

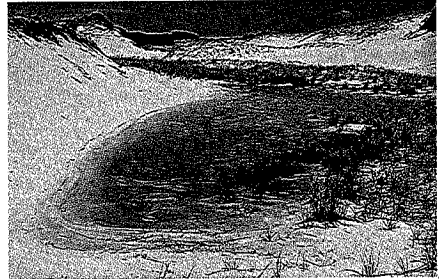
WHAT IS A VERNAL POOL?

Vernal pools are ephemeral wetlands which fill annually from precipitation, runoff, and rising groundwater. Most years they become completely dry, losing water through evaporation and transpiration. The wet-dry cycle prevents fish from becoming established, yet presents a rich, albeit temporary, habitat for many species. Beneath the still waters of these woodland pools is a staggering array of life.

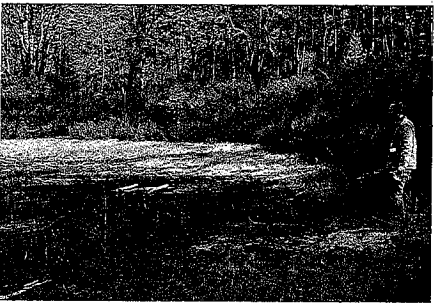
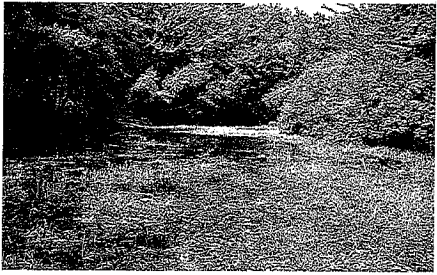
In this guide, we consider vernal pools to be wetlands that are or become isolated while containing water, are utilized by indicator species, and have wet-dry cycles that preclude permanent populations of fish. This definition may not coincide with definitions used for regulatory purposes in Massachusetts and other states nor with usage by some scientists in professional papers.

Vernal pools are variable in appearance, water source, time of filling, surrounding habitat, plant and animal content, and many other factors. In all cases, they share two characteristics: they do not hold water permanently and they are free of breeding populations of fish. In New England, the term "vernal pool" is used to refer to a wide variety of temporary, fish-free wetlands. In the narrow sense, a vernal pool is a temporary wetland which fills each spring (vernal means spring) and dries annually. Few of our pools meet this standard; most fill in the fall or winter and many of our larger vernal pools persist for several years before drying. The popular use of "vernal pool" refers to temporary wetlands regardless of when they fill or dry as long as they support certain animal communities.

Scientists and regulators, on the other hand, may use "vernal pool" with overlapping but still differing meanings. Scientists are concerned with the variable animal communities which result from the differing seasons of pool filling and the duration of the water in the pool. A short-lived spring pool will have a far different



The upland habitat near the pool is home for most vernal pool breeding amphibians and helps determine the species which use the pool. A hardwood forest pool (1) might have blue-spotted salamanders; an interdunal swale (2) Fowler's toads; an open field pool (3) spadefoot toads; a red maple swamp (4) four-toed salamanders.



Pools which are semipermanent are likely to have wetland vegetation. A forested wetland might contain red maple and highbush blueberry (1). Open areas of pools might have emergent herbaceous vegetation (2). Coastal plain ponds form rings of vegetation as they dry (3).

community than a fall-filling pool or one which lasts for several years. Scientists often distinguish between the ephemeral "vernal pool" and longer duration "semipermanent ponds." Regulators may define "vernal pool" based on a number of criteria including its location, the regulations involved, and the species present.

This guide will continue the popular usage of "vernal pool" in its broadest sense. Vernal pools are any fish-free, temporary wetland that supports indicator species.

INDICATOR SPECIES

Because of low oxygen levels and periodic drying, vernal pools are free from breeding populations of fish. Numerous amphibian and invertebrate species have evolved life cycles adapted to the exploitation of a temporary wetland without the predation of fish. Some species are completely dependent upon ephemeral wetlands for parts of their life cycle. Such animals are the "obligate" or "direct indicator" species of vernal pools. "Facultative" vernal pool species ("indirect indicators") are those which use both vernal pools and other wetland habitats for their various life activities. They have physical or behavioral adaptations to deal with the wet-dry cycle of a vernal pool and require a pool which holds water for 2-3 months, but are also found in other wetlands.

In Massachusetts, the vernal pool obligate species are: the wood frog, the spadefoot toad, four species of mole salamander (the spotted salamander, the blue-spotted salamander, the Jefferson

salamander, and the marbled salamander), and two species of fairy shrimp. Facultative species include most of our remaining frogs, a few reptiles, numerous insect larvae, fingernail clams, amphibious snails and leeches.

VERNAL POOL PROTECTION IN MASSACHUSETTS

In Massachusetts, vernal pools are afforded some protection through several regulations, chief among these being the Wetlands Protection Act Regulations and local bylaws. Other regulations which include vernal pool protection are the Surface Water Quality Standards, Title V of the Massachusetts Environmental Code, and the Forest Cutting Practices Act Regulations. Many, but not all, of these regulations require that the pool be "certified" by the Natural Heritage and Endangered Species

Program (NHESP). Certification is a documentation process where a citizen collects evidence of the presence of a vernal pool and its biological indicators and submits this evidence and location maps to the NHESP. The NHESP reviews the submission and subsequently may certify the pool. Certification only establishes that a vernal pool exists. Any protection arises from the application of the various regulations during permit reviews. For complete information on certification and protection in Massachusetts, consult the references on page 70.

— LIFE IN A VERNAL POOL —

A vernal pool is a productive hatchery for terrestrial amphibians. Its short period of intensive growth cycles the nutrients and energy of fallen leaves on the pool bottom into the frogs and salamanders of the adjacent woodlands; these animals make up a significant portion of the wildlife of a forest. Due to our own inattention and the secretive nature of these animals, we do not realize their overall significance. For example, a moderate sized vernal pool might have several thousand wood frogs entering to breed and then returning to the forest. Yet most people, even those who spend extensive time in the woods, never encounter even one of these woodland creatures. Mole salamanders are seldom observed except on rainy migration nights when hundreds might be moving to or from a vernal pool. Yet these animals live out their 20 years of life within a few hundred feet of that pool. How many have you ever seen?

A pool represents the cumulative evolution of a number of species adapted to and exploiting a productive, although temporary, habitat. Activity in the pool is seemingly choreographed so that each species maximizes its own chances for survival. Organisms feed upon one another, yet sufficient numbers survive to maintain the population in future years. Years of drought or other adverse

CERTIFICATION IN MASSACHUSETTS

A vernal pool may be documented for certification by the MA Natural Heritage & Endangered Species Program by any of three methods.

Obligate species method

Submit a photograph of the pool holding water and evidence (photo/tape) of any of the following from the pool:

breeding activity of wood frogs, spadefoot toad, spotted salamander, blue-spotted salamander, Jefferson salamander, or marbled salamander; presence of fairy shrimp.

Facultative species method

Submit photographs of the pool holding water and the pool dry (or other proof of no fish) and evidence (photo/tape) of any two of the following from the pool:

breeding activity of spring peepers, gray treefrogs, green frogs, leopard frogs, pickerel frogs, American toads, Fowler's toads, four-toed salamanders; *presence* of red-spotted newt adults, spotted turtles, wood turtles, Blanding's turtles, painted turtles, snapping turtles, predaceous diving beetle larvae, water scorpions, dragonfly nymphs, damselfly nymphs, dobsonfly larvae, whirligig beetle larvae, caddisfly larvae, leeches, fingernail clams, or amphibious air-breathing snails.

Dry pool method

Submit photograph of a dry pool (or other proof of no fish) and evidence (photographs/specimens) in the dried pool bed of any one of the following:

the shells of fingernail clams or amphibious air-breathing snails, the cases of caddisfly larvae, or the exuvia (shed exoskeleton) of dragonflies and damselflies.



Pools filled by river and stream flooding (1) might contain fish for a period but eventual drying prevents these from being permanent populations. Human activities produce areas which sometimes function as vernal pools. This small quarry (2), abandoned gravel pit (3) and roadside area (4) are fishless and have obligate vernal pool species.

conditions resulting in low survival rates might be followed by exceptional years of population survival.

The food chain within the vernal pool begins with forest leaves dropping or blowing into the pool in fall. Bacteria and fungi begin the decay process and then themselves become food for slightly larger zooplankton such as daphnia, copepods, and rotifers. A variety of insect larvae feed on leaves, shredding them as they forage. The caddisfly larvae both shred leaves and utilize leaf fragments or small sticks to build cryptic cases within which they reside. Other insects, such as the water boatman, amphibious snails and various small crustaceans, feed on leaves and other plant material, reproduce, and become abundant. When the frog tadpoles hatch, they become continual feeders of leaves, other plant material, and algae of the pool. The prolific herbivorous animals are hunted by the developing forms of the predaceous diving beetle, fishfly, dragonfly, damselfly, water scorpion, as well as the adults of some of these and other species. These predators also hunt each other.

Salamander larvae also are carnivorous. When small, they feed on daphnia and similarly sized creatures. As they grow, their diet consists of whatever they can cram into their large mouths, including larger invertebrates and frog tadpoles. Many salamander larvae consume other salamander larvae, usually of different species. Marbled larvae are large enough in mid-spring, when the Jefferson, blue-spotted and spotted larvae hatch, that they can devour considerable numbers of these smaller salamanders. In turn, the Jefferson and blue-spotted are usually larger than the spotted because of earlier egg deposition or faster development. They feed on the larvae of the spotted salamander. Even the spotted larvae can be cannibalistic and feed on other spotted larvae in times of overcrowding, such as when the pool is drying.

The food web continues to become increasingly raveled. Turtles and snakes

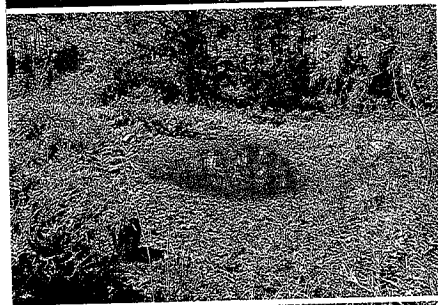
go to the pool to feed on the developing species. Spotted turtles eat the egg masses of spotted salamanders, as well as insects and larvae of amphibians. Ribbon snakes catch amphibian larvae or emerging adults in the shallow vegetation at the pool edge. Nocturnal owls swoop on amphibians traveling to and from the pool. Wading birds eat whatever is available. Raccoons grab tadpoles, large insects, adult frogs and anything else within their reach.

The developing organisms of a vernal pool race to end their dependence on the pool before the water disappears. Whether they win or not, many still become food for others and pass the energy and nutrients from the pool back into the forest. Those that leave the pool alive might survive in the forest ecosystem to return to the pool another year, or they might be eaten by owls, raccoons, or shrews. Those that die in the overheated shallows of a disappearing pool are scavenged by birds, mammals, reptiles, and insects, and enter the forest ecosystem as units of energy. The abundance of amphibians and invertebrates which leave the pool, on their own or in the bellies of others, becomes a substantial amount of the animal tissue found in the adjacent forest and a significant food resource for other upland species, as well as a future nutrient source for forest vegetation.

— IMPORTANCE OF VERNAL POOLS —

Vernal pools are essential habitat for portions of the life cycles of many species. They are also the favored habitat for considerably more species, particularly amphibians, that use them for breeding and feeding in an area of reduced predation. They are also important as water sources for other wildlife, both for drinking on a hot summer day as well as irreplaceable links in the overland passage of various amphibians and reptiles as they travel from one wetland to another.

Vernal pools are indispensable to biodiversity, both locally and globally. For a species with a wide distribution,



Leaves (1), algae and phytoplankton are the food base for life in a vernal pool. Frog larvae (2) turn a considerable amount of leaf material into animal tissue. Many of these amphibians are eaten by predators while in the pool or when they leave as they mature (3). Those that die when the pool dries (4) are consumed by scavengers.

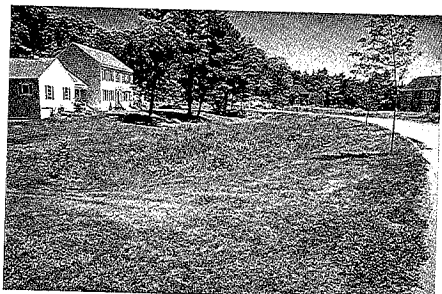
individual vernal pools are essential to the local population. Eliminate those pools and the population of that animal will die out in that area. For a species with a narrow distribution, a specific vernal pool might be the only place on earth that animal is found. If the pool is destroyed, that species will be extinct. Examples exist in the scientific literature of a species identified from one vernal pool, but not found again since the destruction of that pool. In Massachusetts, the Intricate Fairy Shrimp is known from only 10 pools. Spadefoot toads are known from only 40 sites in the entire state. Destruction of only a few pools would jeopardize the existence of these animals in Massachusetts.

HUMAN IMPACTS ON VERNAL POOLS

The increasing population density in New England and resultant sprawl of housing, roads, shopping malls, and recreational ball fields continues to impact vernal pools and vernal pool species. Pools have been filled to create upland or have been used as road drainage detention ponds, both of which are allowable under certain regulations. Critical surrounding habitat is cleared for homes, lawns, fields and parking. Irrigation wells lower the water table and hasten pool drying. Overuse of fertilizers and pesticides threatens the water quality of pools which are highly dependent on runoff as a water source. Mosquito control efforts both drain vernal pools and

chemically or biologically affect species in the pools, other than just mosquitoes. Roads constructed near pools contribute to high mortality. Vehicle traffic is a significant problem for slow moving migratory amphibians where almost the entire local population will move on the same night. Highways with multiple travel lanes and concrete center dividers fragment the habitat, prevent migration and range expansion, and restrict gene flow in a population.

Solutions to these problems, if there are any, are beyond the scope of this guide. If you are concerned about vernal pool species and the human impact on them, become knowledgeable about these species and vernal pools. Then become involved in your local government. The Conservation Commission, Planning Board, Open Space Committee and similar regulatory groups all make decisions which affect land use and vernal pools. Regional organizations involved in environmental issues, species protection and land use issues would include your local watershed association, the Massachusetts Audubon Society, the Nature Conservancy, local land trusts and nature centers. Become proactive now. Don't wait for the vernal pool you know to be threatened.



(1) Vernal pools are basins which naturally collect water. This makes them attractive as water detention structures in subdivision construction. Such use is legal under some conditions although it destroys the biotic function of the pool. (2) Some towns enforce road closings on amphibian migration nights in an effort to minimize damage caused by automobile traffic.

VISITING A VERNAL POOL

The first step to studying a vernal pool is to find one. Considering the abundance of vernal pools, the search should not be difficult. Check with the local conservation commission for information about known pools which might be on public land. Or simply visit conservation property, state parks and forests, and other public open space and look for isolated bodies of water fitting the description of a vernal pool. You could use topographic maps, hiking maps, soil conservation maps and aerial photography to aid your search. As an aid to the identification of vernal pools, the NHESP initiated a program in the fall of 1999 to identify Potential Vernal Pools (PVP) from aerial photography. As of this writing, Bristol and Plymouth Counties have been completed. The remainder of the state should be photo-interpreted for PVPs by the fall of 2001. For information on PVP maps, contact NHESP or MassGIS.

The Executive Office of Environmental Affairs (EOEA) urges citizens to take an interest in vernal pool appreciation, study and protection. However, EOEA strongly recommends that anyone interested in field verification of potential vernal pools or vernal pool certification obtain landowner permission prior to conducting surveys and gathering data. No one pursuing official vernal pool certification should trespass on legally posted property. Teachers should always seek landowner permission before bringing students onto private property for activities.

The actual study of a vernal pool requires little in the way of specialized equipment. At most, you might want a small net, hand lens, shallow container and boots or water socks. Egg masses can be found by looking for them at the water surface or attached to vegetation below the surface. Polarized glasses or casting a shadow on the surface help to eliminate reflections. The net is used to capture invertebrate or amphibian larvae. Run the net through the water randomly and dump the contents into some water in your container. Netting at the water surface or in the leaf litter will result in different collections of animals. After observing your specimens, return them to the pool.

When visiting a vernal pool, consider both your personal safety and the long-term protection of that pool. Be careful of deep water, drop-offs, submerged objects, and the grasping mud of a pool bottom. Recognize and avoid both poison ivy and poison sumac. Children should be properly supervised. In and around the pool, minimize your impact. Do not collect vertebrate specimens. Do not remove egg masses from their attachment sites. Do not transfer animals between pools. Consider and minimize the impact of large groups or multiple visits at a pool.

Visiting a vernal pool and observing the specialized life that utilizes this type of wetland can be a rewarding experience. Find a pool and get to know it. Visit it frequently and observe the changes throughout the year. Share your findings with others in your family, school, and community.



In Massachusetts, a visit to a vernal pool could be for the purposes of documenting biotic communities for official state certification. You would need to photograph the pool and evidence of specific organisms which use the pool. This evidence and maps which pinpoint the pool location would then be sent to NHESP. For more information, see page 5.