Managing Human-Wildlife Interactions:
Coyote (*Canis latrans*)

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The coyote (*Canis latrans*) displays a wide geographic distribution, one that currently includes all of the continental U.S. and much of Canada and Central America, and now may be reaching into extreme northwestern South America (fig. 1). People in the U.S. have managed, harassed, and killed coyotes for well over 150 years to reduce livestock depredations and to supply fur to the fashion industry. Following the local extinction of the gray wolf (*Canis lupus*) from many areas within the lower 48 states, the coyote became the primary predator to sheep, goats, and cattle. Extensive campaigns to manage coyotes prevailed throughout the 1900s and employed methods such as poisoning, trapping, shooting, and aerial gunning (Parker 1995). Use of variations of these techniques continues today to reduce livestock losses. Although these methods can be successful in temporarily reducing predation risk locally, overall coyote populations rarely are reduced for long due to the coyote's dispersal behavior and quick recolonization of depopulated areas.

Figure 1. Range of coyotes within the Northern Hemisphere, 1900-2016. (Reprinted from Hody and Kays 2018. Licensed under CC BY 4.0, https://creativecommons.org/licenses/by/4.0/.)

Although often described as an animal that predominantly inhabits rural lands, coyotes commonly roam suburban neighborhoods and even heavily urbanized cities (e.g., coyotes are well-established in Rock Creek Park in Washington, D.C.). Because of the coyote's versatility, adaptability, and its current wide distribution throughout Virginia, the likelihood of encountering a coyote is real. Thus, residents of the Commonwealth should become more aware and informed about the traits and behaviors of this species to avoid undesirable interactions. This publication provides basic information about the coyote, its expected and normal behaviors and other life history aspects, and suggestions on how to minimize or avoid problems that can arise from our interactions with this fascinating creature.

Biology and Behavior

The coyote's native range originally spanned western Canada, southeastern Alaska, the central prairie states, and arid regions of the southwestern U.S. Today, that range has expanded to include all of the lower 48 states. Coyotes originating from the northern prairies traveled north and east through southern Canada before dispersing into New England, the eastern Great Lakes region, and ultimately into the mid-Atlantic (fig. 2); some coyotes involved in this dispersal bred with gray wolves during this trek. Similarly, some coyotes originating from the lower plains and arid southwest bred with red wolves (*Canis rufus*) while traveling east through the Gulf Coast region and throughout the southeastern states before reaching Virginia. These two waves of founding individuals ultimately merged here in Virginia, beginning in the 1950s. Interestingly, coyotes entering Virginia from the north and carrying remnant gray wolf genes initially were somewhat larger and heavier than those entering from the south; those arriving in Virginia from southwestern ancestry retained a lanky appearance and displayed stronger social pack behavior than did northern animals. Today, as these populations have intermingled and dispersed throughout the Commonwealth, those initial distinctions no longer are readily

evident. In addition to this natural dispersal, hunt clubs and managers of commercial penned hunting operations illegally brought coyotes captured elsewhere to Virginia; many of these animals escaped from their holding pens, further confounding distinctions of true origin.

Figure 2. The extent, timing, and directions of range expansion by coyotes across North America. (Reprinted by permission from the Urban Coyote Research Project, Cook County, Illinois.)

The home range of a coyote may encompass 8-16 square miles and will be largest in areas where food resources are not abundant or are less reliable. Coyotes prefer to hunt in and travel through open woodlands, forest edges, meadows, and riparian draws or gullies. Small woodlots, pastures, fencerows, and other brushy or overgrown habitats in both rural and suburban areas provide excellent cover and foraging opportunities. The wealth of such conditions here in Virginia has allowed the coyote to successfully colonize every county in the Commonwealth.

Coyotes are noticeably larger than Virginia's two common fox species, the red fox (*Vulpes vulpes*) and the gray fox (*Urocyon cinereoargenteus*); the average coyote is approximately the size of an adult collie dog. It has a sharply pointed muzzle and pointed ears that are held erect.

Pelt color is highly variable. Typically, the throat and chest area are light cream colored, with the rest of the coat gray mixed with brown and black tones (fig. 3). The legs, feet, and ears often exhibit reddish tints. Black-tipped guard hairs give many individuals a "salt and pepper" look. Although not common, some individuals are entirely black. The full, bushy tail (usually 12-15 inches long) tipped with black is carried at a downward slant as the animal moves.

In the wild, coyotes rarely live longer than 6-8 years. Adult females normally weigh between 18 and 35 pounds; adult males usually are larger, weighing between 25 and 45 pounds (Linzey 2021).

Figure 3. Typical physical appearance of the coyote. (Image courtesy of U.S. Fish and Wildlife Service, Seedskadee National Wildlife Refuge; photographer Tom Koerner.)

Although coyotes can be solitary or, in the case of young males, gather in loosely structured "bachelor" groups, most maintain strongly territorial social family units that consist of a mated pair of adults who attend to the current year's pups and several juvenile females from a previous litter who serve as "helpers." Juvenile males usually disperse on their own (sometimes driven off by the adult pair) by the end of their first year. Despite many literature accounts that describe coyotes as nocturnal animals, they actually can be quite active in daytime, particularly during spring and early summer when the adults work hard to gather sufficient food for the litter of growing pups. More commonly, coyotes are most active in the early morning and the evening at or just after dusk (known as "crepuscular" behavior). Coyotes not accustomed to interacting with humans tend to be secretive and purposefully avoid such encounters, so people rarely see them even though they may be nearby.

Coyotes' eyesight, hearing, and sense of smell all are very well developed. They communicate principally through scent marking and various vocalizations, for which they have earned the distinction of being one of the most vocal mammals in North America. Vocalizations of the coyote consist of a series of short barks followed by a prolonged high-pitched howl, and various whines, yelps, and growls. On occasion, coyotes

respond to the sirens of nearby emergency vehicles by giving returning howls.

Coyotes are omnivorous — they eat both plant and animal matter. A coyote's diet generally reflects whatever is most available at the time (e.g., relying heavily on berries and other fruits during summer when these items are most abundant). Throughout much of the year, coyotes pursue small to mid-sized mammals, including rabbits, groundhogs (*Marmota monax*), voles, and mice, which make up a large portion of the diet. Adults, chicks, and the eggs of game birds such as the ruffed grouse (*Bonasa umbellus*), wild turkey (*Meleagris gallopavo*), or bobwhite quail (*Colinus virginianus*), and other ground-nesting nongame birds are pursued wherever encountered. White-tailed deer (*Odocoileus virginianus*) appears frequently in the diet of coyotes, though many people debate its actual source. Coyotes are scavengers and thus make full use of resources left behind in the woods during and after the hunting season such as "gut piles" from field-dressed game animals or the remains of whole animals shot by hunters, but not recovered. Additionally, coyotes utilize winter-killed or road-killed deer wherever available. However, they also are adept predators and prey on live deer, especially recently born deer fawns they find in the spring. Contrary to common myth, coyotes in Virginia pose little threat to deer populations in areas with high deer densities, but, where deer numbers already are low (due mostly to poor habitat quality), the combined effects of predation by coyotes, black bears (*Ursus americanus*), and bobcats (*Lynx rufus*) may impact deer population status or recovery negatively. Coyotes also prey on domestic animals left unprotected or vulnerable in pastures, such as poultry, fowl, sheep, goats, or small calves, as well as free-roaming companion animals (cats and small dogs).

Coyotes first breed at 2 years of age, although young females may enter the breeding population earlier where hunting or trapping pressures are heavy or in areas where coyote numbers naturally are low and food resources and territorial space are abundant enough to sustain a higher population. Coyotes pair with a single mate for life (monogamous behavior), but occasionally, a female will leave her previous mate for a more dominant male as a way to increase her fitness and the survival of her pups. Mating occurs from late January through early March, and pups are born 60-64 days later. Litter size ranges from four to eight pups, with an average of 5.3. The den usually is well hidden on a south-facing brushy hillside or outcrop. Coyotes may dig a new burrow or simply widen an existing burrow created by a groundhog or fox. A mated pair often will have several den sites within the territory to which they can move pups if one site is disturbed by humans

or predators. Both adults help care for the young, and unmated female siblings from a previous year may assist as well. Pups are weaned at 6 weeks of age and slowly begin accepting solid foods and learning how to hunt.

Ecologic Status and Economic Importance

Coyotes fulfill several important ecological roles. They act as a predator of common pest species such as mice, Norway (*Rattus norvegicus*) and black (*Rattus rattus*) rats, voles (*Microtus* spp.), moles, and groundhogs, and as a scavenger of carcasses of recently deceased animals (e.g., victims of vehicular impact, those fatally wounded and unrecovered by hunters, and those succumbing to natural causes). This "housekeeping" behavior (i.e., the removal of carcasses) affords both health and aesthetic benefits and may help stem the spread of some diseases.

Here in the Commonwealth, the Department of Wildlife Resources (DWR) currently classifies the coyote as a "nuisance species." Under this statutory classification (4VAC15-20-160, https://law.lis.virginia.gov/admincode/title4/agency15/chapter20/section160/), the coyote is afforded little protection and may be taken at any time and without limit (except on National Forest and DWR Management lands), provided legal methods for take, as defined by DWR, are used. This important classification simplifies options for those dealing with problem coyotes.

The DWR estimates the total harvest of coyotes is somewhere between 20,000 and 25,000 animals annually. Coyotes are taken opportunistically while hunters are pursuing other game species and through the purposeful pursuit specifically for coyotes. They also are taken during the regulated furbearer trapping season, though harvest via traps is lower than that amassed through hunting. Currently, coyote pelts comprise a minor component of the fur trade in Virginia, as there has been relatively little demand for and low dollar values given to coyote pelts. Nevertheless, the number of coyotes harvested by trapping in the Commonwealth had been rising steadily for nearly 20 years before declining somewhat in recent years: 1,295 coyotes harvested in 1993-1994, about 8,300 in 2001-2002, 11,592 in 2007-2008, but only 2,898 in 2013-2014 (Kidd, Harris, and Baer 2014). The trends in harvest predominantly mirror average pelt prices, but participation by trappers also declines when they believe the coyote population is down and their likelihood of trapping success may suffer as a result. However, the most recent tally revealed a slight increase in harvest (3,750 animals) during the 2020-2021 season (Michael Fies, DWR Furbearer Biologist, pers. comm.). Although trapping harvest appears to have declined from the

historic highs of the mid-2000s, most managers believe the coyote population remains stable and actually may be increasing somewhat in suburban and urban habitats.

Despite a very low occurrence of human personal safety incidents since coyotes first arrived in Virginia, they do represent a potential threat to human and domestic animal health and safety. Like other resident members of the canid family, coyotes can be carriers of the canid strain of the rabies virus. They also serve as a potential vector for canine distemper in areas where this disease is endemic. Where coyotes have become habituated and lost their innate fear of humans, they may become emboldened or occasionally threatening or aggressive; such behaviors are most likely to materialize where coyotes have been fed or encouraged to closely approach people. Though uncommon, the potential of someone being bitten by or involved in an aggressive interaction with a coyote nevertheless does exist.

When allowed unimpeded access, coyotes will prey upon vulnerable livestock (poultry/fowl, sheep, goats, swine, and cattle). Across the entire U.S. cattle industry, 41% (n = 16,880 animals) of all predation losses of adult cattle and 53.1 % (n = 126,810 animals) of calves were attributed to coyotes. Although these are significant numbers, losses to predation overall account for only 2.4% of all mortalities in cattle and 11.1% in calves; losses to nonpredatory factors far exceed those attributed to predators (NAHMS 2017a). Here in Virginia, coyote depredation on cattle and calves has remained relatively stable over the last decade and displays a distinct bias toward calves (Table 1).

Table 1. Annual depredation loss of cattle and calves in Virginia, as reported in the 2015 USDA National Animal Health Monitoring System Cattle Death Loss survey (NAHMS 2017a).

Livestock Type	Total Loss to All Predators	Loss to Predators as a Percent of Inventory	Loss Attributed to Coyotes
Adult Cattle (>500 lbs.)	1,590	0.1%	20.0%
Calves	8,570	1.3%	74.8%

Nationally, coyote depredations on sheep and goats, though smaller in total number of mortalities compared to cattle and calves, have remained relatively unchanged since 1994 (NAHMS 2015, 2017b). Although predation losses among sheep and goats are smaller in total number of mortalities when compared to cattle and calves, those losses can be more impactful to producers of sheep and goats as the number of animals affected per incident on an individual farm can be high (3-15 sheep per farm and 9-19 goats per farm) (NAHMS 2015, 2017 b). Predation therefore has the potential to cause severe impact on small farm operations and hobbyists where methods of predator deterrence are lacking.

Table 2. Annual depredation loss of sheep and lambs and goats and kids in Virginia, as reported in the 2015 National Animal Health Monitoring System Loss Surveys (NAHMS 2015, 2017b).

Livestock Type	Total Loss to All Predators	Loss as a percent of Inventory	Loss Attributed to Coyotes
Adult Sheep	1,166	2.2%	94.2%
Lambs	2,924	5.3%	62.9%
Adult Goats (all types)	157	0.3%	61.6%
Kids (pre-weaned)	1,200	3.7%	56.5%
Kids (post-weaned)	378	3.7%	56.5%

Depredations by coyotes can occur at any time of the year, but incidence peaks in spring and summer when sheep and cattle often give birth and when the need to feed young growing pups increases for coyotes. Because domestic and feral dogs, black bears, bobcats, and black vultures (*Coragyps atratus*) also prey upon livestock, it is important to accurately differentiate depredations attributed to coyotes from those of other predators. In many Virginia counties, livestock producers are eligible to receive monetary compensation for damage to livestock caused by free-roaming dogs, whereas damage inflicted by wildlife is not covered. In some instances, depredation claims have been submitted as dog damage in an effort to obtain financial compensation for losses actually inflicted by coyotes.

Conflict Management
Confirm Presence and Identification

If you suspect that coyotes are using your property, but you haven't yet observed them directly, look for other signs of their presence. A common way to determine if

coyotes are in an area is to find their footprints. To the casual observer, coyote tracks probably are indistinguishable from those of domestic dogs. However, the shape of the tracks, the position of the nail marks, and the pattern of the stride can tell you which species made the tracks. The shape of a coyote's tracks (fig. 4) appear oblong when compared to those of a similar-sized dog (fig. 5). The two central toenails on a coyote's foot usually are close together and appear parallel or point slightly inward. The two outer toenails often do not register (i.e., leave an impression) in coyote tracks, but, where they do imprint, they also point forward. The front foot is larger and more rounded than the rear, has a prominent heel pad impression, and is 2½-3 inches long and about 2 inches wide. The rear paw leaves shorter impressions, and the heel pad often imprints only as a small round dot. Coyotes have a direct registering gait, meaning the rear foot typically imprints within the front track. In contrast, dogs rarely walk with a direct registering gait, so the rear and front tracks typically do not overlap each other. The toes and nails of dogs usually point outward rather than forward, and the heel pads register strongly in both the rear and front tracks.
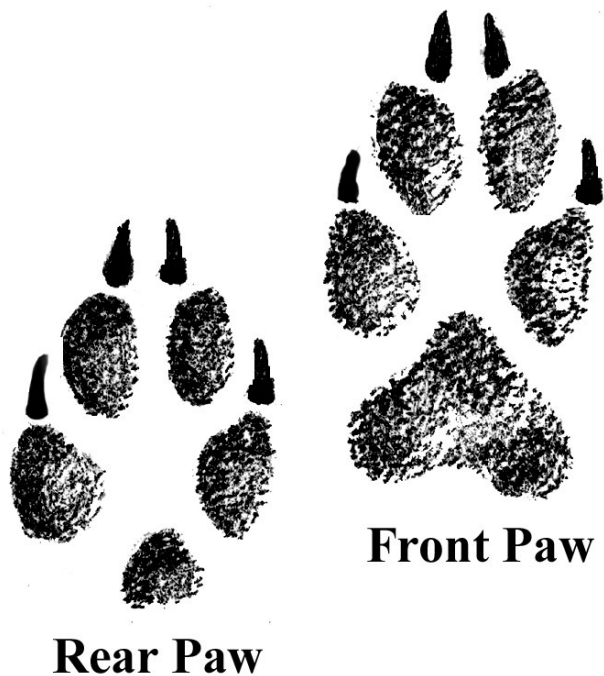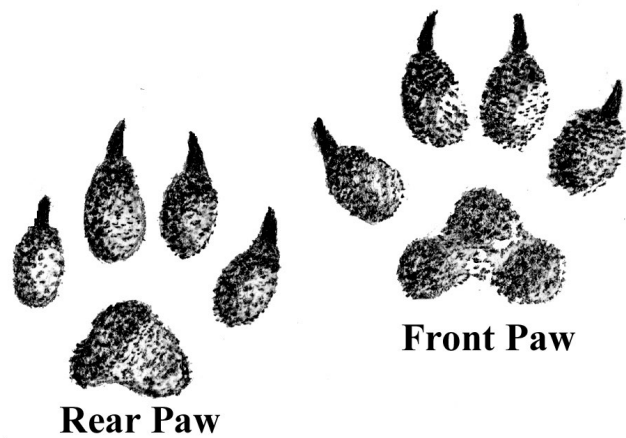

Figure 5. Front and rear footprints of typical domestic dog. (Illustration by co-author Danny Dove.)

To reduce the potential for coyote damage to personal property, landowners should take precautionary measures before any problems occur and recognize that no single technique will provide absolute protection from coyote damage. Once armed with a good understanding of coyote behavior, landowners can reduce the potential for depredations through appropriate and timely use of preventive measures. If you live in an area where coyotes are present, recognize that coyotes are persistent and adaptable, and that several management techniques may be necessary if problems are to be avoided. Those affected by coyotes must be willing to develop a comprehensive and adaptive management strategy that is tailored to suit their site-specific needs and economic situation.

Tolerance

Recognizing that coyotes fulfill an important ecological role by preying on rodent or other mammalian pests, one approach to dealing with coyotes is simply learning to co-exist with them where this is feasible. Landowners who are not experiencing problems with coyotes may enjoy watching them on their property or benefit from the rodent control they provide around residential areas or grain production enterprises. Realistically, though, it is not prudent to encourage coyotes to inhabit residential properties solely to gain better rodent control, as this likely will increase the potential for coyotes to habituate to humans and perhaps lead to other problems.

Basic Husbandry Methods

If you allow unsupervised pets to roam freely outdoors, you must acknowledge that they are vulnerable to potential threats, including predation. To avoid creating a wildlife interaction problem, pets should be fed indoors. In cases where outdoor feeding is necessary, the amount of food provided should be limited to no more than the

Figure 4. Front and rear footprints of a coyote. (Illustration by co-author Danny Dove.)

pet will consume in a single feeding. Readily accessible, reliable, and abundant food sources left unattended outdoors will attract an array of wildlife, including coyotes and many species that coyotes prey on. Once wild animals begin to rely on supplemental foods found in close proximity to humans, habituation in these animals often increases the potential risk of injury or exposure to transmissible disease for humans and their pets also rises. Therefore, any activities or practices that attract wildlife close to one's residence or place of business should be avoided.

Dense brushy or overgrown weedy areas close to your residence can provide suitable cover for both potential prey species and coyotes. Limiting the amount of such cover or thinning it out to reduce its density may help reduce wildlife use of these areas.

Livestock producers are encouraged to adopt sound husbandry practices to help reduce the potential for coyote depredations. The Virginia Office of the U.S. Department of Agriculture's Wildlife Services program administers the Virginia Cooperative Wildlife Damage Management Program (VCWDMP), a program designed to assist livestock producers in protecting their stock from wildlife depredations. The VCWDMP has been providing on-site technical assistance and direct control since the early 1990s to producers who experience problems with coyotes. This office also disseminates information on preventive control strategies that can make farm operations more resilient to coyotes. Examples of suggested approaches are techniques that reduce exposure to potential danger, such as confining poultry or fowl to an enclosed structure at night when they are most vulnerable. In the absence of confinement facilities, animals could be moved to fenced pens close to occupied buildings or well-illuminated areas. Birthing is a time of high vulnerability for livestock, so producers are encouraged to take special precautions during these periods. Selective pasturing, where ewes with newborn lambs are moved to central, less vulnerable pastures, may help reduce the incidence of loss. Where economically and logistically feasible, moving sheep into fenced night paddocks (discussed below) will make them less available to coyotes during the most vulnerable period of the day. Placing these night paddocks near buildings or centers of human activity or adding exterior lighting also can discourage coyote activity. Adoption of these practices also makes it easier for producers to quickly monitor for losses to depredation.

Other management practices producers should consider include the immediate removal and proper disposal of carcasses and the adoption of estrus synchronization of sheep or cattle. Carcasses of any dead livestock animals should be removed from fields or pastures immediately upon detection to prevent coyotes from developing an association between livestock production facilities and carcasses as food sources. Estrus synchronization allows a producer to schedule livestock birthing at times that do not coincide with the coyote's increased demand for food for pups, which normally occurs during spring and early summer. Estrus synchronization programs also may hold other benefits to producers, such as allowing them to capture better market prices for stock at different times of the year or assuring that lambs and calves are born during more favorable weather conditions.

Nonlethal Control Methods

In addition to good husbandry and effective habitat maintenance, nonlethal control methods may deter or prevent damage caused by coyotes. However, use of some forms of nonlethal techniques can require substantial investments of time and money. In general, there are three categories of nonlethal deterrents applicable to coyotes — guard animals, repellents, and fencing. Each of these categories will be reviewed briefly below.

Guard Animals

Having a human shepherd monitor a flock or herd is labor-intensive, time-consuming, and costly; using guard animals provides an alternative. Some of the more successful guard animals are dogs, llamas, and donkeys or mules. To be successful, a guardian animal must develop an attachment to or bond with the animals they are to guard. This bonding, combined with the guard animal's natural aggression toward predators, can make a guard animal an effective protector.

• **Dogs:** Guard dogs have proven to be effective deterrents against predators, including coyotes (Green and Woodruff 1990). That said, guard dogs may not be appropriate for all situations and not all breeds of dogs perform well; an improperly handled or poorly trained dog can injure or kill the animals they are supposed to protect. Unlike herding dogs (e.g., border collies), properly trained guard dogs stay within the flock or herd and provide continuous protection. Breeds commonly used as guardian animals include the Great Pyrenees, Akbash, Anatolian Shepherd, Komondor, and Maremma. The larger breeds typically are more effective in deterring coyotes.

To become a successful guard animal, each dog needs proper training and routine care, both of which can become expensive. A guard dog should be acquired as a puppy, as soon after weaning as possible, and placed among the livestock animals it will be guarding so that the necessary bond between dog and livestock develops — it is this early bonding that fosters the development of the protective behavior in the dog. A guard dog

will need some form of temporary shelter within the paddock for periods of extreme weather. The guard dog should be fed similar to any other pet fed outdoors — provide only as much food as will be consumed in a single feeding to avoid attracting other wildlife. Direct and frequent interactions between the guard dogs and humans (other than the primary handler) must be minimized to prevent the dogs from becoming attached to people and then abandoning the flock; guard dogs must be viewed as tools or implements, not pets, if they are to remain useful. On average, the typical guard dog has a working life of about three to five years, although some breeds may continue working well for up to eight years (Green, Henderson, and Collinge 1994).

- **Llamas:** Llamas may be a better choice as a guard animal in some situations. Llamas eat what the livestock eat, so they do not require special feeding, and they typically live for 18-25 years, and so have a longer working life than dogs. Llamas bond well to livestock, especially with sheep, without specialized training, but the level of aggressiveness they show toward predators often varies among individual llamas. As is true with dogs, some llamas may never become good guard animals. When using llamas as guard animals, they must be used singly; when more than one llama is placed in a paddock, they frequently will pair off with one another and cease to defend sheep. The same is true if another llama is present in an adjacent pasture; they will hang together at the fence line rather than circulate within their respective flocks. Also, it is impractical to use a single llama with a large flock — one guardian animal will be severely challenged to protect a large, well-dispersed flock. Because of llamas' innate dislike of canids, they may react negatively to herding dogs; this may cause difficulties for producers who use herding dogs to manage their flocks.

- **Donkeys:** Use of donkeys as guard animals is very similar to llamas. Although donkeys and mules can be effective guard animals, they too must be used singly to prevent association with other donkeys. Experience has shown that a jenny (female) is preferred, as jacks (male) can become aggressive toward sheep and calves and could stomp, bite, or inflict injury or death on members of the flock.

Repellents

In theory, a repellent should stimulate fear or cause an animal to avoid a treated object or area by delivering an unpleasant visual image, taste, smell, or noise of sufficient strength to cause the desired response. Effective repellents often trigger multiple senses in the animal simultaneously, thereby heightening the stimulus received. To maximize the effectiveness of a repellent-based management strategy, rotate the use of several different repellents over time rather than relying on only a single product. Periodically changing where one places a deterrent or the timing of its implementation will help create unpredictable patterns of use on the property, which therefore increases overall effectiveness.

The active ingredients in a chemical-based repellent produce a bad taste and/or smell that theoretically will deter the target animal. However, at this time, no registered or authorized repellents exist for use on coyotes.

Use of loud sounds sometimes can provide temporary relief from coyote damage. However, to avoid disturbing neighbors, noise-producing devices probably should be used only in isolated rural settings. Repeated and predictable patterns of noise often will lead to coyotes becoming habituated to that sound and, over time, they eventually ignore the threat a noise might represent, unless some other form of deterrence also is used. An example of a common noise deterrent is the propane cannon (fig. 6), which produces a loud, but often predictable, noise. To combat habituation, it is best to use a device that has variable timer settings or motion-detection capability that allows the device to activate at irregular intervals.

Figure 6. A propane cannon deployed in the field. (Image courtesy of the U.S. Department of Agriculture; photographer Lance Cheung.)

Visual deterrents capture the attention of an animal by presenting something new or unusual in the animal's territory or simulating something that represents a perceived threat (e.g., a dangerous situation, a predator, or a competitor). Deterrents that replicate the presence of humans sometimes are more effective than unusual objects placed in the field. Coyotes not yet habituated to humans usually will avoid situations where opportunity for direct contact with people exists. Because coyotes naturally are curious, they initially may approach and investigate a new or unique object with which they have no prior experience rather than flee. The reality is that many commercially available visual deterrents fail to deter coyotes because

they quickly habituate to these devices and do not recognize them as viable threats.

Fencing

Although exclusion fencing can be an effective management practice to reduce coyotes' access to pastures, high construction and maintenance costs or the presence of highly irregular topography may make fencing impractical. Before installing any fencing, the owner should conduct a thorough feasibility and economic evaluation to determine if fencing is justifiable. Creating a coyote-proof fencing system can be costly and challenging — some coyotes always seem to find a way to dig underneath, climb, jump over, or find an opening or gap in any protective barrier. Even so, a well-constructed and maintained fence can deter coyotes' overall access to pastures or limit their pathway to certain points of entry where lethal removal is more effective. In some situations, producers may find it simpler or perhaps more cost-effective to supplement, rather than completely replace, an existing but imperfect fence. Adding several strands of electrified wire to the outside or top of an existing fence or improving selected sections of a fence by repairing obvious gaps or holes with woven wire can bring noticeable benefit. Additionally, recent research has shown that adding strips of wide red plastic tape to fencing (called fladry; fig. 7) reduced coyote depredations substantially (Windell et al. 2022). However, both the proper spacing of strips and a particular method of tying strips to fencing proved to be critical elements that determined the ultimate success of this technique (Young, Draper, and Beck 2019).

Figure 7. Installation of fladry fencing to a grazing paddock in an effort to deter coyote depredation (Image courtesy of USDA-Wildlife Services, National Wildlife Research Center; photographer Pamela Manns.)

When considering installation of new fencing, the topography of the land often will dictate the type or design to use. For relatively flat pastures, high-tensile electric fencing (fig. 8) may work well. This type of fence typically is constructed with at least seven alternating "hot" (electrified) and "cold" (non-electrified) wires, the lowest of which is "hot" and placed no higher than 6 inches above the ground to prevent coyotes from going underneath. Each of the next two wires should be no more than 6 inches apart from each other to prevent coyotes from penetrating through the fence. The spacing of wires gradually increases to 8-10 inches as fence height increases. Due to the significant tension maintained on these wires to keep them taut, stout wooden support posts are needed at corners or where the fence changes direction. Spacing of the main support posts may vary from 15 to 90 feet depending on the nature of the topography; metal t-posts or fiberglass supports then are spaced every 10-20 feet between the wooden posts. Proper grounding is necessary to ensure maximum effectiveness and to reduce the risk of damage to the system due to lightning strikes. High tensile systems generally are not effective in hilly areas or when crossing gullies or draws, as gaps will open under the bottom strand and provide access points for coyotes.
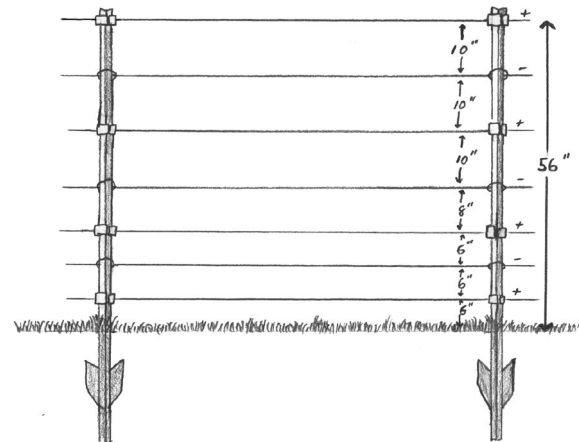

Figure 8. High-tensile electric fence used to deter coyotes on flat or level terrain. (Illustration by co-author Danny Dove.)

Woven-wire fencing (fig. 9) is adaptable for use in hilly areas and can be modified to address gaps created by gullies or stream crossings. The finished height of this fence depends on the desired level of protection needed and acceptable cost. Woven-wire fencing is available in various heights and, where additional height and/or width is needed to fill detected gaps, electrified or barbed wire strands can be added at the top and bottom. To maximize effectiveness, the bottom of the fence should be placed on or as near to the ground as possible. Stout wooden posts provide support in corners and wherever the fence changes direction; metal t-posts, spaced 14-16 feet apart, provide support between the wooden posts. In situations where a coyote successfully penetrated a fence, it is

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easier to determine where that penetration occurred with woven wire than with high tensile fencing. Breaks or gaps in a fence immediately are obvious and indications of whether an animal passed through or beneath it often will be evident (e.g., hairs caught in fence, evidence of digging under, vegetation flattened from repeated use of opening). Once located, the owner can repair that opening or fit it with traps or snares to target the offending animal.
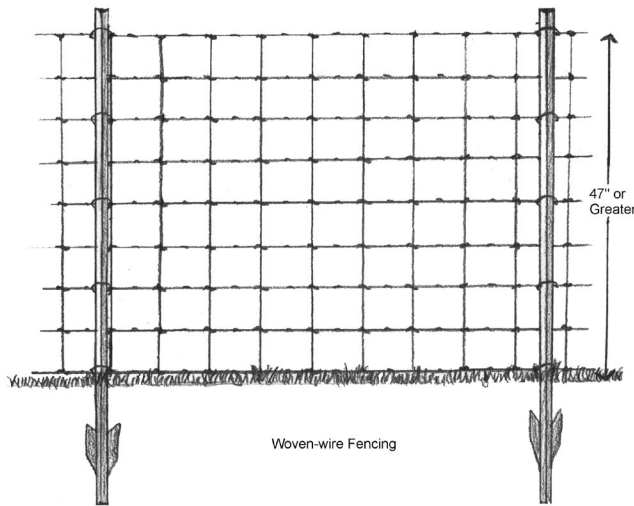

47" or Greater

Woven-wire Fencing

Figure 9. Woven-wire fence used to deter coyotes. (Illustration by co-author Danny Dove)

Regardless of the type of fence design used, producers must pay special attention to gateways. Most commercially available gates require adding woven wire panels across the gate to prevent coyotes from entering between the gate's bars. Further, an improperly installed gate that leaves gaps underneath it or at its sides negates all efforts to construct a functional deterrent against coyotes; they will find and use these defects repeatedly once detected.

Other Nonlethal Options

Live-capturing and relocating coyotes to other areas is not a viable strategy. Under existing wildlife (https://law.lis.virginia.gov/admincode/title4/agency15/chapter30/section50/) regulations (4VAC15-30-50), it is illegal to transport or release a live-trapped coyote anywhere other than on the property where caught, unless one holds a permit from DWR to do so. Further, relocated and released animals may carry with them diseases or parasites that currently are not present in the chosen release area, and thus these released animals can act as vectors for the spread of potentially harmful organisms.

Contraception and sterilization techniques may sound promising as ways to stabilize or reduce coyote numbers, but these techniques are not yet feasible. Treatment with contraceptives is constrained by legal and logistical complications. Currently, no contraceptive material

is available nor legally registered for use on coyotes. Furthermore, contraceptives typically must be re-administered annually to sustain reproductive disruption; this is extremely difficult to accomplish on wild, free-roaming animals. Sterilization also is challenged by logistic difficulties and high economic costs associated with having to capture, transport, and then perform the surgical procedure necessary to render an animal infertile, all of which makes this option unfeasible on a large scale. Because reproduction among coyotes is quite successful and untreated individuals can freely enter a treated population through normal dispersal, it would be nearly impossible to sustain any population reduction through reproductive inhibiting methods alone.

Lethal Control Methods

If husbandry and nonlethal options fail to resolve verified coyote problems adequately, lethal control measures will be necessary to reduce predation. Lethal control strategies should target offending or potentially offending coyotes during times of increased livestock vulnerability, such as during calving and lambing. By strategically removing the breeding, or alpha, pair of offending coyotes at high-risk sites, such as a sheep farm with historic predation, and doing so in late winter or early spring before a new litter is born, the disruption in the local population may offer temporary relief from depredations. A primary concern with use of lethal methods is the potential for injuring or killing nontarget animals, such as pets (especially dogs), foxes, or even livestock that inadvertently come into contact with the lethal method. Commonly used methods of lethal removal of offending animals include trapping and shooting.

Trapping

Because the coyote is classified as a "nuisance" species, there are few restrictions or limits regulating the capture and removal of coyotes in Virginia. Trapping can be effective in removing a problem animal, especially after the offending animal's habits and travel routes have been determined using direct observation and physical evidence such as tracks, feces, or hair. Careful site assessment and strategic trap placement is necessary to reduce potential threats to nontarget animals. However, few landowners today have experience or the field knowledge needed to trap coyotes successfully. Coyotes subjected to sloppy or ineffective trapping attempts often become very wary and extremely difficult to trap in the future, so it is best to leave trapping to professionals. Upon request, the staff of the USDA-Wildlife Services/VCWDMP will provide direct control assistance that often includes use of traps and snares. These agents also offer producers instruction in proper trapping techniques. In addition, other professional assistance may be available from

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experienced recreational trappers. The DWR maintains a [database of licensed trappers](https://dwr.virginia.gov/wildlife/nuisance/trappers/) (https://dwr.virginia.gov/wildlife/nuisance/trappers/) who provide services to individuals seeking assistance with wildlife problems. Additional help and guidance on trapping issues can be obtained from the [Virginia Trappers Association](https://virginiatrappersassociation.org/) (https://virginiatrappersassociation.org/).

By design, traps are constructed to function either as live-capture or lethal-capture devices. Regardless of their intent, live-capture traps in Virginia typically are viewed as lethal devices when dealing with problem species because, by regulation, any animal captured alive must be released somewhere on the property where it was captured or it must be killed. Citizens cannot possess or transport a wild animal nor liberate said animal on property they do not own without authorization from DWR to do so.

Although used infrequently to capture coyotes, a live-catch box or cage trap (i.e., one with a door that closes behind the animal after it has entered) has the advantage of allowing unharmed release of nontarget animals captured unintentionally. Live-capture devices also include various foothold traps (fig. 10). Effective locations to place a foothold trap would be along known travel routes, where a coyote has dug under a fence, or at a break in a fence that a coyote is using for access. Some trappers use scents or lures as attractants, but these may increase the risk of drawing in a nontarget animal. By state regulation, each trap placed in the field must bear a metal tag that displays the owner's name and address or the DWR issued trapper ID number, unless the trap is set legally on property owned by the individual doing the trapping. After setting a trap, a trapper must inspect that trap at least once every 24 hours.
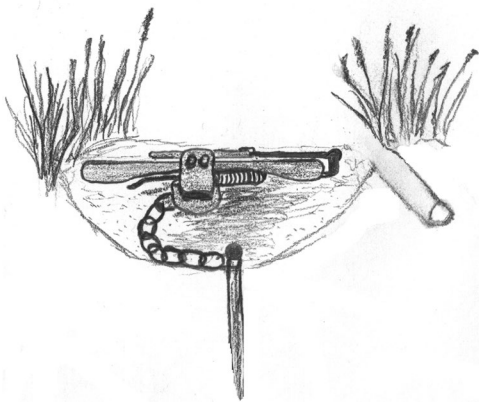

Figure 10. Side view of a steel foothold trap placed in a dirt-hole set. A stake is driven into the bottom of the hole underneath the trap and the chain and trap are covered lightly with finely sifted soil so as not to interfere with the depression of the trigger pan. Scent can be placed in a small hole dug to the side of the trap and made to look like a mouse burrow to attract the curiosity of the coyote. (Illustration by co-author Danny Dove).

A snare is a capture device typically set in a gap in a fence or along a travel corridor that coyotes use. A snare can be set either as a live capture method (by ensnaring a foot) or as a lethal set (by ensnaring the animal around the neck), depending on the needs of the operator. As the animal steps into or passes through the snare's opening, it will engage the snare, which then tightens around the foot or the neck of the animal. For applications involving coyotes, most trappers employ lethal sets (figs. 11a, b). Snares usually are constructed of high-tensile cable and are anchored securely to prevent an animal from escaping with the snare still attached.
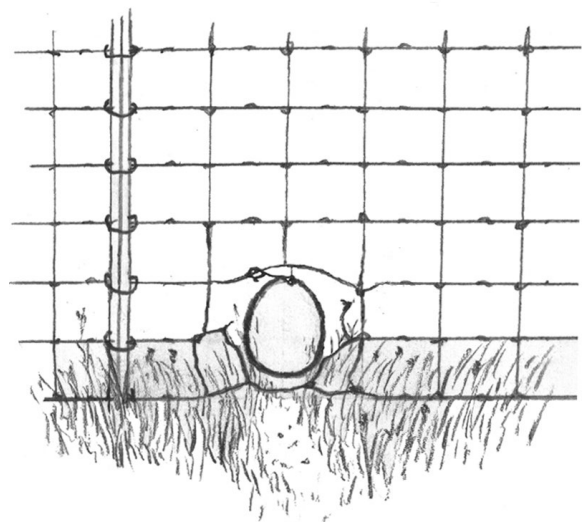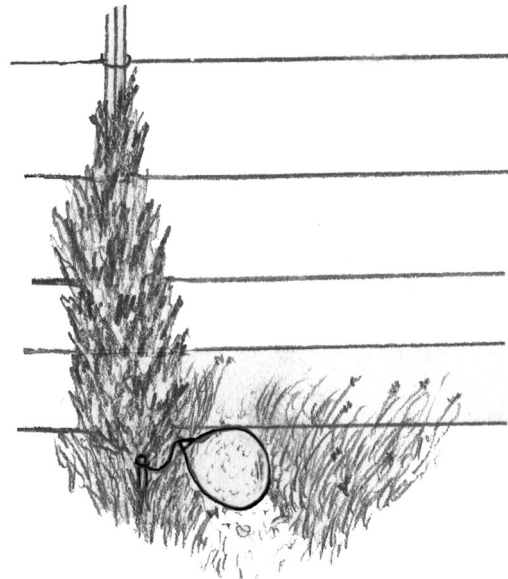
Figures 11a and 11b. Body-gripping snares set in coyote passageways through high-tensile (a) and woven-wire (b) fences. The zopen loop of the snare centers in and covers the width of the opening in the fence, with the bottom of the loop positioned 2 inches above the ground. A piece of thin wire or thread that will give way at the slightest pull secures the top of the loop to the fence. Snares are anchored using a strong fence wire, fencepost, or stake. (Illustrations by co-author Danny Dove).

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Although state regulations allow citizens to shoot coyotes at any time during the year, landowners are responsible for determining whether local ordinance and safety concerns make this option feasible. Most municipalities and cities have established ordinances that prohibit the discharge of firearms within corporate limits; it therefore is imperative that anyone considering use of a firearm to check on local restrictions before attempting to shoot a coyote. Even where shooting may be legal, individuals still should apply recognized [firearm safety precautions](https://bit.ly/10firearmsafety) (https://bit.ly/10firearmsafety) to evaluate whether shooting in the intended area is wise. Use of electronic predator calls to draw in coyotes is allowed on private lands (with written permission of the owner) and on public lands where not specifically prohibited.

Toxicants and Fumigants

Although toxicant products such as sodium fluoroacetate (Compound 1080) in Livestock Protection Collars or sodium cyanide in M44s historically were available for use on coyotes in Virginia (with application restricted only to certified personnel of the VCWDMP), the registrations on these products have expired. As a result, use of toxicants currently is not legal and other more effective, targeted, and safe techniques exist. That said, a fumigant product — the sodium nitrate gas cartridge — is registered and available as a method for coyote den site management. Although similar in design and application to gas cartridges used to manage groundhog burrows, commonly referred to as "smoke bombs," the coyote cartridge is much larger to distribute the active ingredients more effectively throughout the bigger space of a coyote den. Once ignited, placed well inside the burrow entrance, and then sealed in with dirt, the canister slowly smolders and releases a thick and suffocating smoke throughout the chamber. These cartridges are effective only on occupied den sites.

Final Upshot

Successful management of coyote problems often requires use of a variety of damage abatement measures tailored to each individual situation. The coyote is an exceptionally clever animal and now is a permanent resident throughout the Commonwealth. Therefore, it is imperative that Virginia's landowners become familiar with its life history and the ecological role it fills. With well-informed decision-making and application of appropriate management strategies, landowners and coyotes can co-exist with reduced risk of serious damage.

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Other Suggested Resources

Virginia Cooperative Wildlife Damage Management Program, U.S. Department of Agriculture, Animal Plant Health Inspection Service-Wildlife Services: 105 B Ponderosa Drive, Christiansburg, VA 24073, (540) 381-7387 https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/operational-activities/sa_livestock/ct_protecting_livestock_predators.

Virginia Department of Wildlife Resources: https://dwr.virginia.gov/wildlife/nuisance/coyotes/.

Virginia Trapper's Association: https://virginiatrappersassociation.org/.

Scan to access more publications about wildlife.

https://bit.ly/42YbGH9