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# Managing Human-Wildlife Interactions: Beaver *(Castor canadensis)*

*Authored by Jim Parkhurst, Associate Professor of Wildlife Conservation and Extension Wildlife Specialist, Fish and Wildlife Conservation*

Although the beaver (*Castor canadensis*) is classified as North America's largest native rodent (figure 1), most people recognize the animal not for its size, but as Mother Nature's master engineer. Beavers are well-known for constructing dams, building impressive lodges, and impounding stream flows to create ponds where none previously existed. In doing so, beavers create habitats that, in addition to meeting their own needs, enhance the survival of many other wildlife species, thus helping to increase overall biodiversity. However, when beavers apply their engineering skills in human-dominated landscapes, conflicts quickly arise. Plugged stormwater drainage culverts collect runoff that then floods and destabilizes roads from the excessive saturation. Basements and backyards of residential properties (some with private septic systems) become inundated. Trees or ornamental woody landscape plantings are felled or damaged as beavers gather construction materials. Agricultural fields and crops located within riparian corridors are destroyed by untimely flooding. All are examples of some of the negative situations that can arise when beavers inhabit developed areas. Beavers also are often blamed for being the primary host of giardiasis (sometimes referred to as "beaver fever"), a waterborne parasitic infection of the gut to which humans are susceptible; however, other animals, and even humans themselves, can be equally responsible for its spread. Nevertheless, giardia remains a potential health concern often associated with beaver colonies located in close proximity to areas of human occupation.

This publication examines the life history and activities of the beaver and presents an evaluation of the available options for managing beaver interactions. Hopefully, readers will find tools that will allow humans and beavers to coexist in relative harmony so that the ecological benefits attributed to beavers can be realized while avoiding serious physical and economic damage arising from the activities of these fascinating animals.

Figure 1. Beaver foraging on fresh vegetation at Denali National Park. (Photo by Emily Mesner, U.S. National Park Service, 2017, https://commons.wikimedia.org/wiki/File:A_beaver_eats_dinner_near_Horseshoe_Lake_on_Thursday,_June_29,_2017._(16f4796c-d685-426a-ae6b-f02b117cac5c).JPG#file.)

## Biology and Behavior

Beavers are widely distributed throughout much of North America. They currently are found in every county of Virginia, though regional abundance varies considerably — beavers are most plentiful in the southern Piedmont and Coastal Plain regions of Virginia where numerous low-gradient waterways are common.

Beavers are surprisingly larger than many people would expect, especially for those who have little experience

with these animals. An adult beaver normally weighs between 30 and 60 pounds, but individuals weighing as much as 80 pounds occasionally have been captured. Most adult beavers measure between 35 and 50 inches in total length, which includes the 8- to 10-inch-long tail. Beavers have short legs, strong digging claws on the front feet, and large, powerful, webbed hind feet used for swimming. The broad, hairless, paddle-like tail is used as a rudder when the beaver swims, but it also helps steady the beaver when it stands on its hind feet and when attempting to cut down a tree or shrub. Beavers communicate vocally using whines, grunts, hisses, and a variety of nasal sounds, but they also will slap the surface of the water with the tail to alert other beavers of potential danger.

During late summer and throughout the fall, beavers accumulate a thick layer of body fat. The tail serves as an important seasonal storage site for fat, which swells noticeably by late fall. Although this layer of body fat provides extra insulation against the cold, it more importantly represents an energy source the beaver will tap throughout the winter.

Beavers display several physical adaptations that enhance their ability to survive in the aquatic environment. They have uniquely modified split toenails on the two inner toes of the hind feet that are used to groom and clean their fur. Once grooming is finished, beavers apply a water-repellent coating to the fur, using an oily substance produced in a gland located beneath the tail. In addition to this water repellency, properly groomed fur holds a thin layer of air next to the skin and helps insulate the beaver from the effects of cold water. Beavers also have special muscles and valves within the nose and ears that close to keep water from entering, and each eye is protected by a transparent membrane when swimming underwater.

Beavers have exceptionally strong jaws and sharp chisel-like front teeth adapted for cutting woody plants and peeling bark. The two brownish-orange colored teeth centered on both the upper and lower jaws (i.e., the incisor teeth) grow continuously throughout the life of the beaver (figure 2). These teeth are positioned in the jaw at a specific angle so that, when the upper teeth pass over the lower teeth, they lightly grind against each other with each bite, sharpening the cutting edges and preventing them from growing too long.

Figure 2. Frontal view of a beaver's head and characteristic bright orange teeth used for gnawing wood. ("Beaver teeth" photo by Jason Richards, "blacksummer88," https://www.flickr.com/photos/33695771@N00/2379003146, licensed under CC BY-NC-SA 2.0, https://creativecommons.org/licenses/by-nc-sa/2.0/?ref=openverse.)

Beavers normally live no more than five to eight years in the wild, but some individuals have lived as long as 20 years in captivity. Given their large size and the limited amount of time they spend away from the protection of water, adult beavers have relatively few natural predators, aside from humans. However, their young offspring can fall prey to black bears, coyotes, dogs, bobcats, and perhaps great horned owls. Because of their relatively low mortality and an abundance of suitable habitat, Virginia's beaver population has been expanding over the last several decades, though no specific statewide population estimate currently exists.

Many people view beavers as being primarily nocturnal, yet they occasionally are observed during daylight hours, especially when dispersing to a new territory or when repairing damage to a dam or lodge. Beavers are monogamous and will pair off with the same mate for life. Mating occurs during January and February, and kits (young beavers) are born in May or June, typically in a litter of three or four. A colony of beavers usually consists of the adult pair, last year's offspring (called yearlings), and the current year's crop of kits. Once the yearlings reach 2 years old, they leave or are forced out of the colony by the adults and will search for mates and start a new colony of their own elsewhere.

Beavers will inhabit nearly any water body that has a reliable and plentiful supply of woody vegetation nearby, but they prefer water systems characterized by low gradient flow. Stream and lake habitats are used most often, but beavers also occupy farm ponds, wetlands, settling lagoons associated with sewage treatment plants, aquaculture facilities, or any other areas where flowing water exists. Beavers are one of only a few wild animals capable of significantly altering a habitat to suit

their needs. They spend considerable time building and meticulously maintaining dams to impound water (figure 3). Construction of dams and lodges usually occurs during late summer and early fall. Female beavers assume a major role in the construction of a dam or lodge, whereas males act more as building inspectors. However, the sound of rushing water will stimulate all beavers in the colony to inspect their structures for leaks or breaches and, if a breach is detected, all members immediately jump into action to repair the defect. Dams are constructed to impound and maintain water at a depth sufficient to cover the opening to the lodge, but this water also provides a protective environment within which the beaver can safely move about its territory. Beaver dams can range from 2 to 10 feet in height and can extend more than 100 feet in length. What is believed to be the longest dam of record was found in Alberta, Canada, in 2007 and measured over 2,700 feet long (Linzey 2021). In most situations, once water behind the dam reaches a depth of about 24 inches, beavers will gather materials similar to those used to construct dams (i.e., sticks, brush, rocks, mud) to build the lodge (figure 4) within which the family will reside. Lodges can be identified by their round, dome-like appearance and may extend 3 to 6 feet above the water's surface. Beavers enter and leave the lodge through an underwater opening that prevents most predators from entering the lodge. However, not all beavers live in a lodge — they sometimes will simply burrow into the embankment that rises from the shoreline of a pond, lake, or large stream to make a bank den. The area immediately above the underwater entrance to this den is covered with sticks and mud, giving it an appearance very similar to that of a lodge. Beavers are strongly territorial and, to delineate the perimeter of their domain, they will create a series of small mounds (usually less than 4-6 inches high) composed of mud, leaves, and sticks, on which they spread a pungent oil called "castoreum" they obtain from glands near their tail. These boundary markers serve to inform and warn other beavers that the area is already occupied.

Once the initial construction activities have been completed, beavers spend their time eating, maintaining the various structures, and collecting food for the winter. Beavers are herbivores, and an adult beaver may consume 20-30 ounces of food per day, which equates roughly to the amount of bark and smaller branches obtained from a 2-inch diameter tree every two days. During spring and summer, the beaver's diet consists mostly of aquatic plants such as grasses, sedges, and rushes, as well as farm crops such as soybeans or corn, and the succulent new growth of small shrubs. As winter approaches, they switch over to predominantly woody material, such as the limbs, branches, and bark of numerous tree and shrub species, including willow, alder, tulip poplar, red maple, dogwood, sweet gum, beech, pine, red cedar, and other species that grow near water. They cut the branches from felled trees into manageable lengths, transport them back to the area where the lodge is located, and then anchor these stems into the bottom of the impoundment near the lodge opening. In climates where water bodies are subject to freezing over, beavers rely on these stored underwater food caches to survive the winter under the ice. Once all the bark, leaves, and smaller twigs have been stripped and eaten, the remaining sections of branches will be stored for future use as material to maintain or repair the dam and lodge.

Figure 3. Typical dam structure created by beavers to impound slow flowing water. ("Beaver Dam Across the Canal" photo by Tom Gill, https://www.flickr.com/photos/10199807@N00/4543569311, licensed under CC BY-NC-ND 2.0, https://creativecommons.org/licenses/by-nd-nc/2.0/jp/deed.en.)

Figure 4. Characteristic dome-like lodge structure created by beavers. ("Beaver lodge near Shoshone Lake" photo by Jacob W. Frank, Yellowstone National Park, U.S. National Park Service, 2018, https://www.flickr.com/photos/80223459@N05/43786506581.)

Given Virginia's mild winters and the fact that many beaver ponds rarely freeze over for extended periods of time, beavers in this region often remain active throughout the winter, cutting down and transporting fresh plant material for immediate use. In the event of an unusually harsh winter, beavers will use whatever remains in the underwater food cache and rely on their stored fat reserves to make it through the winter.

# Economic Status and Importance

In North America, Native Americans looked upon the beaver as a reliable source of meat and fur, so having sustainable populations of beavers was important to many tribes. However, beginning in the mid-1600s and extending through the 1800s, beaver populations were exploited heavily by European settlers. Large international fur trading companies began shipping beaver pelts (figure 5) obtained from North America around the world, where they were made into coats and other popular fashion items of the times. In large part, the expansion of European settlement into western North America was made possible by the economics associated with the growing demand for pelts by the fur industry. As another sign of this phenomenal demand for pelts, the fur industry's interactions were not restricted to only settlers — representatives of the fur industry quickly recognized and began to utilize the skills of indigenous people as a way to increase the harvest of pelts. Because beaver fur was deemed such a valuable commodity, pelts were traded like currency for almost anything a person needed.

Because regulations to prevent the over-harvest of wildlife did not yet exist, the ever-growing demand for beaver pelts led to the complete removal of beavers from much of their natural range in North America by the late 1800s, including here in Virginia. Between 1932 and 1938, the Virginia Game Commission (a precursor to today's Department of Wildlife Resources, or DWR) embarked on a program to reestablish beavers in the Commonwealth; 35 beavers purchased from states that still had native populations were released in nine counties across Virginia. The offspring from these original 35 beavers subsequently were captured and relocated to other parts of Virginia so that, by the early 1950s, beavers had reoccupied many parts of their former range in Virginia. Eventually, beaver populations had recovered sufficiently enough that a regulated trapping season on beaver was opened in 1953. At that time, trappers could still demand a fine price for prime beaver pelts. In subsequent years, the price of beaver pelts fluctuated with supply and demand within the international fur market and the needs of the fast-changing fashion world. As a result, whenever demand and price declined, participation and the number of beavers harvested by recreational trappers fell, mirroring conditions in the commercial markets.

Figure 5. Finished beaver pelts being auctioned at an Alaskan fur market. ("Beaver pelts" photo by Kim F ("akseabird"), 2008, https://www.flickr.com/photos/93752018@N00/2489060476, licensed under CC BY-NC 2.0, https://creativecommons.org/licenses/by-nc/2.0/?ref=openverse.)

Today, trapping beavers for fur remains a traditional seasonal activity for a core of trapping enthusiasts, but participation has fallen dramatically from historical highs, primarily due to decade-long declines in pelt prices. The 2020-2021 Annual Trapper Survey conducted by DWR found approximately 360 licensed trappers harvested 3,186 (plus or minus 516) beavers during the 2020-2021 season. From this harvest, 648 pelts were purchased by Virginia fur dealers at an average price of $7.93 per pelt (total statewide pelt value: $5,138) (Mike Fies, DWR Furbearer Project Leader, personal communication). When compared to similar data gathered less than 10 years ago (Kidd, Harris and Baer 2014), the extent of the decline becomes evident (total pelts sold: 5,811; average price/pelt: about $15; statewide return for pelts: $87,909.34). In addition to pelts, a niche market also exists for castoreum, the oily secretion beavers produce, which is used in the manufacture of perfumes as well as the scents and lures trappers use to improve their trapping success.

As the number of beavers taken via recreational trapping has declined, those removed in response to resolving human-beaver conflicts has been increasing, and now likely exceeds the regulated harvest. The economic impact of the physical damage caused by beavers in

Virginia (in terms of actual loss and insurance payout) is estimated to be about $1 million annually (Scott Barras, State Director, USDA-Wildlife Services, personal communication). Examples of this damage include timber and agricultural crop loss, damage to roads, septic systems, and property by flooding, and destruction of ornamental plants used in landscaping.

Beavers are important ecologically for the modified habitats they create that benefit a variety of other organisms (figure 6). The dams they build alter the hydrology of flowing waters, allowing unique plant communities to colonize the impounded waters that then attract a wide variety of waterfowl, other aquatic birds such as herons, egrets, and kingfishers, various reptiles and amphibians, and an assemblage of aquatic insects. In drought-prone areas, beaver ponds become important mechanisms for water retention and conservation within watersheds, as they collect and hold water captured during wet periods and slowly release that water as demand for moisture increases. However, dams restrict the flow of water and beavers remove shade-providing woody vegetation along the shoreline, both of which can raise the water's temperature and negatively affect dissolved oxygen levels. As flowing water slows down, the sediments it carries fall out of suspension and will collect behind the dam, slowly filling the basin. Although these modified conditions can be beneficial for some organisms, they also impose significant stresses on others, including trout and many aquatic insects that depend upon cool, flowing waters.

Figure 6. Canada goose using a beaver lodge as a nesting site. (Photo of "Canada Geese Nesting on Beaver Lodge, Crawford County, PA 1960" by Frederic J. Brenner, https://commons.wikimedia.org/w/index.php?curid=9618354 and licensed under CC BY-SA 3.0, https://creativecommons.org/licenses/by-sa/3.0/?ref=openverse.)

According to the Centers for Disease Control and Prevention, although their incidence is low, several diseases associated with beavers or the habitats they create can pose potential threats to humans. *Giardia limbia*, a pathogenic intestinal parasite, is transmitted through feces deposited by beaver and other mammals (including otters, muskrats, mink, and even infected humans) into water systems. Municipal water supplies that draw water from reservoirs and that lack chlorination or fine mesh filtration treatment can become contaminated with the Giardia parasite and lead to the spread of giardiasis, an intestinal ailment that is debilitating to those infected (CDC 2022a). Another, though less common, beaver-related health concern is *Blastomycosis dermatitidis*, or Gilchrist's Disease. Individuals who have had recent contact with old beaver lodges or dams may be at risk for blastomycosis, a pneumonia-like disease of the lungs that arises from the inhalation of fungal spores. The spore-producing fungi reside in soils, decaying foliage, and vegetation, but spores typically don't become airborne unless the soil or decaying material is disturbed. Because very specific temperature, nutrition, and humidity conditions are necessary for the growth and production of the infecting spores, the incidence of blastomycosis is quite low (CDC 2022b). Hunting dogs occasionally have become infected with blastomycosis while retrieving ducks shot over beaver impoundments. In the few documented cases of human blastomycosis exposure (e.g., in Minnesota), individuals became infected while dismantling and removing old beaver dams. In cases of suspected exposure, treatment is available for both giardiasis and blastomycosis at most medical facilities today.

## Strategies to Manage Interactions with Beavers

As is true with many wildlife issues, employing only a single management technique likely will not provide complete resolution of a beaver conflict. However, when initiated in a timely fashion, maintained properly, and applied with an understanding of beaver behavior, options are available that can reduce the likelihood of experiencing significant damage. People who reside near viable beaver habitat (especially properties abutting water features) should recognize the risks inherent in living there and acknowledge that future interactions are possible. Beavers are clever, persistent animals and may be able to circumvent some of the techniques mentioned below. Therefore, those affected by beavers should have a well-designed, comprehensive management strategy that incorporates multiple techniques.

## Tolerance

Because beavers fulfill the important ecologic role of creating wetlands and providing habitat for a variety of wildlife, one approach to dealing with beavers is simply learning how to coexist with them. Beavers are intriguing animals and being able to see how they live and to observe their engineering feats can be fun and educational. Where beavers pose no immediate threat to roads or driveways, septic systems, or highly valued landscaping, landowners may consider leaving them alone. In many riparian systems, a colony of beavers usually will be forced to leave the area after four to seven years, once they have exhausted the available food supply. In contrast, the wildlife species attracted to the beaver impoundment will remain long after the beavers have left or until the dam ultimately fails and water levels return to pre-beaver conditions.

## Preventive Measures

Realistically, it is difficult to keep beavers away from property once they take an interest in it. Techniques such as preemptively cutting down and removing the woody vegetation along the shoreline and the immediate adjoining upland fringe have been suggested as ways to limit available food sources and potential construction materials. This tactic theoretically assumes beavers will overlook the property that is trying to be protected in favor of other more suitable areas farther upstream or downstream; however, the approach has not proven feasible given the distance beavers travel in their search for food and materials. It also ignores the fact that other variables (such as potential den or lodge sites) may be more important in the animal's decision-making. To date, no visual or auditory frightening deterrent has demonstrated any measurable effect on reducing beaver presence or activity.

## Nonlethal Methods

Nonlethal control measures used to deter beavers can be expensive and many require a substantial investment of time and effort to put into place. Examples of nonlethal strategies include repellents and the use of fencing and water-leveling devices.

### Repellents

Although commercial products may be available, there is no evidence that chemical repellents are effective in reducing or preventing beaver activity. The suggestion to coat the lower 4-6 feet of trees with a sand-based paint appears frequently, but evidence supporting the efficacy of the technique does not exist. In fact, beavers regularly gnaw through woody stems that are coated with mud or other coarse grit, suggesting this coating does little to deter a beaver from chewing.

### Fencing

Individual trees or especially valuable specimen plants can be protected by encircling the plants with heavy gauge woven-wire fence (2-by-2-inch mesh size) supported by sturdy metal posts (figure 7). To allow for future plant growth, never attach the guard directly to a tree with nails or staples. Instead, install the guard so that a gap of no less than 5-8 inches remains all the way around between the fence material and the plant's stem. To prevent a beaver from gnawing above this protective barrier, each tree guard should be at least 3 feet tall to account for the height of the animal when it stands on its hind legs. Each fence guard must be attached securely to the support posts to prevent the beaver from lifting it up or pulling it down. If wooden support stakes are used, remember to put them inside the guard or the beaver simply will chew them off. In areas where deep snow can accumulate, tree guards must be tall enough to account for the additional height of packed snow on which a beaver may stand and be able to reach over the top of the guard. Treating individual plants using this technique rarely is cost-effective over large areas and may prove to be unfeasible for more than a couple dozen specimens.

Figure 7. Protective tree guard fencing to deter beaver damage to a specimen tree. (Reprinted by permission from New York Department of Environmental Conservation, Bureau of Wildlife, Beaver Damage Control Techniques Manual, 1996, p. 9, https://www.dec.ny.gov/docs/wildlife_pdf/nuisancebeaver.pdf.)

For larger areas, a barrier can be created for either temporary or permanent installation using a single strand of high-tensile electric wire staked to sturdy posts, with the wire positioned about 4-6 inches above the soil surface. Power is supplied by an energizer connected

either directly to a 110-volt supply or to a solar-rechargeable battery. This "fence" should be constructed on the slope of the shoreline where beavers haul out of the water, and especially across any existing paths beavers currently are using. The intent is to deter beavers from coming out of the water and accessing areas where valuable trees, landscape plantings, or other vegetation could be cut and removed. The electric wire will deliver a mild shock upon contact with the beaver and hopefully cause the animal to reverse direction. It should be noted that this type of fencing demands constant surveillance and periodic maintenance to remove limbs or other vegetation that contacts the wire, any of which will ground out the electrical circuit.

Other types of prefabricated electric and non-electric fences are available commercially. Some of the simplest prefab electric setups are made with support posts already incorporated, making installation fast and easy — just unroll a section of fencing, stand it upright, push the stakes in the ground, and attach the electrical connectors to an energizer. These fences can be used in two ways: as a vertical linear barrier running along the shoreline to keep beavers from accessing land where protection is desired, or as an enclosure to protect an area or group of plantings from the beaver. Electric fences must be used with caution, especially around young children and pets. In fact, many municipalities have adopted ordinances prohibiting the use of electric fencing, so landowners must determine if it is legal to operate an electric fence in their area before installing and activating any such device.

## Water-leveling Devices

Water-leveling devices are used to maintain the flow of water through road culverts that beavers try to block. They also are used to manage the height of water behind a beaver dam without the need to remove the dam or destroy the beavers. Once incorporated into a blockage, these devices allow water to flow through the obstruction in a way that prevents the beavers from detecting the leakage. If the devices are installed properly, beavers are unable to circumvent them. Beavers instinctively are alerted to possible breaches by the sound of running water, which causes them to search for and repair any breaks in their dams. Water-leveling devices can be made from a variety of materials, including wood, logs, plastic or metal pipes, or wire mesh boxes or troughs. Some levelers are complicated to build and most will require the services of a hydraulic engineer to properly assess the volume and flow rate of water that must be accommodated, which determines how many leveling units are needed to adequately handle estimated flows. Because altering a beaver dam may affect the integrity or persistence of a wetland that has formed upstream from the dam, **a wetland alteration permit may be required** under local, state, and/or federal wetland regulations; it is the landowner's responsibility to check with permitting authorities whether a permit is necessary before any dam alterations occur.

Some examples of water-leveling devices include:

- **The Clemson Beaver Pond Leveler**. This device was designed primarily for applications where management of the water level behind a beaver dam is needed. To function properly, the device (figure 8) must be permanently incorporated into the dam structure. This is best accomplished by cutting a break through the dam, inserting the device, and then waiting for the beavers to repair the breach in the dam. The device consists of two major components: on the outflow side are sections of solid, 8-inch diameter polyvinylchloride (PVC) culvert pipe that may terminate with a movable elbow fitting that will serve as a riser (to regulate the height of water behind the dam); above the dam is the intake device made from sections of 10-inch diameter perforated PVC pipe surrounded by a cylinder of galvanized welded wire.

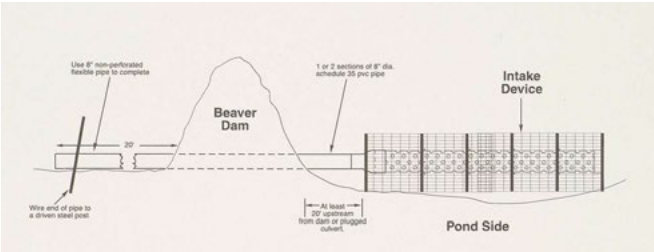


Figure 8. Design for the construction and installation of a Clemson Pond Leveler. (Reprinted by permission from Minnesota Department of Natural Resources, The Clemson Beaver Pond Leveler, 2001, p. 5, http://files.dnr.state.mn.us/assistance/backyard/privatelandhabitat/clemson_beaver_pond_leveler.pdf.)

- **Beaver Deceiver**. Although similar in many ways to the Clemson Pond Leveler, the Beaver Deceiver differs in that its principal application is for maintaining water flow through road culverts (figure 9). Over the years, the Deceiver's design and installation techniques evolved as its creator gained greater understanding of how beavers respond to the placement of water flow devices, leading to improvements in its

functionality. Many modifications made during this evolution related to improving the upstream end of the device to maximize inflow, such as increasing the number of entry holes in the receiving pipe, experimenting with different types of strainer baskets or diffuser caps, or installing "T" shaped attachments to enhance the intake of water over a larger area that beavers are unlikely to plug. Attention also was focused on protecting the entrance to the culvert where the discharge pipe is inserted — various designs of stout fencing structures are incorporated in every installation that allow continuous flow through the culvert opening while also serving to lock the device's inflow pipe firmly in place (figure 10).

In almost every case, the objective is to have beavers incorporate the water-leveling device into the dam or culvert blockage they are trying to maintain. Intake pipes must extend a considerable distance upstream from the beaver's structure (typically a minimum of 20 feet) to reduce the likelihood that beavers will detect where water is escaping and thus prevent them from plugging the intake pipe.

An essential factor in assuring success with any water-leveling device is to not allow the elevation of water in the impoundment to fall below a level where the opening to the beaver's den or lodge would be exposed. If that happens, beavers usually will move just upstream from where the leveling device exists and immediately construct a new dam that will raise the water level and re-establish the covering of water over the lodge opening. Therefore, proper installation of a water-leveling device requires time and some engineering knowledge to accurately establish where the finished height of water needs to be set. Water-leveling devices can be expensive, anywhere from a few hundred to several thousand dollars, depending on the price of the construction materials and the number of devices needed to properly handle the projected volume of flow. However, if properly sized and placed, water control devices provide an opportunity for beavers and landowners to coexist without the threat of serious flooding.

## Lethal Controls

If all attempts to deter beavers have failed, then removal of problem animals may be necessary. Where damage to timber, crops, ornamental or landscape plants, septic systems, or roads has occurred, the owner or lessee of the property may kill the offending beavers or have them killed by a certified nuisance wildlife operator or licensed trapper as outlined in Section 29.1-518 of the Virginia Administrative Code (https://law.lis.virginia.gov/vacode/title29.1/chapter5/section29.1-518/). Two methods commonly used to remove offending beavers are trapping and shooting. The use of poisons to kill beavers is not allowed in Virginia; as a result, no toxicant or fumigant products currently are registered for use on beavers in Virginia.

Figure 9. Flow device constructed of stout fencing material used to prevent beavers from blocking the movement of water through a road culvert. (Photo, "Trapezoidal Culvert Protective Fence Westford, MA" by Michael Callahan, 2004, https://commons.wikimedia.org/w/index.php?curid=9449818 and licensed under CC BY-SA 3.0, https://creativecommons.org/licenses/by-sa/3.0/?ref=openverse.)

Figure 10. Example of a derivation of the Beaver Deceiver flow device. (Photo, "Beaver Deceiver," 2020, by Alex Schubert of the U.S. Fish and Wildlife Service Mountain Prairie, is online at https://www.flickr.com/photos/51986662@N05/50091655076.)

## Trapping

In accordance with provisions of 4VAC15-60-20 of the Virginia Administrative Code (https://law.lis.virginia.gov/admincode/title4/agency15/chapter60/section20/), there is a continuous open season for trapping beavers within the incorporated limits of any city or town in Virginia and within the counties of Arlington, Chesterfield, Fairfax, Henrico, James City, Loudoun, Prince William, Spotsylvania, Stafford, Roanoke, and York. Outside of these areas, a regulated open season for trapping beavers extends from Dec. 1 through the last day of February each year. A valid Virginia trapping license is required to trap beavers during this established season; landowners who trap on their own property are exempt from this licensing requirement, but they still must abide by all other trapping regulations and reporting requirements. Trapping can be an efficient, cost-effective means to manage beaver populations while providing affected individuals or communities a method to keep beaver numbers in balance with society's desires and tolerances. However, trapping alone will not prevent beavers from recolonizing a suitable habitat in the future, so periodic surveillance of riparian habitats is needed to monitor beaver activity.

Landowners who are experiencing damage from beavers are allowed to trap the offending animals, but many individuals today lack trapping experience and most do not possess the equipment necessary to perform such tasks. In such cases, it is best to leave trapping to professionals or licensed wildlife control agents. To locate a licensed trapper or wildlife control agent nearby, landowners can visit the Department of Wildlife Resources' website to access the "Find a Trapper Tool" (https://dwr.virginia.gov/wildlife/nuisance/trappers/), which presents a county-by-county list of individuals who provide trapping services. (Note: In most cases, these trappers will charge a fee for their services.)

Two categories of traps are suitable for taking beaver: live traps and lethal traps. Live traps are designed to capture the animal alive, whereas lethal traps are designed to kill the animal as swiftly and humanely as possible. The Bailey trap and the Hancock trap (figure 11) are two common designs of "suitcase" traps used to capture beavers alive. These are large, heavy, and somewhat cumbersome traps to deploy. They typically are baited with freshly cut sections of small branches. Live-capture traps commonly used for other wildlife, such as large Hav-A-Hart or Tomahawk box traps, are available, but rarely are used due to lower trapping success. For many individuals contemplating trapping a beaver using live-capture methods, the disposition of a live-caught beaver unknowingly may become a problem for that individual. In accordance with state regulation 4VAC15-30-10 (https://law.lis.virginia.gov/admincode/title4/agency15/chapter30/section10/) and the Code of Virginia Section 29.1-521 (https://law.lis.virginia.gov/vacode/29.1-521/), it is illegal to remove a beaver from the point of capture and transport it for release on property owned by someone else. Given the lack of suitable release sites, most live captured beavers eventually end up having to be killed. This regulation was imposed to avoid transferring beaver conflicts from one area to another as well as to reduce the likelihood of distributing disease.

Figure 11. Example of a "suitcase" style of live catch cage trap used to capture beaver. (Reprinted from Chapter 2 of Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by U.S. Department of Agriculture's Animal and Plant Health Inspection Service—Wildlife Services, 2019, p. 6, available to download at https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/2-cage-trap-peer-reviewed.pdf.)

Typically, most wildlife control agents will resort to using some form of lethal trap. Among the available options, the Conibear (size No. 330), a type of body-crushing trap (figure 12), is most commonly used. Steel foothold traps also may be used in water settings to capture beaver. Snares with an opening of less than 12 inches in diameter sometimes may be used in identified beaver trails and haul-out locations, but snares can only be used on private lands and where written permission from the landowner to do so is held in the trapper's possession. All traps set in the field must bear a metal tag that clearly displays the trapper's name and address or the DWR-assigned trapper's "customer identification number" (CID number); trapping conducted by a landowner on the landowner's own property is exempt from this requirement. Specific details on allowable trap sets, trap size limitations, dates of trapping seasons, and allowable bag limits are available on the DWR website (https://dwr.virginia.gov/hunting/regulations/furbearertrapping/).

Figure 12. A typical lethal trap set for beaver using a Conibear trap. (Used by permission from Stephen M. Vantassel, Internet Center for Wildlife Damage Management.)

## Shooting

Although allowed by state law, use of shooting as a method of take for beavers raises a number of practical and safety concerns. Many cities and towns have local ordinances that prohibit the discharge of firearms within their municipal boundaries. Before considering shooting as an option, you must first determine whether a firearm can be used in your area. Where shooting is allowed, special care is needed when firing at or near water bodies. Shots aimed toward the water are subject to ricochet and slugs careening off the surface of the water can travel substantial distances; thus, special care must be taken prior to pulling the trigger to verify that a safety zone exists well beyond the intended target. Where the potential for ricochet is high, use of a shotgun with heavy waterfowl loads or buckshot may be a better choice instead of a rifle or pistol. Whenever possible, beavers should be shot while they are on land rather than in the water.

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