Managing Spring Wetlands For Fish and Wildlife Habitat

Louis A. Helfrich, Department of Fisheries and Wildlife Sciences, Virginia Tech
James Parkhurst, Department of Fisheries and Wildlife Sciences, Virginia Tech
Richard Neves, Department of Fisheries and Wildlife Sciences, Virginia Tech

Why Springs Are Valuable

Natural springs are important aquatic resources. They are a reliable source of clean, high-quality groundwater that flows at a relatively constant rate and temperature. Because springs are dependable, they are an increasingly valuable supply of water for people and wildlife, particularly during droughts. Thousands of rural households in Virginia rely on springs for domestic use and watering livestock. Springs supply water to commercial enterprises (breweries, distilleries, fish hatcheries, water bottlers) and agriculture (cropland irrigation, livestock watering). They support recreational uses, such as fishing, swimming, and boating. Property values escalate on land with a natural spring, spring-fed stream, or spring pond.

Springs offer critical habitat for Virginia's fish and wildlife populations, including some endangered and threatened species. Springs help keep downstream water temperatures low and stream flows regular, thereby extending the distribution of trout and other cold-water fishes. In Virginia, springs and groundwater provide stable cold and cool waters, extending trout and smallmouth bass waters statewide.

Fish, salamanders, and invertebrates (animals without backbones, such as insects and snails) thrive in clean, spring-fed streams. The moist soil and lush vegetation along stream banks offer food and shelter for birds and other animals. Sculpins, blacknose dace, and trout are among the fish species that inhabit cold spring waters in Virginia. The continuous flow of clear, cool water supplied by springs provides a refuge for many aquatic animals, especially during hot weather and droughts. Spring streams and riparian lands provide critical water, food, refuge, and travel corridors for wildlife such as turkey, deer, bear, raccoon, and songbirds.

What Is a Spring?

The word spring comes from the German word springer, which refers to leaping from the ground. Springs may range from tiny seep holes, through which groundwater oozes to form puddles or wet spots on the ground, to large fissures in rocks or openings in the ground. If the rate of flow is rapid, a pool of clear water will form around the area of groundwater discharge. Water, running out of the pool, erodes a channel and marks the beginning of a spring-fed stream.

Springs are replenished by precipitation entering soil and overlying rock materials in recharge areas and filling up the pores of an aquifer or groundwater storage compartment. Aquifers may be considered porous conduits filled with sand and other materials

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that transmit water from recharge to discharge areas. Groundwater may discharge as a spring when the water table reaches the earth's surface. Most springs arise as slow seeps of unpressurized groundwater surfacing through fractures in the bedrock.

There are two general types of springs: gravity springs and artesian springs. A gravity spring is created when water moving through subsurface permeable materials reaches an impermeable layer and is forced to the surface. Gravity springs also occur where the land intersects the water table. Gravity springs are particularly sensitive to seasonal fluctuations in the amount of groundwater in storage and frequently dwindle or disappear during dry periods.

Artesian springs discharge from a confined aquifer where the water is under pressure and rises through any cracks or openings in the confining layer. If the pressure is great enough, fast, free-flowing artesian springs may result. Artesian springs are particularly sensitive to well drilling, and pumping water out of the aquifer may cause springs to dry up.

The temperature of shallow groundwater is nearly uniform, reflecting the mean annual temperature of the region. It ranges from a low of about 37ºF in the north-central part of the United States to more than 77ºF in southern Florida. In Virginia, the typical groundwater temperature is 57ºF. By contrast, surface water temperatures in rivers and lakes may range from freezing in northern regions to greater than 100ºF on hot summer days in the South.

Virginia Springs

Natural springs occur throughout Virginia, but the greatest concentration and largest springs occur in the Valley and Ridge Province. Springs in this province are particularly common in karst areas, where fractures, cracks, and channels promote rapid groundwater recharge, movement, and storage. Large springs usually occur in limestone formations at low elevations. Groundwater may discharge as small springs or seeps along hill slopes in the Cumberland Plateau and Blue Ridge provinces. The soil is thin, and relatively nonporous rock, such as granite or marble, is near the surface. In the Piedmont and Coastal Plain provinces, springs are rare and small with flows generally less then 20 gallons per minute (gpm).

Spring Flow

Springs are classified by size according to their average discharge on a scale that runs from a magnitude of 1 (flows over 45,000 gallons per minute) to 8 (less than 1 gallon per minute). Based on this scheme, Virginia has no first magnitude springs, but does contain at least 10 springs of second magnitude. The largest Virginia spring, Woolwine Spring, near Newbern, had a recorded flow of 10,300 gpm, but was submerged by the construction of Claytor Lake Reservoir in 1938.

Spring streams vary in size depending on the geology, topography, and groundwater availability. Flow rates and volumes depend on differences in the groundwater recharge and discharge elevations, and on the size of the fractures and openings discharging the groundwater to the surface.

Most Virginia springs are small, discharging at a rate less than 100 gpm. About half of the springs included in the Virginia Springs Survey have flows less than 100 gpm; 75 percent have flows less than 500 gpm. Flow rates of most Virginia springs are relatively constant year-round. However, discharges vary with weather patterns in areas characterized by sinkholes and fractured rock, where flood- and rainwater are directed into the ground. Intermittent springs flow only during wet periods when the water table rises to the land surface. Despite their size, springs offer important breeding, feeding, and nursery areas for amphibians, fish, birds, and mammals.

Calculate Your Spring Flow

Flow (discharge) is the volume of water moving from the spring per unit of time. You need this measurement to estimate water storage and supply, changes in water availability, and water-use rates. You can get estimates of flow by measuring all of the water diverted through an opening in a dam or multiplying the stream's cross-sectional area by the current speed. On small springs, you can dam or divert the flow through a small opening and measure the time required to fill a container of known volume.

For large springs, use a tape measure to determine the average stream width and depth, and multiply this cross-sectional area by the current speed. To estimate the current speed, toss a floating object – an orange is recommended – into the spring and clock the time it takes to travel a known distance. If your spring averages 2 feet wide x 1 foot deep (an area of 2 square feet) and the current speed is 3 feet per second (the orange travels 30 feet downstream in 10 seconds), then a rough estimate of your spring flow is 6 cubic feet per second (area in square feet times speed in feet per second equals cubic feet per second) or 2,700 gallons per minute (1 cubic foot per second [cfs] = 450 gpm).

Spring Water Temperature

Virginia has both cold-water and thermal (warm- or hot-water) springs. The Virginia Spring Survey has located more than 1,500 cold-water springs and 100 thermal springs. The water temperature of cold-water springs averages between 52ºF and 58ºF, about the same as the mean annual air temperature. Thermal springs with waters heated deep within the earth flow at water temperatures of 60ºF to 110ºF year-round. Warm springs have a mean water temperature greater than the average air temperature, but less than 98ºF; hot springs have mean water temperatures greater than 98ºF.

Most spring waters have fairly uniform water temperatures that vary only a few degrees annually. However, water temperatures of small, shallow springs or those with high surface water contributions (recharge) can fluctuate considerably on a daily and seasonal basis. The water temperature of small, shallow springs is regulated more by air temperature than the temperature of the earth. Deep springs, influenced by the earth's internal heat, have more stable and higher water temperatures.

Spring Water Quality – Natural Constituents

Spring waters unaffected by human activity reflect the quality of groundwater and the chemical composition of local rock and soil. Spring waters can be mineral-rich (hard water) or mineral-poor (soft water), depending on the prevailing geology. Springs in limestone rock generally have a high mineral content; those issuing from hard rock, like granite, have few minerals. Water hardness is due to dissolved calcium and magnesium, which are present in most rocks, especially limestone, dolomite, and gypsum. Thermal springs generally have a higher mineral content than cold springs.

The taste, color, and odor of spring water reflect a particular mix of minerals, dissolved gas, and organic constituents. Saline springs are rich in sodium, calcium, and magnesium, while sulfur springs have an abundance of hydrogen sulfide. Chalybeate springs contain iron and alkaline springs have an abundance of calcium. Spring waters unaffected by surface activities are typically clear and clean as a result of the natural filtering ability of soil and rock materials. Dark brown or tea-colored water may result from acids (tannic and humic) leached from plants and other organic matter. Cloudy, white-color water may result from high concentrations of dissolved solids and calcium. Iron compounds in oxygenated water can impart a red or rust color.

Developing Springs for Wildlife

Water Is a Key Habitat Component

Water, food, and cover are essential components of wildlife habitat. To meet their daily water needs, some animals can sustain themselves by taking in morning dew or by ingesting the water contained in succulent plants. Others, such as turkey and whitetail deer, need larger amounts of water daily to survive. The supply and quality of water available throughout the year often determine the distribution and health of wildlife populations.

Springs can be important drinking water sources for wildlife, and spring owners can modify and manage these waters to enhance wildlife habitat. Providing habitat for wildlife may be as simple as protecting the spring's water quality, or as involved as planting vegetation and manipulating the water source. Developing a dependable water source may require alterations, such as providing a method of storage for dry periods when water may not flow to the surface.

With proper planning and design, providing an oasis for wildlife can be combined easily and inexpensively with the normal development of a spring for livestock watering or as a domestic water supply. Before attempting to improve natural water sources, get advice on water development and on creating and managing wildlife habitats.

Before electing to develop a spring for improving wildlife habitat, determine the quantity and reliability of the spring. Can it provide water during all seasons to meet wildlife needs? Even intermittent springs and seeps which produce very low quantities of water may provide important habitat, if you can ensure that water availability coincides with the water needs of the wildlife population. Spring development is not, however, just a simple matter of collecting water and making it available. Plan your development to achieve specific purposes with a minimum of detrimental effects.

Spring Development for Wildlife

Developing a water source with low flows might simply entail digging out the soil to form small, permanent or semi-permanent pools in a woodland or meadow. The flow of small springs and seeps can be improved by clearing any debris blocking groundwater flows and can be collected and concentrated into a single stream that will not freeze readily and will be available year-round. In some karst (limestone sinkhole) areas, you should not develop springs, because too much digging can divert subsurface drainage, create fractures, and reduce flows.

Spring development is intended to improve water flow, quantity, and yield. It usually includes creating a downstream pool with clay or a stone or concrete wall. Water also can be stored in a concrete or plastic covered storage tank at the point of spring emergence. An intake pipe often is located at the source of the spring and collects the water that flows to the collection pool or tank. The size of the collection pool or tank can vary with the capacity of the spring, but for small springs pools are often 5 x 5 feet and 2 to 3 feet deep and spring tanks have about a 500-gallon capacity. Do not create the pool or place the tank directly over the springhead. The weight of the water may create more pressure than the flow pressure and stop the spring from flowing. Divert surface runoff from the springhead by a diversion ditch or wall. Often grasses and other surface vegetation are planted around the springhead to filter surface runoff and protect water quality.

If water flows are sufficient, small ponds can be constructed in a series downstream. Even if the pond is seasonal or temporary, it can provide important wildlife watering, resting, feeding, nesting, and cover habitat during part of the year. Vernal ponds, those filled by spring rainwater, are critically important as breeding habitats for amphibians (salamanders, frogs, and toads). Even as vernal ponds dry, in late summer, they sustain and add a diversity of wildlife habitat.

A wildlife pond is simply a shallow depression dug in the soil to hold water from surface rainwater runoff or spring flows. If dug below the water table, a wildlife pond also pools groundwater seepage. Wildlife ponds usually are dug, excavated ponds. Excavated soil can be used to form the embankment of the dam and shore banks. Large ponds in accessible areas may be excavated by machines (bulldozer, back hoe) to remove and store the topsoil, shape shorelines, pack the soil, construct the dam, and spread the topsoil on the pond bank. You can plant wildlife attractive plants that will quickly revegetate because the topsoil is rich in nutrients and organics. Small ponds in inaccessible areas can be built by hand or can be excavated by the blasting method. Contract with a commercial explosives engineer, licensed to legally purchase, transport, store, and use explosives if you wish to consider this method.

To insure the pond will hold water, select a site with sufficient clay soil (20 percent or more clay) or use a bentonite clay sealant. You can purchase bentonite clay at quarries and farm supply stores. Bentonite is effective on porous, sandy soils that contain insufficient amounts of clay. This clay has the capacity to expand up to 20 times its original size when moistened. For best results, spread the bentonite evenly over the dry pond bottom at a rate of 50 pounds per 100 square feet of area, mixed with the existing soil, moistened, and then compacted with a roller. Other sealants, including soluble salts and polyphosphate chemicals, are effective on certain soils. Laboratory analysis of the soil is essential to determine the appropriate type of sealant and its rate of application.

Another increasingly popular method of pond sealing for wetland ponds on soils that are too porous involves lining the bottom with flexible synthetic plastic or rubber sheeting. These are commonly used to line landfill areas. Liners made of EPDM (ethylene propylene) or PVC (polyvinyl chloride) that are 20 mils thick are recommended. Liners are expensive, and may limit the size of your wildlife pond. Liners larger in size than 40x40 feet are heavy and difficult to transport and position.

Use “aquatic-safe” liners that do not contain toxic chemicals. Do not use plastic tarps or drop cloths, which frequently contain toxins and are thin and easily punctured. To protect against punctures, cover the pond liners with at least six inches of soil. You can purchase plastic or rubber sheeting from local hardware stores. A landfill-grade synthetic liner covered with soil can last 30 years or more. The soil cover protects the liner from puncture by deer hooves and provides overwintering habitat for amphibians and invertebrates.

Do not construct a wildlife pond in an existing wetland. The purpose of this publication is to create new wetland habitat for wildlife and protect or restore existing wetland habitat. A permit from the U.S. Army Corps of Engineers and state agencies may be required to build in an existing wetland or riparian area.

Protecting Spring Water Quality and Wildlife

Preserve Riparian Areas

Protecting the critical buffer zone along the riparian areas of springs and spring-fed streams is the best way to ensure good water quality and to benefit fish and wildlife. Trees, grasses, and shrubs provide shade, cool temperatures, food, and shelter for fish, birds, and other animals. The thick roots of grasses, wildflowers, and shrubs bind the soil to the banks, slow storm runoff, and prevent erosion and sedimentation. A lush filter strip of vegetation around the spring pool and along the spring-fed stream traps harmful nutrients, sediments, and pesticides on land before they can enter the water. Damaged, denuded riparian areas should be replanted with native vegetation.

Fence Stream Banks

Fencing promotes better pasture management and limits access by livestock to springs. Fencing lessens the chance of livestock injury on steep, eroded banks, reduces erosion, improves water quality, and protects fish and wildlife habitat. Water-borne diseases (leptospirosis, mastitis) can occur when livestock drink from and defecate into the same water source. Livestock needs can be met by providing watering tanks located off the spring site to supply cleaner, safer water or by restricting watering and cattle crossings to small areas where the banks and bottom of springs and spring-fed streams can be graveled to minimize erosion.

Limit Livestock

Livestock are attracted to springs and the surrounding spring environs (riparian areas) for drinking water, food (forage grasses), and shade. Livestock, especially cattle, trample and overgraze vegetation and increase erosion and siltation. Unfenced spring pools and spring-fed pasture streams – where livestock can enter unimpeded – tend to be shallow, muddy, and silted-in and to have bare banks, scarce wildlife habitat, few pools and riffles, low oxygen concentrations, high water temperatures, and reduced fish and insect populations.

Livestock wastes, such as manure and urine from pastures, barnyards, and feedlots, can contaminate spring waters with excess nutrients, poisonous methane and ammonia gases, and disease-causing bacteria, viruses, and parasites. Waters polluted with animal waste acquire an unpleasant taste and a foul odor and are unfit for drinking, swimming, and fishing. Disease-causing bacteria and viruses can infect healthy livestock herds and humans downstream.

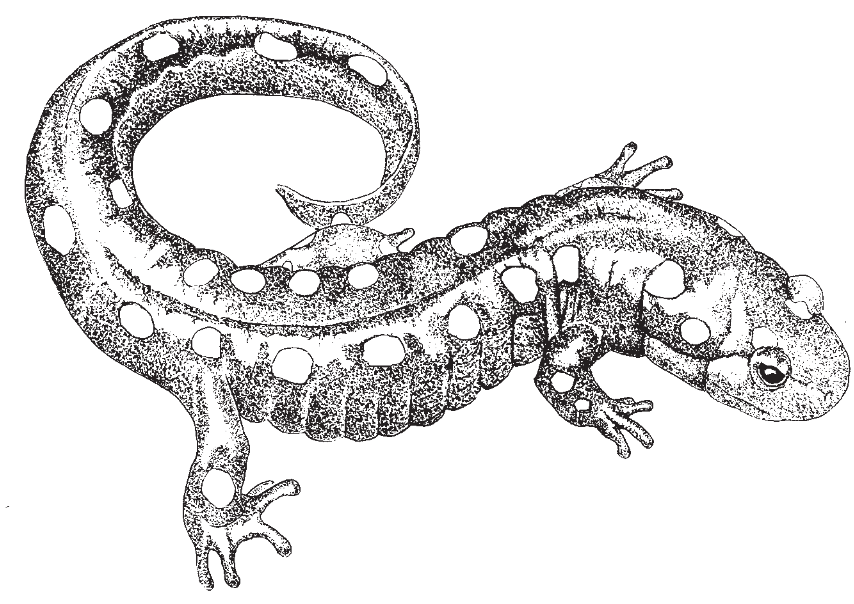
Reduce Soil Erosion

Each year millions of tons of topsoil are washed each year from freshly plowed fields, over-grazed pastures, logged forests, urban developments, and strip-mined lands into Virginia's waters. Topsoil regenerates slowly, and erosion removes this richest part of the soil where nutrients, organic matter, and beneficial soil microbes are found. On land, erosion can lower soil fertility and decrease plant production, and in the water, these fine soil particles can cover spring and spring-fed stream bottoms and suffocate aquatic life. Harmful chemicals may be associated with materials eroded from the land. Limiting land disturbance around springs and spring-fed streams and adopting best management practices when clearing land, plowing, burning, building structures, constructing roads, dumping, filling, mining, and dredging will help keep the soil on the land and out of your spring.

Minimize Fertilizer and Pesticide Use

Reducing the amount of nitrogen and phosphorus fertilizers on farmland, gardens, and lawns can significantly reduce the contamination of springs, streams, and groundwater. Testing the soil to determine the amount and type of fertilizer needed can save money and protect water quality. Avoid spreading manure or applying fertilizers near springs, streams, or on steep slopes, especially during rainy weather or when the ground is frozen. Site animal-waste storage tanks and manure piles well away from waterways.

Pesticides (insecticides, herbicides, fungicides) are toxic chemicals widely used by farmers, foresters, exterminators, and homeowners to kill harmful insects and weeds, to increase crop and timber harvests, and to prevent the spread of plant, animal, and human parasites and diseases. When applied improperly, pesticides can poison waters. Use less toxic chemicals and select pesticides that are readily degradable. Integrated pest management (IPM), an alternative to relying solely on pesticides, includes the use of biological control (natural pest predators and competitors), cultural practices (types of plantings and tillage), genetic manipulation (pest-resistant crop varieties), and carefully planned use of chemicals to protect crops, forests, and livestock. When using pesticides and fertilizers, follow directions and properly dispose of residues and containers.



Reviewed by Michelle Davis, research associate, Fisheries and Wildlife