \$28 million. In Montgomery County alone, annual deer vehicle collisions have risen 23 percent, from 1,705 in 1997 to 2,127 in the year 2002. Deer vehicle collisions also cause human suffering, and the incidence of serious injuries and fatalities is increasing.

Deer Management Challenges

The natural predators of deer, such as wolves, coyotes and mountain lions, are no longer present in adequate numbers, therefore, population management through hunting is necessary to maintain acceptable population levels. However, even with generous bag limits and expanding hunting seasons, deer herds

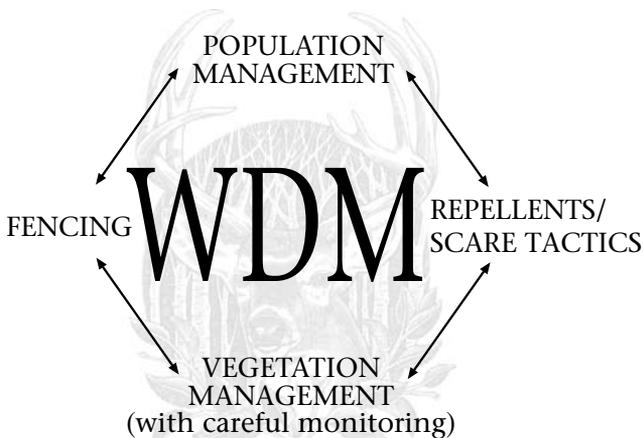


Figure 1. An integrated wildlife damage management program for deer may include a combination of management options.

continue to grow. This is especially true in suburban residential areas where traditional hunting is difficult to practice and deer have successfully adapted. The overall cause of the increase can be attributed to human populations shifting to rural and suburban homesites. Most land is privately owned and many well-meaning landowners do not allow access for hunting. The lack of hunting on many public and private lands results in deer refuges. Local land use regulations coupled with differing public opinions and an overall decrease in hunting, allows deer populations to grow unrestricted in many developed and undeveloped areas.

Although hunting is the most practical and economical way to regulate deer populations, other control measures, such as repellents, scare and harassment, fencing and vegetation management, are needed as part of an overall integrated strategy to manage deer damage.

Integrated Pest Management

When deer significantly damage crops, forests, or vehicles, they are considered to be a nuisance. The best approach to control deer damage is an integrated wildlife damage management plan, which includes careful monitoring of any one, or combination of, the following strategies: population management, fencing, repellents, or vegetation management (Figure 1). Although nonlethal techniques can help minimize damage caused by deer in any one area, the lack of any population control will likely result in an increasing population and the problems associated with this increase. Controlling deer damage requires a comprehensive program.

The combination of control options one should use in an IPM program will depend on accurate assessment of the problem and the desired outcome. Answering the following questions will help you consider the factors specific to your situation, which will help in planning an IPM program and potentially save time, expense, and frustration.

1. How much money am I losing as a result of deer damage? Surprisingly few people carefully calculate their annual losses resulting from deer damage. Regardless of whether the damage is to landscapes or crops, this question

must be answered to analyze the costs and benefits of the various control measures.

2. What are the types of deer damage?

There are primarily three types of deer damage: 1) browsing of plant parts, 2) antler rubbing of sapling bark, and 3) trampling of plants.

To recognize deer browsing, look for torn leaves or stalks with ragged ends. Deer have no upper incisors and must jerk or tear plants when feeding. Woodchucks, rabbits, and other small rodents usually leave cleanly cut plant stalks.

Another form of damage occurs when male deer rub their antlers on small flexible saplings. This is characterized by vertical scrapes and shredded bark on the saplings and exposed underlying wood. Trampling of vegetation occurs when deer bed down in an area, use an area as a travel path, group for various reasons, or when males fight in the fall during the rut.

It is important to determine the type of damage because certain controls are only effective against certain types of damage. For example, repellents may be effective against browsing damage, but they have little effect on antler rubbing or trampling.

3. What is the annual pattern of deer damage?

This will vary from year to year depending on weather, habitat, deer density, and other factors. Many fruit growers have planted young trees, successfully used repellents for 2 to 3 years, and then lost their entire investment as a result of deer grazing after a single severe summer or winter. It is best to plan a deer damage control program that is based on the most severe instance of damage in the past 5 years.

4. What is the seasonal pattern of deer damage?

Like annual damage patterns, seasonal damage patterns must be evaluated over a period of years. In general, summer damage is less extensive than winter damage, because other sources of food often are available in the summer. Fruit growers, foresters, nursery operators, and Christmas tree growers commonly lose dormant buds and annual growth to deer during the winter when other food is not available. In these cases, fencing, which can be costly, may be the only realistic option. However, farmers who suffer damage to field and row crops during the summer probably can use repellents or lower cost fencing to minimize damage.

5. What are the characteristics of the local deer population?

Growers should investigate deer hunting and population-density data for their region, as well as travel routes and high-use areas, such as stream corridors, woodlots, or areas with low hunting pressure. Much of this information is available from the district wildlife biologist at the DNR Wildlife Division.

6. What about the site?

The size and characteristics of an area, as well as the farm management plan, are critical to selecting appropriate deer control measures. If planting sites are to be replaced or expanded, control measures should take this into account. Controlling damage on a short-term site-by-site basis is costly and inefficient.

The size of the site is important. Large areas usually have lower per-acre, per-year control costs, but higher deer pressure because alternative food sources are far away. If fencing is used, it is important to provide travel corridors for deer. As the size of fenced areas increases over 20 to 25 acres, the effectiveness may decrease as deer penetrate the fenced area.

Farmers should remember that forests, fields, and brush around a site encourage grazing because deer do not have to stray far from cover. There is less deer damage potential in sites surrounded by open or developed land.

7. What about controlling other wildlife?

Some deer control programs can be altered to control other pests. With slight modifications, electric fences can impede raccoons, woodchucks, and rabbits.

Deer Pressure and Control Options

Deer damage control programs are most effective when planned well before crops are planted. Very low deer pressure may not warrant action when the cost of the damage is less than the cost of controlling it. Behavioral deterrents, such as repellents, usually are effective against low to moderate deer pressure. Deer repellents disrupt, rather than eliminate, deer feeding, and some damage will still occur. When deer damage reaches high levels in spite of repellents, damage may become economically intolerable. Under these conditions, fences are the best possible

control measure. In general, it is best to consider fencing as a cost of doing business in areas with heavy deer pressure. This is especially true with new orchards, fields, and other production areas.

Costs and Benefits of Control Methods

It is useful to estimate the cost-benefit ratio for a given control method, taking into consideration the annual cost of a control measure versus the annual cost of the deer damage. At this time the following question must be answered: **“How much money and time am I willing to spend to reduce the deer damage?”** The financial and human resources available to deal with the problem often will dictate the control options available. Fencing may be very cost-effective, but the grower must have the money to build the fence. Hunting and vegetation management options are not costly, but they will not usually solve the problem unless they are done properly.

A thorough cost-benefit analysis by growers will usually show the more costly options are worthwhile investments. For example, New York fruit-tree studies have shown that the cost of implementing an effective repellent program for more than a few years costs more than the cost of installing a standard high-tensile fence that can last for decades. Also, repellents become less economical, and properly installed fencing more cost-effective, as the size of a site increases; the larger the lot, the more dramatic the drop in fencing costs per acre.

At one Maryland nursery, deer caused approximately \$2,000 damage each year within a 5-acre tract. The cost of a commercially installed high-tensile fence is approximately \$4,000, and it will last for approximately 20 years. It is easy to see that the fence would more than pay for itself within a few years.

The key to an effective IPM program is monitoring on a regular basis to see if the program is working. It is difficult to change seasonal deer feeding habits after they have begun. Therefore, it is important to try to monitor whatever controls are being used to anticipate problems.

Altering Deer Habitat—Vegetation Management

Habitat for any wildlife species consists of food, cover, water, and space found within the home range of the species. The home range of a deer is about 1 square mile for does and up to 4 square miles for bucks. Studies in suburban areas indicate many deer live most of their life within a ¼-mile radius. Most landscapes in Maryland provide each of the habitat components within the home range of deer.

Deer prefer to stay near the edge of woodlands and brush areas that provide good cover. Many people see deer in mature forests with little undergrowth and assume deer prefer this type of habitat, but it is less desirable than dense woody thickets that provide food and cover. Farm crops and landscape trees and shrubs provide high-protein nutrition sources, as do native sources of browse, such as tree sprouts and seedlings. Thus, growers and homeowners usually experience the greatest amount of damage to crops and forests near these edges. Consider the following solutions:

- ◆ Leave as much open area as possible between field edges and planted material. Clear underbrush from field edges to a width of approximately 60 feet to reduce cover for deer. Bushhog this area a few times a year. However, growers must consider that destroying deer habitat means destroying the habitat of other wildlife as well.
- ◆ Plant landscape trees and shrubs that are not highly preferred by deer. Due to the high amount of deer pressure throughout the region, this strategy may not work in most locations. However, this strategy will tell you which species are likely to be browsed first so you can provide additional protection with fencing, repellents, or other means. Table 2 provides a few selections of species in these categories. For a more complete list of tree, shrub, annual, and perennial species, refer to fact sheet 655, “Resistance of Ornamentals to Deer Damage.”

- ◆ Use repellents and fencing near field edges.
- ◆ Placate deer by planting a “nurse crop,” a crop deer favor and may eat instead of your main crop. This technique can be prohibitively expensive, however, and it can backfire by actually attracting more deer to the area.

Managing Deer Habitat through Forest Stewardship

If you own more extensive areas of forestland that are being browsed by deer, you should implement a forest stewardship plan that considers the deer on the property. Deer prefer native browse that is close to the ground. This type of habitat can be created by forest harvest practices that thin or remove the forest canopy and allow more sunlight to reach the forest floor. Sunlight will then stimulate new growth. When the creation of native habitat through good forestry is combined with an effective hunting program, deer populations and damage can be greatly reduced at little cost. In many cases, this strategy can provide additional income through the sale of forest products, which allows woodland owners to make improvements to roads, fences, habitat, and structures that they could not otherwise afford.

In many cases, forest owners may want to minimize browsing of new regeneration of oak, ash, and other species, to allow it to become established. Many owners prefer to have slash from forest harvest operations cut low to the ground (2 to 4 feet) for aesthetic reasons. However, if slash is left uncut or piled high, it will make it difficult for deer to reach new regeneration. This can increase regeneration of desirable species, but it will have aesthetic consequences. In some cases, the use of electric or nonelectric fencing may be necessary to physically keep deer out of recently harvested areas so that the new forest regeneration can become established. The fence should be left in place for at least 5 years.

Forest Stewardship Planning

If you own more than five acres of forest, the Maryland DNR Forest Service or a private professional forester can prepare a written forest

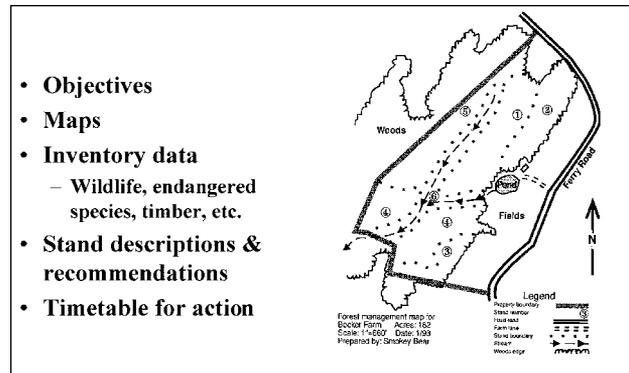


Figure 2. Components of the Forest Stewardship Plan.

stewardship plan for your property. A professional forester will look at your forest resources, divide the forest into different areas or stands that are similar enough to be managed as separate units (Figure 2), and then provide inventory data and descriptions of each of the stands. For each identified stand, the forester will recommend specific forest stewardship practices. The intensity of the recommended practices will depend on your objectives. The recommended practices will be part of a chronology of activities that will take place over a period of 10 years or so. Your forest stewardship plan will become your roadmap to forest activities over the next decade. The forester can inform you of assistance programs that are available to help you carry out the recommended practices and assist you with the timber sale process, if needed.

A great benefit of improving native habitat for deer on your property is that deer will then stay there throughout the hunting season. This will increase hunter success because deer will no longer leave the property to find more desirable habitat. An added benefit of having a written forest stewardship plan is that you can request deer management permits (known as “crop damage permits”) from the Maryland DNR Wildlife Division to remove overabundant deer that are damaging forest regeneration. The permits allow you, or other persons you identify, to harvest additional doe deer in or out of season. More details on this are found on page 28. The number of your state forester or wildlife biologist can be found in the blue pages of your phonebook. Educational seminars and publications are also available through your local

Table 2. Resistance of Ornamentals to Deer Damage.
(Partial list from Maryland Cooperative Extension Fact Sheet 655)

Rarely Damaged		
	<i>Botanical Name</i>	<i>Common Name</i>
Trees	Amelanchier canadensis	Shadbush
	Betula papyrifera	Paper Birch
	Cryptomeria japonica	Japanese Cedar
	Picea pungens glauca	Colorado Blue Spruce
	Pinus sylvestris	Scotch Pine
	Pseudotsuga menziesii	Douglas Fir
Shrubs and Climbers	Asimina triloba	Pawpaw
	Berberis spp.	Barberry
	Buxus spp.	Boxwood
	Calastrus scandens	American Bittersweet
	Cornus sericea	Red Osier Dogwood
	Hibiscus syriacus	Rose of Sharon
	Ligustrum vulgare	European Privet
	Rhamnus cathartica	Common Buckthorn
Annuals, Perennials & Bulbs	Achillea spp.	Yarrow
	Aconitum spp.	Monkshood
	Aquilegia spp.	Columbine
	Antirrhinum majus	Snapdragon
	Arisaema triphyllum	Jack-in-the-Pulpit
	Convallaria majalis	Lily-of-the-Valley
	Dicentra spectabilis	Bleeding Heart
	Ecinaea purpurea	Purple Coneflower
	Fritillaria spp.	Fritillary
	Hyacinthus orientalis	Hyacinth
	Lavandula spp.	Lavender
	Lobularia maritime	Sweet Alyssum
	Narcissus spp.	Daffodil
	Rudbeckia spp.	Coneflower
	Tagetes spp.	Marigold
	Tropaeolum majus	Nasturtium
Seldom Damaged		
	<i>Botanical Name</i>	<i>Common Name</i>
Trees	Ammelanchier candensis.....	Shadbush
	Cornus kousa	Korean Dogwood
	Fagus sylvatica	European Birch
	Lindera benzoin	Spicebush
	Pinus resinosa	Red Pine
Shrubs and Climbers	Buddleia spp.	Butterfly Bush
	Forsythia spp.	Forsythia
	Lonicera spp.	Honeysuckle
	Myrica pensylvanica	Bayberry
	Nandina spp.	Heavenly Bamboo
	Spiraea spp.	Spiraea
	Syringa villosa	Late Lilac
	Syringa vulgaris.....	Common Lilac
	Viburnum rhytidophyllum.....	Leatherleaf Viburnum
	Viburnum carlesii	Koreanspice Viburnum
	Viburnum plicatum	Doublefile Viburnum
	Weigela florida.....	Old Fashion Weigela

Table 2. Resistance of Ornamentals to Deer Damage (continued)

Annuals, Perennials, & Bulbs	Aruncus dioicus	Goat's Beard
	Aster spp.	Aster
	Chrysanthemum spp.	Chrysanthemum
	Iris spp.	Iris
	Lobelia spp.	Lobelia
	Lupinus spp.	Lupine
	Oxalis spp.	Sorrel
	Potentilla spp.	Potentilla
Zinnia spp.	Zinnia	

Occasionally Damaged

	<i>Botanical Name</i>	<i>Common Name</i>
Trees	Acer rubrum	Red Maple
	Acer saccharum	Sugar Maple
	Juniperus virginiana	Eastern Red Cedar
	Quercus alba	White Oak
	Quercus rubra.....	Red Oak
	Salix spp.	Willow
	Tilia americana.....	American Linden
Shrubs and Climbers	Campsis radicans	Trumpet Vine
	Hamamelis spp.	Witch Hazel
	Hydrangea arborescens	Smooth Hydrangea
	Parthenocissus quinquefolia.....	Virginia Creeper
	Rhododendron spp./deciduous tree forms	Rhododendron
	Rosa multiflora.....	Multiflora Rose
	Spirea prunifolia	Bridalwreath Spirea
Syringa x persica	Persian Lilac	

Frequently Damaged

	<i>Botanical Name</i>	<i>Common Name</i>
Trees	Acer platanoides.....	Norway Maple
	Cercis canadensis	Redbud
	x Cupressocyparis leylandii	Leyland Cypress
	Ilex 'Nellie Stevens'	Nellie Stevens Holly
	Pinus strobus.....	White Pine
	Tsuga spp.	Hemlock
Shrubs and Climbers	Clematis spp.	Clematis
	Ilex cornuta.....	Chinese Holly
	Kalmia latifolia.....	Mountain Laurel
	Rhododendron hybrids.....	Evergreen Azaleas & Rhododendron
	Rosa hybrids.....	Hybrid Roses
	Taxus spp.	Yew
Annuals, Perennials, & Bulbs	Hedera helix.....	English Ivy
	Helianthus spp.....	Sunflower
	Hosta spp.	Hosta
	Hemerocallis spp. & hybrids	Daylily
	Lilium spp.....	Lily
	Pelargonium spp.....	Geranium
	Trillium spp.	Trillium
	Viola spp.	Pansies & Violas

Extension office. Access to local forest service and Extension offices, as well as lists of wildlife biologists and licensed professional foresters can be found at www.naturalresources.umd.edu.

Scare Devices

Loud noises, scarecrows, and dogs may deter deer over a short period (a few days to weeks), but these strategies generally lose their effectiveness as time passes. Deer have a great ability for adapting to their environment. However, scare devices may be quite effective if damage is minimal, the crop will be harvested shortly, or when used in combination with other control techniques.

Gas exploders set to detonate at regular intervals are the most common scare devices (Figure-3). Newer devices are available that emit short, irregularly spaced blasts of sound. They can be purchased from commercial sources (approximately \$350) or borrowed from equipment-rental establishments. To maximize their effectiveness, exploders should be moved every few days. If this is not done, deer will quickly become accustomed to the noise.

Fireworks and gunfire may provide quick, temporary solutions, but this method is labor-intensive. A portable radio tuned to a station with an all-night talk show is a good idea. Again, the radio must be moved frequently to remain effective.

Dogs Contained by Buried Electric Fencing

Pairs of free-ranging dogs contained by buried electric fencing (“invisible fencing”) around a protected area can be an effective deterrent.

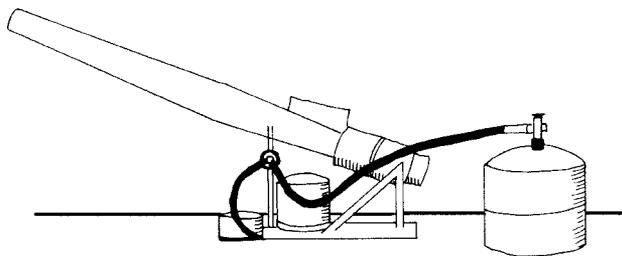


Figure 3. Propane exploders are a common scare device. (From S. Craven and S. Hygnstrom’s “Controlling Deer Damage in Wisconsin,” Publication No. G3083, University of Wisconsin–Extension, Madison. Reprinted with permission.)

House pets are usually not effective because deer feed in the evening when house pets are less likely to be roaming.

Commercial companies have taken the invisible fence technology used in home systems and developed a commercial system for large acreages. Research in commercial orchards and nurseries has found that areas of 20 to 40 acres can be protected from deer damage. The actual acreage depends on topography, visibility, snow cover, and other factors. The dogs are sourced from shelters, trained and fitted with an electronic collar that will sound off and finally give a slight shock if the animal comes too close to the buried fence wire. Each dog must be carefully selected to get a suitable breed that is independent, but good with people. Automatic feeding and water stations are positioned in the protected area, and owners agree to follow a rigorous dog maintenance protocol. A pair of dogs is used in each fenced area so that they have companionship and do not go wild. The dogs are visited by humans on a regular basis to maintain animal-human contact. Dogs chase deer away from inside the fenced area. There are successful applications of this technology to deter geese and groundhogs as well.

In one demonstration study in a commercial nursery, the initial cost of the control box, fence wire for a 6,000-foot perimeter (35 acres) installed by the producer, automatic feeders, dog food, veterinary care, batteries for collars, and dog shelters was approximately \$4,000, or \$0.65 per linear foot. The annual long-term expense of dog care can run \$365 per year (\$730 per pair) or \$1 a day per dog. As with any system, growers need to compare the long-term cost with that of high-tensile fencing. The control box is capable of protecting three zones, so additional areas could be protected at lower cost, but the dog cost would be similar.

Two-year results of a Cornell University study in three apple orchards in New York protected by Off Limits Crop Protection Systems found significant reductions in bud loss, more bloom density, and higher yields. A study at the University of Maryland in an area with heavy deer pressure protected by Off Limits Crop Protection Systems found apple trees outside the fenced area failed to survive one year, while those

in the protected area developed normally. While protecting deer was the main objective, the dogs also killed significant numbers of groundhogs and raccoons. While economic data appear favorable, it is important to realize the system functions more as a repellent or scare device than as a physical barrier.

This technology provides a cost-effective option for commercial fruit growers, nurseries, and others with high-value crops. It has been utilized by many growers in the mid-Atlantic area. The fact that it eliminates the need for cumbersome gates that limit equipment access is a major selling point. However, the dogs require a lot of care and situations may arise if dogs escape from the fence or fail to chase the deer. The owner is then left with the difficult task of finding a home for the dog in question and sourcing a new dog to take its place. While the initial cost of this system is lower than the cost of an 8-foot fence, the long-term expense and care of dogs must be considered when comparing this system with the higher one-time cost of an 8-foot exclusion fence that may last 20 to 25 years.

Ultrasonic Deer Devices

The development of ultrasonic devices to repel deer has increased, and many products for small landscapes are available commercially. These devices produce high-frequency, short-wave ultrasonic sounds that are inaudible to people, although some animals, such as deer, dogs, and cats, can hear well in the ultrasonic range. Devices are sold that are triggered by an infrared detector that turns on the ultrasonic device and a floodlight to further startle the deer.

Much anecdotal evidence exists that suggests these devices may be effective in some applications. However, in many cases the deer will become used to the noise. Research is ongoing, but, to date, none of these products have been proven effective.

Many drivers install deer whistles on the front bumpers of vehicles in an attempt to reduce deer-vehicle collisions. These whistles operate at frequencies of 16 to 20 kHz and are intended to warn animals of approaching vehicles. There is no research that indicates that deer are frightened

by a particular frequency or that the devices reduce deer-vehicle collision. In fact, they give drivers a false sense of security.

Roadside Reflectors

Roadside reflectors have been used with varying success to reduce deer-vehicle collisions in Maryland and elsewhere. Reflectors deflect the headlights of passing cars, creating a wall of light that shines parallel to the road, which possibly discourages the approach of deer. Reflectors provide a warning only when vehicles are present and at low light times of the day, such as dawn, dusk, and nighttime. It is unclear if deer adjust to the reflectors. Some research indicates deer in residential areas may respond less favorably to reflectors, since they are more accustomed to human activity and light. Reflectors have been tried in problem areas in Maryland and other states with mixed success. At a cost of \$12,000 per mile of road to install, plus maintenance cost, the use of roadside reflectors will have to depend on local conditions, funding, and more applied research.

Understanding How Repellents Work

Repellents disrupt and reduce instances of deer feeding on plants for a short period of time and must then be reapplied. Repellents are most effective when used in orchards, nurseries, gardens and on ornamental plants. Their value for row crops and forages is limited because of their expense, application restrictions, and variable results. The use of repellents can help to protect vulnerable landscapes, but they usually are expensive and require regular application. Repellents are most effective when used as part of an Integrated Pest Management program that includes other repellents, scare devices, fencing, vegetation management, and population control.

Repellents fall into three categories: taste, odor, and combination taste and odor. **Taste-based repellents** are applied directly to plants and repel deer because of their foul taste. They are most effective on dormant trees and shrubs. New growth that occurs after treatment is unprotected. Taste-based repellents may reduce the palatability of forage crops and should not be used on plant parts that are intended for human consumption,

unless it is labeled for that use. Because taste-based repellents require consumption of the plant material, damage still may occur as deer sample a plant and then move on.

Odor-based repellents repel deer by their foul smell or odor. As a general rule, odor-based repellent products usually out-perform taste-based products. Some odor-based repellents are applied directly to plants whereas others are placed near plants you want to protect. Border applications of odor-based repellents may protect large areas at a relatively low cost. Crops grown for human consumption can not be protected by odor-based repellents when applied directly, unless labeled for that purpose.

Combination odor and taste-based repellents provide the benefits of both types of repellents and allow for a range of applications. They are becoming more available. In areas with high deer densities and browsing pressure, crops and landscapes can be damaged if only a taste- or odor-based repellent is used and many deer sample the plants. By combining odor- and taste-based active ingredients, effectiveness may be increased. Different formulations allow the user to change the repellent and confuse deer by changing the range of odors and tastes.

Anyone using repellents should understand some basic principles:

- ◆ Do not feed deer. This only develops a feeding pattern that is difficult to break.
- ◆ Repellents do not eliminate browsing, they only reduce it; therefore, repellent success is measured by the reduction, not elimination, of damage. If minimal damage is not acceptable, 8-foot fencing is the best option. Bird-netting can be used to protect individual shrubs or small planting beds.
- ◆ Rainfall will wash off repellents with time, so they will need to be reapplied. Some repellents weather better than others. As a general rule, odor-based repellent products usually out-perform taste-based products, but it is unrealistic to expect more than 5 to 6 weeks of protection from any commercial repellent when you have high deer populations and browsing pressure during the dormant season.

Protection may last longer when conditions and seasonal factors are less severe.

- ◆ Repellents do not reduce damage caused by antler rubbing.
- ◆ Repellents work by altering deer behavior. Therefore, they work best if used before feeding habits become established in a certain area. Deer establish their winter feeding habits in the late fall and spring.
- ◆ The availability of other, more palatable deer food dictates the effectiveness of repellents. When food is scarce (for example, during the winter or a drought period), deer may ignore both taste and odor-based repellents.
- ◆ A repellent that works in one area may not work elsewhere, even if the crop and conditions are similar to the first site.
- ◆ If you use repellents, do not overlook new preparations and products. New products are constantly appearing on the market. Learn about repellents by their active ingredients, not just by their trade name.
- ◆ Deer become accustomed to the same repellent and may learn to ignore the foul taste and odor. Alternating repellents with each application might help to keep them confused and wary.
- ◆ Deer damage is an increasing problem and will be with us for years. Growers and homeowners who are facing long-term problems should compare the cost of repellents and fencing over many years. In many cases, it is more cost-effective to invest in a fencing system.

Applying a Commercial Repellent

Application methods for commercial repellents range from machine sprayers to manual backpack sprayers to handheld sprayers purchased at department stores. For large farms and commercial operations, machine sprayers are most economically efficient. The number of applications can be reduced by using compatible repellents (there are very few) in regularly scheduled pesticide programs.

Apply repellents on dry days when temperatures are above freezing and rain is not expected for a number of hours so they can dry properly. Whereas small trees should be completely treated, the cost of treating larger trees

can be reduced by limiting repellent application to the terminal growth within reach of deer (6 feet above the deepest snow).

Repellent applications are divided into two general classes based on the time of the damage: 1)-*winter or dormant season*, and 2) *summer or growing season*. Dormant season damage is most common in nurseries, orchards, forest seedlings, residential landscapes, and Christmas tree crops. It is most difficult to control due to the lack of other food sources. Growing season damage is most common in field and row crops. Apply repellents before the anticipated periods of deer browsing. The objective is to make the planted material unattractive to deer, so that they feed elsewhere. Once a feeding pattern has been established, repellents are usually less effective. It is important to note that if no alternative foods source is available or if deer pressure is too high, even the best planned repellent program may fail. This is why it is essential to analyze your situation.

As a preventative measure, the first repellent application of a summer control program should take place within 2 weeks of budbreak. During the growing season, repellents should be applied as necessary to protect new growth, usually every 3 to 4 weeks. For some crops, it may be possible to disrupt deer feeding simply by spraying a wide strip on the border of the planting. For dormant season protection, midfall and early winter applications are recommended.

Regardless of the type of application program used, every program should be planned in advance and implemented on schedule. Periodic monitoring is essential for determining the necessity and timing of subsequent applications.

Available Commercial Repellents

The list of available commercial repellents continues to grow as new products are developed that are taste- and odor-based, and that use a combination of taste and odor. Many users of repellents tend to focus on the trade names of different repellents and are very confused about how and why they work. Confusion can be reduced by learning about the *active ingredient* that makes the repellent effective and selecting your repellent based on the active ingredient, not the trade name.

The information that follows attempts to organize the vast number of available products by active ingredient for two main categories:

- ◆ **Repellents for use on edible plants**—as a group these repellents tend to wash off quicker than contact repellents and may require special stickers such as Wilt Pruf, Latex 202-A, Vapor Guard, or Weathershield (known as anti-transpirants) to make them last longer.
- ◆ **Repellents not for use on edible plants**—as a group these repellents tend to have formulas that make them stick to the surface to which they are applied. They are commonly used on ornamentals where long-term effectiveness is desired.

A third category includes zone repellents. These are commercial products that are packaged in a hanging bag (sachets) or are sprayed over the area to provide a scent that attempts to keep deer out of the area. Sachets filled with soap or meat meal that putrefies with age are available commercially. Research on these products has been limited.

Noncommercial Repellents

All noncommercial repellents are odor-based repellents that are applied to trees, shrubs, and vines. When using noncommercial repellents, make sure you are using a registered material for that application. For example, "home remedies" such as moth balls are not registered for this use, and they should not be considered for this purpose. To effectively deter deer in an urban or suburban environment, use scents that are not naturally found in those areas. Three noncommercial repellents are human hair, tankage, and soap. All are odor-based repellents that are applied to trees, shrubs, and vines.

Human hair. Human hair is a repellent that costs very little, but may not consistently repel deer year-round. However, many people have obtained successful results for periods of time. Obtain hair from local beauty salons and barbershops and store it in plastic bags before use. When using hair as a control method, bag it in 1/8-inch or smaller mesh bags (Vexar [Dupont] material used in fruit and vegetable packaging) or nylon stockings. The bags should contain at least two large fistfuls of hair and be attached to plants

at a height of 28 to 32 inches. On older trees and vines, place bags no more than 3 feet apart on outer branches. Attach them in early spring and redistribute fresh bags of hair monthly. Some users have reported increased success by periodically spraying the bags with cologne or aftershave.

Soap bars. Several recent studies and numerous testimonials have shown that ordinary bars of soap applied like hair bags can reduce deer damage. Hang bars of soap every 3 feet on vulnerable trees and shrubs. Leaving the wrapper in place, drill a hole in each bar and suspend it with a twist tie or string. As the bars weather away, they must be replaced. This method is labor-intensive, but many fruit growers claim it is an effective and economical control, especially on very young trees. Any inexpensive brand of soap will work. Some vendors sell ready-to-use bars.

Tankage (putrefied meat scraps). Tankage is a slaughterhouse byproduct traditionally used as a deer repellent in orchards. It repels deer by smell, which is readily apparent. To prepare containers for tankage, remove the tops from

aluminum pop cans, puncture the sides in the middle of the cans to allow for drainage and attach cans to the ends of 4-foot stakes. Drive the stakes into the ground 1 foot from every tree you want to protect or at 6-foot intervals around the perimeter of a block. Place 1 cup of tankage in each can. You can use cloth bags instead of cans. You may have to replace the containers periodically because fox or other animals sometimes pull them down.

Considerations for Choosing a Specific Repellent: Effectiveness, Longevity, Ease-of-Use, and Cost

Effectiveness and Longevity in Residential Landscapes

Studies of the effectiveness of different repellents on nursery plant species and residential landscapes show large differences in these factors (Tables 3 & 4). *In general, it is unrealistic to expect more than 5 to 6 weeks of protection from any commercial repellent when you have high deer populations and browsing pressure during the dormant*

Table 3. Repellents for Use on Edible Plants. Some repellents wash off easily with rainfall and may require the use of an adhesive additive to increase longevity. Adhesives are a group of additives known as "anti-transpirants" that are added to the repellent mixture and increase its resistance to weathering. Some common trade names are: Vapor Gard, Weathershield, and Latex 202-A.

Mode of Action	Active Ingredient	Use on Edibles	Longevity	Trade Names
Odor	salts/fatty acids	Yes (EPA label)	Washes off after heavy rain *	* Hinder *Deerbusters deer & rabbit repellent
Odor	garlic oil	Yes (EPA label)	Washes off after heavy rain *	* Deerbusters deer & insect repellent
Taste	capsaicin	Yes (EPA label)	After heavy rain *	* Miller's Hot Sauce
Odor	Predator urines	Not directly (But can apply nearby to protect edibles)	30 days plus or minus	* Coyote and wolf urines (many companies offer products)
Odor Taste	Fish by-products and/or beef by-products	Not within 8 weeks of eating (Used as a growth stimulant with repellent properties secondary)	15-30 days	* Bobbex * Deerbusters plant growth stimulant

* New growth requires application more often.

season characteristic of northern climates. Protection may be longer when the conditions and seasonal factors are less severe. In the residential environment, there are large differences in the effectiveness and longevity of different repellents with similar costs.

Applied research in Montgomery County, Maryland, has found that certain repellents provide up to 13 weeks of protection for desirable landscape plants (yews and azaleas) during the dormant season. Different repellents representing the range of active ingredients were applied to yew and azalea shrubs in January of 2000, 2001, and 2002, using a research design, and followed for 9 to 13 weeks. The sites selected were in an area with high deer pressure (greater than 100 deer per square mile) and included residential homes, regional parks, and parks adjacent to active development sites. The amount of vegetation lost to deer browsing was measured weekly. Overall, the shrubs treated with repellents significantly

reduced deer browsing compared to the control plants that were not treated (see Figure 4).

Even at sites with high deer pressure, most repellents held damage to a minimum for 6 to 8 weeks. At sites with light to moderate deer pressure, a minimum of 10 or 12 weeks was more common. Warmer and drier winters will increase the effectiveness of repellents. While odor-based repellents have proven more effective in the colder northern climates, they showed no clear advantage in the Mid-Atlantic. For more information on this study of repellents, contact your local Cooperative Extension office or go to www.naturalresources.umd.edu.

Effectiveness and Longevity in Forest Agriculture

Repellents can be effective for short-term forestry applications on seedlings that only need a few years of protection to grow out of the reach of deer. In agricultural applications,

Table 4. Repellents Not for Use on Edible Plants. These are repellents designed to stick to ornamental trees and shrubs and provide a longer period of control.

Mode of Action	Active Ingredient	Longevity	Trade Names
Odor Taste	egg-based	5-6 weeks*	* Deer-Away * Liquid fence BGR * Rejex-It Deer Chaser
Taste	Fungicide Thiram-based products	5-6 weeks*	* Bonide Chew-Not * Deerbusters deer repellent & turf fungicide
Odor Taste	Edible animal protein (bloodmeal products)	5-6 weeks*	* Deerbusters Deer II * Plantskydd * Repellex
Taste	Denatonium benzoate or bitrex	5-6 weeks*	* Tree Guard * Ropel * Repel
Odor Taste	Some combination of the following: egg-based, garlic, fish oil, hot pepper, bitrex	5-6 weeks*	* Bobbex * Deer Blocker * Deerbusters Deer I * Deer Stopper II * Deer Off MGD deer repellent Not Tonight Deer

* It is not realistic to expect commercially available repellents to be effective for more than 5-6 weeks with high deer densities and browsing pressure commonly found during the dormant season in cold northern climates. Effectiveness might last longer in mid-Atlantic regions with milder climates and little snowfall. New growth requires application more often.

repellents may be suited to short-term crops such as strawberries or vegetables that only need protection during the growing season when other food sources are available for deer and they can be discouraged from frequenting the target area.

Cost and Ease of Use

Repellents usually are not cost-effective in managing deer damage over a long period of time for either commercial growers or residential homeowners. Studies in New York have shown that the cost of a repellent spray program for reducing deer damage year round in orchards exceeds the cost of high-tensile deer fencing after only a few years. Money spent on repellent applications could be wasted if unusual weather conditions force deer to eat crops as a result of the loss of alternative foods. Table 5 lists the costs of commercial and noncommercial repellent materials (not including labor) from various research studies that have been conducted in nurseries and orchards.

Because many residential homeowners are not as concerned as commercial growers about cost, the use of repellents in residential landscapes is increasing. However, even residential homeowners soon will find that the long-term cost of repellents can be prohibitive, as can the

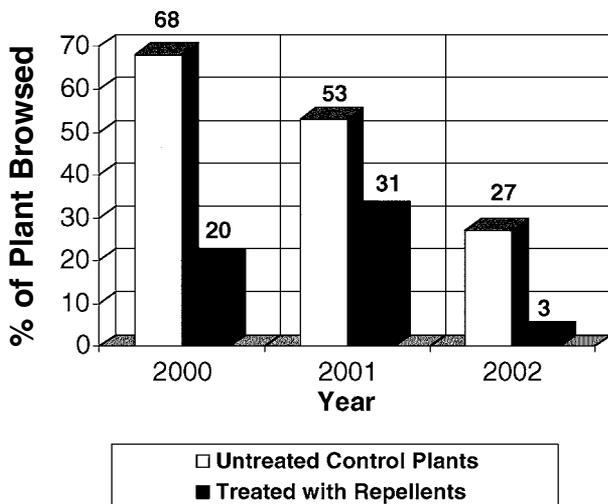


Figure 4. Loss of plant material by deer browsing in repellent applications in Montgomery County in each of three years. Applications were made in January and lasted 9 to 13 weeks. Winter 2002 was unusually warm, which resulted in better performance of repellents because other food sources were available.

Table 5. Cost of repellent material (not labor) from various research studies, primarily in nurseries and orchards (McIvor & Conover, 1991).

Repellent	Material cost per acre (in dollars)
Human Hair	10
Soap	60
Hinder	12–41
Miller’s Hot Sauce	11–91
Thiram	46–225
Deer Away	180–400

need for regular applications. Table 6 provides a list of repellents, their active ingredients, and the cost per ounce for different mixtures. Some repellents can be purchased as ready-to-use (RTU) or as a concentrate and then mixed with water for use as needed. In general, RTU products are more expensive per ounce than concentrates. Purchasing larger quantities of either RTU products or concentrates also reduces the per unit cost. Ready-to-use products are easier to use than those that require mixing and are most popular with residential users. Some concentrates have special mixing requirements that make them difficult to use and may not appeal to some users.

Residential homeowners increasingly are using electric and nonelectric fencing instead of repellents as the realities of cost, marginal effectiveness, and regular application of repellents become apparent. Fencing may pose problems due to aesthetic considerations, local covenants, liability access, and other concerns, but these problems can be addressed through education. Many residential homeowners find bird netting a reasonable alternative to the use of repellents during the winter.

Fencing

Where deer pressure is moderate to high, or if the growing stock is very valuable, fencing that physically excludes or deters deer from growing areas is a necessity. An 8-foot fence will physically exclude deer, although a few might still penetrate. A

Table 6. Cost per ounce for ready-to-use (RTU) and concentrate forms of selected deer repellents. Prices were selected from readily available catalogs and web sites in October 2000. This was not intended to be an exhaustive list, but to demonstrate to the reader how prices vary by the formulation and type of product. In general, RTU formulations are much more expensive per ounce than concentrates. Also, the cost per ounce will decline with the purchase of larger quantities of an RTU or concentrate formulation (for example, a lower price for a gallon of RTU material, rather than a quart). There might be differences in the coverage of different products, which might make one product treat more vegetation than another per ounce.

Trade Name	Active Ingredient(s)	Cost of one quart (32 oz) of ready-to-use	Cost per ounce of RTU material	Cost of concentrate that will make about two gallons (256 oz)	Cost per ounce for material from concentrate
Deer-Away (2 components mixed with water)	37% egg solids	n/a	n/a	\$37.18	\$0.15
Deer Off	3.125% egg solids; 0.0006% capsaicin and 0.0005% garlic	\$18.99	\$0.59	\$44.99	\$0.18
Deerbusters Deer I	25% egg solids; 0.0042% garlic; 0.0042% white pepper	\$19.95	\$0.62	\$49.95	\$0.20
Liquid Fence	25% egg solids; 3% garlic powder	\$9.95	\$0.31	\$14.98	\$0.06
Repellex	7.5% dried animal blood plasma	\$18.99	\$0.59	\$57.50	\$0.22
Bobbex	edible fish oil, other assorted materials; 0.0024% dried blood; 0.00048% garlic oil	\$18.00	\$0.56	\$26.00	\$0.13
Plantskydd	87% edible animal protein; 3% vegetable fat; 5% salt; 5% water	\$23.00	\$0.72	\$33.00	\$0.15
Tree Guard	(bitrex) 0.2% denatonium benzoate	\$14.50	\$0.45	n/a	n/a
Hinder	15% ammonium soaps of higher fatty acids	n/a	n/a	\$6.25	\$0.024
Miller's Hot Sauce	2.5% capsaicin	\$19.95	\$0.62	\$33.00	\$0.13

Note: Read the label and compare prices, active ingredients, and coverage.

10- to 12-foot fence will stop deer. Many designs of electric and nonelectric fence are available. They range in cost from pennies per foot to as much as \$7 per linear foot (see Table 7). If you are attaching fencing to trees, never nail directly to the tree. Nail a 2 x 4 pressure-treated board to the tree, then attach insulators and fencing to the board. The fence will be easier to maintain and can be adjusted as the tree grows.

Consider fencing a long-term investment. A well-maintained fence should last between 5 to 25 years, depending on the type. Most fences pay for themselves within a few years by reducing losses caused by deer damage. For example, it is not uncommon for a high-tensile type fence around an orchard, nursery, or other high-value crop to pay for itself within 1 to 3 years.

As deer have become more numerous, many growers who have installed multi-wire 8-foot electric fencing systems in the past have found that deer are going through these fences. There is a trend toward the use of non-electric wire mesh fences to physically exclude deer.

Electrified Fencing

Electric deer fences are the most common and effective type of fencing used. They are effective because deer, unless chased, prefer to go through or under a fence rather than attempt to jump over it. Electric fences are powered by high-voltage, low-impedance chargers, which provide timed pulses (45 to 65 per minute) of short duration (0.0003 per second). How well a charger will perform depends on its power output measured in joules under load. Deer hair is hollow and well-insulated, and their hooves are small and pointed, which lessens the impact of an electric shock. Therefore, conventional fence chargers that will deter cattle may lack sufficient output to deter deer. The charger also must be matched to the fence design. The suppliers listed in Table 8 can provide more information. A good rule of thumb when selecting a charger is that one joule of output from a charger will adequately power 3,000 feet of fence wire. By determining the perimeter of your fenced area and the number of wires that will be charged, you can get a rough idea of your charger needs. All electric fences should be marked with signs.

Table 7. Types of deer fencing and installed cost per linear foot (cost does not include charger*).

Type of fence	Deer pressure	Labor and material cost per linear foot (in dollars)	Material cost per linear foot (in dollars)
8-foot woven wire	High	5–7	2–4
8-foot plastic mesh	High	1.00–1.50	0.82
Slanted 7-wire	High	1.75–2.25	1.50–2.00
Vertical 7-wire	Moderate to high	1.50–2.00	0.75–1.50
Spider Fence 5-wire	Moderate to high	0.70–0.80	0.35–0.40
¾-inch bird netting— 7-foot wide mesh	High	—	0.26
Peanut butter	Low to moderate	0.30	0.10
Two-strand polywire	Low to moderate	0.35	0.18

* An AC-powered charger to cover substantial acreage costs about \$200 to \$500.

Note: See page 8 for cost of using free-ranging dogs contained by buried electric cable.

Table 8. Sources of Deer Damage Control Products. The Internet Center for Wildlife Damage Management (www.wildlifedamage.unl.edu) is a USDA-funded and university-sponsored website that offers links to many deer damage control products, services, publications, and educational events. Vendors for a range of deer control products can be found on the Internet.

Source	Fencing supplies			Repellents	Scare devices	Tree shelters
	Electric	Nonelectric/ wire-plastic	Underground electric w/dogs			
Ben Meadows Company Atlanta, GA (800) 628-3013 www.benmeadows.com				✓	✓	
Benner's Garden, Inc. Bala Cynwyd, PA (800) 753-4660 www.bennersgardens.com		✓		✓	✓	
DeerBusters Frederick, MD (800) 248-DEER (3337) www.deerbusters.com	✓	✓	✓	✓	✓	
Electrobraid Fence Nova Scotia, Canada (888) 430-3330 www.electrobraid.com						
Forestry Suppliers, Inc. Jackson, MS (800) 647-5368 www.forestry-supplies.com				✓	✓	✓
Kencove Fence Blairsville, PA (800) 245-6902 www.kencove.com	✓	✓				
Kiwi Fence Systems, Inc. Waynesburg, PA (412) 627-8158 www.kiwifence.com	✓	✓				
Myers Seed Company Baltimore, MD 800-458-7333				✓		
Off Limits Crop Protection System Chantilly, VA 22021 (800) 538-3647			✓			
Premier Fence Co. Washington, IA (800) 282-6631 www.premier1supplies.com	✓					
TreePro Lafayette, IN (800) 875-8071 www.treepro.com						✓
Treessentials Company St. Paul, MN (800) 248-8239 www.treessentials.com						✓
West Virginia Fence Corporation Lindside, WV (800) 356-5458 www.maxflex.com	✓	✓				

Chargers can be either AC-, battery-, or solar-powered and maintain a charge greater than 5,000 volts on several miles of fence. It is best to use AC-powered chargers because they have a lower cost per joule of output and are most reliable. A power wire can be run to the fence location, or aluminum fence wire can be run considerable distances on posts from an AC-powered charger to the remote fence location. The cost of running a well-maintained electric fence with a 4-joule energizer for 1 year is equivalent to the cost of running a 40-watt light bulb for 1 year. Battery chargers are adequate, but must be maintained properly. Solar chargers have a solar panel that keeps a battery charged, but they are very expensive and high-joule units must be custom-made.

An important development in deer fencing is the discovery that baiting fences with peanut butter or other attractants can greatly increase the effectiveness of an electric fence. The smell of the peanut butter attracts the curious deer so that they touch the fence with their nose. The shock the deer gets in its head area has a much greater impact than a shock to a leg or other body part. This better conditions the deer to stay away from the fence.

Other research has found that a strip of cotton cloth saturated every 4 to 8 weeks with an odor-based repellent and applied at intervals along a fence also increased the effectiveness of an electric fence. In this case, the odor reinforces the negative impact of the electric shock.

Fence Maintenance and Effectiveness

Many landowners experience problems with deer penetrating fences after the first year due to lack of maintenance. Fences must be maintained to remain effective. Gaps between the bottom of a fence and the ground, common in uneven terrain, must be plugged. Vegetation must be kept off of the lower fence wires using herbicides or mechanical means to reduce grounding and voltage loss. The voltage must be checked regularly and broken strands quickly repaired. Deer constantly test the fence, and if they find they can penetrate it because the power is off or for some other reason, the fence will lose its effectiveness. Another common mistake is not electrifying the fence strands

before leaving the area during construction or afterward. Some people have made the mistake of leaving a fence in place for weeks or months, but they turn off the power during the offseason. This renders the fence ineffective even after it is re-electrified, because the deer have learned that they can penetrate it. It is important to understand that most fences are not true physical barriers, but behavioral barriers. The electric shock conditions the deer to stay away. Once deer know they can penetrate this fence, its effectiveness is seriously reduced.

Another problem experienced with fences is not providing a minimum 10- to 15-foot cleared buffer on the outside of the fence to allow deer to see the fence. Otherwise, they will run into the fence and break it or go through it. On steep slopes this buffer must be wider.

The following discussion presents some general information on various types of fencing that differ in cost and have differing applications.

Permanent Nonelectric Deer Fences

Wire mesh fencing (Figure 5). This fence is best suited to protecting high-value crops under severe deer pressure (i.e., orchards and nurseries). Originally developed for raising deer in New Zealand, wire mesh fencing has become more popular as increasing deer populations have compromised multi-wire electric fence designs. This nonelectric fence is expensive and can be difficult to construct, but is easy to maintain, strong and long-lived. Installing a wire mesh fence used to mean installing 4-foot sections of hogwire, which lacked the strength and longevity of the newer designs. The new wire mesh fencing systems use a tightlock-knot that is very strong and comes in a single piece up to 8-foot tall. The Class 3 galvanizing means the fence may last for 25 years or more with little maintenance. Posts can be as far apart as 40 feet. However, the initial cost is high (\$5 to \$7 per linear foot installed). Other designs include a 6-foot woven wire fence with strands of high-tensile wire above that to a height of 8 to 10 feet.

Plastic mesh fencing (Figure 6).-The use of nonelectric plastic mesh fencing has residential and landscape applications. The fencing is lightweight, high-strength, and virtually invisible against a wooded backdrop, so it does not detract

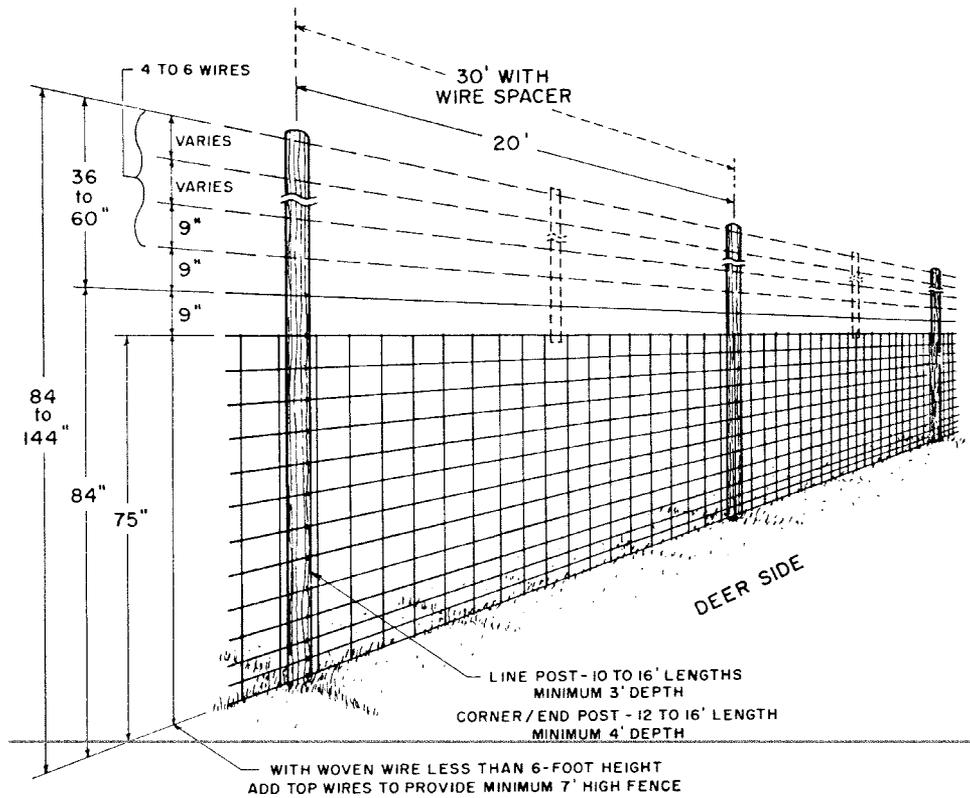


Figure 5. High-tensile, woven wire, deer-proof fence. (From "Deer and Agriculture in West Virginia," Publication No. 810, West Virginia Cooperative Extension Service, Morgantown. Reprinted with permission.)

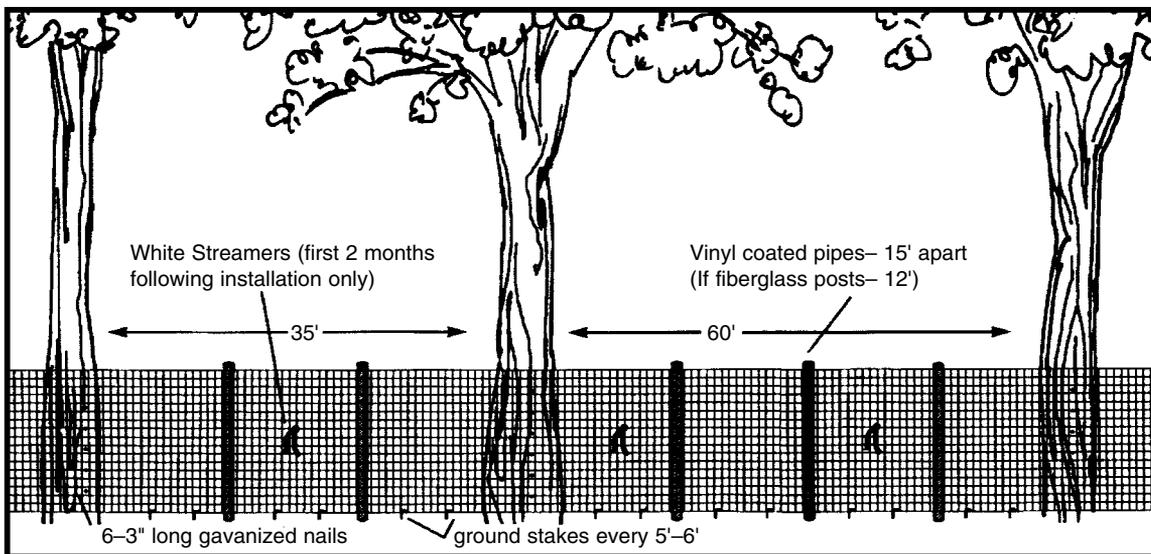


Figure 6. Plastic mesh fencing. (From "Deer Damage a Problem?," Benner's Gardens, Inc. Reprinted with permission.) Do not nail directly to trees. Nail a 2 x 4 pressure-treated board to the tree and then attach the fence to the board.

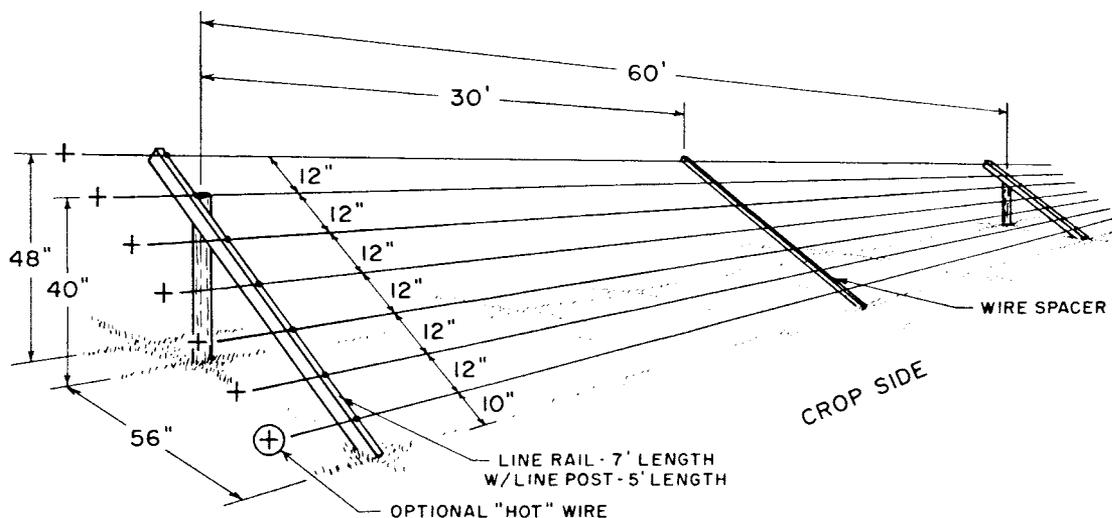


Figure 7. Slanted, high-tensile, deer-proof fence. (From "Deer and Agriculture in West Virginia," Publication No. 810, West Virginia Cooperative Extension Service, Morgantown. Reprinted with permission.)

from the appearance of the property. The product available is an 8-foot black plastic mesh fence with an expected life of 10 years. This type of fence can be attached to existing trees or hung on pressure-treated posts. The light weight of the material minimizes the need for many posts. White streamers, 12 inches long, are attached 4 feet off of the ground every 12 feet to warn the deer of the barrier. Galvanized 12-inch stakes can be purchased to secure the fencing to ground every 12 feet. The cost of the fencing material, excluding posts, is approximately \$0.82 per linear foot.

Electric Permanent and Semipermanent Fencing

Slanted seven-wire fence (Figure 7). This fence differs from the vertical fence in its post alignment and wire barrier, which are constructed at a 30-degree angle to the ground. Its three-dimensional design, which measures 5 feet high and 8 feet wide, and electric shock present a formidable barrier.

The fence is constructed using 12-gauge wire. The wires are attached to slanted fence battens at 50-foot intervals to attain the three-dimensional effect. One drawback to this fence is that it requires 8 feet of space along its entire length,

which increases maintenance cost and removes a larger area from production. Cost, excluding labor, is \$1.50 to \$2 per linear foot.

Vertical electric deer fencing (Figure 8). This is a permanent fence originally developed by Pennsylvania State University and has since been modified and improved and is now widely used. It has proven highly effective on up to 25 acres. There is a wide variety of fence materials and specific designs, including the number of wires (5, 7, 9, or more) and fence height (5 to 10 feet), that you can use. Posts are usually driven into the ground with a mechanical device and high-tensile wires (12-gauge) applied and maintained under very high tension, hence the need for good support. The fence is powered by a high-voltage, low-impedance, New Zealand-style charger.

Properly maintained, this fence has a life expectancy of at least 20 years. Cost, excluding labor, ranges from \$0.75 to \$1.50 per linear foot.

Electric Spider fence (Figures 9a and 9b). This is a fencing concept that combines multiwire electric fencing technology with medium cost and good exclusion capability. This five-wire fence is 48 inches tall and uses a lighter 17-gauge wire that is not under high tension. The only driven posts are the corners and intermediate fiberglass posts are used periodically to maintain wire spacing and

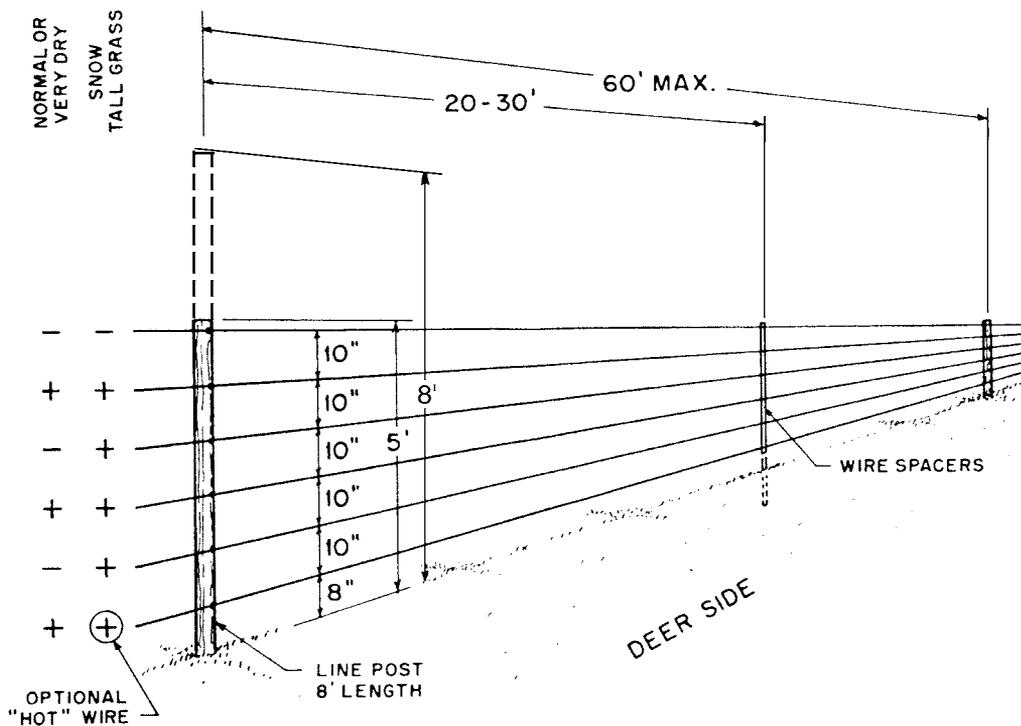


Figure 8. Vertical, high-tensile, electric deer-proof fence. An 8-foot fence is required to provide a physical barrier for deer, but many shorter electrified versions can be used to provide behavioral barriers. (Adapted from “Deer and Agriculture in West Virginia,” Publication No. 810, West Virginia Cooperative Extension Service, Morgantown. Reprinted with permission.)

height. The minimal wire tension is increased or decreased by wrappings on the Spider G-Spring at the gate opening system. Because there are few driven posts and low tension, the fence is only semipermanent and much cheaper to construct than conventional high-tension systems. Baiting with peanut butter flags, described later, is essential to make this fence effective.

The finer gauge wire can break more easily than conventional 12-gauge wire if hit by deer or falling branches. However, this has not proven to be a major problem because the fence will lean under force and then straighten. Also, an adequately cleared buffer around the outside of the fence can minimize these problems. Properly maintained, this fence has a life expectancy of about 10 to 12 years. Cost, excluding labor, ranges from \$0.35 to \$0.40 per linear foot.

Electrobraid fence. This fencing system from Canada is widely used for horses, but may have some application as a psychological barrier for

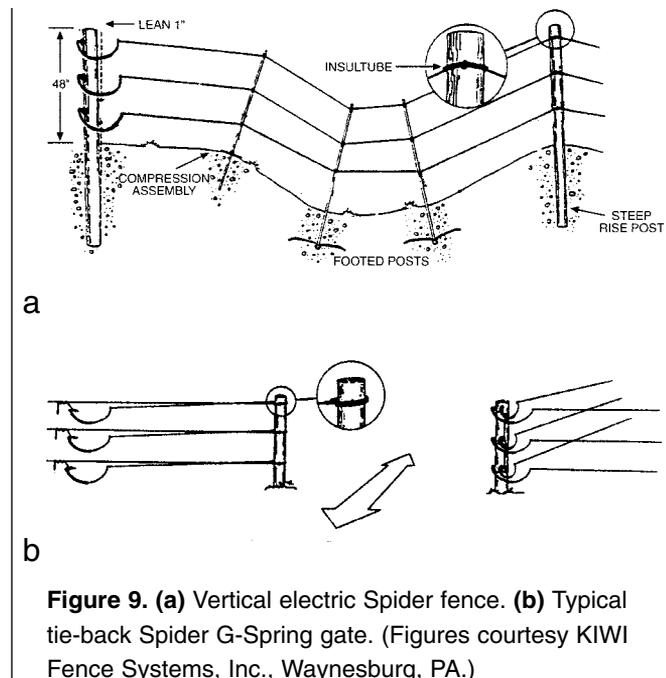


Figure 9. (a) Vertical electric Spider fence. **(b)** Typical tie-back Spider G-Spring gate. (Figures courtesy KIWI Fence Systems, Inc., Waynesburg, PA.)

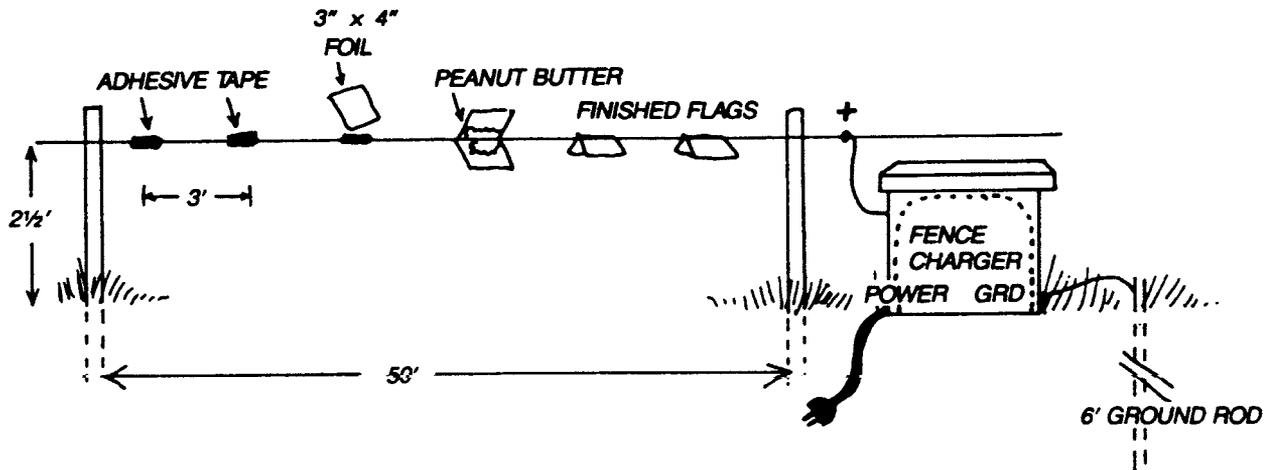


Figure 10. Single strand polywire/polytape electric fence. (From S. Craven and S. Hygnstrom's "Controlling Deer Damage in Wisconsin," Publication No. G3083, University of Wisconsin–Extension, Madison. Reprinted with permission.)

deer. Few, if any, applications for deer have been installed in the mid-Atlantic region, but it has been used to keep deer off airport runways in Canada. The fence material is a thick, pliable, visible, and strong polyester braid, interwoven with copper to carry an electric charge. It is durable and easy to install. Fiberglass posts can be up to 50 feet apart. Most of the applications described in company literature are for 4 to 6 foot fences, or for 2-braid forestry fences that are similar to polywire/polytape applications. The braid has a 25-year life and is powered by a high-voltage, low-impedance, electric charger. Overall, the material cost is higher compared to most other fencing materials. Properly maintained, this fence material has a life of 25 years. Cost for braid, posts, and brace posts for a 4-foot, 5-braid fence is \$1.30 per foot. This does not include the charger, gates, etc.

Temporary Electric Deer Fences

Temporary electric fences are not physical barriers but do provide inexpensive protection for many crops on small and large acreage. The polywire or polytape electric fence coated with peanut butter can be effective for home gardens, small nurseries, small orchards, and truck crops subjected to moderate deer pressure. They work best in the summer and fall when deer have other food sources. They are easy to construct and the materials are readily available at local farm stores.

The fences attract deer with their bright colors and peanut butter odor that is applied as "bait." The fence is designed to attract the animal's attention and encourage them to touch the fence with their nose, thereby receiving a strong but harmless electrical shock (high-voltage, low-ampereage). Similar to the strategy behind many farm livestock fences, deer are conditioned to avoid the fence and the food source that lies behind it. These fences are portable, have a life expectancy of 5 to 7 years and can be installed for \$0.10 to \$0.18 per linear foot (including the charger). A variation of this fence includes substituting a suitable repellent such as Hinder or Deer-Away for peanut butter. A strip of cloth tied on the fence can be soaked every 4 to 8 weeks with a sprayer. Studies from Cornell University have shown this to be even more effective at repelling deer than the use of peanut butter.

Polywire/Polytape fence (Figures 10 & 11). Polywire is composed of three, six, or nine strands of metal filament braided with strands of brightly colored polyethylene. A wider polytape is also available and has the advantage of being stronger and more visible, but is also more expensive. A common problem with polytape is that it is battered by wind and its life may be shortened dramatically. Both polywire and polytape come in a wide variety of colors; however, many users claim the white provides the greatest contrast to most backgrounds and is easier for the deer to

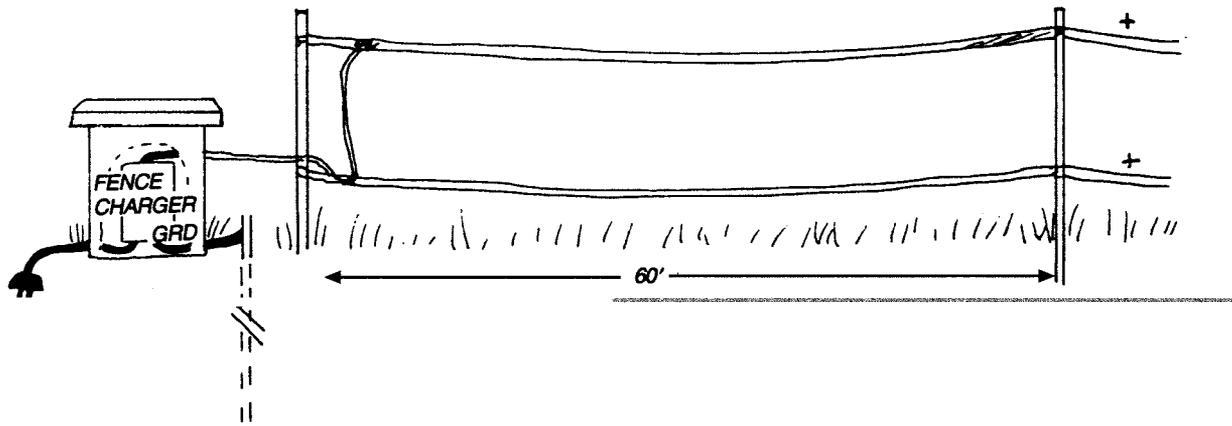


Figure 11. Two-strand polywire/polytape electric fence. (From S. Craven and S. Hygnstrom's "Controlling Deer Damage in Wisconsin," Publication No. G3083, University of Wisconsin–Extension, Madison. Reprinted with permission.)

see, especially at night. Loss of voltage over long distances of polywire/polytape can be a problem. Purchase materials with the least electrical resistance (ohms/1,000 ft) for these applications.

There have been many applications of polywire and polytape in deer fencing. In its simple application, an electrified single strand of polywire or polytape is suspended approximately 30 inches above the ground by 4-foot fiberglass rods at 20- to 50-foot intervals. This basic design can be adapted. A second wire can be added to increase effectiveness: one wire placed 18 inches from the ground and the top wire at 36 inches above the ground. This prevents fawns from walking under the fence and also increases the chances one wire will remain electrified if deer should knock the fence over. Usually only the top wire is baited. In smaller areas, such as home gardens, more wires can be added on taller poles if desired, and closely spaced bottom wires can keep out rabbits and groundhogs. It is important that vegetation be mowed or removed from under the fence so the fence does not short out.

Baiting is critical to the effectiveness of this fencing system. Aluminum foil "flags" (foil squares, 4 inches by 4 inches, folded over the wire) are attached to the wire at 20- to 50-foot intervals using tape or paper clips to hold them in place. Aluminum flashing or screening can also be used and has the advantage of not being damaged or blown off. Closer spacing may be necessary near existing deer trails and during the

first few months of the fence's use when deer behavior is being modified. The underside of the flags are baited with a 1:1 mixture of peanut butter and vegetable oil, or just peanut butter. The smell encourages deer to touch or sniff the flags, leaving a vivid reminder of why they should avoid the fence. The flags should be rebaited every 4 to 8 weeks, depending on weather conditions. As mentioned earlier, the application of odor-based deer repellents to strips of cotton cloth tied to the fence can be more effective than baiting with peanut butter.

For fields larger than one acre, it may be more practical to apply the peanut butter mixture directly to the wire. You can make a simple applicator by mounting a free-spinning, 4-inch pulley on a shaft inside a plastic ice cream pail. Fill the pail with the peanut butter-vegetable oil mixture, which should have the consistency of very thick paint. Coat the entire wire with the mixture by drawing it along the pulley. Apply the peanut butter mixture once a month. Attach foil flags near runways or areas of high deer pressure. This baiting strategy can also be used with polytape fences. Check the fence weekly for damage by deer on ground vegetation. Other baits can also be effective. Some commercial distributors are marketing liquid scents that are easier to apply.

This fencing design does exert high tension on the corner posts. The use of fiberglass posts

Table 9. Cost of materials for a two-strand, baited, rectangular polywire fence (516 feet x 258 feet; 1,548 total perimeter).

Quantity	Item	Cost (in dollars)
1	2-joule electric charger + ground rod	130
2	Spools of polywire (1,650 feet each; 3,300 feet total)	72
40	Fiberglass footed posts + clips (\$1.35 each)	54
4	4-foot metal corner posts with 1-inch PVC covering	6
1	Roll of heavy-duty aluminum foil/signs	10
1	Jar of peanut butter/vegetable oil	5
Total		277 ¹

Note: The cost of the fence can be reduced by using only one strand of polywire or using wooden stakes with plastic insulators. Likewise, the use of polytape would increase the cost. Increasing the acreage to 5 acres will only require additional wire and stakes.

¹When divided by the total perimeter (1,548 feet), the cost is \$0.18 per linear foot, including the charger.

for corner posts will usually require the use of stakes and ropes to hold them up. Holes can be dug and wooden fence posts with insulators installed. A simpler option is the use of 4-foot metal fence stakes that have a flat plate on the bottom that is hammered into the ground. A piece of thin-walled 1-inch PVC pipe can be slipped over the metal stake to act as an insulator with the polywire or polytape wrapped around it a few times. This allows stringing the wire with sufficient tension to hold the flags.

Proper maintenance of the fence is essential for long-term effectiveness. It is likely the deer will knock the fence over until they are trained to stay clear. This is common near well-used travel paths. It is important that the fence be located at least 15 feet from any forest edge or brush so the deer have a chance to see it. The user must check the fence every day for the first month to make sure it is charged and upright, in case it was knocked down. The easiest and safest way to check fence voltage is with a digital or color meter.

The use of electric fences in and around home sites can cause concern for children and other visitors. One option is to put the fence charger on a timer so that it only comes on from dusk to

dawn. This is very workable in areas where deer are not found during daytime hours.

A sample budget for a 3-acre, two-strand, baited fence using polywire is shown in Table 9. Most materials can be purchased from fence suppliers listed in this publication and from local farm stores. The metal fence stakes and PVC can be found in local farm stores. Some of the fence suppliers listed in Table 8 now offer ready-made kits that include all of the materials needed to fence 1 acre or more.

Effectiveness of Temporary Electric Fences

Temporary deer fences have been used in Maryland and other states to protect corn, soybeans, fruit trees, forest plantations, Christmas trees, vegetable crops, home gardens, nurseries, and other crops. The effectiveness of the applications and the acreage that can be protected is highly dependent on the season, presence of snow cover, proper fence maintenance, location of existing deer trails, alternative habitat, and deer pressure. Based on past experience with temporary fences, the following generalizations can be made:

1) If protection is only needed during the growing season when other food sources are available to deer, large acreages may be effectively protected.

2) Protection of areas of any size might not be possible during the dormant season since other food sources are usually lacking. Presence of snow cover is an important factor that will greatly reduce effective dormant season protection. Snow cover insulates the ground and makes most temporary fences ineffective.

3) The maintenance associated with temporary fences during the dormant and growing season on larger acreages is so demanding that it may not be practical for many growers.

4) If fenced areas cut across existing deer trails, it will be very difficult to change these behavioral patterns. Fences will likely be compromised.

5) If deer pressure is severe, no temporary fence may be effective.

6) If a temporary fence has become ineffective and is being penetrated, it is best to remove the wire for a season and retrain the deer later.

7) If protection is needed for multiple years and the effectiveness of temporary fencing is questionable, consider multistrand steel fencing designs.

The use of temporary fences to protect young pine and hardwood plantations of small size is a promising forestry application. Currently, tree shelters and repellents are used in many cases, but their expense can be prohibitive. The use of temporary fences for 3 to 5 years to allow seedlings to establish themselves can be a very cost-effective application when compared with the use of tree shelters and repellents. An added advantage is that the fence can then be moved for other applications. However, to date, results of studies on the use of temporary fences in areas with winter snow cover have been discouraging, even for small areas. In areas with little winter snow, this option may be more effective.

Tree Shelters

The tree shelter (Figure 12) is a transparent, corrugated polypropylene tube that is placed around seedlings at the time of planting. The tube is supported by a 1-inch by 1-inch wooden stake located next to the shelter. An ultraviolet inhibitor is added to the polypropylene to prevent it from breaking down too rapidly when

exposed to sunlight. The shelter disintegrates after about 7 to 10 years.

A 4-foot shelter is commonly used and will prevent deer browsing on tree seedlings. A 5-foot shelter may be needed in areas with excessive browsing or heavy winter snowfall. The tube has the added benefit of promoting rapid height growth of the seedling by acting like a "mini-greenhouse." After the seedling emerges from the tube, it will increase rapidly in diameter to become a tree that can stand alone after a few years. It is important that the shelter not be removed after installation.

The shelter is used mostly in forestry applications to protect hardwood tree seedlings, with 70 to 100 shelters used per acre. Manufacturers now have larger diameter shelters available, which claim to be better suited to pine seedlings. The shelters make it easy to apply herbicides for weed control. Although they are very effective, the shelters are costly. Prices continue to come down as competition has increased, however. Prices for quantities of 100 or more 4-foot shelters with stakes average about \$2.85 per shelter. Those considering using tree shelters should compare the cost-effectiveness of tree shelters, repellents, and temporary fencing for their situation.

Population Management

Deer populations in Maryland are capable of doubling within a few years if they are not

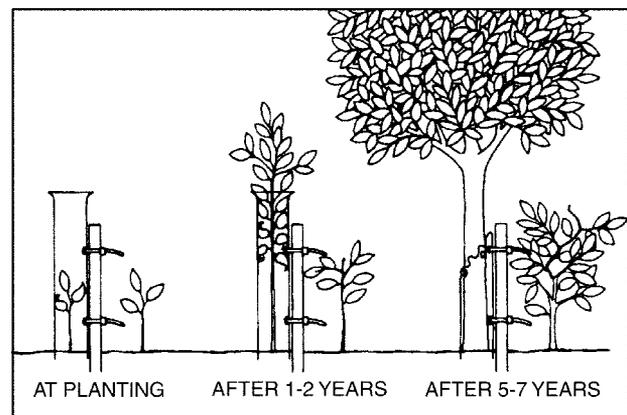


Figure 12. Growth of tree seedlings with (left) and without (right) the protection of tree shelters. (Figure courtesy of Treessentials Company, St. Paul, MN.)

controlled. With diminished populations of natural predators, the most efficient type of population control is hunting. Although other types of population control, such as infertility treatments, are being researched, it is unlikely they can or will be economical or biologically effective in free-roaming deer populations. Refer to the reference list for other publications that discuss alternative population control methods.

A typical deer herd in Maryland may contain three does for every buck. In many herds the ratio of does to bucks is higher. One buck is capable of mating with many does, so eliminating bucks has little effect on the growth of the herd. Figure 13 shows how the population of a deer herd can double in one year (without hunting or other mortality) and the effect of hunting on the rate of population increase.

Other mortality factors, such as vehicle collisions and death by starvation in the winter, could also reduce the rate of increase in the herd size.

Deer herds in Maryland are hunted to maintain populations that are compatible with human land

use. This is called the cultural carrying capacity. This contrasts with biological carrying capacity, which is the deer population the available habitat can support. Most growers suffering damage want to reduce deer populations, but the goal must be more specific. For example, do you want to eliminate all of the deer, or do you only want to reduce the population so that damage is at an acceptable level? Do you want to reduce damage, but also produce trophy-quality bucks? Each of these options requires population regulation. The most practical way to regulate the population is hunting.

Hunting

Many landowners hunt deer on their property, but fail to reduce populations to a level that significantly decreases crop damage. In many cases, attempts to reduce populations through hunting are frustrated by neighbors who do not hunt deer, thereby providing a deer refuge during the hunting season. Still other landowners have concerns about their liability in case of a hunting accident. Although there are many reasons for failure, population dynamics show that the sex of the deer killed is more critical to effective management than the number. In most areas of Maryland, approximately 35 to 40 percent of the does must be killed to stabilize the population, and a greater percentage must be killed to reduce it.

Developing a Hunting Program

Many landowners realize that to effectively reduce doe populations, they must recruit an adequate number of successful hunters on their property. The number of hunters in Maryland is slowly declining, especially among youth. Therefore, developing and training new hunters of all ages is strongly encouraged. Maryland law provides considerable liability protection for landowners who do not charge a fee. More information on this topic can be found in Fact Sheet 617, "Recreational Access and Landowner Liability in Maryland," available from your county Extension office. Following the suggested guidelines below will help to ensure that hunters will be responsible on your property while being effective in their efforts.

Undisturbed population

Year 1: Deer population in the fall:

27 does + 9 bucks = 36 deer

90 percent (24.3) of the does produce an average of 1.3 fawns each by the following fall:

$24.3 \times 1.3 = 32$ new fawns

Year 2: 36 original deer + 32 new fawns = 68 deer in the herd the following fall

This herd has almost doubled in 1 year.

Hunted population

Year 1: Deer population in the fall:

27 does + 9 bucks = 36 deer

50 percent of the 27 does are killed by hunting, leaving approximately 14 does.

90 percent of the remaining does (12.6) produce an average of 1.3 fawns each by the following fall: $12.6 \times 1.3 = 16$ new fawns

Six of the 9 bucks are killed by hunting, leaving 3 bucks.

Year 2: Fourteen remaining does plus the 16 new fawns plus 3 remaining bucks totals 33 deer, which is a slight reduction in population.

Figure 13. Population dynamics of a sample deer herd.

Recruiting Effective Hunters

- ◆ Invite hunters who are safe, dependable, and capable. Hunters can be family, friends, or reliable acquaintances. Remember that their efforts will determine the success or failure of the hunting program.
- ◆ Require hunters to apply for a doe permit if necessary. Remind hunters of the September application dates to secure doe permits for firearms season. Either sex usually can be taken during archery and muzzleloader seasons.
- ◆ Specify that hunters must harvest a doe before killing a buck.
- ◆ Consider leasing your land to a local hunt club and develop a contract with clearly defined responsibilities and actions. Although many landowners use leases (contracts) only when hunters pay for leasing rights, leases are appropriate if no fee is charged. Your local Extension office can provide copies of sample lease agreements (refer to the references in this bulletin as well).

Hunting Strategies

- ◆ Minimize scouting the week before opening day. Scouting immediately before the season may reduce hunter success. Deer are alerted by the unfamiliar odors, sounds, and sight of people and move to less disturbed areas. Scouting is essential, but should be done several weeks before the hunt.
- ◆ Concentrate hunting efforts during the opening weekend. Deer are most vulnerable on opening day, before they become aware of hunter activity and alter their behavior.
- ◆ Hunt from stands. This increases success and lessens chances for detection by deer. Safety is very important. Make sure stands are sturdy and located far enough apart to avoid an accident.
- ◆ Encourage hunters to use the most productive stands.
- ◆ Encourage hunters to remain on their stands throughout the day. Many deer

are killed after noon when other hunters on the move disturb the deer and cause them to flee.

- ◆ Maintain the pressure after opening weekend and during other seasons. Deer become more difficult to bag as the season progresses. Driving deer from thickets toward pre-positioned hunters can be very effective. Remember that archery season precedes the firearms season and archers can be very effective in bagging deer from stands.
- ◆ Work with your neighbors to encourage them to allow deer hunting.

Managed Hunts

Managed hunting uses regulated hunting methods and laws in combination with more stringent controls and restrictions as dictated by the landowner or elected officials. The Maryland DNR Wildlife Division has worked with many communities throughout the state to develop managed hunts in state and county parks and residential areas with the objective of reducing overabundant deer populations to acceptable levels. One advantage of this type of hunting is that it is very cost-effective.

First, professionals will meet with the community to gain consensus and explain the procedure. Typical restrictions and conditions of managed hunts include requiring hunters to pass a hunter safety and marksmanship test, and to shoot from tree stands only in certain directions; limiting the use of weapons (shotgun versus bow and arrow); restricting the hunt to certain days and times; closing access to the land; and notifying the public of the hunt. Other conditions may include donation of deer to shelters and charity through organizations such as Farmers and Hunters Feeding the Hungry.

Sharpshooting

Several communities have employed trained, experienced personnel to lethally remove deer through sharpshooting with considerable success. A variety of techniques can be used in sharpshooting programs to maximize safety, humaneness, discretion, and efficiency. The cost per deer for sharpshooting programs has varied,

ranging from \$91 to \$310 per deer. The high cost of this technique to local communities will often result in the use of more economical reduction measures such as managed hunts, which can be more cost-effective on a long-term-basis.

Crop Damage Permits

In many cases, the severity of deer damage requires immediate action, even if it is not hunting season. Most state wildlife agencies can issue crop damage permits to commercial growers and/or forest landowners to allow off-season hunting. These permits are useful for eliminating nuisance deer, and keeping year-round pressure on a deer herd. Crop damage permits can be an effective part of a long-term hunting program.

In the past, Deer Management Permits (commonly known as “crop damage permits”) were mostly provided to commercial agricultural producers. Recent changes in the Deer Management Permit system in Maryland specifically enable forest landowners to obtain deer damage permits to harvest deer throughout the year to reduce the damage to existing forests and plantations. Deer Management Permits are now available for owners of woodland that have forest management plans or tree planting plans written by a Department of Natural Resources (DNR) forester or a licensed professional forester. New applicants will have to contact their regional DNR Wildlife Division office.

A wildlife biologist will visit the property and issue a Deer Management Permit to the landowner, if the damage is verified. The biologist will then provide a certain number of deer tags that the landowner can fill anytime of the year. Tags are issued for antlerless deer only and the number will depend on the situation. When the tags are filled, new tags may be provided without another visit by the biologist, which streamlines the program. Many landowners may not hunt, but still wish to reduce deer damage. The landowner can assign other agents (hunters) to fill the tags. Landowners who meet the requirement above should contact the regional Maryland DNR Wildlife Division office near them for more information. Landowners in other states should contact their state wildlife agency for details on their state program.

Suburban Deer Control

Deer damage is no longer just a rural problem. Population increases in rural areas, lack of hunting pressure, firearms discharge restrictions in developing areas, and deer adaptability to suburban habitats, among other factors, has resulted in rapid increases of suburban deer populations. The result has been increased damage to suburban landscapes, deer-car collisions, and to forest ecosystems (understory damage and regeneration failure). In Montgomery County alone, a rapidly growing, 495-square-mile area adjacent to Washington, DC, more than 2,000 deer were killed on county highways in 2002. Great conflicts have developed between local governments, state agencies, and various citizen groups over how to deal with the problem.

The options open to homeowners and associations are usually limited to nonlethal combinations of control methods, such as fencing, repellents, and landscapes designed with plant species less desirable to deer (refer to Fact Sheet 655, “Resistance of Ornamental Plants to Deer Damage”).

Unfortunately, reducing the deer population is the only method that offers a long-term solution. Efforts to reduce deer populations by use of special hunts, sharpshooters, and special permits have resulted in serious conflicts between various groups due to a lack of consensus and research-based information.

Many states and localities, with the help of resource professionals and citizen participation, have found an effective method to address this problem. Rather than use public meetings, which often end in arguments rather than solutions, a citizens’ task force or advisory board composed of representatives of various groups has worked effectively in building consensus. Many approaches have been used by different states and localities, but those that succeed have similar attributes.

First, the state wildlife agency, in cooperation with another respected state or county organization, such as the Cooperative Extension Service, organizes a task force averaging 8 to 15 members, including farmers; sportsmen; foresters; conservationists; and representatives from small businesses, law enforcement and park

services, and community associations. Initial meetings should concentrate on scientifically based information presented by wildlife biologists concerning population levels and the different management options. Information from other members about deer-car collisions, landscape and forest damage, hunting concerns, and other aspects of the issue help educate and sensitize all members to different viewpoints. It is best to ask task force members to get feedback from stakeholders during the process, and, through reasonable discussion, reach consensus on how population target levels can be reached.

Key factors that contribute to the success of task forces include the following: selecting reasonable and respected individuals within the stakeholder groups; focusing concentration on specific objectives; and allowing the task force to make decisions that would be accepted and used by the wildlife agency. Solving suburban deer problems will likely include the continued use of the task force or advisory board approach.

In 1994, Montgomery County, Maryland, successfully completed a deer task force report. The report was followed by the implementation of a comprehensive deer management plan that utilized education, better reporting, and population management options. Managed hunts have been implemented in county and State parks, along with programs to encourage deer harvests on private property. Since then, Howard County has initiated a deer task force.

A key factor in the success of the Montgomery County task force was support of the process by country government through a formal resolution. Once the task force recommendations were completed, the county provided support for a county parks professional to develop and implement a comprehensive deer management plan that actually carried out needed actions. Refer to the reference list to find publications that discuss the various approaches to successful resolution of deer damage management in suburban areas.

For Further Information and Additional Reading

Telephone Assistance

Animal Control Hotline—1-877-463-6497

The Department of Natural Resources Wildlife and Heritage Division and the U.S. Department of Agriculture (USDA) have teamed up to provide a toll-free phone number to report nuisance, injured, or sick wildlife. They can provide advice and some resources to help you with wildlife damage problems. They do not focus on problems with deer, bear, and other larger species. No known website at this time.

Maryland Department of Natural Resources Wildlife Division

Wildlife biologists can provide crop damage permits and answer questions on deer damage management options. Contact the regional DNR Wildlife office near you.

- ◆ Southern Region—Tawes State Office Building, E-1, Annapolis, MD 21401, 410-260-8540
- ◆ Western Region—3 Pershing Street, Cumberland, MD 21502, 301-777-2136
- ◆ Central Region—2 S. Bond Street, Bel Air, MD 21014, 410-836-4557
- ◆ Eastern Region—201 Baptist Street, Suite 22, Salisbury, MD 21801, 410-543-6595

Home and Garden Information Center—1-800-342-2507 (in Maryland only)

Operated by Maryland Cooperative Extension. The Center provides publications and assistance to help Maryland homeowners solve horticultural problems, including wildlife damage problems. Horticulture consultants are available to speak to clients on the telephone Monday through Friday from 8 a.m. to 1 p.m. Callers can also access a wide range of audiotapes 24 hours a day. Call toll-free to speak to a horticulture consultant or access a library of audiotapes. www.agnr.umd.edu/users/hgic

Maryland Cooperative Extension local office

Refer to your local telephone directory for the MCE office in your county or check their hours and visit. Many offices have horticultural programs or master gardeners who can provide

assistance. Publications on a range of topics can be ordered through your local office.

www.agnr.umd.edu/MCE/offices.cfm

Websites

Maryland Cooperative Extension-Natural Resources Extension Programs—www.naturalresources.umd.edu

Select the “wildlife management” link, then “wildlife damage management.” This site links to sources of information on wildlife damage management.

Maryland Department of Natural Resources-Wildlife & Heritage Division—<http://www.dnr.state.md.us/wildlife>

Provides links to their offices, programs, publications, and reports.

Internet Center for Wildlife Damage Management—<http://wildlifedamage.unl.edu>

This is a USDA-funded and university-sponsored effort. You can also find the university nearest you and their online wildlife publications. The site also offers the professional in wildlife control the latest library materials, news, business information, and job prospects.

Home and Garden Information Center—<http://www.agnr.umd.edu/users/hgic>

Operated by Maryland Cooperative Extension. The Center provides publications and assistance to help Maryland homeowners solve horticultural problems, including wildlife damage problems. Horticulture consultants are available to speak to clients on the telephone Monday through Friday from 8 a.m. to 1 p.m. Callers can also access a wide range of audiotapes 24 hours a day. Call toll-free to speak to a horticulture consultant or access a library of audiotapes: 1-800-342-2507 (in Maryland only).

DeerCrash.com—<http://deercrash.com>

The goal of DeerCrash is to provide a central location where users can deposit and retrieve reliable, timely, and pertinent information that will assist them in identifying means of significantly reducing deer-vehicle collisions and enhancing public safety on roadways.

Deer and People in New Jersey—<http://AESOP.RUTGERS.EDU/~deer>

Provides a one-stop shopping site for research-based information about deer for New Jersey

residents and officials. Most information has application to those in other states.

Publications/Video Resources

Maryland Cooperative Extension Publications—Publications are available online and others are available from county Extension offices. To contact the office in your county, either visit <http://www.agnr.umd.edu/ces/cooffices.html> for a full listing of offices, or check for the listing in your local telephone directory. For out-of-state orders, please send orders for publications to: Production & Distribution, 6300 Sheridan Street, Riverdale, MD 20737 or call 301-403-4263. Checks should be made payable to the University of Maryland. A full listing of natural resources publications is found at: <http://www.naturalresources.umd.edu>.

- ◆ EB354—*Managing Deer Damage in Maryland* (\$2) printed copy only
- ◆ FS357—*Recreational Access and Landowner Liability* (\$2.50) printed copy only
- ◆ FS655—*Wildlife Damage Management: Resistance of Ornamentals to Deer Damage* (free) hard copy or online (<http://www.naturalresources.umd.edu/Publications.html>)
- ◆ NRAES Bulletin 11—*High-Tensile Wire Fencing* (\$2) printed copy only

Maryland Game Program and Annual Report—Published annually by the Maryland Department of Natural Resources Wildlife Division. Includes harvest statistics for deer and other game species as well as economic effects. <http://www.dnr.state.md.us/wildlife/gptoc.html>

Deer as Public Goods and Public Nuisance: Issues and Policy Option in Maryland—106-page proceedings from October 27, 1997 conference in College Park, MD. Edited by Bruce L. Gardner. Copies available for \$5. Send check (payable to University of Maryland) to: Center for Agriculture and Natural Resource Policy, 2200C Symons Hall, University of Maryland, College Park, MD 20742-5535, 301-405-0057. Available online at <http://www.arenr.umd.edu/policy/Deer-Management-in-Maryland/home.htm>.

Howard County Deer Management Task Force-Report—The Howard County Deer Task

Force was created in 1996 by the County Council and was charged with investigating the deer situation within the county, examining the options available to deal with problems, and recommending a course of action. In July 1999, the Task Force report was released. For availability of paper copy, contact the Howard County Recreation & Parks at 410-313-1675. Available online at <http://www.co.ho.md.us/rap/natresources%5Fdeer.htm>.

Montgomery County Deer Management Program and Recommendations—The Comprehensive Management Plan for White-tailed Deer in Montgomery County, MD, developed in 1995, calls for the Deer Management Work Group to review deer-impact data and present a list of recommendations for the upcoming year. This is done on an annual basis. Report available online at <http://www.mc-mncppc.org/environment/deer/index.shtm>.

Cornell Cooperative Extension Resources—Publications and videos may be ordered by contacting Cornell University Media Technology Services Resource Center, 7 Cornell Business Technology Park, Ithaca, NY 14850, 607-255-2080. www.cce.cornell.edu/publications/catalog.html.

- ◆ *Managing White-Tailed Deer in Suburban Environment*—This 52-page manual reviews the biology of the white-tailed deer and discusses methods for reducing deer-related problems. Comprehensive strategies are outlined. Fencing and repellents are covered, as well as options for lowering deer populations and experimental techniques for deer fertility control. 147IB245, \$10.50.
- ◆ *Suburban Deer Management: Voices, Views, Visions*—Explains the causes of deer overpopulation, describes health and safety concerns and property damage, explains the positive and negative effects, and controversy, of various solutions. Suggests ways to determine solutions for communities. 28 min. Video (147VSDM), \$20.95. Complements the manual, *Managing White-Tailed Deer in Suburban Environments*.

- ◆ *Human-Wildlife Conflict Management*—Wildlife management calls for skillful integration of social and biological information. This guide is designed to help wildlife managers with biological backgrounds integrate human considerations into decisions involving conflicts between people and wildlife. The guide focuses on two components of human dimension: Social Assessment and Stakeholder Engagement. (47HWCM), \$8.45.
- ◆ *Whitetails at the Crossroads*—One of the most admired animals, the white-tailed deer, is causing dissension in some areas of the U.S. and Canada. According to a review in *Probe* newsletter, "If you are looking for a video that will explain the issues surrounding deer management, this is the video for you. Its non-emotional, straightforward discussion of the facts stands as an excellent example of how one should discuss management issues in the public forum." Video (147VWC), \$20.95.
- ◆ *Integrated Pest Management for the Deer Tick*—Describes the life cycle and biology of the tick, personal protection, landscape management, and chemical management. (139IFS100.00), \$2.10.
- ◆ *Wildlife Damage Management in Fruit Orchards*—Reviews the problems caused by wildlife, discusses methods to protect plants, and highlights promising experimental techniques to control damage. The information applies to deer, voles, woodchucks, rabbits, and birds. An extensive list of annotated references for specific information. 28 pp. (147IB236), \$5.85.

West Virginia Cooperative Extension Service—Publications available online. For availability of paper copies, contact William Grafton, WVU Extension Wildlife Specialist, 311 Percival Hall, P.O. Box 6125, Morgantown, WV 26506-6125, 304/293-4797, ext. 2493.

- ◆ **Deer and Agriculture in West Virginia**—*online publications*: Fundamentals of Deer Management; Landowners Can Manage Deer Herd; Fundamentals of Deer Harvest Management; Deer Control in Home Gardens; An Integrated Approach to Deer

Damage Control; High-Tensile Fence Do's & Don'ts; Identification of Deer Damage; Deer Damage Hurts the Pocketbook; How to Field Dress a Deer; State of Pa. Venison Recipes. All available online at <http://www.wvu.edu/%7Eagexten/wildlife/index.htm>.

A Literature Review for Assessing the Status of Current Methods of Reducing Deer-Vehicle Collision by Dr. Brent J. Danielson and Dr. Michael W. Hubbard. A 25-page report prepared for The Task Force on Animal Vehicle Collisions, The Iowa Department of Transportation, and The Iowa Department of Natural Resources, submitted September 1998. Available online at <http://www.iastate.edu/%7Eecodi/Deer/litreview.htm>.

Prevention and Control of Wildlife Damage—Compiled by the University of Nebraska Cooperative Extension. This handbook is a comprehensive reference of North American vertebrate species. Each chapter is devoted to a specific animal. It contains five publications on damage identification, 23 on rodents, 16 on carnivores, 11 on other mammals, 20 on birds, 7 on reptiles and amphibians, and other sections on vertebrate pesticides, supplies, and materials. This reference comes in both book and electronic format (CD-ROM). Each copy (either book or CD) is \$40 plus \$5 shipping. Copies of the book plus CD-ROM are \$60 plus \$5 shipping. The website enables you to preview some of the chapters. To order by mail contact: Wildlife Damage Handbook, 202 Natural Resources Hall, University of Nebraska, Lincoln, NE 68583-0819, 402-472-2188. <http://deal.unl.edu/icwdm/showPage.shtml?menuID=966800293>.

An Evaluation of Deer Management Options—Available at no cost by sending a stamped, self-addressed envelope to Whitetails Unlimited, Inc., P.O. Box 422, Sturgeon Bay, WI 54235-0422, 414-743-6777. You may also visit their website to obtain this and other free publications: <http://www.whitetailsunlimited.com/forms/contactus.tpl>.

Deer Overabundance—Published by the Wildlife Society. Edited by Robert Warren. Special issue with 50 articles addressing management

issues related to deer overabundance. Published by the Wildlife Society, 5410 Grosvenor Lane, Bethesda, MD, 301-897-9770. Cost: \$22.50. <http://wildlifedamagegroup.unl.edu/form/deermanagementform.pdf>.

Journal of Wildlife Management and the Wildlife Society Bulletin—Published by the Wildlife Society, 5410 Grosvenor Lane, Bethesda, MD, 301-897-9770. Includes numerous scientific articles on deer. Visit The Wildlife Society's website for more information: <http://www.wildlife.org>.

The Role of Bowhunting in Wildlife Management—Written by E.W. Kurzejeski, et al. (1999) A review and recommendations. Paper, \$6. Available through the Wildlife Society. <http://www.wildlife.org/publications/index.cfm?tname=pubs&pubid=pub14>.

White-tailed Deer Ecology and Management—Written primarily for use by persons in the wildlife profession, the book was carefully prepared to be of interest and use to sportsmen and other wildlife conservation enthusiasts. It contains more than 450 photos, original artwork by Cindy House, 16 color pages, 137 figures, 118 tables, and over 2,000 references. Cost: \$39.95, plus \$2.50 for shipping and handling. Copies are available from Stackpole Books, 5067 Ritter Road, Mechanicsburg, PA 17055, 800-732-3669 voice, 717-796-0412 fax. <http://www.stackpolebooks.com/cgi-bin/StackpoleBooks.storefront>.

Scientific References

- American Veterinary Medical Association. "2000 Report of the AVMA Panel on Euthanasia." *Journal of the American Veterinary Medical Association* 218, no. 5 (2001).
- Andelt, W.F., K.P. Burnham, and D.L. Baker. "Effectiveness of Capsaicin and Bitrex Repellents for Deterring Deer Browsing by Captive Mule Deer." *Journal of Wildlife Management* 58 (1994): 330-34.
- Anderson, R.C. "Height of White-Flowered Trillium (*Trillium grandiflorum*) as an Index of Deer Browsing Intensity." *Ecological Applications* 4 (1994): 104-09.

- Associated Press. "County Officials Balk at Cost of Deer Reflectors." *Asbury Park Press*, October 15, 2000, 1.
- "Bridgewater Officials Clear Way for Deer Hunt," *Newsday*, June 19, 2001.
- "Morris County Installs Deer Reflectors to Cut Down Roadway Collision." *The Star-Ledger*, June 9, 2000.
- Augustine, D.J. 1997. "Grazing Patterns and Impacts of White-Tailed Deer in a Fragmented Forest Ecosystem." Thesis, St. Paul, MN: University of Minnesota.
- Augustine, D.J., and L.E. Frelich. "Effect of White-Tailed Deer on Populations of an Understory Forb in Fragmented Forests." *Conservation Biology* 12 (1998): 995-1004.
- Balgooyen, C.P., and D.M. Waller. "The Use of *Clintonia borealis* and Other Indicators to Gauge Impacts of White-Tailed Deer on Plant Communities in Northern Wisconsin, USA." *Natural Areas Journal* 15 (1995): 308-18.
- Ballard, W.B. "Public Attitudes and Wildlife Science." *Northeast Wildlife: Transactions of the Northeast Section, The Wildlife Society* 51 (1994): 63-70.
- Barber, H.L. 1984. "Eastern Mixed Forest." In *White-Tailed Deer: Ecology and Management*, edited by L.K. Halls, 345-54. Harrisburg, PA: Stackpole Books.
- Becker, S.E., and L.S. Katz. "Effects of exogenous prostaglandin-F2a (PGF2a) on pregnancy status in white-tailed deer." *Zoo Biology* 13 (1994): 315-323.
- Belant, J.L, T.W. Seamans, and C.P. Dwyer. "Evaluation of Propane Exploders as White-Tailed Deer Deterrents." *Crop Protection* 15, no. 6 (1996): 4, 6.
- Beringer, J., L.P. Hansen, R.A. Heinen, and N.F. Giessman. "Use of Dogs to Reduce Damage by Deer to a White Pine Plantation." *Wildlife Society Bulletin* 22 (1994): 627-32.
- Beringer, J., L.P. Hansen, and O. Sexton. "Detection Rates of White-Tailed Deer with a Helicopter Over Snow." *Wildlife Society Bulletin* 26, no. 1 (1998): 24-28, 1.
- Beringer, J., et al. "Factors Affecting Capture Myopathy in White-Tailed Deer." *Journal of Wildlife Management* 60, no. 2 (1996): 373-80,-2.
- Bertrand, M.R., et al. "Effects of Parturition on Home Ranges and Social Affiliations of Female White-Tailed Deer." *Journal of Wildlife Management* 60 (1996): 899-909.
- Boer, A.H. "Science of Wildlife Management: A Perspective from a Public Agency." *Northeast Wildlife: Transactions of the Northeast Section, The Wildlife Society* 51 (1994): 71-74.
- Boldgiv, B. 2001. "Estimation of Abundance and Movement Patterns for White-Tailed Deer (*Odocoileus virginianus*) in Cayuga Heights, New York." Ph.D. Dissertation, Ithaca, NY: Cornell University.
- Bomford, M., and P.H. O'Brien. "Sonic Deterrents in Animal Damage Control: A Review of Device Tests and Effectiveness." *Wildlife Society Bulletin* 18 (1990): 411-22.
- Brown, D.T., and G.J. Doucet. "Temporal Changes in Winter Diet Selection by White-Tailed Deer in a Northern Deer Yard." *Journal of Wildlife Management* 55 (July 1991): 361-76.
- Brown, R.G., W.D. Bowen, J.D. Eddington, W.C. Kimmins, M. Mezei, J.L. Parsons, and B. Pohajdak. "Evidence for a Long-Lasting Single Administration Contraceptive Vaccine in Wild Grey Seals." *Journal of Reproductive Immunology* 35 (1997): 53-64.
- Brown, T.L., et al. "The Future of Hunting as a Mechanism to Control White-Tailed Deer Populations." *Wildlife Society Bulletin* 28 (2000): 797-807.
- Bruinderink, G.W., T.A. Groot, and E. Hazebroek. "Ungulate Traffic Collisions in Europe." *Conservation Biology* 10 (August 1995): 1059-67.
- Burke, D., A. Deatly, R.E. Eriksen, R.C. Lund, P.A. McConnell, and R.P. Winkel. 1990. *An Assessment of Deer Hunting in New Jersey*. Trenton, NJ: New Jersey Division of Fish, Game, and Wildlife, Bureau of Wildlife Management.

- Butfiloski, J.W., D.I. Hall, D.M. Hoffman, and D.L. Forster. "White-Tailed Deer Management in a Coastal Georgia Residential Community." *Wildlife Society Bulletin* 25, no. 2 (1997): 491-95, 2.
- Canadian, J., and W.F. Siemer. 2001. "Community Attitudes about Deer Management in the Village of Cayuga Heights, New York." In *Human Dimensions Research Unit Series*, Vol. 1-7, edited by Human Dimensions Research Unit. Ithaca, NY: Cornell University.
- Casey, D., and D. Hein. "Effects of Heavy Browsing on a Bird Community in Deciduous Forest." *Journal of Wildlife Management* 47 (July 1983): 829-36.
- Center for Wildlife Damage Control. 1998. *How Are White-Tailed Deer Affecting Agriculture in New Jersey?* Survey findings, briefing report, and maps. Pittstown, NJ: Clifford E. and Melda C. Synder Research and Extension Farm 5.
- Chase, L.C., T.M. Schusler, and D.J. Decker. "Innovations in Stakeholder Involvement: What's the Next Step?" *Wildlife Society Bulletin* 28 (2000): 208-17.
- Christoffel, R.A., and S.R. Craven. "Attitudes of Woodland Owners toward White-Tailed Deer and Herbivory in Wisconsin." *Wildlife Society Bulletin* 28, no. 1 (2000): 227-34, 1.
- Cirnicelli, L., A. Woolf, and J.L. Roseberry. "Residential Attitudes and Perceptions toward a Suburban Deer Population in Southern Illinois." *Transactions of the Illinois State Academy of Science* 86, no. 1-2 (1993): 23-32, 1-2.
- Clines, F.X. "At a National Park White Tail Deer Reign and Local Homeowners Areirate." *New York Times*, December 20, 1999, 1.
- Conover, M.R. "Monetary and Intangible Valuation of Deer in the United States." *Wildlife Society Bulletin* 25, no. 2 (1997): 298-305, 2.
- Conover, M.R., and D.J. Decker. "Wildlife Damage to Crops: Perceptions of Agricultural and Wildlife Professionals in 1957 and 1987." *Wildlife Society Bulletin* 19 (1991): 46-52.
- Conover, M.R., and G.S. Kania. 1988. "Effectiveness of Human Hair, BGR, and a Mixture of Blood Meal and Peppercorns in Reducing Deer Damage to Young Apple Trees." In *Proceedings of the Third Eastern Wildlife Damage Control Conference*. Third Eastern Wildlife Damage Control Conference, Gulf Shores, AL.
- Conover, M.R., W.C. Pitt, K.K. Kessler, T.J. DuBow, and W.A. Sandborn. "Review of Human Injuries, Illnesses, and Economic Losses Caused by Wildlife in the United States." *Wildlife Society Bulletin* 23, no. 3 (1995): 407-14, 3.
- Craven, S.R., T. Barnes, and G. Kania. "Toward a Professional Position on the Translocation of Problem Wildlife." *Wildlife Society Bulletin* 8 (1998): 171-77.
- Craven, S.R., and S.E. Hyngstrom. 1994. "Deer." In *Prevention and Control of Wildlife Damage*, edited by S.E. Hyngstrom, R.M. Timm and G.E. Larson, D25-40. Lincoln, NE: University of Nebraska Cooperative Extension.
- Cromwell, J.A., R.J. Warren, and D.W. Henderson. "Live-Capture and Small-Scale Relocation of Urban Deer in Hilton Head Island, South Carolina." *Wildlife Society Bulletin* 27 (1999): 1025-31.
- Curtis, P.D., M.J. Fargione, and M.E. Richmond. 1994. "Preventing Deer Damage with Barrier, Electrical, and Behavioral Fencing Systems." In *Proceedings of the 16th Vertebrate Pest Conference*. 16th Vertebrate Pest Conference, Davis, CA: University of California, Davis.
- Curtis, P.D., and J.R. Hauber. "Public Involvement in Deer Management Decisions: Consensus Versus Consent." *Wildlife Society Bulletin* 25, no. 2 (1997): 399-403, 2.
- Curtis, P.D., R.J. Stout, and L.A. Myers. "Citizen Task Force Strategies for Suburban Deer Management: The Rochester Experience."
- Curtis, P.D. and D.J. Decker. "Beyond a Citizen Task Force: The Future of Community Based Deer Management." University of California, Davis. 19th Vertebrate Pest Conference. San Diego, CA, March 6-9, 2000.

- Daniels, T.J., D. Fish, and I. Schwartz. "Reduced Abundance of *Ixodes scapularis* and Lyme Disease Risk by Deer Exclusion." *Journal of Medical Entomology* 30 (1993): 1043-49.
- Danielson, B.J., and M.W. Hubbard. 1998. *A Literature Review for Assessing the Status of Current Methods of Reducing Deer-Vehicle Collisions*, 29 pages. Iowa Department of Transportation and Iowa Department of Natural Resources.
- Deblinger, R.D., et al. 1995. "Efficiency of Controlled, Limited Hunting at the Crane Reservation in Ipswich, Massachusetts." In *Urban Deer: A Manageable Resource? 1993 Symposium of the North Central Section, The Wildlife Society*, edited by J.B. McAninch, 75-79. St. Louis, MO.
- Deblinger, R.D. et al. "Ecological Benefits and Hunter Acceptance of a Controlled Deer Hunt in Coastal Massachusetts." *Northeast Wildlife, Transactions of the Northeast Section, The Wildlife Society* 50 (1993): 11-21.
- DeCalesta, D.S. "Effect of White-Tailed Deer on Songbirds within Managed Forests in Pennsylvania." *Journal of Wildlife Management* 58 (1994): 711-17.
- Decker, D., and L. Chase. "Human Dimensions Approaches to Citizen Input: Keys for Successful Policy Making." University of Maryland.
- Decker, D.J., and M.E. Richmond. 1995. "Managing People in an Urban Deer Environment: The Human Dimensions Challenge for Managers." In *Urban Deer: A Manageable Resource? 1993 Symposium of the North Central Section, The Wildlife Society*, edited by J.B. McAninch, 3-10. The Wildlife Society.
- Decker, D.J, K.M. Loconti-Lee, and N.A. Connelly. 1990. *Incidence and Costs of Deer-Related Vehicular Accidents in Tompkins County, NY*. Ithaca, NY: Cornell University.
- DeGraaf, R.M., et al. 1991. *Population Ecology, Habitat Requirements, and Conservation of Neotropical Migratory Birds*, 26 pages. General Technical Report. United States Forest Service.
- DeNicola, A.J., D.J. Kesler, and R.K. Swihart. "Remotely Delivered Prostaglandin-F2a Implants Terminate Pregnancy in White-Tailed Deer." *Wildlife Society Bulletin* 25, no. 2 (1997a): 527-31, 2.
- DeNicola, A.J., D.J. Kesler, and R.K. Swihart. "Dose Determination and Efficacy of Remotely Delivered Norgestomet Implants on Contraception of White-Tailed Deer." *Zoo Biology* 16 (1997): 31-37.
- DeNicola, A.J., and R.K. Swihart. "Capture-Induced Stress in White-Tailed Deer." *Wildlife Society Bulletin* 26 (1997): 500-08.
- DeNicola, A.J., D.J. Kesler, and R.K. Swihart. "Ballistics of a Biobullet Delivery System." *Wildlife Society Bulletin* 24, no. 2 (1996): 301-05, 2.
- DeNicola, A.J., S.J Weber, C.A. Bridges, and J.L. Stokes. "Nontraditional Techniques for Management of Overabundant Deer Populations." *Wildlife Society Bulletin* 25, no. 2 (1997b): 496-99, 2.
- DeNicola, A.J., K.C. VerCauteren, P.D. Curtis, and S.E. Hyngstrom. 2000. "Managing white-tailed deer in suburban environments." Cornell Cooperative Extension, The Wildlife Society, Ithaca, NY.
- Derr, D., P. Maas, and M. Hartley. 2001. "New Jersey Residents Perception of Deer in Suburbs." Rutgers University, New Brunswick, NJ. <http://aesop.rutgers.edu/~agecon/deer>
- Doenier, P.B., G.D. DelGiudice, and M.R. Riggs. "Effects of Winter Supplemental Feeding on Browse Consumption by White-Tailed Deer." *Wildlife Society Bulletin* 25, no. 2 (1997): 235-43, 2.
- Drake, D., and J. Grande. "Assessment of Wildlife Depredation to Agricultural Crops in New Jersey." *Journal of Extension* 40, no. 1 (February 2002). <http://joe.org/joe/2002february/rb4.html>

- El Hani, A., and M.R. Conover. 1995. "Comparative Analysis of Deer Repellents." In *Repellents in Wildlife Management*, edited by J.R. Mason, 147-55. Fort Collins, CO: U.S. Department of Agriculture National Wildlife Research Center.
- Falk, N.W., H.B. Graves, and E.D. Bellis. "Highway Right-of-Way Fences as Deer Deterrents." *Journal of Wildlife Management* 42 (1978): 646-50.
- Foster, M.L., and S.R. Humphrey. "Use of Highway Underpasses by Florida Panthers and Other Wildlife." *Wildlife Society Bulletin* 23, no. 1 (Spring 1995): 95-100, 1.
- Fraker, M.A., et al. 2000. *Immunocontraception of an Island Population of Feral Fallow Deer (Dama Dama) in British Columbia*. Sydney, BC, Canada: TerraMar Environmental Research, Ltd.
- Frelich, L.E., and C.G. Lorimer. "Current and Predicted Long-Term Effects of Deer Browsing in Hemlock Forests in Michigan, USA." *Biological Conservation* 34 (1985): 99-120.
- Frost, H.C., G.E. Storm, M.J. Batcheller, and M.J. Lovallo. "White-Tailed Deer Management at Gettysburg National Military Park and Eisenhower National Historic Site." *Wildlife Society Bulletin* 25 (1997): 462-69.
- Girardin, P., C. Bockstaller, and H. Van der Werf. "Indicators: Tools to Evaluate the Environmental Impacts of Farming Systems." *Journal of Sustainable Agriculture* 13 (1999): 5-21.
- Guynn, D.C., and G.K. Yarrow. 1997. "Ecosystem Management and Wildlife Management: Compatible or Conflicting?" Proceedings of the Eastern Wildlife Damage Management Conference, Clemson University.
- Hayne, D.H. 1984. "Population Dynamics and Analysis." In *White-Tailed Deer: Ecology and Management*, edited by L.K. Halls, 203-10. Harrisburg, PA: Stackpole Books.
- Hooper, R.G., H.S. Crawford, and R.F. Harlow. "Bird Density and Diversity as Related to Vegetation in Forest Recreation Areas." *Journal of Forestry* 71 (1973): 766-69.
- Horsley, S.B., and D.A. Marquis. "Interference by Weeds and Deer with Allegheny Hardwood Reproduction." *Canadian Journal of Forest Research* 13 (1983): 61-69.
- Horton, R.R., and S.R. Craven. "Perceptions of Shooting-Permit Use for Deer Damage Abatement in Wisconsin." *Wildlife Society Bulletin* 25 (1997): 330-36.
- Ishmael, W.E., and O.J. Rongstad. "Economics of an Urban Deer-Removal Program." *Wildlife Society Bulletin* 12 (1984): 394-98.
- Jacobs, A. "Town's Plan for Excess Deer: Ship Them Out." *New York Times*, April 18, 2000, 1.
- Jaren, V., et al. "Moose-Train Collisions: The Effects of Vegetation Removal with a Cost-Benefit Analysis." *Alces* 27 (1991): 93-99.
- Jones, J.M., and J.H. Witham. "Post-Translocation Survival and Movements of Metropolitan White-Tailed Deer." *Wildlife Society Bulletin* 18 (1990): 434-41.
- Jones, M.L., N.E. Mathews, and W.F. Porter. "Influence of Social Organization on Dispersal and Survival of Translocated Female White-Tailed Deer." *Wildlife Society Bulletin* 25, no. 2 (1997): 272-78, 2.
- Karr, J.R., and R.R. Roth. "Vegetation Structure and Avian Diversity in Several New World Areas." *American Naturalist* 105 (1971): 423-35.
- Kays, J., and D. Tregoning. 1997. "From Deer Problem to People Solution: A Case Study from Montgomery County, Maryland." University of Maryland Cooperative Extension. Proceedings of the Eastern Wildlife Damage Management Conference.
- Kays, J.S. 2001. *Managing Deer Damage in Maryland*. Riverdale, MD: University of Maryland.
- Kays, J.S. 1995. "Deer Protection for small forest plantations: comparing costs of tree shelters, electric fencing, and repellents." Morris Arboretum. Proceedings of Tree Shelter Conference.
- Kearns, C.A., and D.W. Inouye. "Pollinators, Flowering Plants, and Conservation Biology." *Bioscience* 47 (May 1997): 297-307.

- Kilpatrick, H.J., A.J. DeNicola, and M.R. Ellingwood. "Comparison of Standard and Transmitter-Equipped Darts for Capturing White-Tailed Deer." *Wildlife Society Bulletin* 24 (1996): 306-10.
- Kilpatrick, H.J., and M.R. Ellingwood. "Bluff Point Coastal Reserve: A Deer Management Dilemma." *Northeast Wildlife: Transactions of the Northeast Section, The Wildlife Society* 50 (1993): 23-27.
- Kilpatrick, H.J., and S.M. Spohr. "Movements of Female White-Tailed Deer in a Suburban Landscape: A Management Perspective." *Wildlife Society Bulletin* 28 (2000): 1038-45.
- Kilpatrick, H.J., S.M. Spohr, and G.G. Chasko. "A Controlled Deer Hunt on a State-Owned Coastal Reserve in Connecticut: Controversies, Strategies, and Results." *Wildlife Society Bulletin* 25 (1997): 451-56.
- Kilpatrick, H.J., and W.D. Walter. "Urban Deer Management: A Community Vote." *Wildlife Society Bulletin* 25, no. 2 (1997): 388-91, 2.
- Kilpatrick, H.J., and W.D. Walter. "A Controlled Archery Deer Hunt in a Residential Community: Cost, Effectiveness, and Deer Recovery Rates." *Wildlife Society Bulletin* 27 (1999): 115-23.
- Kirkpatrick, J.F., I.K.M. Liu, and J.W. Turner. "Remotely Delivered Immunocontraception in Feral Horses." *Wildlife Society Bulletin* 18 (1990): 326-30.
- Kovach, B. "Deer Reflectors Revisited." *Minnesota Roadsides*. December 1998.
- Langenau Jr., E.E., S.R. Kellert, and J.E. Applegate. 1984. "Values in Management." In *White-Tailed Deer: Ecology and Management*, edited by L. K. Halls, 699-720. Harrisburg, PA: Stackpole Books.
- Lehnert, M.E., and J.A. Bissonette. "Effectiveness of Highway Crosswalk Structures at Reducing Deer-Vehicle Collisions." *Wildlife Society Bulletin* 25, no. 4 (Winter 1997): 809-18, 4.
- Loker, C.A., D.J. Decker, and S.J. Schwager. "Social Acceptability of Wildlife Management in Suburban Areas: Three Cases from New York." *Wildlife Society Bulletin* 27 (1999): 152-59.
- Lutz, J.A., and B.T. Swanson. "Reducing Deer Damage to Woody and Herbaceous Plants." In *Mammals*, Chapter 20.
- MacArthur, R.H., and J.W. MacArthur. "On Bird Species Diversity." *Ecology* 42 (1961): 594-98.
- Marchinton, R.L., and D.H. Hirth. 1984. "Behavior." In *White-Tailed Deer: Ecology and Management*, edited by L.K. Halls, 129-68. Harrisburg, PA: Stackpole Books.
- Marquis, D.A. 1983. "Regeneration of Black Cherry in the Alleghenies," 106-19. Hardwood Symposium of the Hardwood Research Council. New Orleans, LA: United States Forest Service, Southeast Forest Experiment Station.
- McCabe, T.R., and R.E. McCabe. 1984. "Of Slings and Arrows: A Historical Retrospection." In *White-Tailed Deer: Ecology and Management*, edited by L.K. Halls, 19-73. Harrisburg, PA: Stackpole Books.
- 1997. "Recounting Whitetails' Past." In *The Science of Overabundance: Deer Ecology and Population Management*, edited by H.B. Underwood, W.J. McShea, & J.H. Rappole, 11-26. Washington, DC: Smithsonian Institution Press.
- McCaffrey, K.R., J. Tranetzki, and J. Piechura. "Summer Foods of Deer in Northern Wisconsin." *Journal of Wildlife Management* 38 (1974): 215-19.
- McNew, K. and J. Curtis. 1997. "Maryland Farmers Lose Bucks on Deer-Damaged Crops." In *Deer as Public Goods and Public Nuisance*, edited by B. L. Gardner, 13-20. College Park, MD: University of Maryland.
- McNulty, et al. "Localized Management for Reducing White-Tailed Deer Populations." *Wildlife Society Bulletin* 25, no. 2 (1997): 265-71, 2.

- McShea, W.J., and J.H. Rappole. "White-Tailed Deer as Keystone Species within Forested Habitats of Virginia." *Virginia Journal of Science* 43 (1992): 177-86.
- McShea, W.J., H.B. Underwood, and J.H. Rappole, Eds. 1997. *The Science of Overabundance: Deer Ecology and Population Management*. Washington, DC, London, UK: Smithsonian Institution Press.
- Michigan State University Cooperative Extension. 1998. *Fencing for Deer Damage Control*. Lansing, MI: Michigan State University Extension.
- Miller, L.A., B.E. Johns, and D.J. Elias. "Immunocontraception as a Wildlife Management Tool: Some Perspectives." *Wildlife Society Bulletin* 26 (1998): 237-43.
- Miller, M.W., M.A. Wild, and E.A. Williams. "Epidemiology for Chronic Wasting Disease in Captive Rocky Mountain Elk." *Journal of Wildlife Diseases* 34 (1998): 532-38.
- Miller, S.G., S.P. Bratton, and J. Hadidian. "Impacts of White-Tailed Deer on Endangered Plants." *Natural Areas Journal* 12 (1992): 67-74.
- Mitchell, J.M., G. Pagac, and G. Parker. "Informed Consent: Gaining Support for Removal of Overabundant White-Tailed Deer on an Indiana State Park." *Wildlife Society Bulletin* 25, no. 2 (1997): 447-50, 2.
- Nelson, D.H. "Citizen Task Forces on Deer Management: A Case Study." *Northeast Wildlife: Transactions of the Northeast Section, The Wildlife Society* 49 (1992): 92-96.
- Newsom, J.D. 1984. "Coastal Plain." In *White-Tailed Deer: Ecology and Management*, edited by L.K. Halls, 367-80. Harrisburg, PA: Stackpole Books.
- Nielsen, C.K., W.F. Porter, and B.H. Underwood. "An Adaptive Management Approach to Controlling Suburban Deer." *Wildlife Society Bulletin* 25, no. 2 (1997): 470-77, 2.
- Ossinger, M. 1992. *Discovery Bay Deer Reflector Study*. Olympia, WA: Washington State Department of Transportation.
- Peck, L.J., and J.E. Stahl. "Deer Management Techniques Employed by the Columbus and Franklin County Park District, Ohio." *Wildlife Society Bulletin* 25 (1997): 440-42.
- Predl, S. "Efforts to Manage the White-Tailed Deer of Princeton Township New Jersey." *Northeast Wildlife: Transactions of the Northeast Section, The Wildlife Society* 50 (1993): 49-55.
- Purdy, M. "A Frenzy Over Feeding Bambi & Co. in Princeton." *New York Times*, April 8 2001, 1.
- Putman, R.J. 1988. *The Natural History of Deer*. Ithaca, NY: Comstock Publishing.
- Putman, R.J. "Deer and Road Traffic Accidents: Options for Management." *Journal of Environmental Management* 51 (1997): 43-57.
- Reed, D.F. "Mule Deer Behavior at a Highway Underpass Exit." *Journal of Wildlife Management* 45, no. 2 (1981): 542-43, 2.
- Reeve, A.E., and S.H. Anderson. "Ineffectiveness of Swareflex Reflectors at Reducing Deer-Vehicle Collisions." *Wildlife Society Bulletin* 21 (1993): 127-32.
- Riley, S.J., and C.K. Nielsen. 2001. "Mitigation of Deer-Vehicle Accidents in the United States: Needs Statement and Suggested Research to Support Decisions," 10/30.
- Risenhoover, K.L., et al. "Hearing Range in White-Tailed Deer: Implications for Vocal Communication." Submitted to *Journal of Mammology*.
- Robertson, D.J., and M.C. Robertson. "Eastern Mixed Mesophytic Forest Restoration." *Restoration Management Notes* 13 (1998): 64-70.
- Romin, L.A., and J.A. Bissonette. "Deer-Vehicle Collisions: Status of State Monitoring Activities and Mitigation Efforts." *Wildlife Society Bulletin* 24 (1996): 276-83.
- Romin, L.A., and L.B. Dalton. "Lack of Response by Mule Deer to Wildlife Warning Whistles." *Wildlife Society Bulletin* 20 (1992): 382-84.
- Rosenberry, C.S., R.A. Lancia, and M.C. Conner. "Population Effects of White-Tailed Deer Dispersal." *Wildlife Society Bulletin* 27 (1999): 858-64.

- Rudolph, B.A., W.F. Porter, and H.B. Underwood. "Evaluating Immunocontraception for Managing Suburban White-Tailed Deer in Irondequoit, New York." *Journal of Wildlife Management* 64 (2000): 463-73.
- Salter, R. "Deer Whistle May Not Be Sound Investment." *The Times Union*, December 1 1996, G11.
- Sauer, P.R. 1984. "Physical Characteristics." In *White-Tailed Deer: Ecology and Management*, edited by L.K. Halls, 73-90. Harrisburg, PA: Stackpole Books.
- Sayre, R.W., and M.E. Richmond. 1992. "Evaluation of a New Deer Repellent on Japanese Yews at Suburban Homesites." In *Proceedings of the Eastern Wildlife Damage Control Conference*, 38-43. Eastern Wildlife Damage Control Conference.
- Schafer, J.A. and S.T. Penland. "Effectiveness of Swareflex Reflectors in Reducing Deer-Vehicle Accidents." *Journal of Wildlife Management* 49, no. 3 (1985): 774-76, 3.
- Schantz, K., R. Jennings, and R. Naugle. 2001. *Immunocontraception of White-Tailed Deer at The Frelinghuysen Arboretum, Morristown, New Jersey*. 2000 Progress Report. Humane Society of the United States.
- Schmitt, S.M., L. Sullivan, and J. Sikarskie. "Bovine Tuberculosis in Free-Ranging White-Tailed Deer from Michigan." *Journal of Wildlife Diseases* 33 (October 1997): 749-58.
- Schwartz, J.A., et al. "Captive and Field Tests of a Method for Immobilization and Euthanasia of Urban Deer." *Wildlife Society Bulletin* 25 (1997): 532-41.
- Stafford, K.C. "Reduced Abundance of *Ixodes Scapularis* with Exclusion of Deer by Electric Fencing." *Journal of Medical Entomology* 30 (1993): 1-11.
- Stout, R., and B. Knuth. 1995. "Using a Communication Strategy to Enhance Community Support for Management." In *Urban Deer: A Manageable Resource? 1993 Symposium of the North Central Section, The Wildlife Society*, edited by J.B. McAninch, 123-31. St. Louis, MO: The Wildlife Society.
- Stout, R.J., et al. "Comparison of Three Public-Involvement Approaches for Stakeholder Input into Deer Management Decisions: A Case Study." *Wildlife Society Bulletin* 24, no. 2 (1996): 312-17, 2.
- Stout, R.J., B.A. Knuth, and P.D. Curtis. "Preferences of Suburban Landowners for Deer Management Techniques: A Step Toward Better Communication." *Wildlife Society Bulletin* 25, no. 2 (1997): 348-59, 2.
- Strole, T.A., and R.C. Anderson. "White-Tailed Deer Browsing: Species Preferences and Implications for Central Illinois Forests." *Natural Areas Journal* 12 (1992): 139.
- Suhay, L. "As the Line Separating the Suburbs and Countryside Blurs, the Wildlife Gets Squeezed or Worse." *New York Times*, Oct. 1 2000, 1.
- Swihart, R.K., P.M. Picone, A.J. DeNicola, and L. Cornicelli. 1995. "Ecology of Urban and Suburban White-Tailed Deer." In *Urban Deer: A Manageable Resource? 1993 Symposium of the North Central Section, The Wildlife Society*, edited by J.B. McAninch, 35-44. St. Louis, MO: The Wildlife Society.
- Swihart, R.K., et al. "Nutritional Condition and Fertility of White-Tailed Deer (*Odocoileus Virginianus*) from Areas with Contrasting Histories of Hunting." *Journal Canadien de Zoologie* 76, no. 10 (1998): 1932-41, 10.
- Syers, J.K., A. Hamblin, and E. Pushparajah. "Indicators and Thresholds for the Evaluation of Sustainable Land Management." *Canadian Journal of Soil Science* 75 (1995): 423-28.
- Telford III, S.R., et al. "Incompetence of Deer as Reservoirs of the Lyme Disease Spirochete." *Journal of Tropical Medicine and Hygiene* 39 (1988): 105-09.
- Tilghman, N.G. "Impacts of White-Tailed Deer on Forest Regeneration in Northwestern Pennsylvania." *Journal of Wildlife Management* 53 (1989): 424-53.
- Turner, J.W., I.K.M. Liu, and J.F. Kirkpatrick. "Remotely Delivered Immunocontraception in Captive White-Tailed Deer." *Journal of Wildlife Management* 56 (1992): 154-57.

- Turner, J.W., J.F. Kirkpatrick, and I.K.M. Liu. "Effectiveness, Reversibility, and Serum Antibody Titers Associated with Immunocontraception in Captive White-Tailed Deer." *Journal of Wildlife Management* 60 (1996): 45-61.
- U.S. Fish and Wildlife Service. 1998. *1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: New Jersey*. Washington, DC.
- Van Deelen, T.R., et al. "Mortality Patterns of White-Tailed Deer in Michigan's Upper Peninsula." *Journal of Wildlife Management* 61 (1997): 903-10.
- Vercauteren, K.C., and S.E. Hygnstrom. "Effects of Agricultural Activities and Hunting on Home Ranges of Female White-Tailed Deer." *Journal of Wildlife Management* 62 (1998): 280-85.
- Waller, D.M., and W.S. Alverson. "The White Tailed Deer: A Keystone Herbivore." *Wildlife Society Bulletin* 25, no. 2 (1997): 217-26, 2.
- Waring, G.H., J.L. Griffiths, and M.E. Vaughn. "White-Tailed Deer Roadside Behavior, Wildlife Warning Reflectors, and Highway Mortality." *Applied Animal Behaviour Science* 29 (1991): 215-23.
- Warren, R.J. 1997. "Deer Population Management through Hunting and Alternative Means of Control." In *Deer as Public Goods and Public Nuisance*, edited by B. L. Gardner, 81-88. College Park, MD; University of Maryland.
- Wilson, et al. "Microgeographic Distribution of Immature Ticks Correlated with That of Deer." *Medical and Veterinary Entomology* 4 (1990): 151-59.
- Winchcombe, R.J. "Controlled Access Hunting for Deer Population Management: A Case Study." *Northeast Wildlife, Transactions of the Northeast Section, The Wildlife Society* 50 (1993): 1-9.
- Wood, P., and M.L. Woolfe. "Intercept Feeding as a Means of Reducing Deer-Vehicle Collisions." *Wildlife Society Bulletin* 16 (1988): 376-80.
- Wywialowski, A. "Agricultural Producers' Perceptions of Wildlife-Caused Losses." *Wildlife Society Bulletin* 22 (1994): 370-82.
- Ziegler, S.S. "Relict Eastern White Pine (*Pinus Strobus* L.) Stands in Southwestern Wisconsin." *American Midland Naturalist* 133 (1995): 88-100.
- Zuchowski, D. "Trafficking in Deer Alerts Game Unit, Helps PENDOT Target Roads for Those Warning Signs." *Pittsburgh Post-Gazette*, January 19 1997, W-2.

Reviewed by:

James Parkhurst, Extension Wildlife Specialist, Department of Fisheries and Wildlife Sciences, Virginia-Polytechnic Institute and State University, Blacksburg, VA.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Maryland, College Park, and local governments. Thomas A. Fretz, Director of Maryland Cooperative Extension, University of Maryland.

The University of Maryland is equal opportunity. The University's policies, programs, and activities are in conformance with pertinent Federal and State laws and regulations on nondiscrimination regarding race, color, religion, age, national origin, gender, sexual orientation, marital or parental status, or disability. Inquiries regarding compliance with Title VI of the Civil Rights Act of 1964, as amended; Title IX of the Educational Amendments; Section 504 of the Rehabilitation Act of 1973; and the Americans With Disabilities Act of 1990; or related legal requirements should be directed to the Director of Human Resources Management, Office of the Dean, College of Agriculture and Natural Resources, Symons Hall, College Park, MD 20742.

The Maryland Cooperative Extension's programs are open to all citizens without regard to race, color, gender, disability, religion, age, sexual orientation, marital or parental status, or national origin.



V2003