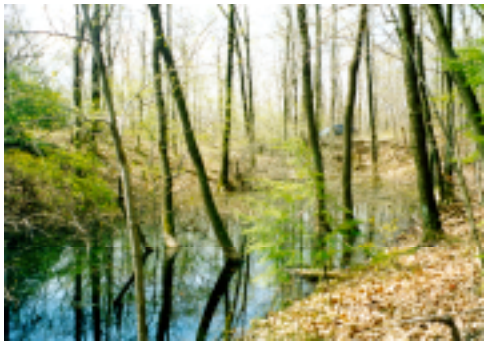
VERNAL POOL WETLANDS

Introduction

Vernal pool wetlands are unique biological habitats. They are critical for the survival of many amphibians such as spotted salamanders.

The first warm, rainy nights of March bring a stir to the forest floor. There beneath the thick decomposing leaf litter and in deep subterranean tunnels excavated by shrews, the spotted salamanders have lived since the previous fall. Rain drops, warming temperatures, and instinct, drive these creatures with the bright yellow polka dots to move across the landscape, under leaves and twigs, over rocks, through mud and across streams and roads to the *vernal pool wetlands*.



This journey is a risky adventure. Most arrive safely to their breeding grounds, but others cannot find their pools hindered along the way by insurmountable obstacles such as steep road embankments and open inhospitable manicured lawns or find them disturbed, not the friendly environment they left a few months ago. Some succumb along the treacherous journey as they pass over unfamiliar terrain: roads, parking lots and lawns.

Vernal pool wetlands are unique biological habitats. They are critical for the survival of spotted salamanders and other amphibians such as marbled and Jefferson's salamanders, and wood frogs. Many other wildlife species use them for mating and breeding, for feeding and as sources of water, and certain invertebrate species such fairy shrimp, snails and fingernail or sphaeriid clams also depend upon them.

Is Every Pool a Vernal Pool?

Definition

There are many terms used to describe habitats that are flooded periodically, terms such as temporary ponds, ephemeral pools, vernal ponds, autumnal ponds, and astatic waters. However, not all temporarily flooded areas qualify as vernal pool *habitat*. Vernal pools are typically small, temporary bodies of

Not all temporarily flooded areas qualify as vernal pool habitat.

standing water that are most obvious in the spring of the year. Vernal pools derive their name from "vernalis," the Latin word for spring because they can be filled by spring snowmelt, precipitation, and groundwater seepage. In order to meet the definition of a vernal pool *habitat*, a wetland must have the following physical and biological characteristics:

It is a contained basin depression lacking a *permanent* hydrologic inlet or outlet

It does not support a fish population

During a typical year it contains surface water of varying depth for a duration of at least *two* months from spring through early summer, and then is dry for all or most of the remainder of the growing season (some semi-permanent fishless waterbodies can also provide *functional* vernal pool habitat).

supports the breeding and development of at least one of the following species: wood frog, spotted salamander, Jefferson's salamander, marbled salamander, fairy shrimp

In Southern New England many seasonally flooded forested swamps provide *functional* vernal pool habitat, even though the recognizable vernal pool habitat within the swamp can be relatively small or be comprised of several widely scattered micropools that are deep enough to hold water for several weeks or months. Some of these flooded swamps, which include riparian and floodplain wetlands, are extremely productive for obligate vernal pool amphibians.

NOTE: The above definition is based upon conversations with a number of vernal pool experts, and the publication "Wicked Big Puddles" published by the Massachusetts Vernal Pool Association

Where are the Vernal Pools?

In Connecticut

In Connecticut, vernal pools are found in a variety of ecosystems and landforms. They commonly occur in depressions in glacial till soils, where a dense hardpan or bedrock (e.g. on trap rock ridges) can form a restrictive layer that holds standing water. Vernal pools are also found in depressions formed

on soils that are derived from very fine textured glacial lake deposits, such as those found in the northern half of the Connecticut River Valley. Vernal pools are also associated with kettle hole depressions, "pingo" scars, river floodplain oxbow ponds, and with some man-made depressions such as those that occur in gravel pits and quarries. The principal loss of water in many of these situations is from evaporation and subsidence of the groundwater table.

Why are Vernal Pools Unique?

Vernal Pool Life History

The ecology of vernal pools creates a unique environment upon which a number of wildlife species have become dependent. Some species are so dependent on this environment that they are not able to successfully reproduce anywhere else.

The ecology of vernal pools creates a unique environment upon which a number of wildlife species have become dependent.

The vernal pool environment is made up of a series of interactions among plants and animals from both terrestrial and aquatic habitats. Certain deciduous trees and shrubs that are adapted to seasonally flooded soils grow around the edges of the pool. Each fall they shed their leaves, which collect in the bottom of the depression. Fungi and bacteria break down this leaf litter. When the pool fills in the spring it becomes a principal source of nutrients for macroinvertebrates including mollusks, crustaceans, and adult insects. Salamander larvae, reptiles, frogs, toads, some birds consume these macroinvertebrates. Species such as fairy shrimp and mosquito larvae are an especially important food source for the amphibians that are entirely dependent on vernal pools for breeding and early development. And these amphibians in turn are important sources of biomass for the forest ecosystem.

By late March and early April wood frogs and spotted salamanders migrate on the earliest warm, rainy nights and enter the pools where mating occurs and eggs are deposited on submerged twigs and other woody debris. The larvae will begin to grow by using the nutrients contained in the eggs. When they emerge from the fully developed eggs they will feed on plant material and aquatic invertebrates in the water column. While the wood frog tadpoles pursue a vegetarian diet, the larval salamanders are carnivorous. They continue their early development while drawing upon the nutrient resources of the vernal pool. Upon metamorphosis adult amphibians emerge from the vernal pool and disperse into the surrounding upland habitat where they forage for food until the next breeding period when this cycle will be repeated.

NOTE: The above is adapted from "A Guide to the Identification and Protection of Vernal Pool Wetland of Connecticut" (Donahue, 1996). This publication is available from the Maps and Publications Room of the CT DEP.

What Lives in Vernal Pools?

Obligate and Facultative Vernal Pool Species

Vernal pools provide habitat for a variety of aquatic and terrestrial organisms. They serve as a source of water, food and cover for many upland species that do not utilize them for breeding. For instance, songbirds are attracted to vernal pools because of the abundance of berry producing shrubs and insect life that is typically associated with them (see Table 3 for a partial list of wildlife attracted to vernal pools).

Vernal pools provide necessary breeding habitat for certain amphibian and macroinvertebrate species. These are referred to as *obligate* vernal pool species (see Table 1). Other species are classified as *facultative* species meaning that they can breed in a variety of aquatic habitats, including vernal pools (see Table 2).

Survival Strategies of Vernal Pool Species

Because vernal pools typically dry up in the middle to late summer many of these organisms have developed specialized strategies to survive. These include rapid growth, so that eggs can complete development during the time that water is present. When conditions become unfavorable some species will leave, while others will "wait it out" in a dormant state until the pool floods again. For example, fairy shrimp eggs can rest in the sediments for many years, and fingernail clams and snails aestivate (the summer analog of hibernation) in the mud. Some species, such as marbled salamanders and caddisflies, lay their eggs in the dry vernal pools in fall, and the eggs withstand drying and cold until the pool floods in the fall, during a winter thaw, or during spring snowmelt and showers.

Common Vernal Pool Species

The following are some typical vernal pool species commonly encountered. Other more rare or uncommon species, such as the blue-spotted salamander and the Jefferson's salamander, also breed in vernal pools.

TABLE 1: OBLIGATE VERNAL POOL SPECIES

Amphibians

Spotted salamander
Jefferson's salamander
Marbled salamander
Wood frog
Eastern spadefoot toad

Spotted Salamander *(Ambystoma maculaturm)*

The most widespread and best known and largest "mole" salamander in Connecticut. This is the "poster child" of vernal pool amphibians. Migration begins on the first mild rainy nights of spring, usually late March. Egg masses are attached to twigs or plant stems several inches below the surface of the water. The eggs hatch in four to eight weeks and the larvae usually transform between late July and September. *Ambystoma*, including spotted salamanders, are long-living (10 to 20 years).

TABLE 2: FACULTATIVE VERNAL POOL SPECIES

Amphibians

- Green frog
- Blue-spotted salamander
- Pickerel frog
- Northern spring peeper
- Gray tree frog
- Eastern American toad

Reptiles

- Snapping turtle
- Painted turtle
- Spotted turtle

Invertebrates

- Snails
- Fingernail clams
- Mosquito larvae
- Predatory caddisflies

Marbled Salamander *(Ambystoma opacum)*

Widely distributed in Connecticut but absent from high elevations (above 1100'). They are locally common on the trap rock ridges of the central Connecticut River Valley. Marbled salamanders breed in the late summer or fall and lay their eggs in shallow depressions, usually in the dry beds of vernal pools. Females guard their eggs until they are covered with water. Hatching time varies with the time at which the clutch is covered with water. The larvae overwinter beneath the ice in temporary ponds and transform in late May or June.

Wood Frog *(Rana sylvatica)*

In Connecticut the wood frog is widespread and ubiquitous, found from sea level to high elevations. Adults live in many types of woodlands, less often in swamps and bogs. Breeding takes place around late March, often concurrent with mole salamander breeding. Eggs hatch in 10 to 30 days, and the emerging tadpoles transform into
adults some 6 to 15 weeks later.

TABLE 3: WILDLIFE ATTRACTED TO VERNAL POOLS (selected)

Reptiles

- Water snakes

Gray Tree Frog *(Hyla versicolor)*

In Connecticut the gray tree frog is widely distributed, but quite cryptic and therefore, rarely observed. This facultative vernal pool species inhabits wet woods, or brush near ponds, pools or swamps. Breeding usually occurs between early May and July. Egg laying begins some 20 to 35 days after adults first appear at the pond or pool. Eggs hatch in 4 to 5 days and tadpoles transform some 50 to 60 days later.

Spotted Turtle *(Clemmys guttata)*

In Connecticut the spotted turtle, a facultative vernal pool species, is widespread at elevations below 700'. It lives in unpolluted, small, shallow bodies of water and is often seen basking on floating matter or on shore. Breeds March to June. Eggs are laid in well drained sandy soil June to July, usually three to five in number. Hatchlings emerge late August to September.

What Threatens Vernal Pools?

Land Development

Because vernal pool wetlands are often small, isolated, and dry much of the year they can be easily overlooked and inadvertently damaged or destroyed.

The uplands surrounding vernal pools are integral parts of these unique wetland ecosystems. Because vernal pools are ecosystems that are functionally tied to their immediate surroundings, permanent changes to topography and vegetation from the development of land can pose the greatest risk to vernal pool habitat. For such changes to be destructive they need not only occur in the vernal pool itself, but also could occur within its contributing watershed or even much further. For instance, changes that take place outside the vernal pool can prevent wildlife from returning to the pool to breed or can severely diminish the re-population of some of these systems during migration and dispersal pulses following extreme climatic events such as droughts. Development is the principal source of *habitat fragmentation*, a phenomenon that affects vernal pools.

Development near a vernal pool can have other indirect impacts on this type of habitat. Urban contaminants, such as nutrients and hydrocarbons can find their way to a vernal pool via surface or groundwater degrading water quality.

Clearing of the forest canopy near a vernal pool can effect soil and water temperatures and soil moisture content, variables that can influence both the migration and breeding success of many vernal pool species.

Ongoing scientific and applied research on vernal pool systems is shedding light on which mitigative strategies are most effective in their conservation. The *site-specific study* of vernal pools is paramount, to determine population size and diversity, migration patterns and important terrestrial habitats for the non-aquatic life cycle stages. If more than one vernal pool habitat occurs in an area the study should also focus on the relationship between these habitats. Individual pools should not be treated as independent entities but as part of a dynamic interdependent mosaic. Collection of such baseline information and careful design of development site plans can lead to land development that is sensitive and which ensures the continuing viability of these unique features of the Southern New England landscape.

Some Conservation Strategies

To protect vernal pools from degradation several steps can be taken that can work together.

Identify and Evaluate Vernal Pools: This is the essential first step. Beyond identifying an area as a vernal pool it must be evaluated as to its function relative to "reference" vernal pools. Is this a very productive vernal pool that has a high biodiversity and that is a "source" to other less productive vernal pools in the area? Or, on the other side of the functional scale, is it a "sink" vernal pool that provides habitat for a few of the more opportunistic obligate vernal pool species, such as wood frogs, only during "ideal" years (e.g. wet years), and which must rely on other more productive vernal pools for re-population?

Avoid the Degradation of Vernal Pools: Protecting the watershed of a vernal pool and ensuring that its water budget (i.e. both surface water and groundwater inputs) remains constant is important. Ideally, development within a vernal pool's watershed should be avoided unless a project's proponent can prove that water quality will not be compromised.

Protect the Upland Fringe Adjacent to Vernal Pools: This is the area that provides shade and an energy source (e.g. leaves, twigs) to the pool. This is the area where young-of-the-year amphibians (i.e. juveniles) tend to concentrate until conditions are right for dispersal.

Protect Adjacent Upland Habitat: Obligate vernal pool amphibians can travel up to half a mile from breeding sites. Although protective buffer zones in the order of 500 feet to 600 feet wide or more can be supported based on the biology of vernal pool amphibians, they may strain the credibility of regulations protecting wetlands. Also, protective buffers this wide should only be contemplated for the most productive and diverse of vernal pool habitats. Protecting the upland habitat for species that are terrestrial for most of their life cycle may require the use of open space planning, special overlay zoning, and other land use management techniques.

Avoid Placing Migratory Barriers in Areas Adjacent to Vernal Pools: Roads may be the worst threat as migratory barriers and sources of mortality for vernal pool amphibians. Cape Cod berms, instead of traditional curbing, can help in some instances. Amphibian tunnels should be reserved for use on roads with high traffic volume.

Selected Vernal Pool-Related Publications:

Caduto, M. J. 1990. Pond and Brook: A Guide to Nature in Freshwater Environments. University of New England Press. 276 pp.

Colburn, E. A., Ed, 1991. Certified: A Citizen's Step-by-Step Guide to Protecting Vernal Pools. Massachusetts Audubon Society. 107 pp.

DeGraff, R. M. and D. D. Rudis. 1986. New England Wildlife: habitat, natural history, and distribution. USDA Forest Service Gen. Tech. Rep. NE-108. 491 pp.

Downer, A. 1992. Spring Pool: A Guide to the Ecology of Temporary Ponds. New England Aquarium, Boston, MA. 57 pp.

Fellman, B. (ed.). 1998. Out Hidden Wetlands: The Proceedings of a Symposium on Vernal Pools in Connecticut. Yale University Center for Coastal and Watershed Systems and the Connecticut Department of Environmental Protection.

Kenney, L.P. 1995. Wicked Big Puddles. Vernal Pool Association, Reading Memorial HS, Reading, MA. 58 pp.

Klemens, M. W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut. Bulletin No. 12. 318 pp.

Meritt, R. W. and K. W. Cummins. Eds. 1983. An Introduction t the Aquatic Insects of North America. 3rd Edition, Kendall-Hunt Publishing Co., Dubuque.

Smith, H. M. 1978. Amphibians of North America: A guide to field identification. Golden Press.