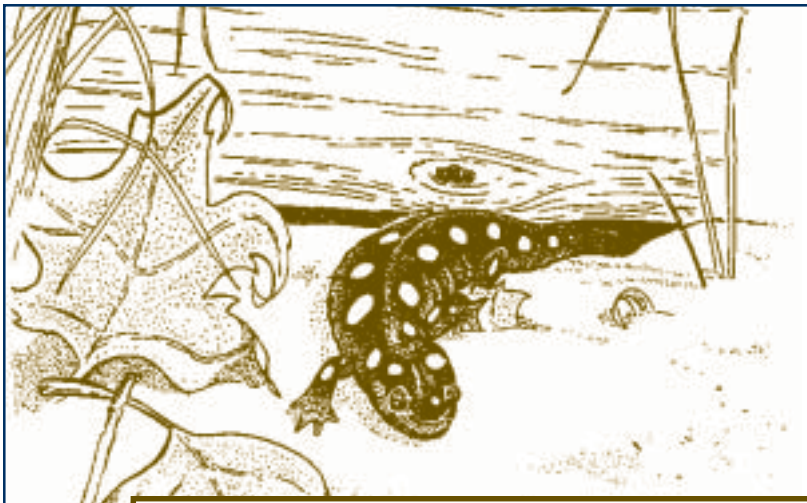
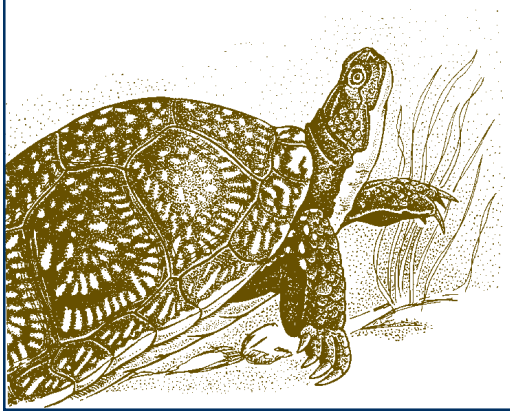


Identification and Documentation of Vernal Pools in New Hampshire

First Edition Edited by Anne Tappan

Second Edition Edited by
Michael Marchand



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About New Hampshire's Nongame and Endangered Wildlife Program

As the steward of New Hampshire's wildlife resource, the New Hampshire Fish and Game Department is responsible for the conservation of over 500 wildlife species. About 75 percent are nongame wildlife — species not hunted, fished or trapped. Twenty-four species are endangered and twelve are threatened. The Nongame and Endangered Wildlife Program was established in 1988 to develop and implement a program to protect and enhance this diverse group of wildlife.

The Program protects endangered, threatened and common species, connects wildlife to special habitats and restores landscapes that make it possible for wildlife to thrive. Most field projects are carried out in cooperation with other New Hampshire wildlife agencies and organizations.

The Nongame and Endangered Wildlife Program receives no funds from sporting licenses or related fees. Traditionally, funds have been raised annually from private sources, and are matched by the state.

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Development of the manual was by the N.H. Association of Wetland Scientists, Vernal Pool Working Group. Text editor was Anne Tappan. In addition, the following people contributed to the development and refining of the manual:

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Conservation Commission members, citizens and Girl Scouts in Loudon and Litchfield field tested a draft of the manual.

The enthusiasm and commitment, as well as the criticisms and comments, of all involved made this manual possible.

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This manual is based on *Certified: A Citizen's Step-by-Step Guide to Protecting Vernal Pools*, fourth edition, 1991, by the Massachusetts Audubon Society, Lincoln, MA. and used by permission.

CONTENTS

continued on next page

Chapter One

INTRODUCTION

VERNAL POOLS: UNIQUE HABITAT, UNIQUE WILDLIFE

A vernal pool is a temporary body of water which provides essential breeding habitat for certain amphibians – such as wood frogs, and spotted salamanders – and invertebrates – such as fairy shrimp. These unique wetlands typically cycle annually from flooded to dry. Vernal pools vary in size, shape, and location. Some are as small as several square feet in area; others extend to several acres during maximum flooding. The pools appear year after year in the same spots, except during exceptionally dry years. Pools occur in a variety of sites, including small depressions in the woods, kettle holes, oxbows on river floodplains and gravel pits. Many occur in isolated depressions in areas far away from rivers and streams, lakes, and typical wetland areas. These differences are of little significance to the wildlife that depend on vernal pools for habitat; for them, the important considerations are water, food, cover (concealment) and lack of some predators.

Vernal pools are valuable as wildlife habitat because of the wide range of species that use them, including turtles, frogs, salamanders, fairy shrimp, clam shrimp, fingernail (or "pill" or "pea") clams, caddis flies and other aquatic insects. Some of these species (certain invertebrates, salamanders and frogs) are rarely found outside of areas containing vernal pools. Vernal pools provide a safer breeding ground for these species than permanent waters, because there are no fish to eat the eggs or larvae. In addition to the species specially adapted to vernal pools, these wetlands may serve as local watering holes for nearby animals; a feeding ground for birds, snakes, turtles and some mammals; or a hibernation site for turtles. A profusion of plant life may grow in and around the depression where the pools form, providing food and cover for other species.

Vernal pools, used as breeding sites, provide a critical element in the life cycle of certain amphibians and invertebrates. The aquatic stage of vernal pool inhabitants is a race against time to complete development before the pool dries up. For salamanders, the time between hatch and metamorphosis is highly variable. These species are able to metamorphose earlier and at a smaller size when a pool threatens to dry early, or metamorphose larger and later if the aquatic environment is more favorable.

Adult salamanders emerge from their subterranean haunts on the first relatively warm rainy nights of early spring. Spotted salamanders (which are black with large yellow dots and are up to eight inches long) and the smaller Jefferson and blue-spotted salamanders (which are grey-black with finely speckled blue spots) find their way back to the pools in which they were born. Wood frogs are among the early arrivals, their chorus of duck-like quacks punctuating the night. Fairy shrimp are likely already present. Their eggs survive in the mud of dried pools and hatch early the next spring, when the pool is full of water.

Male salamanders arrive first and wait for the females, which generally follow soon after. In the pool, males and females participate in a mass courtship ritual known as congressing. Males deposit gelatinous capsules, usually about one- half-inch long, on the bottom of the pool. Females then take these sperm-filled packets, known as spermatophores, into their vents (cloacae) and fertilization occurs internally at the time of egg deposition. Then the eggs are laid in gelatinous masses in the water.

The adults leave the pool after breeding, normally awaiting a rainy or wet night before returning to their cavities in the forest floor. The eggs hatch in four to eight weeks. The tadpole-like larvae are entirely aquatic and breathe with external gills. They gradually develop legs and jaws during their time in the pool. After two or three months (usually between July and September), they transform into young adults. When they have lost the last traces of their gills, they leave the pool to begin the next phase of their lives in the surrounding upland forest.

In addition to being vital as small, individual habitats for local plants and animals, vernal pools fill another important role. If we think of them as specialized aquatic stepping stones within a larger habitat type, we see that groups of pools form “corridors” of wetland habitat along which wildlife may travel. If the corridors do not exist, these creatures will be isolated and more vulnerable to drastic changes in their surroundings. These factors make the pools and surrounding uplands important habitat for the wildlife of New England.

USING THIS MANUAL

The goal of this manual is to train people to identify and document vernal pool habitat. Although concerned about vernal pools, many people are not well acquainted with this particular wetland type. Awareness of vernal pools – their occurrence and importance – is the first step to their protection. Identification and documentation of vernal pool habitat is a key step. This manual will show you how to locate, identify and document vernal pools and indicator species.

Vernal pools are especially vulnerable to human disturbance. The same characteristics that make vernal pools valuable breeding sites for certain species increases the possibility of disturbance or destruction. The ephemeral nature of this habitat makes vernal pools difficult to see during much of the year. Many vernal pools are small and isolated, also making them difficult to notice. Before a change in land use of an area, identification and documentation are vital to protecting vernal pools.

The definition and documentation criteria in this manual provide a standardized approach to evaluate and document the location and condition of vernal pool habitat. This information will enable citizens, conservation commissions and state agencies to take steps to protect this unique habitat.

Once you have become involved with field observations, you may discover that you are hooked. For those wishing to pursue their interests further, a bibliography at the end of this manual provides listings of field guides and other references. Addresses and telephone numbers of organizations and agencies interested in vernal pools are provided in the Appendix.

DOCUMENTATION VS. PROTECTION

Vernal pool protection is a two-part process. One involves identification of a pool as important wildlife habitat. The other involves obtaining protection from disturbance. Although any vernal pool that can support breeding salamanders and/or other species that depend on this habitat for survival can be documented, the pool is not necessarily afforded sufficient protection at the present time.

If vernal pools are not specifically protected under current state wetlands protection regulations, why document vernal pools? Information about vernal pools can accomplish the following:

- Help landowners learn about and appreciate the values of vernal pools on their properties and apply protective measures. Individual landowners have ultimate control over what is done on their properties. Many people, if they know they have something unique or valuable, will act to protect it. Actions can range from not dumping lawn clippings in a vernal pool to making changes in development plans or even placing permanent conservation restrictions on the area of the property where the vernal pool is located.

- Provide a basis for protection at the local level. Some municipalities have local wetland ordinances. You may wish to work to have your local ordinances amended to include vernal pool habitat or to draft such an ordinance for your city or town.

- Provide a basis for better statewide protection. We need to obtain information about just how many of these important wildlife habitats “fall through the cracks” of the existing wetland protection system, so that the wetland regulations can be modified to protect important vernal pools.

- Contribute to scientific investigations about vernal pools and the wildlife that depend on them. Much remains to be discovered about the ecology of vernal pools and the organisms that depend on them. By being tied into a statewide network of vernal pool observers, you will be contributing important information to the understanding and conservation of New Hampshire wildlife.

TERMS USED TO DESCRIBE VERNAL POOLS

For the purposes of this manual, **a vernal pool is typically a temporary body of water providing essential breeding habitat for certain amphibians and invertebrates and does not support fish.**

Vernal pool habitat is characterized by extremes, annually ranging from flooded in spring to dry in late summer. Characteristics of a vernal pool are influenced by topography, surrounding vegetation and rainfall. The size and duration of a particular pool may be quite different year to year due to local snow and rainfall conditions.

Vernal pools are found in a variety of site types surrounded by various habitat types. A pool may be in an upland site, bottomland isolated site or associated with floodplain

wetlands. Surrounding habitat may be forest (hardwood, softwood or mixed), field, shrub swamp, marsh, gravel pit or other. Size, depth and cover (branches or vegetation in the pool) also vary.

Vernal pools may be known by a variety of rather non-standard names. These additional names and characteristics provide a broader description of these wetlands. The major variables are duration of wet/dry cycles, season of filling, and pool size. All of the following waterbodies may be vernal pools.

Vernal pool or pond is a term used to describe temporary ponds that fill up with water in the spring as a result of snowmelt, spring rains, and/or elevated groundwater tables. (Vernal comes from the Latin word for spring.) This term is also used to describe pools that reach their maximum size in springtime and has come to be used broadly as a synonym for "temporary pond." As noted above, in New Hampshire the term has been given a specific definition, with particular criteria for documentation as important wildlife habitat.

Temporary pool or pond is the most common general term used to describe aquatic habitats that are periodically flooded, then dry up. It is applied to a wide variety of aquatic habitats, ranging from short-lived puddles that form in low areas after rainstorms and remain only for one to two weeks, to kettlehole basins that contain some water most of the year and usually dry up only for a month or two in midsummer.

Autumnal pool or pond fills in fall or early winter. Purists reserve the term "vernal pool" for spring-filled ponds that stay dry in fall and winter. Many of the temporary ponds in the state, although often referred to as vernal ponds, fill in fall as groundwater tables rise and remain flooded until summer and are thus autumnal ponds.

Ephemeral pool or pond is usually used to describe pools that retain water only for a short length of time, from a day or two to a week. Most commonly, ephemeral pools form after rainstorms. Sometimes the term is used to describe longer-lived pools that dry seasonally but contain water for several months each year.

Astatic waters do not dry up completely each year, but rather fluctuate dramatically in size from large, seasonally flooded basins to small permanent pools. Because the area of permanent water is small, it tends to be very low in oxygen in the summer, and may dry up in exceptionally dry years. Fish and other animals that need permanent water cannot survive in these ponds. The ponds thus function like vernal pools despite the persistence of the permanent pool. In attempting to bring more precision into the definition of these variable habitats, wetland scientists use the term "astatic (nonstable) waters" to emphasize the seasonally fluctuating water levels.

Chapter Two

LOCATING VERNAL POOLS

THE ROLE OF THE CONSERVATION COMMISSION

Conservation commissions are in an excellent position to spearhead a community effort to locate, document and verify vernal pools. Commissions are encouraged to verify information received on any documented pool and to periodically recheck pools.

Individuals can work alone or with a friend, but are encouraged to work with the town conservation commission. Talk to the town conservation commission to find out if they are involved in vernal pool documentation. The town clerk will have a list of members. Attend one of the commission's meetings (call first to be placed on the agenda). If you are working on your own, share your findings with the commission. Information you have collected is very useful.

LOCATING POOLS

A systematic search of the town for vernal pools is highly recommended. If this is not feasible, pursue vernal pool documentation on any level. All information on vernal pools is valuable.

Pools can be located by using one or any combination of the following methods:

- networking
- map work
- road work
- random traverse
- locating dry pools
- locating autumnal pools

NETWORKING

To get help and build a network of "pool scouts," put an announcement in your local newspaper or town newsletter asking for volunteers to identify vernal pools. Citizens may enjoy the opportunity to learn about this unique aspect of nature. Those who are unable to do the work themselves should be encouraged to call in to suggest likely locations. Many neighbors know of "spring pools" or "places with salamanders."

- Contact scout troops, school groups, garden clubs, sporting organizations, watershed associations or university biology departments.

- Ask a local paper or town newsletter to run a public service announcement or a story

about vernal pools. Submit such a story yourself; the local paper will probably print it. Include a request for information or partners to help you identify some pools for documentation.

MAP WORK

Many types of maps, and possibly aerial photographs, are available in town and regional offices and libraries. Depending on the purpose of the map and level of landscape detail, they may be useful in locating actual pools or, more likely, suggest areas to explore for vernal pools.

Be aware of limitations of maps and aerial photographs. Certain features will be highlighted, or conversely, less likely to show up, depending on the original purpose of the map. Since vernal pools are often small and/or isolated, a pool may not show on aerial photographs or topographic maps. Know the scale of your map. Start with maps of an area you are familiar with; it is helpful to be able to match the map with what you know of the land. Use maps to target areas or sites to field check.

On topographic maps look for contours designating depressions, wet spot symbols and small water bodies. Look for concentrations of these features. Use $7^1/_2$-minute maps for greater detail. Also look for floodplains, oxbows, remnants of old riverbeds, wetland areas associated with rivers and streams, and low-lying depressions that may collect spring runoff, snowmelt or seepage.

When examining aerial photographs, pay close attention to forested areas. Pools can be any size, but are usually small and round or elliptical shaped and may occur in clusters. A well-defined basin in an upland area may indicate a vernal pool; however, pools may occur at any elevation.

Certain features on aerial photographs make vernal pools more visible:

- leaves off of deciduous trees and shrubs
- no ice or snow cover
- spring time (pools full)
- large scale (1" = 400' to 1" = 1,000')
- color infrared is the best (and the most expensive); black and white will work.

Some problems you may encounter searching aerial photos for vernal pools:

- coverage of the town may be incomplete or out-of-date
- pools under dense conifer cover or densely vegetated with shrubs may not show up
- on black and white photos, clusters of conifers may show up as a dark spot which looks like a pool

Town offices may have:

Town Wetland Maps or Federal Emergency Management Agency (FEMA) **100-year Floodplain Maps** may be available through the town conservation commission or planning board. FEMA governs building in floodplains and provides maps of floodplain areas.

Town Aerial Photographs show the local area in large scale. They are often taken in the spring and may show locations of larger vernal pools. Be aware that aerial photos may be years or decades old and much may have changed.

Government agency maps include:

U.S. Geological Survey (USGS) Topographic Maps can be purchased from many outdoor/camping/book stores. Ask for 7$^{1}/_{2}$-minute maps, because they will show the greatest detail. Though it may be difficult to locate new pools on unfamiliar land using these maps, they do show the lay of the land, and may indicate areas to explore. Topographic maps also can be viewed online at http://www.topozone.com.

Natural Resources Conservation Service (NRCS) Maps are available for most counties and show soil types. To locate potential vernal pool sites, look for peat and "muck" soils that indicate the presence of wetlands, and for symbols for wetlands and isolated depressions. These maps are available at NRCS offices and possibly through your town office or library. (Note that the NRCS was formerly known as the Soil Conservation Service (SCS).)

U.S. Fish and Wildlife Service National Wetlands Inventory (NWI) Maps may be available at some town offices and regional planning commissions. Complete coverage of the state is available from the New Hampshire Office of State Planning and Energy Porgrams. (see p. 65) NWI maps will not identify many small vernal pools; some larger pools will appear. Wetland classes that are most likely to be associated with vernal pools include PUB (palustrine, unconsolidated bottom), PSS (shrub wetland), PFO (forested wetland).

Geographic Information Systems (GIS)
If you have access to a geographic information system (e.g., ArcView, ArcMap), many sources of information are available as spatial data layers. These layers can be requested from the University of New Hampshire Complex Systems GRANIT webpage (http://www.granit.sr.unh.edu). For a complete listing of available data layers, see the GRANIT catalog. Several layers available include topographic maps (digital raster graphics), digital aerial photographs (digital orthophoto quads), and NWI data layers.

ROAD WORK

Car cruising can be very productive on warm, rainy spring nights when migration to breeding pools is taking place. Dusk and nighttime are best. The basic idea is to drive slowly (10-15 mph) on roads that cut through good or likely habitat. Look for migrating salamanders and frogs on the first few warm rainy nights of early spring. Observe the general direction in which they are headed. Also listen for wood frog choruses. These calls do not carry very far, so this method will only locate breeding pools close to the road. Spring peepers, more widespread and easier to hear, are not indicator species, but may indeed be calling from a vernal pool. Explore that area for possible breeding pools. You can cover a lot of territory and then can return to the hot spots for more thorough searching.

This method is best done with one or more spotters accompanying the driver – for safety reasons and to avoid running over salamanders and frogs. Don't allow the excitement of seeing amphibians in the road detract from traffic safety. Pull off to the shoulder to stop. Look for oncoming vehicles before jumping out.

If you encounter a rare or unusual amphibian or reptile (see RAARP information, page 64) that has been road-killed, and are willing to collect it:

(1) place the specimen in an appropriate size jar (plastic is preferred) and fill the container with rubbing alcohol sufficient to submerge the specimen, or;
(2) place the specimen in a plastic bag, keep it cool and freeze it as soon as possible;
(3) include collection data with every specimen: date and time collected, exact location, your name, comments. Take the specimen to: Michael Marchand, N.H. Fish and Game headquarters, Concord; or Dr. James Taylor, Zoology, UNH. DO NOT send specimens through the mail.
(4) if the specimen cannot be collected, a clear photograph may be used to verify the identity of the species (see page 63).

RANDOM TRAVERSE

Pools may be encountered while checking town lands, hiking with family or on other outings. Make note of these pools to investigate yourself or pass the information along to your town conservation commission.

LOCATING DRY VERNAL POOLS

Dry pools may be found in late summer, fall and winter (in the absence of snow cover). Dry pools are more difficult to locate than flooded pools. Documentation, which primarily relies on evidence of amphibian breeding and the presence of certain invertebrates, is very difficult. If you find a possible vernal pool in the dry season, note the location for follow-up in spring.

The following characteristics may help you to notice dry pools:

- Flat topography with variability, especially depressions in the landscape. Areas with several, or a chain of, depressions have increased value as vernal pool habitat.

- Evidence of hydrology
  (1) leaves darkened by water stains or a film of sediment. You may need to brush away this season's leaves to reveal the stained layer
  (2) siltation marks or water stains on surrounding trees or vegetation
  (3) trees with buttressed trunks or stilt roots
  (4) sphagnum moss around the edge of a depression
  (5) wetland plants growing in a dry depression

- Fingernail clams dormant just below the leaf litter, in the top duff layer. These clams are whitish and smaller than a finger nail.

LOCATING AUTUMNAL POOLS

Some pools begin to refill in fall or early winter from groundwater or rain fall. Pools may be evident from a distance in the leafless landscape. Look for pools in late fall and into winter prior to significant snowfall. The silvery sheen of a frozen pool surface may indicate a vernal pool. Note the location of these pools for a spring follow-up visit.

PICK A POOL

Investigate your favorite pool (if you have one) first – it will be the easiest because you know it already, and the process will provide the experience and incentive to do more.

Public lands – particularly those with recreation, school, or other facilities – can undergo environmental degradation as a result of heavy visitation or facility expansion. Conservation lands are probably least susceptible but should be considered as well. Identification of vernal pools can ensure that these areas will be protected in the event of forestry activity or trail construction on conservation land.

Remember, even if the pool is small and isolated, documentation of its existence may help protect it. Your documentation information can be vital in convincing law makers of the need for additional vernal pool protection.

START ANYTIME, BUT SPRING IS BEST

Spring (March through May) is the easiest time of year in which to locate and document pools. In early spring salamanders are migrating, frogs are calling, courtship, mating and egg laying are occuring. In mid to late-spring, egg masses remain visible; larval salamanders and frogs (tadpoles) appear late spring into summer. Documentation is possible at other times of the year as well, but it can be more difficult.

GET PERMISSION TO LOOK FOR VERNAL POOLS ON PRIVATE LAND

In New Hampshire, privately owned open spaces have traditionally been open to public access. State law holds that individuals entering onto properties that have been subject to such public access are not guilty of trespassing. (Note, though, that it is illegal to enter on any private land in a motorized vehicle without permission from the owner.) It is wise and courteous to ask for permission of a landowner when you plan to enter property for the purpose of identifying vernal pools for documentation. **You may not enter any posted private land without first getting permission from the owners of the property.** It is recommended that you obtain permission to enter non-posted land as well.

If you wish to obtain permission to look for vernal pools on a piece of property but do not know who owns the land, you can find out through the tax assessor's office or town tax maps. Call or write to the owner or knock on the door and ask for permission to walk on

the land. Tell the landowner who you are and explain your interest in observing pools on the property. Be sensitive to the fact that some owners may not appreciate your efforts to document pools on their land.

FIND OUT ABOUT ACCESS TO PUBLIC LAND

Don't assume that permission to observe pools on public land is automatic. Some public lands are restricted – public wells and watershed lands, for example, and solid waste disposal sites, hospitals, airports, and prison properties. Wildlife refuges and parks may have restricted areas for the protection of wildlife from human disturbance. If you are unsure whether public access is permitted on public property where you wish to look for vernal pools, obtain permission from the department or organization that administers the lands on which you plan to walk.

NOTIFY THE AUTHORITIES

In many parts of the state, people routinely walk in woods and open areas; in other, more populated areas, the local police may look on such activities suspiciously. Depending on the conditions in your area, you may find it useful to notify the local police of the areas where you will be parking and/or walking. This is particularly sensible if you will be walking in the woods at night.

Notifying the police ahead of time will prevent your having to make awkward explanations to an officer some rainy night. It may be useful to put a note in your car window explaining who and where you are.

Chapter Three

SURVIVAL STRATEGIES OF VERNAL POOL ANIMALS

Because vernal pools are isolated and variable habitats, with widely fluctuating temperature and oxygen levels accompanying the seasonal appearance and disappearance of water, specialized strategies for survival are found in salamanders, frogs and invertebrates that inhabit vernal pools. Three to five months is typical for the completion of the amphibian cycle, from egg laying through metamorphosis. Invertebrates inhabiting vernal pools may complete their life cycle in less time.

Strategies of amphibians and invertebrates include:

1. Rapid growth, so eggs and larvae can complete development during the time water is present to avoid dry conditions. When metamorphosis is completed, frogs and salamanders transform from aquatic larvae into terrestrial juveniles and migrate away; adult insects fly away.

2. Certain invertebrates “wait it out” in a dormant state until the pool floods again. Fairy shrimp eggs can rest in the sediments for years until conditions are right for hatching, fingernail clams and snails aestivate – the summer equivalent of hibernation – in the mud. Caddis flies lay their eggs in the dry pool depressions in fall. The eggs withstand drying and cold until the pool floods later in the fall or in spring from snowmelt and showers. Remarkably, the young caddis flies in spring-flooded pools catch up with those in fall-filling depressions and are ready to emerge at the same time, before the pool dries up in summer.

Many species associated with vernal pool habitat, notably certain salamanders and frogs, require both aquatic and terrestrial habitat to complete their life cycle. These two habitats must be close enough to allow these species to move freely between them. Jefferson and spotted salamanders travel an average of 150 m (500 feet) to breeding pools. Though distances of almost a mile have been noted, an increase in migration distance increases the risk of predation. The aquatic habitat provided by vernal pools, though temporary, is needed for breeding and development of larvae. On completion of breeding, adults and metamorphosed juveniles leave the pools to feed and winter in nearby terrestrial habitat. Although these species actually spend a majority of their lives in a non-aquatic environment, vernal pools provide a critical component of their life cycle.

CONDITIONS AFFECTING AMPHIBIAN MIGRATION

Amphibian movements to spring breeding pools are strongly correlated with periods of high humidity or rainfall. Local conditions of temperature, precipitation, humidity and soil moisture all offer clues about when spring amphibian movements will take place in your locale.

- Look for amphibian migrations when early spring air temperatures are above 40^{F} (4^{C}).
- Arousal from hibernation is triggered by the first warm rain or substantial snow melt.
- Frogs and salamanders will migrate without rain and wet ground if temperatures (above 50^{F}, 10^{C}) and humidity (83-87%) are high enough.
- Amphibians can most readily be located and observed within 24 hours after rains.

Migration and breeding begins earlier in the south and east, later in the west and northern regions of the state. Early April is typically the time of amphibian movement, though it may occur as early as mid-March. Males head to breeding sites first, with females following a few days later. Open water may not be a prerequisite for the courtship. Spotted salamanders have been seen swimming under a thin film of ice, and wood frogs may be heard calling from pools rimmed with ice.

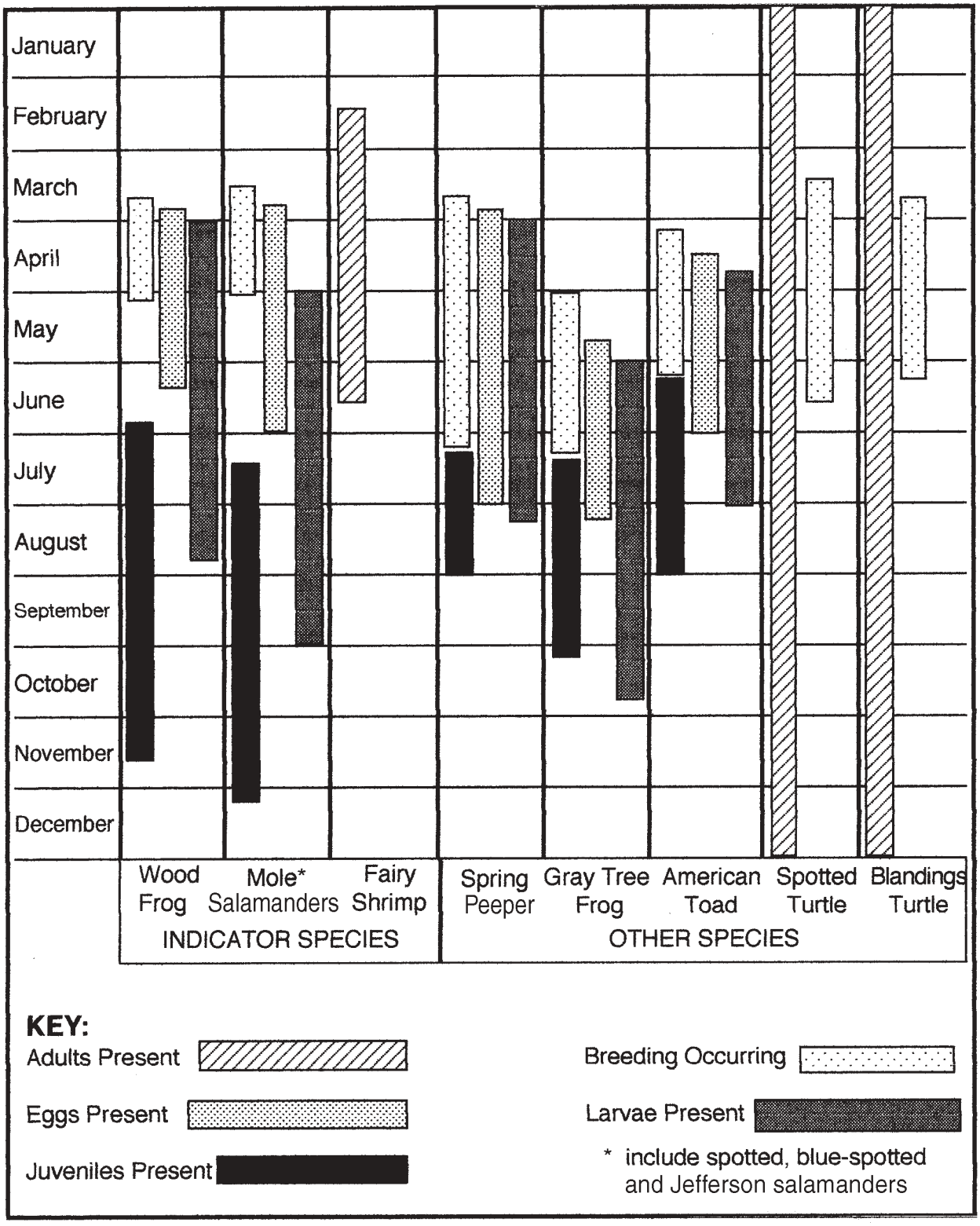
Conditions which bring a vast number of salamanders together at the same time and place are not present every year. Such assemblages have taken place during prolonged rains, permitting many individuals to reach the breeding ponds at essentially the same time. Consider yourself fortunate if you witness such a spectacle.

Migration of adult salamanders to the breeding ponds normally takes place at night, beginning soon after dark and sometimes continuing until dawn, if suitable conditions are maintained. Salamanders within a short distance of the pool may reach it the first night. Those traveling greater distances may take several nights (even under favorable conditions) or as much as two weeks if cold weather interrupts.

Favorable periods of migration occur sporadically, often widely separated by intervals of resumed wintery conditions. If night temperature falls below freezing, salamander movement is halted. Tagged spotted and Jefferson salamanders studied in Kentucky moved only during periods of late night precipitation and at temperatures above 40^{F} (4^{C}). Migration halted as rain ceased, temperatures dropped or dawn approached.

Most salamanders are nocturnal, or at least avoid direct light. During the breeding season, however, usually secretive species may be found out and about during the day. Jefferson salamanders – and likely other salamanders – rest during the day under leaves and other submerged objects in the breeding pool.

Figure 1. **VERNAL POOL LIFE THROUGH THE SEASONS**
(Timing may vary depending on environmental conditions and location.)



SEASONAL ARRIVAL OF INDICATOR SPECIES

Spotted salamanders, though the most conspicuous of the spring salamanders, are not the earliest. They are usually preceded by **Jefferson/blue-spotted salamanders** by 2 to 3 days and sometimes as much as a week. The earliest Jeffersons arrive well in advance of frog activity. Blue-spotted salamanders appear about the time wood frogs emerge from hibernation. Males normally migrate 1 to 2 days in advance of the females.

Approximately 50% of the **spotted salamanders** arrive at pools within the first 5 nights of migration; that 50% of the population will have completed their courtship activities in 7 to 10 days. The courtship of nearly the entire population will have been completed within 2 to 3 weeks. The adults then disperse from the pond and resume their fossorial (underground) lives.

Wood frogs emerge from hibernation and begin their annual migration to breeding ponds when melting snow and spring rains saturate the ground. Although **spring peepers** are more familiar as harbingers of spring, wood frogs actually appear first.

Although the onset of the breeding cycle is weather related and variable for wood frogs, its duration is relatively constant. Wood frogs are “explosive” breeders – the entire sequence of arriving, mating, egg laying and returning to the terrestrial habitat is accomplished in a very brief time. This may be as short as a week in some pools.

Wood frog calling, mating and egg-laying occur mainly in the early night hours and gradually diminish toward dawn. Calling and breeding activity often occurs during the day in undisturbed locations.

Though **spring peepers** use vernal pools, this vocally conspicuous amphibian breeds in a wide range of wetland types. The spring peeper is not a vernal pool indicator species, as is the wood frog.

See *Figure 1* for time periods species are present in vernal pools.

Chapter Four

VERNAL POOL SPECIES

INDICATOR SPECIES

INDICATOR SPECIES are those species that depend on vernal pool habitat for all or a portion of their life cycle. Though indicator species may be found in other types of wetlands or in permanent water, vernal pool habitat provides the greatest chance for successful reproduction. The invertebrates and amphibians considered to be vernal pool indicator species in New Hampshire are listed below.

CRUSTACEANS

Fairy shrimp (Order Anostraca, *Eubranchipus*, most common species)

AMPHIBIANS

Spotted salamander (*Ambystoma maculatum*)
Blue-spotted salamander (*Ambystoma laterale*)
Jefferson salamander (*Ambystoma jeffersonianum*)
Marbled salamander (*Ambystoma opacum*)
Wood frog (*Rana sylvatica*)

FACULTATIVE SPECIES

FACULTATIVE SPECIES are those species that use vernal pools, yet are not dependent upon them for breeding. These organisms are capable of successfully reproducing and completing their life cycles in various permanent aquatic habitats, including swamps, marshes, streams, ponds, and lakes. The species considered to be vernal pool facultative species in New Hampshire are listed below.

CRUSTACEANS

Clam shrimp (Orders *Spinicaudata* and *Laevicaudata*)
Isopods (Order *Isopoda*)
Amphipods (Order *Amphipoda*)

MOLLUSCS

Fingernail clams *(*Order *Venerioda)*
Amphibious snails (Order *Basommataphora*)

INSECTS

Caddis flies (Order *Trichoptera*)

AMPHIBIANS

Four-toed salamander (*Hemidactylium scutatum*)

Eastern newt (*Notophthalmus viridescens*)
Spring peeper (*Pseudacris crucifer*)
American toad (*Bufo americanus*)
Gray treefrog (*Hyla versicolor*)
Green frog (*Rana clamitans*)

REPTILES

Spotted turtle (*Clemmys guttata*)
Blanding's turtle (*Emydoidea blandingii*)
Wood turtle (*Glyptemys insculpta*)
Painted turtle (*Chrysemys picta*)
Snapping turtle (*Chelydra serpentina*)

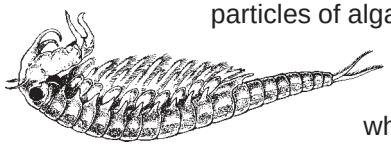
VERNAL POOL SPECIES PROFILES

Indicator species are completely dependent on vernal pools during the aquatic phase of their life cycles, typically during the egg and/or larval stages. These pools also may be utilized by other less specialized species. Characteristics of the terrestrial habitats surrounding pools and breeding pools that are needed by each organism are described below. A brief description of each organism, including its current known distribution and status in New Hampshire is included as well. Data on distribution is constantly being collected and updated through the Reptile and Amphibian Reporting Program (RAARP) and other various sources. Contact N.H. Fish and Game for updates.

*Indicates species is a vernal pool indicator.

CRUSTACEANS

FAIRY SHRIMP*



Description: Free-swimming filter feeders. They are omnivorous, eating such things as particles of algae and small crustaceans. To optimize food consumption, fairy shrimp feed while on their backs, rhythmically filtering the water with their legs as they swim. The different species of fairy shrimp vary somewhat in size, color, and shape. Observable characteristics include: delicate, transparent, elongated body; no carapace (shell-like covering); swim with their legs up; 11 pairs of leaf-shaped swimming legs; pair of compound eyes on stalks; long tail, sometimes with "neon" spots near the tip; generally brown, orange, or red in color.

Size*:* Range in length from 1.25-2.5 cm (0.5 to 1.0 in). Large compared with many other swimming invertebrates.

Distribution and Status: The common fairy shrimp *(Eubranchipus vernalis)* is locally abundant. Though widespread geographically, fairy shrimp are generally restricted to vernal pools on a seasonal basis. Their temperature tolerance is limited to about 4-15° C (40-60° F). Other factors potentially affecting their distribution include water chemistry, hydrology, and presence of algae in the spring.

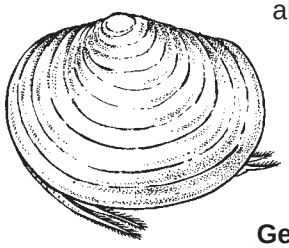
General Habitat: Inhabit small, often temporary ponds, particularly in cold water. They

are among the most characteristic inhabitants of vernal pools, especially in spring and early summer.

Life History: Fairy shrimp appear soon after spring thaw. Following breeding, the egg sacs are carried by one of the parents. The adults live for only a short time thereafter, usually dying simultaneously with the drying of the pool. At death, the resistant eggs are freed from the parent and remain on the pond bottom. Flooding of the pool the following year stimulates emergence from the egg.

CLAM SHRIMP

Description: Bivalve carapace which consists of two articulated parts joined by either a fold (*Limnadia* spp.) or a true hinge (*Lynceus* spp.). The carapace is semi-translucent allowing for a slightly obscured internal view. In the Limnadia species of clam shrimp, external rings are visible on the carapace, but are absent in *Lynceus* species.



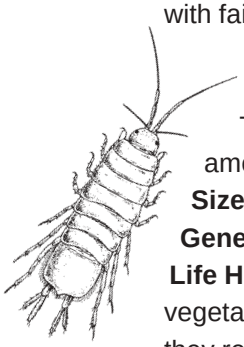
Size*:* Carapace approximately 10 mm (3/8 in).

Distribution and Status: Little is known about the occurrence and distribution of clam shrimp in New Hampshire.

General Habitat: Limited to ephemeral waters. Certain species (*Limnadia*) are typically found in ephemeral waters that are merely tiny pools in grassy depressions or rock crevices. Other species (*Lynceus*) are more likely found in large pools in upland woodland areas or in river flood plains.

ISOPODS

Description: Isopods can be described as aquatic sowbugs (pill bugs). Often confused with fairy shrimp, but can be distinguished by their distinctive dorsoventrally compressed appearance (narrow when viewed from the side). Their brown to light gray bodies have numerous segments, with both first and last segments being the largest. They are poor swimmers, preferring to use their seven pairs of legs to crawl among the decaying vegetation on the pool bottom.



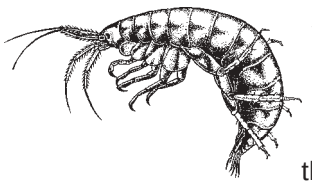
Size*:* Extremely small, rarely exceeding 15 mm (1/2 in).

General Habitat: Found in virtually every type of aquatic habitat.

Life History: Isopods feed on such things as dead and dying leaves and other aquatic vegetation. These tiny detritivores are a crucial part of vernal pool ecology. Not only do they remove dead animal and plant material, but also, by processing large plant material into smaller particles, they increase colonization of algae and fungus thereby providing nutritious food for developing frogs.

AMPHIPODS

Description: Commonly known as scuds or side-swimmers. Often confused with fairy shrimp, but can be distinguished by their distinctive laterally compressed appearance (narrow when viewed from the top).



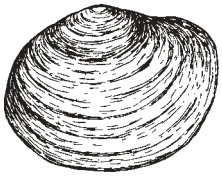
Size*:* Extremely small, ranging in size 5 mm (less than ¼ in) to 15 mm (1/2 in).

General Habitat: Found in virtually every type of aquatic habitat.

Life History: These omnivore-detritivores spend much of their time among the decaying leaves and vegetation on the bottom of vernal pools.

MOLLUSCS

FINGERNAIL CLAMS



Description: These small bivalve molluscs also are referred to as pea or pill clams. The different species of fingernail clams are difficult to identify. Some species are quite variable, having no clear diagnostic features.

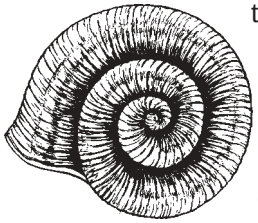
Size: Less than 2.5 cm (1 in) in length.

Distribution and Status: Occur in a variety of aquatic habitats, including lakes, ponds, streams, and vernal pools. Only one species, *Sphaerium occicentale*, is an inhabitant of woodland pools. It is currently found in Massachusetts and likely in New Hampshire.

Life History: Certain species are highly adapted to living in vernal pools, capable of surviving in essentially dry pool beds for several months without apparent loss of viability.

Verification: Empty shells found in dry pool beds can be collected and submitted along with other information on the pool being documented.

AMPHIBIOUS SNAILS



Description: Shells come in a variety of shapes that are usually brown in color. They breathe air and are typically seen hanging upside down at the surface of pools with their "lung" opening exposed to the atmosphere. Adults graze on algae as well as decaying plant and animal matter.

Size: Range from 0.5-5 cm (0.25-2 in).

General Habitat: Occur in vernal pools, ponds, streams, and floodplains.

Life History: The snails emerge from the mud when flooding occurs. Small clusters of jelly-like eggs are laid on vegetation and other materials in the pools. When the pool dries up, the snails burrow into the mud on the pool bottom and emerge when the pool refills.

Verification: Empty shells found in dry pool beds can be collected and submitted along with other information on the pool being documented.

INSECTS

Other aquatic insects, such as dragonflies, damselflies, predaceous diving beetles, giant water bugs, whirligig beetles, backswimmers, water boatmen, midges, phantom midges, and mosquitoes, are common in ponds throughout the state but can be found in vernal pools as well.

CADDIS FLIES

Description: Adults resemble small brown moths. Larvae look similar to a white caterpillar with three pairs of legs. Their heads range in color from plain brown to a striking black stripe pattern. The larvae construct tubular cases out of grass, dead leaves, or twigs. These cases look like small sticks or miniature log cabins crawling along the pool bottom.

Distribution and Status: Found statewide in lakes, ponds, streams, rivers, and vernal pools.

Life History: Adult caddis flies lay their eggs in dry depressions of vernal pools or on overhanging vegetation during the fall months. When the pool is flooded in early spring, the larvae emerge from the egg mass. The larvae graze on algae, vegetation, and

decaying plant and animal matter. However, some species are predaceous, consuming salamander eggs. In the early stages, larval cases are less than 0.5 cm (0.25 in) long. But as the larvae proceed through their five molts, the cases can reach lengths of 1-4 cm (0.5 -1.5 in). After the fifth molt, the larvae glue their cases to vegetation and pupate. At the end of pupation, the metamorphosed adults leave their cases and fly away. As summer approaches, adult caddis flies settle into tree holes or caves where they then enter a state of inactivity.

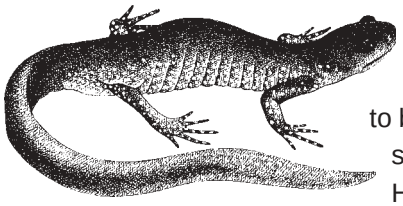
Verification: Empty shells found in dry pool beds can be collected and submitted along with other information on the pool being documented.

AMPHIBIANS

JEFFERSON SALAMANDER*

Description: Dark brown or gray-brown body flecked with white or pale blue and gray vents. Jefferson salamanders are difficult to distinguish from blue-spotted salamanders and hybrids of the two.

Size: Typically 10-18 cm (4-7 in).


ABIGAIL RORER

Distribution and Status: In New Hampshire, the Jefferson salamander is confirmed only from the Keene-Winchester area. Therefore, it is assumed that salamanders with blue spots are most likely to be either blue-spotted salamanders or hybrids of the two. Jefferson salamanders are listed as a Species of Special Concern in New Hampshire.

Terrestrial Habitat: Inhabitant of deciduous woods, favoring pools in comparatively undisturbed, well-drained upland woods. When not breeding, spend most of their time underground. May move up to 625 m (2050 ft) from breeding areas, but travels of 130 m (450 ft) are probably more common.

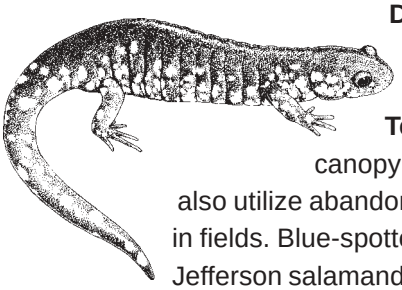
Breeding Pool: Breeds in late March or April in pools lacking fish.

Special Note: The Jefferson/blue-spotted salamander complex is a group that includes the Jefferson salamander, the blue-spotted salamander, and some very unusual hybrids. Distinguishing between hybrids and pure species usually requires special laboratory techniques. Due to this difficulty, it is recommended that you identify salamanders with blue spots as belonging to the Jefferson/blue-spotted salamander complex.

BLUE-SPOTTED SALAMANDER*

Description: Dark blue or blue-gray in color, with distinct bluish spots and black vents. The head is narrow and tapers to a rounded snout.

Size: Ranges in size from 10-12.7 cm (4-5 in).


ABIGAIL RORER

Distribution and Status: Recorded in southeastern part of the state, with one record in northern New Hampshire. Hybridizes with Jefferson salamander.

Terrestrial Habitat: Generally associated with hardwoods with ample canopy cover, deep uncompacted leaf litter, and coarse woody debris. Will also utilize abandoned beaver flowages, anthropogenic (man-made) pools, and ponds in fields. Blue-spotted salamanders tend to be more tolerant of open habitat than Jefferson salamanders.

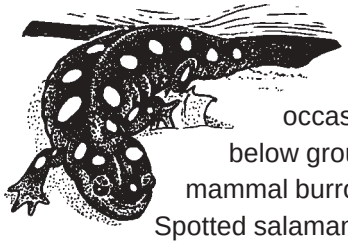
Hibernation: Seek winter cover in mammal burrows.

Breeding Pool: Favor pools with overhanging bushes and grass, sphagnum moss along the edges, and leafy bottoms. Water depth seldom reaches greater than 40 cm (15 in).

SPOTTED SALAMANDER*

Description: Black or gray with up to 50 conspicuous yellow spots arranged in an irregular row on each side of its back. Undersides are lighter, typically slate gray in color.

Size: The largest of our mole salamanders, reaching lengths exceeding 20 cm (8 in).



Distribution and Status: Found throughout the state, but distribution appears sparse due to lack of occurrence information.

Terrestrial Habitat: Most abundant in deciduous and mixed forests, but occasionally utilize pools in open fields. The majority of their time is spent below ground, seeking refuge under leaf-litter, coarse woody debris, or in small mammal burrows. Do not appear to persist in highly disturbed, cleared regions. Spotted salamanders probably travel an average of 120 m (400 ft) from breeding areas to uplands, but may travel over 250 m (800 ft).

Hibernation: In upland forests, most commonly below ground in small mammal burrows or holes created by tree roots.

Breeding Pool: Prefer to breed in temporary to semi-permanent vernal pools free of fish populations, but will utilize such aquatic habitats as beaver flowages and anthropogenic pools. Pools used exclusively by spotted salamanders tend to warmer, less turbid waters located in more open sites than those used exclusively by blue-spotted/ Jefferson salamanders.

MARBLED SALAMANDER*

Description: Relatively chunky salamander with dark body and silver or white crossbands along the back. Markings are gray in females and white in males.

Size: 9-10.5 cm (3.5-4 in).

Distribution and Status: A marbled salamander has been sighted only twice in New Hampshire, once in Milford and once in Hollis. Marbled salamanders are listed as endangered in New Hampshire.

ABIGAIL RORER

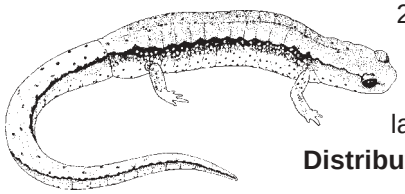
Terrestrial Habitat: Utilize a variety of habitats ranging from floodplain forests to mixed deciduous woodlands with well-drained sandy soils. In the summer can be found under rocks and logs. May move up to 200 m (650 ft) from breeding areas.

Hibernation: Deep burrows.

Breeding Pool: Marbled salamanders are unusual in that they lay their eggs during the fall, in the hollow of a dried-up spring pond. The female will remain with the eggs until rains fill the pool and the larvae hatch.

FOUR-TOED SALAMANDER

Description: Brown or chestnut back and is easily identified by three distinguishing features: 1) four toes on their hind feet; most salamanders have five 2) the tail has a distinct constriction at the base and 3) the belly is bright white speckled with black spots.



ABIGAIL RORER

Size: Males reach 5-7 cm (2-3 in) in total length, females slightly larger.

Distribution and Status: Likely to be found throughout the state south of

the White Mountains where appropriate habitat is found. May be under-reported due to its secretive habits.

Terrestrial Habitat: Adults are terrestrial, residing in undisturbed or mature deciduous forests adjacent to peatlands or moss-dominated depressions.

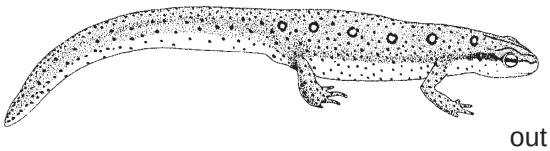
Hibernation: In decaying root stems of trees.

Breeding Pool: Utilize small ponds and slow-moving streams where abundant sphagnum or other mosses are present. Pools with islets of moss and associated logs are most often used as nesting sites. Their nests are situated so larvae will fall directly into the water upon hatching.

Special Note: The conspicuous constriction at the base of the tail marks a specialization that allows the tail to easily detach when snared by a predator. The tail will continue to twitch for several minutes after breaking off.

EASTERN NEWT

Description: Aquatic adults have red spots encircled with black on a greenish or olive back and have a yellow belly. The immature terrestrial stage is known as the “red eft” commonly seen on the forest floor.



ABIGAIL RORER

Size: 7-10 cm (3-4 in)

Distribution and Status: Most common salamander found in lakes, streams, ponds, and marshes throughout the state.

Terrestrial Habitat: Associated with ponds in woodlands, field, orchards and mountains. Occasionally found in gravel pits, quiet areas of streams and shallow areas of lakes.

Hibernation: Adults may overwinter on land or in permanent ponds.

Breeding Pool: Utilizes permanent water including lakes, ponds, marshes, and slow-moving streams as well as vernal pools. Aquatic adults can be a serious predator on eggs and larvae of many salamanders and other amphibians. Typically associated with deeper pools in open areas.

Special Note: Larval, eft, and adult stages of eastern newts produce noxious skin secretions which help deter most predators.

WOOD FROG*

Description: Light tan to dark brown body. It has a conspicuous dark “mask” extending from each eye back to the tympanum. A dark line of the same color typically runs from the front of each eye to the snout.

Size: Medium sized, ranging from 3.7 to 7 cm (1.5-3 in). Females are larger than males.

Distribution and Status: Widespread throughout the state.

Terrestrial Habitat: During the non-breeding season, Wood frogs inhabit deciduous or softwood forests, wooded wetlands, bogs, and along vegetated pond and lakeshores. Terrestrial habitats utilized may be a considerable distance from breeding pools, more than 1000 m (3,280 ft) in some instances.

Hibernation: Under leaf litter or shallow burrows near the surface of the ground.

Breeding Pool: Pools usually in or near wooded areas are used as breeding sites. Breeding may also take place in grassy ditches, cattail marshes, old gravel pits, or hollows in alder thickets flooded by spring rains.

Special Note: The call of the wood frog sounds remarkably like a bunch of ducks quacking.

SPRING PEEPER

Description: Color-variable from dark to light brown. A darker cross marking usually appears on its back. Toes have round disks on their tips.

Size: Smallest of New Hampshire's treefrogs, reaching 1-3 cm (0.75-1.25 in).

Distribution and Status: Widespread throughout the state.

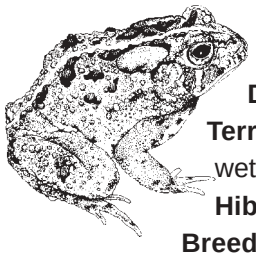
Terrestrial Habitat: Found in deciduous, coniferous, and mixed woodlands, with some preference for brushy, second-growth areas.

Hibernation: On land under moss and leaves during late November until January or early spring.

Breeding Pool: Utilize a variety of ponds, pools, marshes and swamps as breeding sites.

Special Note: The peep of the spring peeper is one of the loudest known animal sounds. It is equivalent to the roar of a motorcycle 25 feet away.

AMERICAN TOAD



ABIGAIL RORER

Description: Dry, warty skin in varying shades of browns, grays, and greens. Dark, irregular patches of black mark their backs with one or two warts occurring within these patches. Chest and bellies are mottled black.

Size: Lengths of 6-11 cm (2-5 in).

Distribution and Status: Widespread throughout the state.

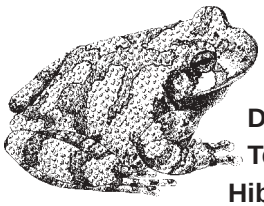
Terrestrial Habitat: Occur in a variety of forested and open habitats, uplands, and wetlands.

Hibernation: In burrows underground 30 cm (12 in) deep.

Breeding Pool: Open shallow waters including vernal pools, ditches, old beaver flowages, anthropogenic ponds with sparse vegetation, and coves of large lakes.

Special Note: The large parotoid gland behind the eye produces noxious toxins that help deter any potential predators.

GRAY TREE FROG



ABIGAIL RORER

Description: Skin glandular, almost warty. Color is extremely variable, ranging from off white to green, gray, or brown. Bright patches of orange or yellow are hidden on the underside of the hind legs. Recently metamorphosed juveniles are an emerald green. Tips of their toes are modified into suction disks for climbing.

Size: 3-5 cm (1.5-2 in).

Distribution and Status: Found throughout the state except in the far north.

Terrestrial Habitat: Appear in forested areas near shallow water.

Hibernation: Under tree roots or leaves.

Breeding Pool: Vernal pools, permanent water, and swamps are used as breeding sites.

Special Note*:* Gray treefrogs have the ability to change color from light gray to pale green.

GREEN FROG

Description: Range in color from green to brown and may have dark spots or mottling. A feature that distinguishes it from the bullfrog is a pair of prominent dorso-lateral ridges extending from the tympanum along the back, which bullfrogs lack.

Size: 5.5-12.5 cm (2.5-4 in) in length.

Distribution and Status: Common throughout New England.

Terrestrial Habitat: Adults live either in or adjacent to waterbodies. They are associated with moist woodlands and a variety of wetlands from shores of ponds, streams, and lakes.

Hibernation: Underground or under the water from October through March.

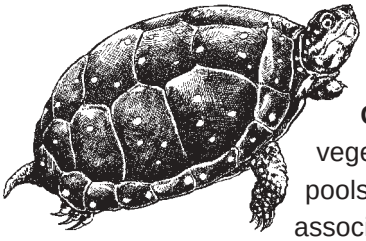
Breeding Pool: Shallow waters of ponds and lakes as well as permanent streamside pools are the preferred nesting sites. Although vernal pools are not used as breeding sites, they are often frequented throughout the season.

REPTILES

SPOTTED TURTLE

Description: Primarily aquatic but are often seen basking on floating matter or on shore. They have smooth dark shells with yellow spots. Number and arrangement of spots varies considerably among turtles and may be lacking all together.

Size: Small turtles that range in length from 8.75 –11.25 cm (3.5 -5 in).



Distribution and Status: Seems to be largely limited to southeastern New Hampshire. Spotted turtles are listed as Species of Special Concern in New Hampshire.

General Habitat: Inhabit small shallow wetlands surrounded by dense vegetation. These wetlands may include slow streams, ponds, vernal pools, bog ponds, and wet meadows. Shrub swamps and tussock marshes associated with red maple swamps appear to be preferred habitat.

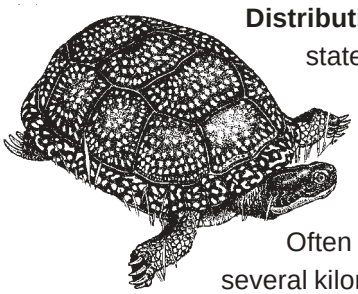
Hibernation: Under tree root balls in vernal pools, forested wetlands, scrub-shrub wetlands, or emergent wetlands.

Special Note: Vernal pools are important to spotted turtles and in some areas this species may be dependent on them. Pools serve as centers in which adults congregate, feed and breed. They may be of especially important to gravid (pregnant) females, providing a source of refuge and concentrated food.

BLANDING'S TURTLE

Description: Distinct bright yellow chin and throat. Their dark, highly domed shells are flecked with small yellow markings.

Size: Length 17.5-22.5 cm (7-9 in).



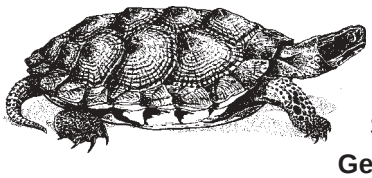
Distribution and Status: Occurs in low numbers in the southeastern part of the state, but has been observed in Holderness and Hancock. Blanding's turtles are listed as Species of Special Concern in New Hampshire.

General Habitat: Semi-aquatic, utilizing intermittent woodland pools and acidic bogs. They appear to favor black (dark) waters found in close proximity (within several hundred meters) to buttonbush pools. Often makes extensive travels among wetland and upland habitats, up to several kilometers.

Vernal Pool Usage: If a vernal pool occurs within the activity range of a Blanding's turtle, it may be heavily used, even as hibernation sites. Vernal pools appear especially important to sub-adults who prefer their characteristically shallower, more vegetated waters. Males and females can be found in vernal pools together during courtship and mating seasons, generally April, May, and early June. Mating has been documented in emergent marshes within scrub-shrub and forested wetlands. Gravid females also may use vernal pools as 'stepping-stones' to reach distant nesting grounds.

WOOD TURTLE

Description: Brown upper shells (carapaces) which appear sculptured or rough. Plastrons are yellow with black blotches and the skin on neck and foreleg is a reddish orange.



Size: Reach lengths of 13-23 cm (5-9 in).

Distribution and Status: Found throughout the state, but not common in any one location. Wood turtles are listed as species of Special Concern in New Hampshire.

General Habitat: Associated with sandy-bottomed streams and rivers, dense thickets in riparian areas, and adjacent meadows.

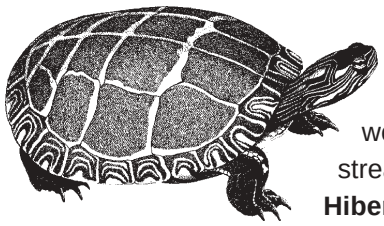
Hibernation: Occurs at the bottoms of streams or rivers.

Vernal Pool Usage: Vernal pools are used extensively during the spring and summer months for feeding.

PAINTED TURTLE

Description: Distinguished by a smooth black or olive carapace, a colorful red margin where the carapace and plastron meet, and a red and yellow striped head and neck. The plastron has no markings and is pale yellow or orange.

Size: Generally 11-15 cm (4-6 in) in length.



ABIGAIL RORER

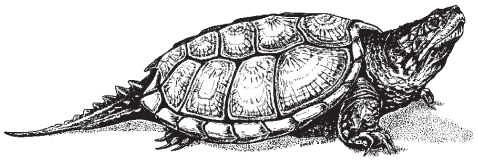
Distribution and Status: Common throughout the state, especially south of the White Mountains.

General Habitat: Utilize shallow, muddy-bottomed ponds, marshes, woodland pools, river, lakeshores, wet meadows, bogs, slow-moving streams, and vernal pools. Often bask on hummocks, logs or rocks.

Hibernation: Burrows into mud or decayed vegetation of pond bottoms.

SNAPPING TURTLE

Description: Shell is deeply serrated and ranges from light gray to black in color, but may appear green due to a dense growth of algae. Their heads are large with a strongly hooked beak. Their tails are long and strongly saw-toothed.



Size: New Hampshire's largest freshwater turtle, reaching lengths of up to 20 inches, but typically 20-30 cm (8-12 in).

Distribution and Status: Common throughout the state, especially south of the White Mountains.

General Habitat: Adults are almost wholly aquatic, commonly found in lakes, swamps, marshes, and vernal pools. Often bury themselves in leaves or mud bottoms, waiting for prey.

Hibernation: In mud or debris in lake bottoms, banks, and muskrat holes.

STATE PROTECTED SPECIES

Certain species of turtles are protected in New Hampshire. State law prohibits taking, possession and importation of Blanding's, spotted, Eastern box, and wood turtle (RSA 212-A). Marbled salamanders are listed as State Endangered in New Hampshire and therefore protected from export, sale, possession, and take. To document the presence of these species, a photograph can be submitted with the vernal pool documentation forms. These species should then be immediately released where captured.

Chapter Five

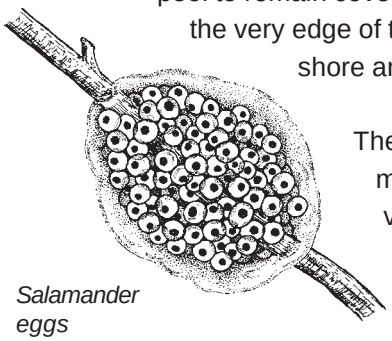
EGGS AND LARVAE OF VERNAL POOL SPECIES

EGGS OF VERNAL POOL AMPHIBIANS

Egg masses of salamanders and wood frogs can be readily distinguished from one another, differing in form and size. Wood frog eggs lack a surrounding gelatinous capsule; they have an unconsolidated shapeless form. Salamander eggs are surrounded by a common gelatinous envelope, with individual eggs visible inside the envelope.

Egg masses of salamanders and wood frogs are laid in the water and are often associated with shrubs, or submerged sticks or logs in a pool. Eggs may be attached to a vertical or horizontal support or hung from the drooping leaves of grasses, sedges or cattails.

When looking for egg masses in early spring, remember they must be far enough into the pool to remain covered by water for a couple of months; they will not usually be found at the very edge of the pool. Generally, salamander egg masses will be within 10 feet of shore and less than two feet below the water surface.



Salamander eggs

The color of the jelly matrix of salamander eggs varies from clear to milky white, or green from symbiotic algae. Each of these color variations is normal. The egg mass has a consistency similar to jello.

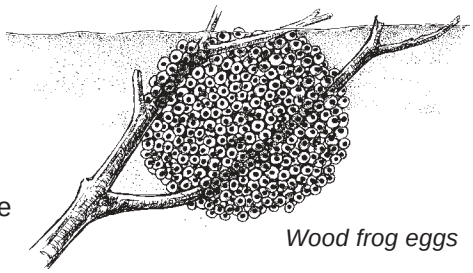
You may find: clear egg masses, where the dark embryos are clearly visible through the jelly matrix; intermediate or grey egg masses where embryos are faintly discernible in a cloudy or grey jelly matrix; or white egg masses where the outer egg jelly is so opaque that embryos are barely discernible, at least during the early stages of development. This polymorphism is caused by the presence or absence of white crystal in the outer jelly layer. (White embryos are not viable).

As the eggs develop the mass may become greenish. In both salamander and wood frog eggs an algae *(Oophilia ambystomatis)* is found within the inner jelly capsules of egg masses. During development, the embryos are supplied with oxygen by the alga. The alga draws nourishment from the embryo and gives the egg mass a pale greenish color.

The approximate time since laying can be judged by the superficial appearance of the egg mass – small masses, where little swelling has occurred and where the embryos are close together, are younger.

Water temperature is a prime factor in determining hatching period of amphibian eggs. One to two months is typical in the northeast when temperatures are 50^{F} (10^{C}) or above.

Salamander eggs hatch a few at a time, as the outer ones develop more rapidly, probably because they receive more light. After escaping the individual egg jellies, the hatchling larvae swim for a few hours within the outer jelly of the mass. In frog egg masses, eggs in the center of the mass tend to hatch first. Frog eggs are darker than salamander eggs, so the mass absorbs heat better, with the eggs in the middle of the mass being the warmest.



Wood frog eggs

Egg masses may be subjected to intense predation by larval caddis flies. At night, predators such as adult eastern newts may be found on salamander egg masses, walking on the surface of the mass and snapping at the eggs.

Salamander eggs tolerate a pH range of 6 to 10 with best hatching success at pH 7 to 9. High embryo mortality has been noted in temporary pools with pH below 6.

WOOD FROG EGGS

- Breed in cold water, have compact submerged egg masses which provide protection from cold, desiccation and freezing.

- The clear jelly capsules surrounding the eggs expand by water absorption and the globular clutch soon attains several times its initial size. An average individual clutch measures 6 to 10cm (2.5 to 4 in) in diameter and contains about 1,750 eggs.

- Individual egg masses are tennis-ball sized and shaped. They are attached to twigs that are just below the surface of the pond.

- Isolated individual clutches are occasionally seen, but most are deposited in large communal masses, which are often confined to a single area of the pool and may consist of more than 100 clutches. Communal deposits look like a lumpy sheet.

DIFFERENCES IN MOLE SALAMANDER EGGS

- Spotted, Jefferson and blue-spotted salamanders are known as mole salamanders.

- It may be difficult to distinguish Jefferson and blue-spotted salamander eggs. The literature does note some differences. Simply list them as eggs of the Jefferson/blue-spotted salamander complex.

- Eggs of the spotted salamander are more closely aggregated than those of the Jefferson salamander and the average number to the mass much larger.

- The outermost jelly covering spotted salamander eggs is much thicker and denser than that of the Jefferson salamander, and the outer surface smoother, as it does not follow the contour of the individual eggs.

SPOTTED SALAMANDER EGGS

- The egg mass is attached to sticks, weeds, grass, stems or reeds in quiet or slowly running water. Usually within 20-25 cm (8-10 in) of the surface, occasionally much deeper.

- Each mass may contain 250 eggs, but 100 to 150 is typical. Immediately after deposition, the mass is 6 to 7.5 cm (2.5 to 3 in) in diameter, but it quickly absorbs water and expands to over 10 cm (4 in).

- Total complement may be deposited in several small masses or limited to one to two large ones.

- Individual eggs are 2.5 to 3 mm ($^1/_{10}$ in) in diameter, with the upper pole dark brown or grey and lower pole dirty white or dull yellow.

- Consistency of the outer jelly sheath is firm.

- Incubation period is 31 to 45 days or more, depending on the water temperature.

JEFFERSON SALAMANDER EGGS

- One to 2 days after mating, females deposit eggs at night (during the day if conditions are cloudy and rainy) on submerged branches, aquatic plants or tree limbs dipping into the water.

- Eggs are deposited in small masses (average number of 16, vary from 1 to 60) in an amber or clear matrix.

- Egg mass is an elongated sausage-shaped mass that is attached to underwater twigs, fern fronds, grasses, sedges or submerged leaves.

- Egg masses are generally concentrated toward the outer perimeter in sunny location of pool.

- Consistency of the egg mass jelly is less firm than the spotted salamander mass.

- Eggs hatch in 30 to 45 days.

BLUE-SPOTTED SALAMANDER EGGS

- Number of eggs per mass highly variable, normal range 6 to 30. Attached to stems and twigs or to leaves on pool bottoms. Consistency of matrix looser than jello.

- Eggs are only slightly adhesive, they fall to the bottom singly or cling lightly to vegetation in loose groups of 2 to 8. The large, clear, jelly capsule makes them virtually invisible in the water.

Figure 2. **CHARACTERISTICS OF EGGS OF AMPHIBIANS USING VERNAL POOLS**

INDICATOR SPECIES			
	WOOD FROG	**SPOTTED SALAMANDER**	**BLUE-SPOTTED/ JEFFERSON SALAMANDER COMPLEX**
Size of mass	6-10 cm (2.5-4 in) often deposited communally	variable in size, to 10 cm (1 in to over 4 in)	variable size
Number of eggs per mass	approx. 1,000 eggs per mass	50-125, average 125	highly variable, 6-30 (blue spot.)/1-60, average 16 (Jeff.)
Shape of mass	individual mass, ball shaped. communal deposits like a lumpy sheet	globular to oval	small, loose, scattered groups. May be cylindrical or sausage-shaped
Color of mass	clear, becoming green	clear, milky or green	clear or clouded with sediment film
Attachment	twigs and stems	usually sticks and stems, also sedges	submerged branches, stems and leaves
Depth	just below the surface	20-25 cm (8-10 in) or more below surface	20-25 cm (8-10 in) below surface to on or near bottom
Incubation period	about 3 weeks	4-8 weeks	3-5 weeks

OTHER SPECIES					
	EASTERN NEWT	**FOUR-TOED SALAMANDER**	**SPRING PEEPER**	**GREY TREEFROG**	**AMERICAN TOAD**
Size of mass	single eggs deposited	variable	single eggs deposited	up to 10x12 cm (4 in x 5 in)	up to 1 m (3 ft) long
Number of eggs per mass	80-450 per female	22-64, average 50. may nest communally	900 per female	10-40	thousands
Shape of mass	n/a	irregular	n/a	flattish mass or surface film	long parallel spiraling strings
Color of mass	n/a	--	n/a	--	transparent, later cloudy as silt and algae adhere
Attachment	aquatic vegetation	in cavities on underside of logs or within clumps of moss or grass	submerged vegetation	loosely attached to vegetation at surface	sometimes threaded through vegetation
Depth	--	directly over a pool	--	at or near surface	on open bottom
Incubation period	about 4 weeks	6-8 weeks	about 6 days	3-5 days	3-12 days

- Females lay eggs in a series of gelatinous masses at the bottom of the pond.

FOUR-TOED SALAMANDER EGGS (not an indicator species)

- This salamander does not lay its eggs in the water. Egg clusters are deposited directly over a pool, in cavities on the underside of logs or within clumps of grass, sphagnum or other mosses.

- Size of egg mass is variable, averaging 50 eggs.

Characteristics of Eggs of Amphibians Using Vernal Pools (Figure 2) provides additional information about eggs of indicator species and other amphibians which may be encountered in vernal pools.

LARVAL AMPHIBIANS

Larval amphibians inhabiting vernal pools are in a race against time – a race against evaporation of the pool. In dry years, many larvae may not grow fast enough to metamorphose before the pool dries. In drought years no larvae may survive. To overcome this, vernal pool amphibians have an early breeding season, prolonged embryo development and rapid larval growth.

Figure 3. **CHARACTERISTICS OF SALAMANDER AND FROG LARVAE**

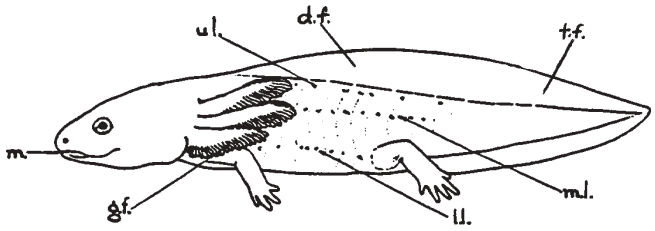


Fig. 3a. Salamander larva; ***m.***–mouth; ***g.f.***–gill filaments; ***t.f.***–*tail fin;* ***d.f.***–dorsal fin; ***u.l.***–upper row of lateral line organs; ***m.l.***–middle row of lateral line organs; ***l.l.***–lower row of lateral line organs.

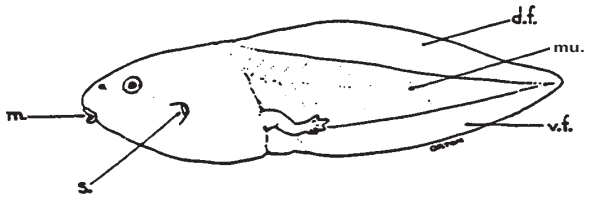


Fig. 3b. Frog tadpole; ***m.***–mouth; ***s.***–spiracle; ***d.f.***–dorsal fin; ***v.f.***– ventral fin; ***mu.***–muscular part of tail.

Used by permission: Biological Survey of the Connecticut Watershed. 1939. Survey Report #4. N.H. Fish and Game Dept.

FROG LARVAE

Frog larvae are commonly known as tadpoles or polliwogs. When first hatched, tadpoles hang from their eggs or nearby vegetation by an adhesive disk appendage on their head. Within a few days the gills cover over and the head and body swell. A tadpole uses its tail to propel itself through the water. The hind legs grow first, then front legs. (Fig. 3b)

A tadpole spends most of its active time feeding. Tadpoles are suspension feeders, they eat primarily plankton and bacteria. Food is ingested as the tadpoles swim or root around on leaf litter to dislodge debris.

WOOD FROG LARVAE (TADPOLES)

Newly hatched larvae or tadpoles measure 7-9mm (less than 1/2 in) in length. As they grow, their color lightens from velvety black to a mottled olive-brown.

Newly hatched tadpoles hang motionless alongside the rapidly deteriorating egg mass. Within a few days they are capable of rapid escape movement. When disturbed, they disappear into the leaf litter or underwater vegetation.

Metamorphosis occurs from late May to mid-August. Transforming juveniles are faithful miniatures of the adults regarding color and marking. Large numbers of tiny frogs – less than 10-12mm (1/2 in) – congregate under shore litter and vegetation before dispersing into surrounding terrain.

AMERICAN TOAD LARVAE (TADPOLES)

Toad larvae or tadpoles are oval (broader near the vent than near the eyes). There is a rounded end to the tail.

Toad tadpoles often congregate in schools – which confuses predators and stirs up bottom detritus to suspend food particles in the water.

SALAMANDER LARVAE

Salamander larvae have bushy gills; a caudal (tail) fin which continues on to the back as a dorsal fin; and tiny legs. The prominent ruff of gills readily distinguish salamander larvae from frog larvae. (Fig. 3a).

The different species of salamanders can have confusingly similar larvae. Many of the physical characteristics overlap. **Some salamander larvae may not be identifiable to species, especially blue-spotted, Jefferson and their hybrids.** Also, recently hatched larvae of many salamander species differ markedly from older ones.

The size at which salamander larvae transform varies from year to year, depending on the conditions in the breeding ponds – such as whether or not the ponds are drying, the abundance of food and water temperature. Competitive interactions within the pool may

Figure 4. **CHARACTERISTICS OF LARVAL AMPHIBIANS USING VERNAL POOLS**

INDICATOR SPECIES			
	WOOD FROG	**SPOTTED SALAMANDER**	**BLUE-SPOTTED/ JEFFERSON SALAMANDER COMPLEX**
Bushy gills	no	yes. prominent ruff of gills	yes. prominent ruff of gills.
Size	at hatch, 7-9mm (.3-.4 in). at metamorphosis, 10-12mm (.4-.5 in).	at hatch, 12-13mm (.5 in). at metamorphosis, 40-75mm (2-3.5 in).	at hatch 8-10mm (.3-.4 in) (blue spot.)/at hatch 11-14mm (.4-.6 in) (Jeff.), at metamorphosis about 50mm (2 in).
Color, pattern	at hatch, velvety black, then lightening to mottled olive-brown.	dull greenish-yellow	color and pattern variable, species probably indistinguishable. Blue-spotted – dark brown with yellow blotches dorsally. Indistinct light lateral band. Underside unpigmented. Jeff. - yellowish with indistinct blotches; underside unpigmented.
Tail	--	tail fin extends forward onto the back.	tail fin extends well forward on to body, nearly to the head. Blue-spot – fins broad, clouded with black.
Larval period	60-70 days	variable, 70-100 days	variable, 60-80 days
Other	when viewed from above, eyes seen on top of head. Transform late May to mid-August.	more slender in appearance than blue-spotted/Jefferson salamanders. Transforms August - September, rarely into October.	big-headed appearance

OTHER SPECIES					
	EASTERN NEWT	**FOUR-TOED SALAMANDER**	**SPRING PEEPER**	**GREY TREEFROG**	**AMERICAN TOAD**
Bushy gills	yes	yes	no	no	no
Size	--	at hatch, 11-14mm (.4-.6 in) at metamorphosis 18-24mm (.75-1.0 in).	at metamorphosis 33mm (1.3 in).	at metamorphosis, 45-50mm (1.7-1.9 in).	at metamorphosis, tiny new toads, 8-10mm (.3-.4 in).
Color, pattern	light yellow to green-yellow with grey or brown flecks or bands above. Belly pale yellow without bands or spots.	yellow-green with dark spots. Spots make a Y on the back of the head.	beige, tan or orangish dorsum, with dark spots and greenish tone. Iridescent creamy venter.	light brown to dark green to black	black
Tail	--	dorsal keel forward only to rear legs. Ventral keel to base of tail.	tan to brown to orange tinge with black spots on outer edge. Fin extends along back.	orangish to wine to scarlet tail fins, extend along back.	relatively short tail
Larval period	--	around 6 weeks	60-90 days	around 60 days	50-60 days
Other	unusual life history with 3 distinct stages. Larvae and adults are aquatic. Juveniles are terrestrial (red efts).	--	when viewed from above, pop-eyed appearance, eyes bulge to sides.	when viewed from above, pop-eyed appearance, eyes bulge to sides.	congregate in schools

affect metamorphosis. They transform at a smaller size where there is increased competition and density.

On rainy nights in late summer, large numbers of newly transformed juvenile salamanders may journey from pools to terrestrial habitat. Though they can be found crossing roads in wooded areas during this migration, they often escape notice because of their small size – 5-6.5 cm (2 to 2.5 in) and dark color.

SPOTTED SALAMANDER LARVAE

At hatch, spotted salamander larvae are 12 to 13mm (1/2 in) long. The background color is dull greenish yellow, with darker areas of olive on the head and small rounded black spots scattered over the dorsal surfaces, forming an indistinct band on either side of the mid-dorsal line. There are no large paired dark spots as in the Jefferson salamander. Gills and slender appendages known as balancers are present at hatching, the forelegs represented by elongate buds. The broad tail fin is continuous with the dorsal fin, which extends to a point opposite the forelegs.

The larval period is 70-100 days. Larvae transform into miniature adults at around 75mm (3 in). Transforming young are found August to September (rarely to October in colder waters). When they leave the pool, the young salamanders may be completely dark. Yellow or orange spots are sometimes acquired within one week of transformation. Recently transformed young linger on the edge of the drying pool, hidden under logs, fallen bark or stones. Eventually they move on to find an underground retreat.

BLUE-SPOTTED AND JEFFERSON SALAMANDER LARVAE

The larvae of blue-spotted salamanders, Jefferson salamanders and hybrids are not readily separable. **Jefferson/blue-spotted larvae have a big-headed appearance** in comparison to the more slender spotted salamander larvae.

The free-swimming, limbless phase of blue-spotted salamander larvae is brief, ending when forelegs develop and become functional. The hind legs soon appear and larvae become bottom dwellers.

The diet of small blue-spotted salamander larvae includes various invertebrates. Large larvae include vertebrates in their diet.

The size of Jefferson salamander larvae at metamorphosis is variable, 48-75 mm (2-3 in). This allows the larvae to escape from drying pools when small, or remain in the water for further growth if conditions are favorable. The length of the larval period may be 66-80 days. Transformed juveniles undergo further growth on land.

Metamorphosis or transformation is signalled by degeneration of gill branches and frequent excursions to the surface to gulp air. Newly transformed larvae are 50-65 mm (2-2.5 in) in total length. Newly transformed juveniles retain noticeable blackened gill stubs for several days, but acquire adult colors and spot patterns within 24 hours of leaving the water.

FOUR-TOED SALAMANDER LARVAE (not an indicator species)

Newly hatched gilled larvae are less than 11-14 mm (1 in) long, with a broad head, prominent eyes and a strongly compressed body and tail.

The tail fin extends forward only to the rear legs, in contrast to the dorsal fin of mole salamanders, which extends well forward on to the back, nearly to the head.

Toes of salamanders develop sequentially, so the number of toes is not diagnostic.

At transformation, the tail is conspicuously short compared to a mature salamander; the tail constriction is barely visible; and a black patch marking the gill closure is visible.

LOCATING LARVAL SALAMANDERS

By day, larval salamanders are typically hidden among vegetation and under debris. At night they move into the water column, where they remain suspended near the surface where they feed. Nocturnal stratification is noted in several species of mole salamander larvae. Advanced larvae rest under debris on the pool bottom during the day.

Stratification of larvae is best seen on dark nights following clear sunny days. Overcast days, bright moonlight, heavy winds, and rainfall disrupt the above pattern.

Young salamander larvae feed to some degree at all times, dining on planktonic invertebrates. However, the intensity of feeding behavior is elevated by a decrease in light intensity (onset of dusk). It has been noted that the concentration of plankton in the top 15 cm (6 in) of water is higher after dark. Some studies found that larval activity decreased or stopped 3-4 hours after dark.

Salamanders in all life stages are carnivorous. The size of the prey is determined by the size of the salamander. Older larvae may be seen stalking over open bottom in search of prey.

When larvae first emerge in the evening, they are very dark. As they move and stratify, larvae become pale, almost translucent. The change is due to expansion and contraction of melanophores (skin pigment).

Characteristics of Larval Amphibians Using Vernal Pools (Figure 4) provides additional information on larvae of indicator species and other amphibians which may use vernal pools.

Chapter Six

FINDING AND HANDLING VERNAL POOL AMPHIBIANS

This section describes a variety of techniques for investigating vernal pools for documentation. You do not need all of them to adequately investigate a pool. Use methods appropriate to the specific site, which enable you to collect required information while causing the least disturbance to the pool and its surroundings. If you are not experienced at exploring aquatic habitats, see "Equipment for Vernal Pool Search and Documentation" in the Appendix.

CAUTION: PROCEED WITH CARE

- During investigation and documentation of vernal pool habitat, some disturbance is inevitable. Move slowly and carefully and minimize handing of animals. Strive for only minor and temporary disruption of the pool.

- Leave your dog at home. A dog romping through a pool can damage egg masses and make the water turbid.

- Youngsters make great field companions! Nevertheless, impress upon them the need for minimal disruption to the pool.

- Handle vernal pool animals and egg masses only when it is necessary for identification, either visually or by photographing the specimen. Do not remove egg masses from the pool or detach them from sticks or other substrates to which they are attached. It is important that the egg masses remain suspended above the pool bottom – otherwise they are subject to siltation and predation and are unlikely to hatch successfully.

- Amphibians have moist bodies and can desiccate (dry out) quickly. Also, most amphibians absorb oxygen and other gases through their skin. Keep your hands moist – dip them into water or pick up moist moss or leaf litter before handling an amphibian. Do not handle them if you have insect repellant on your hands.

- Seining is not recommended as a method for determining absence of fish in a pool because of the disruption it causes and the difficulty of working in a pool crowded with submerged and emergent plants.

Tip: Polarized sunglasses aid in seeing into the water.

FINDING AMPHIBIANS: VISUALS

A variety of techniques used under a variety of conditions are needed to develop an accurate picture of the fauna of a given area. A short-term survey performed when conditions are not favorable may turn up very little. Take your time! Most of the animals that live in vernal pools are small and secretive. **A minimum of TWO visits per site is recommended** – one in early spring, the second about a month later.

At many pools it may be possible to gather documentation without going into the pool. Observations from the edge cause the least disturbance to pool inhabitants.

Generally, daylight searches are recommended. A greater range of amphibian life stages (eggs, larvae, juveniles and adults) and invertebrates are likely to be observed. There is potentially less disturbance to pool inhabitants since you can see better. And it is safer than stumbling around in the dark, especially if you are in an unfamiliar area.

Approach the pool slowly and quietly while looking for larger animals that may be resting on the surface, especially turtles. Walk carefully and stop often, scanning with or without binoculars. If you startle an unsuspecting animal, sit and wait a few minutes – it may reappear. Also, look carefully where it started from, to see if there may be another individual nearby.

Walk around the pool slowly, looking in the water for salamanders, frogs, egg masses and spermatophores. Be careful not to disturb the shoreline by excessive trampling. Bend down and get close to the water surface. This is greatly enhanced by a clear bottom bucket. Try to remain in one spot for a while, alternately scanning and observing closely.

Turn over rocks, logs or other debris on or near the edge of the pool to look for salamander adults or juveniles. Do this gently; restore anything you move to its original position and condition.

You may need to walk out in waders or paddle into a large flooded area in an inner tube or canoe. Be careful not to stir up the bottom or dislodge egg masses if you walk or paddle out into the pool. Egg masses are often attached to submerged twigs. Take special care when moving near woody debris.

Evening searches, during appropriate weather conditions, can reveal salamander courtship. Frog vocalizations may lead you to previously unknown pools.

A head lamp or flashlight greatly enhances nocturnal observations. In most cases light disturbs amphibians only if kept focused on an individual. Salamanders foraging in temporary ponds may be disturbed by movements outside the pond during the day, but typically resume feeding after less than 5 to 15 minutes. At night salamanders are typically not disturbed by movement and often tolerate direct light.

FINDING FROGS: AUDITORY

Vocalizations of frogs are acoustical beacons. Some species call during the day, but activity increases at dusk. Calling activity will be particularly low on cold or windy nights. (Salamanders do not vocalize.)

Movement in or around a pool is likely to disturb calling frogs. When disturbed, a few individuals may cease calling, followed by the entire chorus shutting down simultaneously. If this happens, and the area of the pond you are standing in is silent, remain still. Calling will usually resume in a few minutes. Your disturbance may shut down the chorus for longer periods if the night is cool or the density of calling frogs is low.

Wood frogs call in late March and early April. Wood frog calls have limited carrying power and can seldom be heard far from the pond. The sound is remarkably like the quacking of ducks. Large choruses can create the impression of a continuous rattling sound. Calling often continues during the day in undisturbed locations.

High-pitched jingle bell-like calls of spring peepers are heard from March through May. Peepers may breed in vernal pools, but are not particular about the type of wetland habitat used.

A CD of singing amphibians is included in *Maine Reptiles and Amphibians*, Hunter et al. 1999.

CATCHING AND HANDLING AMPHIBIANS IN THE WATER

If you can't identify an animal adequately while it is in the pool, try to catch it so you can more readily observe or photograph it. A long-handled dip net works best, but an ordinary kitchen strainer will work.

Always keep animals and egg masses covered with water and handle gently. Small animals can be transferred directly from the net to a container filled with pond water. A light colored plastic or enamel pan is recommended. Avoid glass containers.

For clearer inspection and for taking photos, you may wish to lift egg masses slightly above the water surface by sliding a pan underneath. Egg masses lifted above the water should be replaced gently without unnecessary agitation.

Plunge trays are particularly useful where aquatic vegetation is dense. Try a plastic storage tray, approximately 20 x 20 x 5 cm (8 in x 8 in x 2 in). Plunge the tray into the water every few steps and quickly pull it out. The water sucked into the tray will likely contain invertebrates, tadpoles, salamander larvae or occasionally an adult amphibian. To further examine animals, gently pour the water from the tray through a fine-mesh dipnet, separate the animals from vegetation and debris and transfer the animals to a tray or jar for identification and/or photography.

Release your catch as soon as you are finished identifying and/or photographing them. Don't pour them back into the pool. Instead, submerge the holding container in the water and upend it.

CATCHING AND HANDLING AMPHIBIANS ON LAND

On land, most amphibians can be caught by quickly bringing a cupped hand down over them. Be careful not to come down too hard. The captive must then be carefully extricated from beneath your hand. Be careful of the tails of salamanders; they easily detach.

Some individuals will likely have to be held briefly so they can be identified and/or photographed. Remember to handle frogs and salamanders with moist hands. Transfer the animal as quickly as possible to a clear plastic jar with a screw top. A clear plastic bag perforated with small holes and with damp moss or leaves inside will also work. Now you can carefully identify your catch or photograph it through the container. Keep amphibians cool. They should be kept in shade and out of the sun. Release them as soon as possible. It is best to handle only a single animal at a time.

Salamanders can be held for examination by gently grasping a rear leg while supporting the body with the other hand. The animal should have something to hold on to for security. Large salamanders can be held by encircling the trunk of the body with your fingers and letting the head protrude. Do **not** hold a salamander by its tail.

RELEASING AMPHIBIANS

If you do catch a frog or salamander, let it go where it was captured. This point is important: releasing an amphibian outside an area with which it is familiar may decrease its survival chances. This vernal pool documentation process has no requirements for collecting specimens of live animals.

Chapter Seven

DOCUMENTING AND REPORTING VERNAL POOLS

REQUIRED DOCUMENTATION

For a vernal pool to be considered "documented," you must adequately demonstrate that the pool meets certain biological and physical criteria and record the presence of certain species and characteristics by photos and/or detailed written observations.

BIOLOGICAL CHARACTERISTICS

1. Evidence of amphibian breeding.

2. The presence of a vernal pool indicator species (see page 15).

Record observations on a Documentation Form.

PHYSICAL CHARACTERISTICS

1. The pool occupies a confined basin (standing water without a permanently flowing outlet). The pool may have an intermittent stream flowing out of it at high water, but must be isolated some of the time.

2. Record of the wet/dry cycle:

   - Evidence that the pool contains water for at least 2 months in the spring/summer;

   - Evidence that it dries up or does not contain fish.

   A minimum of two visits are needed to document the wet/dry cycle of a pool.

POOL LOCATION

A written description of the pool location and maps of the pool are also part of pool documentation. See Chapter Six.

The **Documentation Checklist** (page 40) will help you determine if you have everything you need to fully describe and document a pool.

DOCUMENTATION CHECKLIST

This checklist is provided to help you organize, assemble and submit the required material for vernal pool documentation. While complete information on a pool is encouraged, all recorded observations are useful. Do send partial information if that is all you have.

Please copy and include this checklist as a cover sheet to assist the person reviewing the material. ***Make copies from original on page 48.***

____ flooded pool visit
  ____ photos included

____ dry, drying pool visit
  ____ photos included

____ field map of pool

____ written directions to pool

____ USGS map, photo copy

____ ONE of the following, indicating pool location:
  ____ tax assessors map
  ____ detailed location information

____ Evidence of vernal pool indicator species (check all present):
  ____ fairy shrimp
  ____ wood frog
    ____ chorus
    ____ amplexus
    ____ egg mass
    ____ tadpoles

  ____ salamander (spotted, Jefferson, blue-spotted)
    ____ courtship
    ____ spermatophores
    ____ egg mass
    ____ larvae

____ Photos of indicator species

____ Documentation forms and maps submitted to <u>both</u>:
  ____ town conservation commission
  ____ Nongame and Endangered Wildlife Program, NH Fish and Game Department, 11 Hazen Drive, Concord, NH 03301

Reporter's name _____

Address _____

_____

Phone number _____

Thank you for participating in the vital process of protecting the resources of your community and the state.

INDICATOR SPECIES DOCUMENTATION

EVIDENCE OF AMPHIBIAN BREEDING AS DOCUMENTATION

To adequately document a vernal pool, you need to look for specific life stages of indicator amphibians and other evidence of breeding. Refer to Chapter 3 for the indicator species list and information. The following are considered to be evidence of reproduction. Any one is sufficient for documentation. You are encouraged to record all species and life stages you observe.

BREEDING ADULTS

Wood frogs – "chorusing," groups of males calling in unison, or mated pairs (amplexus).
Salamanders – courting behavior or spermatophores.
Spermatophores – small (approx. 1/2 inch) vase- or stump-shaped white packets of sperm deposited by male salamanders on leaves or other debris on the pond bottom.

EGGS

Wood frog and salamander egg masses differ in shape and size.
Wood frog eggs – lack a surrounding gelatinous capsule, have an unconsolidated shapeless form.
Salamander eggs – are surrounded by a common gelatinous envelope, individual eggs are visible inside the envelope.

LARVAE

Frog and salamander larvae can be differentiated by visual observation. With close, detailed examination, it may be possible (but not necessary for documentation) to identify the species.
Frog larvae, commonly known as tadpoles or polliwogs, have no external gills.
Salamander larvae have bushy external gills.

TRANSFORMING JUVENILES

Metamorphosing **frogs** show some remnant of a tail.
Transforming **salamanders** have gill remnants.

PRESENCE OF INVERTEBRATES AS DOCUMENTATION

The presence of **fairy shrimp** in a flooded pool is documentation of a vernal pool.

Fingernail clams in a flooded pool should be noted, but unless clams can be identified as *Sphaerium occidentale*, these clams cannot be considered indicator species.

IDENTIFICATION DETAIL FOR DOCUMENTING PRESENCE OF VERNAL POOL INDICATOR SPECIES

Adult amphibians: Identify adult amphibians to the species level.

Amphibian eggs: At a minimum, distinguish between frog eggs and salamander eggs. Documenting the presence of salamander egg masses, regardless of species, or wood frog eggs, is sufficient evidence for documentation. Identification of salamander eggs to species is OPTIONAL.

Larval salamanders: Larval salamanders do not need to be identified to species – it can be challenging. Presence of a larvae with bushy gills is sufficient.

Larval frogs: Species of frog other than the wood frog may use vernal pools. Since the wood frog is the only frog which is a vernal pool indicator species, tadpoles need to be identified to species, or rely on another life stage.

Invertebrates: Fairy shrimp and other invertebrates need only be identified to the group level (family or order), i.e., "a caddis fly" or "a fairy shrimp". If you have the skill, resources and patience to make more detailed identification of invertebrates, your efforts will provide an even greater level of vernal pool information. Additional identification resources are provided in the bibliography.

FILLING OUT THE DOCUMENTATION FORMS

Documentation is recorded on a two-part form and an accompanying cover sheet:

VERNAL POOL DOCUMENTATION (Part 1 of 2) and **VERNAL POOL HABITAT DOCUMENTATION** (Part 2 of 2). This format enables reporting and documentation of critical physical and biological characteristics of a vernal pool.

The documentation form asks for many pieces of information, both required and optional. Filling it out may seem like an overwhelming task. Though complete forms are preferred, an incomplete form is better than no record at all.

It is important to fill out the form as accurately as possible. Do not leave blanks. When in doubt put a "?" in the appropriate spot. If an item is irrelevant or you have no information to report, put a horizontal line in the space.

You have collected valuable information. **Submit data forms, maps, photos and associated information to your town Conservation Commission *and* the Nongame and Endangered Wildlife Program, N.H. Fish and Game Dept.**

The **VERNAL POOL DOCUMENTATION** form (Part 1 of 2) has room for observations made during two visits to the same site. A minimum of two visits to a site is recommended: one in the spring during the flooded stage and a second visit a month or more later as the pool is drying. If you find a pool late in the season or are unable to make

more than one visit, send whatever information you do have.

Use the back of the sheet for the sketch/field map of the pool.

In the LOCATION section include town, road, or other appropriate information. Attached maps, etc. will provide more detail.

In addition to location descriptions and maps, point-specific data is very helpful. If a GPS unit is available, locations can be recorded as latitude/longitude (degrees, minutes, seconds). The Datum of the GPS unit should be set to NAD83. If a GPS unit is not available, latitude/longitude coordinates can be recorded from http://www.topozone.com.

PHOTOS of the pool, surrounding habitat and animals found are encouraged. Indicate if photos are included or available.

Give the DATE of your visit and the TIME START and TIME END of your search time at the pool.

Provide general WEATHER information: temperature, precipitation, humidity, cloud cover, wind.

Determine POOL SIZE by pacing the perimeter or estimate the size at each visit. Indicate if size is by estimate or actual measure.

Measure WATER DEPTH at each visit. Give a range or determine the average depth.

Indicate SPECIES observed (invertebrate and vertebrate), both indicator and other species. Fill in the species and indicate the life stage observed. At a minimum, indicate presence of a species. Provide numbers or subjective information (many, few) where possible.

Include COMMENTS on anything of note or interest.

Figure 5 is a sample completed form. Make copies of the blank form as needed.

The **VERNAL POOL HABITAT DOCUMENTATION** form (Part 2 of 2) is used to describe the pool and its surroundings.

The SITE TYPE describes the general landscape where the pool is located. Use the comment section to describe the site type if necessary.

- A pool in an “upland-isolated” site is not associated with a water body (stream or pond) or any type of wetland. The pool is surrounded by dry land.

- A pool in a "bottomland-isolated" site is in a flood plain but not associated with other wetland habitat. Topography is generally flat and subject to periodic flooding from a stream, especially in the spring.

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Figure 5. SAMPLE

VERNAL POOL DOCUMENTATION (PART 1 OF 2)

Observer's name A. Smith Phone number 555-1234

Address 10 Frog Lane, Concord, NH 03301

Location of pool Steppingstone Road, Lee/Barrington line, roadside

GPS (if available): Latitude 43° 08' 38" N Longitude 71° 01' 10" W Datum NAD 83

Photos attached no pool no animals

Date: 16 April 1994 Time start 10 am Time end 10:30 am

Weather overcast, low 50's Pool size 15' x 20' Water depth 12-18"

☑ measured ❑ estimated

SPECIES	wood frog	spotted salamander	spring peepers	caddisflies	salamander unknown species		
adult							
vocalization	few		few				
amplexus							
courtship							
spermatophores							
eggs	2 masses	6 masses			1 mass		
tadpoles/larvae							
juveniles				14 cases			

Comments:

Date: 2 July 1994 Time start 9 am Time end 9:30 pm

Weather sunny, high 70's Pool size 5' x 3' Water depth 4-8"

SPECIES	spotted salamander	green frog					
adult							
vocalization							
amplexus							
courtship							
spermatophores							
eggs							
tadpoles/larvae	8						
juveniles		4					

Comments:

Use the back of the sheet for sketch/field map of the pool.

Figure 6. SAMPLE

VERNAL POOL HABITAT DOCUMENTATION (Part 2 of 2)

Pool Location Steppingstone Rd., Lee **Observer** A. Smith

SITE /TYPE:

- ✓ upland-isolated (pool not associated with a wetland)
- ____ bottomland-isolated (pool in a floodplain, not in a wetland)
- ____ wetland complex (pool within or associated with a larger wetland habitat, i.e. red maple swamp, marsh, pond edge, other)

HABITAT: (estimate % of type)

- 80% woodland (specify type) ✓ deciduous ____ coniferous ____ mixed
- ____ agriculture or open fields
- ____ gravel pit
- 20% residential
- ____ roadside
- ____ other____

OVERSTORY:

- ____ heavy overstory, >50% shrubs and/or trees
- ____ moderate overstory, <50% shrubs and/or trees
- ✓ open site with grasses, forbs, scattered shrubs

COVER: Any material in the pool that can provide egg attachment sites and offer concealment to aquatic adults and/or developing larvae (estimate % of type).

- 10% shrubs
- 25% emergent vegetation (i.e. grass, cattails)
- few branches, twigs (in pool or overhanging into water)
- ____ submergent vegetation
- ____ sphagnum moss
- ____ other____

BOTTOM: (estimate % of types composing bottom surface)

- ____ sand
- ✓ mud/soft sediment } 100%
- ✓ leaf litter
- ____ submergent vegetation
- ____ emergent vegetation

DOMINANT PLANTS, LIST: (optional)

in pool – clump grass
surrounding pool – red maple, arrowwood, blueberry, red oak.

COMMENTS:

Attach location documentation.

VERNAL POOL DOCUMENTATION (PART 1 OF 2)

Observer's name_____ Phone number _____

Address_____

Location of pool _____

GPS (if available): Latitude_____ Longitude_____ Datum_____

Photos attached _____pool _____animals

Date:_____ Time start_____ Time end_____

Weather_____ Pool size_____ Water depth_____
❑ measured ❑ estimated

SPECIES							
adult							
vocalization							
amplexus							
courtship							
spermatophores							
eggs							
tadpoles/larvae							
juveniles							

Comments:_____

_____

Date:_____ Time start_____ Time end_____

Weather_____ Pool size_____ Water depth_____

SPECIES							
adult							
vocalization							
amplexus							
courtship							
spermatophores							
eggs							
tadpoles/larvae							
juveniles							

Comments:_____

_____

Use the back of the sheet for sketch/field map of the pool.

VERNAL POOL HABITAT DOCUMENTATION (Part 2 of 2)

Pool Location_____ **Observer**_____

SITE/ TYPE:

____ upland-isolated (pool not associated with a wetland)
____ bottomland-isolated (pool in a floodplain, not in a wetland)
____ wetland complex (pool within or associated with a larger wetland habitat, i.e. red maple swamp, marsh, pond edge, other)

HABITAT: (estimate % of type)

____ woodland (specify type) ____ deciduous ____ coniferous ____ mixed
____ agriculture or open fields
____ gravel pit
____ residential
____ roadside
____ other_____

OVERSTORY:

____ heavy overstory, >50% shrubs and/or trees
____ moderate overstory, <50% shrubs and/or trees
____ open site with grasses, forbs, scattered shrubs

COVER: Any material in the pool that can provide egg attachment sites and offer concealment to aquatic adults and/or developing arvae (estimate % of type).

____ shrubs
____ emergent vegetation (i.e. grass, cattails)
____ branches, twigs (in pool or overhanging into water)
____ submergent vegetation
____ sphagnum moss
____ other_____

BOTTOM: (estimate % of types composing bottom surface)

____ sand
____ mud/soft sediment
____ leaf litter
____ submergent vegetation
____ emergent vegetation

DOMINANT PLANTS, LIST: (optional)

COMMENTS:

Attach location documentation.

VERNAL POOL DOCUMENTATION COVER SHEET

Include with documentation for each vernal pool.

____ flooded pool visit
- ____ photos included

____ dry, drying pool visit
- ____ photos included

____ field map of pool

____ written directions to pool

____ USGS map, photo copy

____ ONE of the following, indicating pool location:
- ____ tax assessors map
- ____ detailed location information

____ Evidence of vernal pool indicator species (check all present):
- ____ fairy shrimp
- ____ wood frog
  - ____ chorus
  - ____ amplexus
  - ____ egg mass
  - ____ tadpoles
- ____ salamander (spotted, Jefferson, blue-spotted)
  - ____ courtship
  - ____ spermatophores
  - ____ egg mass
  - ____ larvae

____ Photos of indicator species

____ Documentation forms and maps submitted to <u>both</u>:
- ____ town conservation commission
- ____ Nongame and Endangered Wildlife Program, NH Fish and Game Department, 11 Hazen Drive, Concord, NH 03301

Reporter's name _____

Address _____

_____

Phone number _____

Thank you for participating in the vital process of protecting the resources of your community and the state.

Continued from page 43

- A pool in a "wetland complex" is a pool within a larger wetland complex, such as a red maple swamp or a shallow marsh.

Indicate the HABITAT immediately surrounding the pool and within sight of the pool, if different. Mark all habitat types present; include an estimate of percent of each.

The pool may have an OVERSTORY of shrubs and/or trees. Indicate if the coverage is heavy (more than 50% of the pool surface is overhung by tree branches or shrubs), moderate (less than 50%), or if the site is open to the sky with few to no trees or shrubs.

COVER is any material in the pool that can provide egg attachment sites or offer concealment to aquatic adults or developing larvae. Mark all types of material present. Indicate if material is abundant or scarce.

Indicate the composition of the pool BOTTOM. Mark all types of substrate present, estimating the percentage of types.

Though plants are not specifically indicative of vernal pools, information on DOMINANT PLANTS is useful. List the plant species in and around the pool.

Figure 6 is a sample completed form. Make copies of the blank form as needed.

Refer to the DOCUMENTATION CHECKLIST (see page 40) as you go through the documentation process to be sure you have all the required maps and information. Though complete information is preferred, incomplete reporting is better than no record at all.

VERIFICATION

All reports and records of observations of species using a vernal pool are encouraged and should be submitted. The three levels of verification, described below, reflect decreasing levels of confidence in a record.

(1) A recognizable photograph is submitted or a specimen was collected and preserved.

NOTE: By strict rules of science, only properly labeled specimens deposited in a museum constitute a valid record. However, for this project, collecting of specimens cannot be justified. Animals found dead can be submitted as a record. Photos are the preferred method of recording specimens.

(2) A specimen was handled, examined for identification, then released.

(3) A specimen was seen or heard but not captured.

It is important to distinguish on what basis information is reported: photo/collected specimens, positive identification through handling but without photo or collection, or speculation of species presence/distribution.

PHOTOGRAPHIC DOCUMENTATION

Photographs of animals provide the highest level of verification. Take two or three photos and send the best. In order to get a good, recognizable photo you may have to handle a specimen. Pictures of an animal in the hand are perfectly acceptable.

Know the limitations of your camera. Fixed focus (Point and Shoot) cameras cannot focus closer than 3 to 4 feet. Read your instruction manual to be sure. Some slightly blurry pictures will work, most will not. A flash may be necessary, even during the day.

See Appendix: “How to Photograph Amphibians and Reptiles” for additional information.

NEGATIVE RECORDS

To a certain extent, information about where a species does not occur can be useful in determining species ranges and habitat preference, although it is much harder to be certain about a species’ absence. If you locate a pool that looks like it has outstanding potential for vernal pool indicator species, but none are found, report it anyway.

Chapter Eight

DOCUMENTING THE POOL LOCATION

Precise mapping of the vernal pool location is essential for its documentation and protection. The following information will help you pinpoint the vernal pool on paper. Maps and descriptive information should enable others, unfamiliar with the area, to locate the pool for verification, follow-up observations or protection. Complete documentation of pool location *requires the following FOUR items*:

1) A field or sketch map that you prepare at the site, showing the features of the pool and its position relative to local landmarks. Any other depressions or small pools in the general area should also be indicated to avoid confusion as to which pool has been documented (Fig. 7a).

2) Vernal pool maps:

- a photocopy of the appropriate USGS topographic map, showing the location of the pool (Fig. 7b);
  and one of the following:
- a tax assessor's map, or other map showing property lines and ownership, with the location of the pool indicated on it;
- detailed location information as outlined on page 53.

3) Written directions to the pool (Fig. 7c).

4) GPS Coordinates: if a GPS unit is available, pool location can be provided in latitude (D.M.S.) and longitude – NAD 83.

THE SKETCH MAP

The **Field or Sketch Map** – should include the following information:

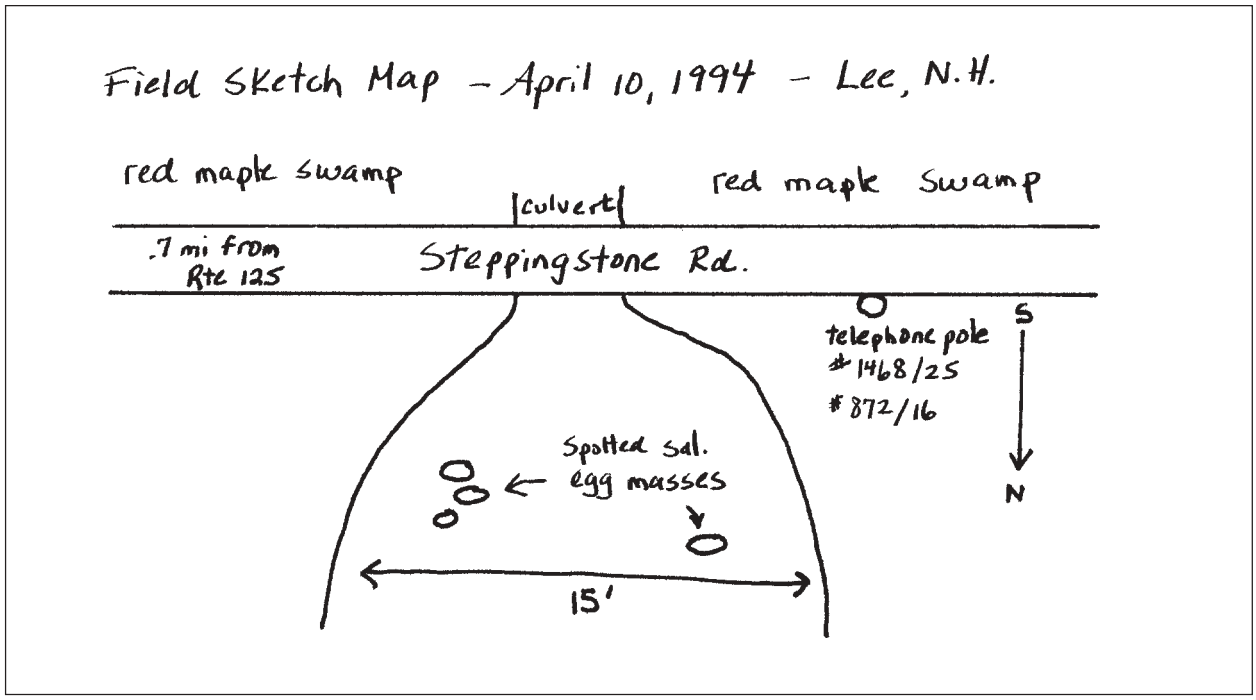
a) the bearing and distance to the pool from a logical, specific starting point (such as the road you've walked in from);

b) distances and bearings from at least two permanent landmarks within 1,000 feet of the pool. Show on your map the point from where you took your bearings;

c) the approximate size and shape of the pool, including compass orientation;

d) locations of sightings of indicator species, such as salamander egg masses;

Figure 7a. **FIELD SKETCH MAP**



e) any other important identifying features, such as fallen trees in the water, rock outcrops, distinctive stands of trees (e.g., white cedars), wetland indicator plant species, etc.;

f) the point(s) from which you took general photographs of the pool.

(See Appendix: Determining Distance for how to estimate distances using pacing.)

PREPARING VERNAL POOL MAPS

1) Collect the maps you need beforehand. Make 8½ in x 11 in photocopies of those sections of the maps showing the area where your pool is located. Remember to copy the quadrangle name, north arrow and other relevant information from the original maps onto these copies.

2) Out in the field, collect rough location data; this should include drawing a sketch map noting bearings, landmarks, etc., for later transfer to your final documents.

3) Plot the pool's position on the various maps as follows:

USGS Topographic Map – "X marks the spot" is sufficient. This map is used to note the general location of your pool and to indicate the area covered by your more detailed maps. You need only to show the approximate location of your pool on this map. (A large-scale map like this isn't accurate enough for exact location. See Fig. 7b.)

Tax Assessor's Map – available at your municipal assessor's office; or an equivalent such as a plot map, available from the planning board. These maps show property boundaries for tax purposes. Clearly show the pool's position. Property lines, other pools in the area, and important landmarks should also be identified.

Detailed Location Information – this information should show the relationship of the pool to at least two permanent landmarks, preferably within 1,000 feet of the pool. The landmarks may either already appear on the map or be drawn in by you. The necessary information may be provided in one of the following ways:

a) You may sketch onto the assessor's map the locations of two permanent landmarks. It is helpful to provide:
   - compass bearings from landmarks to pool;
   - measured distances from landmarks to pool;
   - a written description of the landmarks.

b) You may submit an aerial photograph that clearly shows the vernal pool and permanent landmarks, as well as other pools in the area.

c) You may have a professional surveyor map the location of the pool.

Figure 7b. **USGS TOPOGRAPHIC MAP**

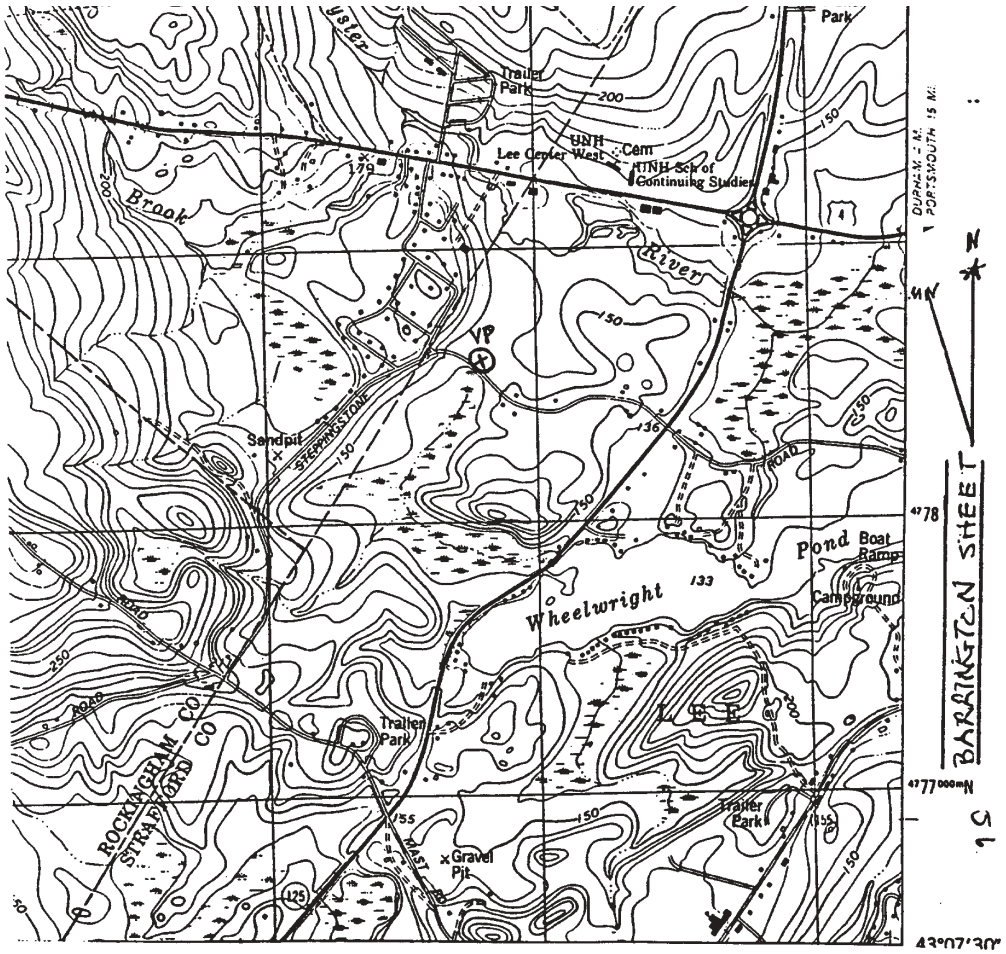


Figure 7c. **WRITTEN DIRECTIONS**

> Pool is .7 mi. west of Rte. 125 on Steppingstone Road, Lee, near Barrington town line. Telephone pole # 1468/25, 872/16 is near culvert. Pool is located at the roadside, with a light screening of vegetation. Pool is about 15' wide and 20' long. Surrounded by grass & shrubs, grading into hardwood forest.

WRITING DIRECTIONS TO THE POOL

Provide clear, precise written directions on how to get to your pool. These provide one of the easiest means for people in the future to locate your pool for verification or protection. A good written description should include:

a) a precise description of a logical starting point for a person walking to the pool, (e.g., “Start at the intersection of Mill Rd. and Spring Lane, 1.2 miles north of Brookfield Town line...”);

b) the distance from the starting point to the pool, in feet;

c) the direction of travel, including compass bearing;

d) distinctive permanent landmarks along the path of travel and/or at the pool.

USING PHOTOGRAPHS TO RELOCATE THE POOL

Taking a photograph of a general view of the pool will make it even easier for others to locate it in the future. To be usable, a photograph should include identifiable permanent landmarks, if at all possible. In addition, you should note the following information in your field notebook for later transfer to the back of the photograph or edge of the slide:

- photo number;
- the day and time of the photo;
- the location of the pool;
- your name and/or the name of the photographer.

Chapter Nine

VERNAL POOL PROTECTION

REGULATORY STATUS

There are no state or federal regulations which specifically name vernal pools. However, the New Hampshire Department of Environmental Services' Wetlands Bureau has jurisdiction within a delineated boundary of a wetland. If a vernal pool occurs in a wetland, then the Wetlands Bureau has regulatory authority over what may take place in that area.

The purpose of the N.H. Wetlands Bureau rules is "...to afford the maximum degree of protection for the natural environment while allowing individual landowners the freedom to use and enjoy their land as is consistent with this public purpose." (Wt 102.01, New Hampshire Code of Administrative Rules)

The "Requirements for Application Evaluation" (Wt 302.04(a)) requires that for all major and minor impact projects the applicant consider the impact of the proposed project on wetlands. Among the 20 factors listed (Wt 302.04(a)1-20), the following possibly apply to vernal pools:

Wt 302.04(a)

(2) the alternative proposed by the applicant is the one with the least impact to wetlands or surface waters on site;
(4) the relationship of the proposed wetlands to be impacted relative to nearby wetlands and surface waters;
(5) the rarity of the wetland;
(7) the impact on plants, fish and wildlife including:
  a. rare and special concern species
  b. state and federally listed threatened and endangered species
  c. species at the extremities of their ranges
(17) the impact of the proposed project on the values and functions of the total wetland or wetland complex.

When an applicant proposes a minor or major impact project that may affect a vernal pool, consideration of these five factors may be required for complete review of the proposed project by the Wetlands Bureau.

DEFINITIONS OF "WETLAND"

More than one definition of "wetland" exists at the federal level and individual states may use their own definition. In general, the criteria required to be present for an area to be considered a "wetland" are the hydrology, hydric soils and plants tolerant of wet conditions.

U.S. Fish and Wildlife Service: Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water...wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.
(Source: Cowardin, L.M., V. Carter, F.C. Golet and E.T. La Roe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U. S. Fish & Wildlife Service, FWS/OBS - 79/31.)

U.S. Army Corps of Engineers and the **U.S. Environmental Protection Agency:** The term "wetland" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support and that under normal circumstances do support a prevalence of vegetation typically adapted for a life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.
(Source: Corps of Engineers Wetlands Delineation Manual. 1987. Technical Report Y-87-1. U.S.A.C.O.E. Waterways Experiment Station, Vicksburg, Miss.)

N.H. Wetlands Bureau, Administrative Rules Wt 101.82: "Wetland" means an area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support and that, under normal conditions, does support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include but are not limited to swamps, marshes, bogs and similar areas.

Vernal pools do not fit neatly into the definitions of a wetland. Hydrophytes (plants adapted for life in water or saturated soils) may occur in vernal pools; however, there are no plants or assemblage of plants particularly associated with vernal pools and some pools are totally lacking in vegetation. Though soils underlaying the middle of a vernal pool typically exhibit hydric characteristics, soils on the periphery may not exhibit the hydric morphology found in wetland soils. Some vernal pools may be overlooked because of their small size, isolated setting and ephemeral nature.

MUNICIPAL INVOLVEMENT

It appears at present that vernal pool protection will best be accomplished at the municipal level by combined efforts of the town conservation commission and planning board.

Town conservation commissions have statutory responsibility to advise state and municipal officials on the protection of all natural resources. They provide a local source of information and assistance to the New Hampshire Wetlands Bureau and municipal officials. A pro-active approach by conservation commissions is recommended, including a systematic search for and mapping of vernal pools and involvement with the planning board in directing future land use.

Possible methods of incorporating vernal pool protection into current municipal activities include the following:

- A municipal Master Plan provides direction and guidance for the future growth and development of a town or city. Conservation commissions should be intimately involved in the development of the natural resource portions of the plan. Vernal pools should be identified as important wildlife habitat and wetlands of significance. Goals developed for future natural resources protection should include the documentation of important vernal pools and the protection of these natural resources to help ensure the biodiversity of the area.

  For more information on Master Planning and other local planning options contact the New Hampshire Office of State Planning and Energy Programs.

- Conservation commissions are encouraged to work with the local planning board to develop mechanisms that will ensure the consideration of vernal pools and other significant wildlife habitats in projects such as site plan reviews and subdivision regulations. Many times small isolated wetlands are considered low value wetlands. The identification and mapping of vernal pools on site plans and subdivision plans will provide an opportunity to mitigate the impacts to these sensitive habitats.

  The Innovative Land Use Controls (RSA 674:21) law allows the development of standards which guide the planning board or its designate. This RSA empowers town planning boards to delegate responsibilities. Zoning ordinances, including Environmental Characteristics Zoning, can be adopted.

- Conservation commissions, working with other local officials responsible for the management of town lands, should map all vernal pools on town property and integrate the protection of these areas into management plans.

- Conservation commissions are encouraged to work with landowners interested in managing their land for wildlife habitat to locate and document vernal pools and integrate protection of these areas into management plans.

Most importantly, vernal pools cannot be protected unless their location is documented. Once members of the community know where vernal pools are located, and their importance to wildlife, it will be a giant step forward in their protection.

Incorporating this information into a central repository at the New Hampshire Fish and Game Department will provide broader access to the information for a wide range of planning purposes.

This manual is intended to aid individuals in the documentation of vernal pools. It does not specifically address the conservation strategies needed to maintain these pools and the species that require them to live. **It is important to remember that although vernal pools provide crucial breeding and foraging habitat for a variety of species, populations of these species will NOT be maintained without adequate protection of surrounding uplands**. For more detail on conserving vernal pools, please see the Bibliography-Vernal Pool Conservation-section, especially *Best development practices: conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States* (Calhoun and Klemens 2002).

Appendix

GLOSSARY

Amplexus: The position assumed by male and female frogs during egg laying and external fertilization; the male is on the female's back, clasping her under her forelegs.

Balancer: A slender, rod-like appendage which projects from each side of the head of newly-hatched larvae in some species of salamanders.

Carapace: The top shell of a turtle, or the hard, shell-like covering of an invertebrate.

Cloaca: The chamber into which the intestinal, urinary and reproductive tracts open.

Compressed: Flattened; laterally compressed – flattened from side to side.

Digit: Finger or toe.

Diurnal: Active by day.

Dorsal/dorsum/dorso: The upper surface of an animal, the "back."

Fossorial: An animal that lives beneath the surface of the ground.

Gill: A feathery or filamentous aquatic respiratory organ.

Hydric soil: Soil that is saturated or flooded during a sufficient portion of the growing season to develop anaerobic conditions in the upper soil layers.

Juvenile: Refers to the stage following metamorphosis when larval characteristics have been replaced by adult characteristics, but the animal has not reached reproductive maturity.

Keel: In salamanders, usually refers to the raised edge along the dorsal surface of the tail in certain species.

Larva (larvae, pl.): A gilled, free-living, post-hatching stage capable of acquiring its own nourishment. The larval stage begins at hatching and ends at metamorphosis.

Lateral: Referring to the side of an animal.

Metamorphosis: A change or transformation; in salamanders refers to the transition from a gilled larval stage to a juvenile stage lacking gills.

Mole salamander: Stout-bodied salamanders, genus *Ambystoma.* These salamanders spend most of their lives underground, entering temporary pools in early spring to breed.

Nocturnal: Active at night.

Plankton: Minute floating organisms; phytoplankton are tiny floating plants, usually algae; zooplankton are animal plankton.

Plastron: The bottom shell of a turtle.

Pond larvae: A type of salamander larva characterized by a deep dorsal fin that extends well forward onto the body, long feathery gills, slender toes and often the presence of balancers during its early stages.

Spermatophore: A structure produced in the cloaca of a male salamander and then attached to the substrate; consists of a gelatinous base and stalk, capped with sperm; sperm transfer occurs when the female salamander removes the sperm packet with her cloaca.

Ventral/venter: The lower surface of an animal; the belly or abdomen.

EQUIPMENT FOR VERNAL POOL SEARCH AND DOCUMENTATION

Be prepared, dressed and equipped so you will be able to effectively search pools and identify and document what you find. Check through the list of suggested equipment, and come up with a combination of gear and techniques which best suits you. Everyone has preferences on what to take to the field. Don't overburden yourself.

OBSERVATION AIDS

NOTE: At many pools it may be possible to gather documentation without going into the pool. Observations from the edge create the least disturbance to pool inhabitants.

A **head lamp** or **waterproof flashlight** for nocturnal forays. The advantage of a headlamp is that both hands are free.

Dip nets of various sizes. A kitchen strainer will do. The local bait shop or sports store is likely to carry a variety of hand nets, or you can make one from an old nylon stocking and a clothes hanger.

Clear plastic jar and/or light-colored enamel baking pan or plastic dishpan for holding specimens while you identify or photograph them. A plastic tray can double as a **plunge tray**. Glass containers are not recommended.

In cool/cold weather, **waterproof boots** are imperative. Hip- or chest-waders are recommended. As the weather warms you may choose to wear old sneakers that can get soaked.

Magnifying glass.

A **clear-bottom bucket** greatly improves the view into the water. Cut the bottom out of a 5-gallon plastic bucket, leaving a 1/2 inch rim around the edge. Glue a piece of plexiglass to the outside of the bottom, using marine sealant or waterproof silicone. Use a waterproof flashlight to enhance viewing in dim conditions.

Binoculars, especially those that focus closer than 15 feet, are very useful in making observations from a distance.

For picking up a road kill, a supply of **zip-lock bags** are in order.

DOCUMENTATION AIDS

A **field notebook** is a must for recording observations. You may prefer to jot down observations during actual field work on a handy notepad then enter the information in a permanent field notebook later. A good field notebook should allow someone else to reconstruct where you went and what you did on a particular day.

Appropriate maps.

Compass.

Field forms.

Clipboard.

Pencils.

Field guides (if necessary).

Camera with flash, capable of close focus (optional).

Yard/meter stick to measure water depth.

Thermometer to measure air and water temperature.

100 foot (or more) **plastic tape** to measure pool size.

A small **knapsack** to carry a notepad, guides, camera, containers etc. This keeps everything organized and ready to go.

DETERMINING DISTANCES

Pacing is a simple but effective method for finding how far it is from one point to another with no equipment. A pace is a double step, e.g., right, left, right. With pacing, you can measure the pool's dimension and find the distance from the road to your pool or from a permanent landmark to your pool.

Most people's pace will be approximately five feet. For our purposes, this should be accurate enough for certification purposes. For tall people one pace will be closer to six feet; for shorter folks, a little less than five feet.

If you would like to more accurately determine the length of your pace, measure a course, 200 feet long, in terrain similar to that you'll be working in. Walk it twice and divide the number of paces it took into 400 feet. Memorize this number.

With practice, you should be able to estimate distances with sufficient accuracy, even in uneven terrain. **Hint:** when walking uphill, your pace will be shorter; compensate by subtracting a few paces from your total. When walking downhill, your pace will be longer; compensate by adding a few paces to your total.

HOW TO PHOTOGRAPH AMPHIBIANS AND REPTILES

These guidelines are provided to help you take identifiable photographs of amphibians and reptiles. Though snakes and turtles are not vernal pool indicator species, they may be encountered. Photographs of any amphibian or reptile are encouraged.

Know the limitations of your camera. Fixed focus (point and shoot) cameras cannot focus closer than three or four feet. Read your instruction manual to be sure. Some slightly blurry pictures will work, but most will not. The best option is a reflex camera with a macro lens or extension rings behind a regular lens. A flash greatly increases your chances of getting a useful photograph. Take two or three pictures and submit the best.

To get a good, recognizable photograph you might need to handle a specimen. Pictures of an animal in the hand are perfectly acceptable. Handle animals carefully; keep your hands moist, keep the animal cool, be careful of a salamander's tail – it can easily detach. Work quickly, do not detain the animal longer than necessary.

FROGS: Virtually all frogs can be identified by a 3/4 view, where you are slightly above and off to one side of the animal. This view will show most identifying features, such as a mask, spots, warts or dorso-lateral folds.

SALAMANDERS: Most salamanders are easily identified from a photograph that is taken directly above them. Since most species are small, try to get as close as your lens will allow. Try to show all legs. It is best to place the salamander on a neutral colored background (a leaf, light bark or backpack) for contrast. A picture of the underside is helpful for identification of some species.

TURTLES: Most of the time a good picture of the top shell (carapace) will suffice. The young of some species of turtles have a different pattern from the adults, so be sure to get a clear shot. A picture of the bottom shell (plastron) is also recommended.

SNAKES: As a group, snakes have a wide variation in colors and patterns, even within members of the same species. Hatchling and juvenile snakes can be dramatically different from adults in color and pattern, and some species have various color morphs as adults. It is best to photograph from above from as close (and safe) a position as possible.

Be sure to include in your field notes the date, location and comments regarding any photographs you take.

N.H. REPTILE AND AMPHIBIAN REPORTING PROGRAM

Contribute to RAARP! The N.H. Reptile and Amphibian Reporting Program is a multi-year project set up to collect accurate information on the distribution and occurrence of reptiles and amphibians state-wide. Since the program began, participants have submitted over 4,633 observations from 217 towns. Though knowledge of New Hampshire's reptiles and amphibians has improved greatly, it remains incomplete and spotty.

Use the form below to report sightings of ANY reptile or amphibian, rare or common, seen in New Hampshire in any habitat. Make copies as needed or obtain a complete RAARP information packet and additional reporting forms from the Nongame and Endangered Wildlife Program, N.H. Fish and Game Department, 11 Hazen Drive, Concord, NH 03301; (603) 271-5859.

NEW HAMPSHIRE REPTILE AND AMPHIBIAN REPORTING PROGRAM (RAARP)

Species:_____ ❑ seen ❑ heard

Date/time: _____ photo taken*: Y N

Age: ❑ adult ❑ young ❑ larva/tadpole ❑ eggs Sex: M F Unk

Number: ❑ one ❑ #_____ ❑ too many to count

Town:_____ Waterbody:_____

Specific location:_____

Habitat description and characteristics used to ID species: Use back of slip

Observer: Name _____ Phone:_____

Address_____

email address _____

Send sightings to:

NHFG – Nongame Program, 11 Hazen Drive, Concord, NH 03301
email: wilddiv@wildlife.state.nh.us

*Maps and photos may be required for rare species validation.

NEW HAMPSHIRE REPTILE AND AMPHIBIAN REPORTING PROGRAM (RAARP)

Species:_____ ❑ seen ❑ heard

Date/time: _____ photo taken*: Y N

Age: ❑ adult ❑ young ❑ larva/tadpole ❑ eggs Sex: M F Unk

Number: ❑ one ❑ #_____ ❑ too many to count

Town:_____ Waterbody:_____

Specific location:_____

Habitat description and characteristics used to ID species: Use back of slip

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email address _____

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*Maps and photos may be required for rare species validation.

NEW HAMPSHIRE AGENCIES AND ORGANIZATIONS TO CONTACT FOR INFORMATION REGARDING VERNAL POOLS

Nongame and Endangered Wildlife Program
NH Fish and Game Department
11 Hazen Drive
Concord, NH 03301
(603) 271-2462

Audubon Society of New Hampshire
Wetlands and Wildlife Department
3 Silk Farm Road
Concord, NH 03301-8200
(603) 224-9909

NH Wetlands Bureau
Department of Environmental Services
PO Box 95
29 Hazen Drive
Concord, NH 03302-0095
(603) 271-2147

NH Office of State Planning and Energy Programs
2-1/2 Beacon Street
Concord, NH 03301
(603) 271-2155

NH Association of Natural Resource Scientists
PO Box 110
Concord, NH 03302
info@nhanrs.org

Harris Center for Conservation Education
341 Kings Highway
Hancock, NH 03449
(603) 525-3394

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NOTES