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# GUIDE TO VERMONT VERNAL POOL MONITORING PROJECT

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**VERMONT CENTER  
FOR ECOSTUDIES**

Uniting People and Science for Conservation

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# VERMONT VERNAL POOL MONITORING PROJECT

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Liza Morse  
ECO AmeriCorps  
Vermont Center for Ecostudies  
PO Box 420  
Norwich, VT 05055

Steve Faccio  
Vermont Center for Ecostudies  
PO Box 420  
Norwich, VT 05055



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**For additional copies of this manual, please contact:** [info@vtecostudies.org](mailto:info@vtecostudies.org)

**For more information, please see:**

<https://vtecostudies.org/projects/forests/vernal-pool-conservation/vermont-vernal-pool-monitoring-project/>

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# CHAPTER I

## INTRODUCTION TO VERMONT VERNAL POOL MONITORING PROJECT

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### What is a Vernal Pool?

Vernal pools are defined by the Vermont Wildlife Action Plan as:

*“ . . . small, open-water wetlands that are filled by rain and snowmelt in spring or fall and are typically dry during the summer months. Such a pool is usually contained within a small forested basin, has no permanent inlet or outlet, and does not support predaceous fish.*

*Forested swamps may also contain vernal pools in small depressions. During particular wet growing seasons, temporary pools may persist without drying completely. Years of filling and drying result in a unique set of*

*conditions that supports a variety of wildlife specialized to take advantage of these conditions. Vernal pools are often rich in unique insects, molluscs, and other invertebrates, as well as amphibians. When conditions are favorable, vernal pools are often used by mole salamanders and Wood Frogs for breeding.”*



VERNAL POOL IN NORWICH, VT

### Intro to VPMon

Vernal pools provide critical habitat for a diverse assemblage of wildlife and yet remain poorly understood in the face of an uncertain future, due to climate change, airborne pollutants, and development. VPMon or the Vermont Vernal Pool Monitoring Project, is a citizen-science project managed by the Vermont Center for Ecostudies, with support from the ECO AmeriCorps program. The Project builds upon the work of scientists and volunteers with the Vermont Vernal Pool Mapping Project, a collaboration

#### Citizen science

The Cornell Lab of Ornithology, an organization with numerous citizen science-based projects, defines citizen science as “projects in which volunteers partner with scientists to answer real-world questions.” They describe citizen science efforts typically as collaborations between scientists and volunteers which expand the capacity for scientific data collection and provide access to scientific information for community members.

*“Cornell Lab of Ornithology.” Defining Citizen Science - Citizen Science Central, [www.birds.cornell.edu/citscitoolkit/about/definition](http://www.birds.cornell.edu/citscitoolkit/about/definition).*

which used aerial photography to identify potential vernal pools throughout Vermont, and continues to rely on volunteers to field verify said pools. VPMon, which piloted in the spring of 2018, relies on the efforts of volunteers to visit designated vernal pools on an annual basis and record information on water quality, vernal pool species, and surrounding habitat. The project’s overall goals are to:

- Build a base of knowledge regarding the state of vernal pools in Vermont
- Raise awareness about the value of vernal pools by involving the public in vernal pool monitoring
- Advance vernal pool conservation planning at the state and local levels

## VPMon Manual

The goal of this manual is to assist trained VPMon citizen scientists with the process of vernal pool monitoring. This manual will assist you with VPMon protocols and with distinguishing between vernal pool species. The proper training as well as the use of this manual help to ensure that the data reported by VPMon volunteers is accurate, thereby ensuring the credibility of the project data.

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# CHAPTER II

## GUIDE TO VERNAL POOL SPECIES

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### **Wood Frog (*Lithobates sylvatica*)**

**Description:** Has dark patch, the “robber’s mask,” usually brown, extending back from each eye. Dark line of the same color usually runs

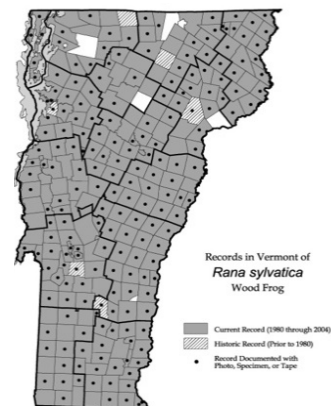


from the front of the eye to the snout. Background color varies from light tan (usually in summer), to dark brown, to rust (especially in spring). Two pronounced ridges are present on each side of the back. Widely distributed in Vermont.

**Size:** Adults range in size from 1.5 to 3 inches.

Females are larger than males. Newly transformed juveniles are about ½” in length and are faithful miniatures of the adults regarding color and markings.

**Call:** Courting males make a hoarse, duck-like quack. They are explosive breeders and may only call for 7-10 days.





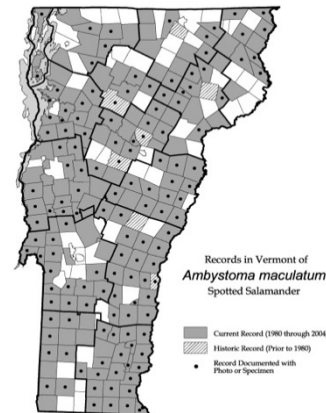
## Spotted Salamander (*Ambystoma maculatum*)

**Description:** Gray brown to blue-black with two irregular rows of bright yellow spots on each side. Underside is lighter, typically slate gray. Mostly found below ground (hence the name “mole salamanders”), often in shrew or other small mammal burrows. They also seek refuge under leaf-litter, rocks, logs, and other coarse woody debris. Move to breeding pools (along with Wood Frogs) during evening rains, often before snow has completely melted. Widely distributed in Vermont.



**Size:** The largest of our 3 mole salamanders, adults are up to 6 to 9 inches long, sometimes larger. Females are usually larger than males.

*The Spotted Salamander has been designated as a “Medium Priority Species of Greatest Conservation Need” in VT.*



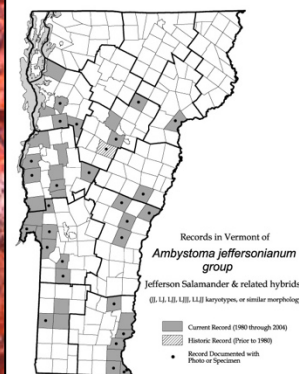
## Jefferson Salamander (*Ambystoma jeffersonianum*)

**Description:** A chunky, charcoal-gray to brown salamander with tiny white flecks on the belly and lower sides. The head and snout are wider and longer in this species than in the Blue-spotted Salamander. Hybrids (see bottom) may have more flecking. Usually the first amphibian to arrive at breeding pools sometimes a week before Wood Frogs and Spotted Salamanders. Found locally in low- to mid-elevation foothill regions of the state. Breed primarily in ridgetop vernal pools.



**Size:** Adults range from 5-7 inches.

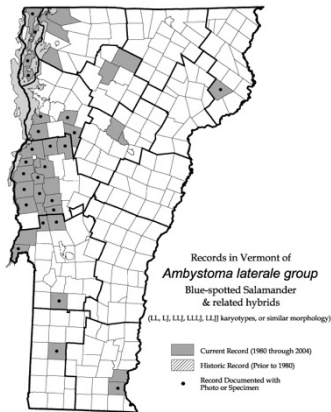
*The Jefferson Salamander has been designated as a “High Priority Species of Greatest Conservation Need” in VT.*



## Blue-spotted Salamander (*Ambystoma laterale*)

**Description:** Dark-colored, slender salamander marked with irregular blue or bluish-white flecks on the sides of the body and tail. Coloration is reminiscent of old enamelware pots. The head is narrow and tapers to a rounded snout. Hybrids (see bottom) tend to be chunkier and browner. Found at lower elevations, primarily in the Champlain

lowlands, with scattered populations elsewhere. Will breed in marshes, swamps, beaver ponds, as well as vernal pools.



**Size:** Breeding adults range from 3.5-5 inches. Hybrids may grow to 7 inches.

*The Blue-spotted Salamander has been designated as a “Medium Priority Species of Greatest Conservation Need” in VT.*



**Jefferson/Blue-spotted Complex** – Hybrid populations between these 2 species appear widespread in Vermont. Physical appearance is highly variable along a gradient from pure Blue-spotted to pure Jefferson, depending on the species to which they are more closely related. This often makes identification difficult.

*Distribution maps courtesy of the Vermont Reptile and Amphibian Atlas –www.vtherpatlas.org*



**Fairy Shrimp** (*Eubbranchipus* species are most common)

Among invertebrate vernal pool indicator species, fairy shrimp are the most easily observed and identified. While several hundred species are known world-wide, at least two species are found inhabiting New England vernal pools. Across Vermont and northern New England, the Knob-lipped Fairy Shrimp (*Eubbranchipus bundyi*) appears to be most common, while to our south the Vernal Fairy Shrimp (*E. vernalis*) is more widespread.

Although little is known about the distribution of the Knob-lipped Fairy Shrimp in Vermont, it appears to be most common in clear, clean

woodland pools, and rarely found in roadside pools impacted from run-off, or those located in fields or other open habitats.

**Description:** While the different species of fairy shrimp vary somewhat in size, color, and shape, all are easily recognized by their combination of stalked eyes, “upside-down” swimming behavior, and orange, reddish, or bronze coloration. The reddish-orange Knob-lipped Fairy Shrimp is most often seen in early spring, shortly after ice-out. Females can be recognized by paired egg sacs located just behind their feathery legs, while mature males appear to have enlarged heads due to the presence of claspers—modified antennae used to grasp females during mating. These small crustaceans typically swim slowly, propelled



Fairy Shrimp male (top) and female (bottom).  
Photos: Vernal Pool Assoc., www.vernalpool.org

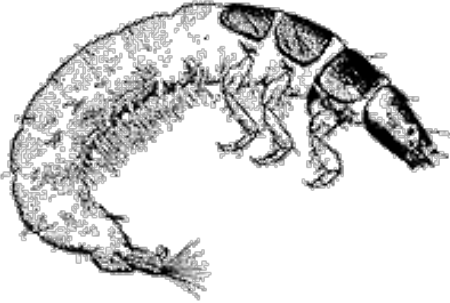


by their rhythmically beating abdominal appendages. From a distance they may look like tiny fish.

**Size:** Length ½ to 1 inch.

### **Caddisfly (Order *Trichoptera*)**

**Description:** Caddisflies are aquatic as larvae and pupae. Larvae are typically found in vernal pools around 1–3 d after flooding. The larvae have three pairs of legs; elongate, cylindrical bodies; soft, thin-skinned abdomens; a thickened head; and a hardened plate on the first thoracic segment. A pair of prolegs, each with a claw-like hook, is found at the end of the abdomen. Caddisfly larvae are easily recognized by the cases they build with silk and either pebbles, sticks, or leaves. These cases allow larvae to create water currents that increase oxygen flow in non-flowing aquatic environments. Adult caddisflies, which are not aquatic, emerge in late spring or early summer, depending on the species.



Drawing: Vermont  
Department of Environmental Conservation

**Size:** Varies depending on the species. Larvae rarely exceed an inch in length.





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# CHAPTER III

## GUIDE TO EGG MASS IDENTIFICATION

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### Egg Mass Identification

**Wood Frog** – Each female frog deposits a single egg mass, which lacks a surrounding gelatinous matrix, giving it a lumpy appearance (right). The embryos are dark on top (to absorb heat) and light below (to reduce predation). Those in the middle of the mass are warmest and hatch first. Soon after being deposited, the clear jelly capsules surrounding each egg absorb water and the ping-pong ball-size clutch expands to the size of a baseball. Egg masses may become greenish from a symbiotic algae.



Expands to the size of a baseball. Egg masses may become greenish from a symbiotic algae.

**Where:** Free-floating or attached to twigs just below the surface. Isolated individual clutches are occasionally seen, but most are deposited in large communal masses which are often confined

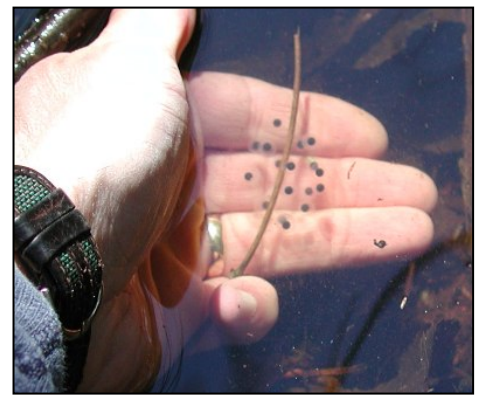
to a single area of the pool and may consist of more than 100 masses. As the eggs develop, communal deposits look like a lumpy sheet. Eggs hatch in 3-6 weeks, depending on water temperature (warmer water speeds development).

**Spotted Salamander** – Egg masses are oval, elongate, or kidney-shaped. Unlike other egg masses, the outer jelly matrix is very firm, like set gelatin, and is either clear, opaque white, or may become green from a symbiotic algae. Embryos are 2.5-3 mm in diameter, and the vitelline membrane (the cloudy halo around each embryo) is the width of the embryo. Egg masses may contain from 30 to 250 individual eggs, and range from 2 inches in diameter up to baseball-size.



**Where:** Egg masses are usually attached to sticks, weeds, grasses, or reeds within 8-10 inches of the surface, occasionally much deeper, and hatch in 4-8 weeks depending on water temperature.

**Jefferson Salamander Complex** – Egg masses of Jefferson Salamanders and their associated hybrids tend to be cylindrical or cigar-shaped, and much smaller than those of the Spotted Salamander. The outer jelly matrix (which is looser than jello), is clear, making the egg masses difficult to see in the water. The vitelline membrane (the cloudy halo surrounding each embryo) is very thin, while in the Spotted Salamander the vitelline membrane is the width of the embryo.



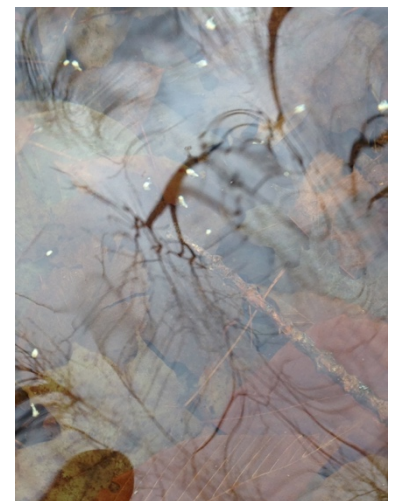
**Where:** Eggs are typically attached to sticks or grasses, and the approximately 1- to 3-inch long egg mass may contain from 5 to 30 embryos. Incubation length and larval stage are similar to Spotted Salamander.

**Blue-spotted Salamanders** and their hybrids typically lay eggs singly in loose sheets on the pool bottom, or in small, “drippy” masses of 2-5 eggs, sometimes attached to sticks. They can be very difficult to see. As with the physical characteristics of the hybrid salamanders, their egg masses may also vary in appearance, depending on the proportion of Jefferson vs. Blue-spotted genes present.



BLUE-SPOTTED SALAMANDER EGG MASS

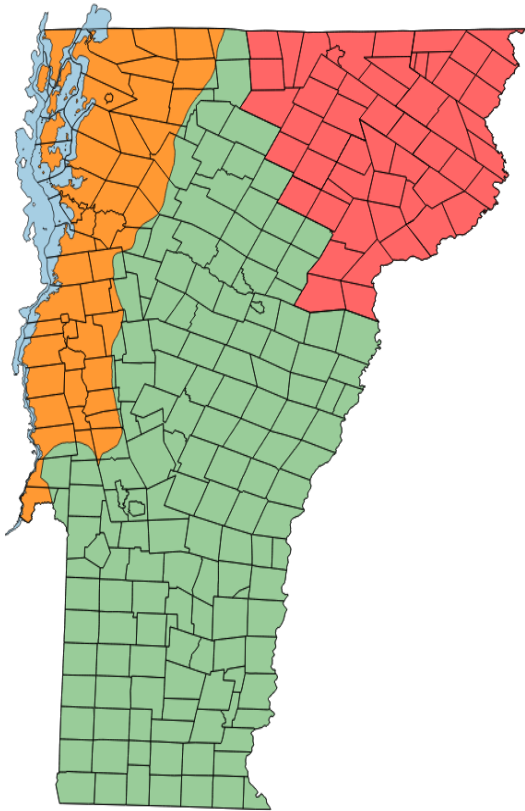
**Spermatophores** are packets of sperm deposited by the male salamander. Female salamanders take the spermatophores up into their bodies and fertilization occurs internally.



SPERMATOPHORES IN A VERNAL POOL PHOTO: KATE BUCKMAN

## Egg Mass Survey Timing

The timing for egg mass surveys of pool-breeding amphibians vary according to geography, elevation and weather. For guidance on timing, VPMon citizen scientists can use our Egg Mass Survey Timing Guide (below). It is important to note that these dates are guidelines. VPMon citizen scientists should rely on local conditions as the definitive determinate of survey timing. For wood frog egg mass surveys, ideal conditions for wood frog breeding are indicated by a spring warm up following ground thaw. For salamanders, ideal conditions are determined by nighttime rainfall events at temperatures of 42°F or higher.



## TIMING GUIDE

\*As conditions may vary annually and locally, VPMon citizen scientists can use these dates as guidelines while using local conditions as the definitive determinate of survey timing.

\*\* Survey timing should be delayed from the general Vermont dates by ~10 days in a dry spring, in shaded sites or sites on north facing slopes, at sites >3,000 feet in elevation, or during late snow melt or in a spring with deep snow.

Optimal times for counting egg masses of pool-breeding amphibians vary according to geography, elevation and weather. Egg mass surveys should happen following snow-melt and will generally fall between mid-April and late-May, though exact dates will depend on local conditions. Egg mass counts are generally best conducted just past the peak breeding period. For wood frogs, this occurs approximately 1 to 2 weeks after full chorus. Salamanders have a more extended breeding period and their eggs do not hatch as quickly as wood frogs. Therefore, surveys to count salamander eggs should be conducted slightly later in the breeding season, generally 2-3 weeks following wood frog egg counts. Suitable conditions for wood frog breeding are indicated by a spring warm up following ground thaw, and for salamanders, nighttime rainfall events at temperatures of 42°F or higher.

		SPECIES	RANGE		TYPICAL PEAK	
VERMONT (General)	WOOD FROG	April 1	May 9	April 11	April 29	
	SPOTTED SALAMANDER	April 18	Mid-June	April 19	May 22	
	JEFFERSON/BLUE-SPOTTED SALAMANDER	April 4	May 23	April 11	April 24	
CHAMPLAIN VALLEY	WOOD FROG	March 22	April 29	April 1	April 19	
	SPOTTED SALAMANDER	April 8	Early June	April 9	May 12	
	JEFFERSON/BLUE-SPOTTED SALAMANDER	March 25	May 13	April 1	April 14	
NORTHEAST KINGDOM	WOOD FROG	April 11	May 19	April 22	May 9	
	SPOTTED SALAMANDER	April 28	Late June	April 29	June 2	
	JEFFERSON/BLUE-SPOTTED SALAMANDER	April 14	June 3	April 21	May 4	



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# CHAPTER IV

## GUIDE TO VERNAL POOL MONITORING

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### Overview

The Vermont Vernal Pool Monitoring Project requires that each pool monitored for the project is monitored by at least two volunteers on an annual basis. Two volunteers are needed to increase the likelihood of detection, or detection probability, of egg masses. This double-observer method helps increase the detection of egg masses which can be missed for a variety of reasons, from murky water to misidentification of an egg mass by the observer. By increasing detection, two volunteers ensure that the egg mass counts for a given pool are as close to the actual number of egg masses present as possible.

Volunteers will visit the pool 4 times over the course of the season. One volunteer will visit the pool prior to the first “big night” of the season – when amphibians migrate to vernal pools to breed – to mount the acoustic monitor and take some measurements. VPMon citizen scientists should rely on local conditions to estimate the date of the first “big night” of the season. For the first “big night” some snow may be present but some bare ground in combination with a warm rainy night are necessary for migration.

For the second and third field visits, both volunteers will visit the pool on a day within the wood frog breeding period and one day within the salamander breeding period. At the end of the summer, one volunteer will retrieve the acoustic monitor and the HOBO temperature logger (if the volunteer does not have the HOBOMobile app). More detailed protocols, as well as a guide for monitoring dates are included in this chapter.

### VPMon Field Schedule

Listed below is the schedule for the VPMon field season as well as the data to be collected and protocols to be followed at each field visit. For a detailed description of each of the field protocols listed, see the “VPMon Protocols” section of the manual.

#### **1<sup>st</sup> Field Visit**

Timing: Prior to 1<sup>st</sup> “big night” of season

Purpose: Deploy acoustic monitors at pool site & collect initial data

Volunteers needed: 1

VPMon Protocols:

- Egg Mass Surveys – if any open water is present on pool
- Amphibian Diseases
- Fairy Shrimp Survey – if any open water is present on pool
- Caddisfly Larvae Survey (ice present on pool)
- Water temperature
- Water level

- Weather

### **2<sup>nd</sup> Field Visit**

Timing: Wood Frog breeding period (see Timing Guide)

Purpose: Egg mass surveys and other data collection

Volunteers Needed: 2

VPMon Protocols:

- Egg Mass Surveys
- Amphibian Diseases
- Fairy Shrimp Survey
- Caddisfly Larvae Survey
- Water Temperature
- Water Level
- Weather

### **3<sup>rd</sup> Field Visit**

Timing: Salamander breeding period (see Timing Guide)

Purpose: Egg mass surveys and other data collection

Volunteers Needed: 2

VPMon Protocols:

- Egg Mass Surveys
- Amphibian Diseases
- Fairy Shrimp Survey
- Caddisfly Larvae Survey
- Physical Parameters (water temperature, water level & vegetation)
- Weather

### **Final Field Visit**

Timing: Following October 1<sup>st</sup> but prior to snowfall

Purpose: Collect acoustic monitors and HOBO logger (if volunteer does not have HOBOMobile app), check batteries on HOBO logger

Volunteers Needed: 1

VPMon Protocols:

- Water level (if water present in pool)

### **Data submission**

Timing: Between field seasons

Purpose: Submit photos, acoustic, and temperature data

## **VPMon Prerequisite: Vernal Pool Mapping**

If the pool you are monitoring has already been mapped, you do not need to fill out the Vernal Pool Mapping Data sheet. However, if your pool has not yet been mapped, please complete the Vernal Pool

Mapping Data sheet according to the Vernal Pool Mapping Project instructions. You can find data sheets and instructions at:

<https://vtcostudies.org/projects/forests/vernal-pool-conservation/vermont-vernal-pool-mapping-project/volunteer-materials/>

Once the pool has been mapped, you do not need to document the information included in that sheet on every visit. Simply note if any changes have occurred from year to year. For example, if agriculture was not noted near the pool when the pool was first mapped, but then you find that a farmer is growing crops close to the pool, you should note that on your Vernal Pool Monitoring Data sheet.

## VPMon Protocols

This section describes all of the field protocols used in VPMon. For instructions on how to fill out the VPMon data sheet and for an example data sheet, see Appendix B.

### Physical Parameters:

#### *Ice Out*

If on your first field visit to deploy the acoustic monitors, some of the pool has open water, record the percentage of the pool that is open water.

#### *Water Temperature*

Water temperature will be measured using the Onset HOBO® Bluetooth Pendant Temperature Data Logger. To download water temperature data, see the VPMon Equipment Guide under Appendix A. On each field visit, note whether or not you downloaded the temperature data. If you were unable to download the data, explain why in the notes section under “Physical Parameter Notes.” This helps us know whether or not volunteers are having technical difficulties with the loggers or if they simply do not have the app.

#### *Water Level*

Use the marked PVC pipe to measure the water level of the pool. Instructions on when and how to install the PVC pipe in the pool can be found in the “VPMon Equipment Guide” section of Appendix A. Markings are spaced 5 cm apart. If the water level falls between markings, round up or down to the nearest mark. On your first visit to install the PVC pipe you will need to measure the water level using a measuring tape or meter stick. If on your final (4th) field visit to download HOBO logger data the pool still contains water, record the water level and submit that along with your data sheets.

#### *Vegetation*

On your 3<sup>rd</sup> field visit, use the following scale (Figure 1) to estimate percent cover for each of the following categories: submerged aquatic vegetation, floating, emergent vegetation, shrubs, and trees. Percent cover should account for any vegetation that covers or shades the pool (ie tree canopy) whether or not the vegetation emerges from the pool itself. If trees and other vegetation are not fully leafed out, simply estimate actual percent cover but do not attempt to predict percent cover under full leaf out.



Scale	Percent Cover
0	0
1	1-10
2	11-25
3	26-50
4	51-75
5	≥76

FIGURE 1 - PERCENT COVER OF VEGETATION

Weather:

Record any precipitation or lack thereof at time of monitoring. If the weather changes during monitoring, record that as well.

*Air Temperature & Humidity*

Use the ThermoPro TP60 Digital Hygrometer Indoor Outdoor Thermometer Humidity Monitor with Temperature Gauge Humidity Meter, Wireless Outdoor Hygrometer to measure air temperature and humidity. Place the ThermoPro and it’s remote sensor on opposite sides of the pool at the beginning of the field visit, avoiding areas of direct sunlight and making sure both are within 200 feet of one another. Prior to departing the field at the end of the visit, record both temperature readings and humidity readings (listed as IN and OUT on the digital screen).

*Wind*

Record wind speed according to the Beaufort Scale (see Figure 2). The Beaufort Scale is a way of estimating wind strength according to the appearance on land or sea.

Beaufort Force	Description	When You See or Feel This Effect	Wind (mph)	Wind (km/h)
0	Calm	Smoke goes straight up	< 1	< 2
1	Light air	Wind direction is shown by smoke drift but not by wind vane	1-3	2-5
2	Light breeze	Wind is felt on the face; leaves rustle; wind vanes move	4-7	6-11
3	Gentle breeze	Leaves & small twigs move steadily; wind extends small flags straight out	8-12	12-19
4	Moderate breeze	Wind raises dust & loose paper; small branches move	13-18	20-29
5	Fresh breeze	Small trees sway; waves form on lakes	19-24	30-39
6	Strong breeze	Large branches move; wires whistle; umbrellas are difficult to use	25-31	40-50
7	Moderate gale	Whole trees are in motion; walking against the wind is difficult	32-38	51-61

FIGURE 2 - BEAUFORT SCALE. [HTTPS://WWW.ALMANAC.COM/CONTENT/HOW-MEASURE-WIND-SPEED-BEAUFORT-WIND-FORCE-SCALE.](https://www.almanac.com/content/how-measure-wind-speed-beaufort-wind-force-scale)

## Amphibian Monitoring

### *Acoustic Monitoring*

Acoustic monitoring for frog chorusing will enable us to assess the phenology, or annual timing, of frog breeding. Monitors must be deployed prior to frog chorusing in order to capture the first date of frog chorusing. Frog chorusing occurs on what are known as “big nights” where male Wood Frogs migrate en masse to vernal pools and begin chorusing to attract mates. Ideal conditions for a “big night” are an evening rain, temperatures of 40 degrees Fahrenheit or above, and some bare ground present in the area. If warm rains occur but there is still a significant snowpack on the ground, a “big night” is unlikely. To be safe, we recommend that volunteers deploy their acoustic monitors prior to ice out, when open water is first present in their pool. Further information on assembling and deploying the acoustic monitor can be found in Appendix A.

### *Egg Mass Surveys*

1<sup>st</sup> Field Visit – if some open water is present on pool:

If pool is thawed or partially thawed, estimate the percentage of the pool thawed. Of the percentage thawed, estimate the proportion of your search area that is visually impaired due to water depth, surface reflection, particulate matter, algae, etc. and record visibility impairment according to the scale found in Figure 3. Search the open area(s) of the pool for signs of breeding. Count any egg masses visible within the open water area. Binoculars may be helpful for counting and identifying egg masses far from the edge of the pool. For every species recorded as having egg masses present in the pool, one egg mass should be photographed and submitted to the VPMon iNaturalist project. For instructions on submitting to iNaturalist, see the Data Submission section in Appendix A. For help identifying egg masses, see Chapter III: Guide to Egg Mass Identification. Note whether there are spermatophores (see “Guide to Egg Mass Surveys”) present within the open water areas. If spermatophores are present, one photograph documenting the spermatophores should be taken and submitted to the VPMon iNaturalist project.

2<sup>nd</sup> & 3<sup>rd</sup> Field Visits:

For egg mass surveys, both volunteers assigned to a given pool will visit that pool on a day within the wood frog breeding period and on a day within the salamander breeding period. For each egg survey day (for wood frogs and then for salamanders), the volunteers may visit the pool independently or together but must both visit the pool but on the same day. Volunteers will be using what is called a double-observer independent protocol. This means that both volunteers will do a survey but that surveys will be independent from one another.

How to survey:

To survey the pool, mark the starting point and walk the entire perimeter of the pool. While walking the perimeter, record every egg mass by species within one meter of pool’s edge on the data sheet. If Wood Frog egg masses have formed into a mat/raft and are uncountable, record the estimated dimensions of the raft in meters in the “Amphibian/Macroinvertebrate Notes” section. Also note the proportion of your search area that is visually impaired due to water depth, surface reflection, particulate matter, algae, etc. and record visibility impairment using the scale in Figure 3. Also note whether or not you used polarized glasses, however your estimates of visual impairment level not be conducted while using polarized glasses. The use of polarized glasses for egg mass surveys is strongly recommended.

For every species recorded as having egg masses present in the pool, one egg mass should be photographed and submitted to the VPMon iNaturalist project. For instructions on submitting to iNaturalist, see the Data Submission section in Appendix A. Egg masses for all species present should be recorded whether or not you are visiting the pool during the wood frog breeding period or the salamander breeding period. For help identifying egg masses, see Chapter III: Guide to Egg Mass Identification.

If volunteers are visiting the pool independently, there are no special precautions that need to be taken when surveying for egg masses except that the first volunteer to survey the pool should not share their findings with the second volunteer until after the second volunteer has completed their survey. If volunteers visit the pool together, counts need to be conducted independently and separately – when one volunteer is counting, the other should not be watching. This is very important to avoid biasing the second observer’s counts.

Code	Description
0	<b>Clear</b> (Survey area not visually impaired)
1	<b>Slightly impaired</b> (<25% survey area visually impaired)
2	<b>Impaired</b> (25-50% survey area visually impaired)
3	<b>Severely Impaired</b> (>50% survey area visually impaired)

FIGURE 3 - VISUAL IMPAIRMENT LEVEL IN VERNAL POOL

### *Spermatophores*

At each field visit, note whether or not you observed spermatophores during your egg mass survey. If you find spermatophores, take a photograph for submission to the VPMon iNaturalist project. For help identifying spermatophores, see Chapter III: Guide to Egg Mass Identification.

### *Amphibian Diseases*

In the event that you see any of the following signs of amphibian diseases, write down and photograph observed symptoms as well as identify the species affected. If you are unable to identify the species affected, write “unknown” and be sure to take sufficient photos to enable the project biologist to determine the species affected.

Disease	Background	Signs/What to Look For
Salamander Chytrid (Batrachochytrium salamandrivorans/Bsal)	<ul style="list-style-type: none"> <li>• Occurrence unknown in the U.S.; High global concern due to risk of import through pet trade</li> <li>• Susceptibility of species in NE unknown</li> </ul>	<ul style="list-style-type: none"> <li>• Symptoms include skin lesions and deformities</li> </ul>
Ranaviruses (Rv)	<ul style="list-style-type: none"> <li>• Can infect amphibians as well as reptiles and fish</li> <li>• Usually occurs in larvae and metamorphs</li> </ul>	<ul style="list-style-type: none"> <li>• dead and/or decomposing individuals in dipnet, along pool edge, or on pool surface or bottom</li> </ul>



	<ul style="list-style-type: none"> <li>• Hundreds of sick/dead individuals may be observed at affected sites over a brief period (1-5 days)</li> <li>• Mass mortality events have been documented in NE</li> </ul>	<ul style="list-style-type: none"> <li>• individuals with extensive reddening (hemorrhaging) on underside, especially at base of legs and at vent</li> <li>• swelling (edema) in body and legs</li> </ul>
Chytrid fungus (Batrachochytrium dendrobatidis/Bd)	<ul style="list-style-type: none"> <li>• Kills frogs and toads within 2-3 weeks of metamorphosis, occasionally lethal in adult newts</li> <li>• Die-offs gradual, rarely more than two dead frogs or toads found at a site</li> <li>• Has been detected in the region; No documented instances in NE of mass mortality</li> </ul>	<ul style="list-style-type: none"> <li>• Adults: skin abnormalities, extended back legs, lethargy, loss of righting reflex</li> <li>• Larvae: <b>infection is non-lethal</b>; jaw sheaths and tooth rows lack pigment or appear deformed</li> </ul>
Perkinsus-like Organism	<ul style="list-style-type: none"> <li>• Kills Ranid tadpoles, rarely other species</li> <li>• Dieoffs may proceed for weeks in a pool</li> <li>• Often causes &gt;90% mortality</li> <li>• Has been detected in the region</li> </ul>	<ul style="list-style-type: none"> <li>• Dead, floating tadpoles</li> <li>• Enlarged light yellow liver/spleen (left, above)</li> <li>• Abdominal distention (right, above)</li> </ul>
Ichthyophoniasis	<ul style="list-style-type: none"> <li>• Infects newts, larval Ranids, adult Ranids</li> <li>• Slight to severe infection of skeletal muscle</li> </ul>	<ul style="list-style-type: none"> <li>• “swollen rump” in recently</li> <li>• Metamorphosed frogs</li> </ul>

### Macroinvertebrate Surveys

Macroinvertebrate surveys do not use a double-observer protocol and can be completed by one VPMon volunteer. The use of polarized glasses while surveying is strongly recommended.

### *Fairy Shrimp Survey*

Fairy shrimp typically hatch shortly after ice-out of vernal pools. For more information on Fairy Shrimp see the “Guide to Vernal Pool Species” section of this manual.

1<sup>st</sup> Field Visit – if some open water is present on pool

Within the open water portion of the pool, count the number of fairy shrimp present to the best of your ability.

## 2<sup>nd</sup> and 3<sup>rd</sup> Field Visit:

Using a tape measure or walking stick marked at a meter in length, survey a square meter area at each of the cardinal directions (or estimated cardinal directions) around the pool. In “Square 1” on your data sheet, record the count for the northern sample square and make your way clockwise around the pool, recording your counts until you finish with “Square 4” to the west. If there are fairy shrimp present in each of your square meter samples, count all fairy shrimp present to the best of your ability. If you observe fairy shrimp, take a picture for submission (see Appendix A for data submission instructions). Polarized glasses are a strongly recommended tool that can help reduce glare on the water’s surface and increase one’s ability to see into the pool.

## *Caddisfly Larvae Survey*

Same as the Fairy Shrimp survey protocol. For more information on Caddisflies, see the “Guide to Vernal Pool Species” section of this manual.

## Decontamination

While our protocols minimize wading in the pool itself, it is never a bad idea to decontaminate one’s gear (boots, etc.) following field monitoring. However, it is imperative that you decontaminate gear between pools if you are moving from pool to pool. Decontamination is an important measure to reduce the spread of diseases and pathogens that impact amphibian populations, namely Chytrid fungus (*Batrachochytrium dendrobatidis*) and Ranavirus. To prevent the spread of these pathogens, gear should be decontaminated using 3% bleach solution. Most household bleach is a 6% bleach solution. To make a 3% bleach solution use 1 part household (6%) bleach to 32 parts water. Diluted bleach solutions should be discarded after 5 days, so only prepare as much solution as you will need for that day. When decontaminating gear between pool visits on the same day, do not bleach anywhere near a drainage, vernal pool, or other aquatic environment.

### Disinfection procedure:

- 1) Thoroughly Scrub and Rinse all equipment, including boots
- 2) Liberally spray Bleach solution on all equipment, including rubber boots and allow 5 minutes
- 3) Thoroughly Rinse again all equipment

### Suggested equipment:

- 3% bleach solution
- Brushes for scrubbing and/or removing mud and vegetation from equipment.
- Hand sanitizers and antiseptic alcohol wipes.
- Handheld bottles and/or pump sprayers for applying bleach and water. Bring clean rinse water.
- Trash bags to carry home disinfected equipment
- Prepare additional sets of equipment if sampling at multiple locations or repeat this procedure between sites

### **Additional Information on amphibian and reptile diseases:**

<http://amphibiaweb.org/declines/diseases.html>

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# REFERENCES

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“Cornell Lab of Ornithology.” *Defining Citizen Science - Citizen Science Central*, [www.birds.cornell.edu/citscitoolkit/about/definition](http://www.birds.cornell.edu/citscitoolkit/about/definition).

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“The IUCN Red List of Threatened Species.” *The IUCN Red List of Threatened Species*, [www.iucnredlist.org/](http://www.iucnredlist.org/).

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# ACKNOWLEDGEMENTS

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This manual and this project wouldn't have been possible without the contributions and advice of many people. Within Vermont Center for Ecostudies, Jason Hill and John Lloyd provided valuable input on study design and statistical analysis. Input and materials such as example data sheets and photos from coordinators and experts involved with other citizen science efforts to monitor and map vernal pools was greatly appreciated, with special thanks to Aram Calhoun, Evan Grant, Adrienne Brand, and Brett Amy Thelen. Thank you to Jeremy Feinberg who shared with us his methods and set up for acoustic monitoring, and to Jim Andrews of the Vermont Reptile and Amphibian Atlas and Rebecca Chalmers of the Vermont Department of Environmental Conservation for their expertise on vernal pools and amphibians in the state of Vermont. A final thank you to our funders – the Vermont Watershed Grants Program and The Lintilhac Foundation – who have contributed our initial funding for the project

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# APPENDIX A

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## VPMon Equipment Checklist

- 5' PVC pipe w/ 5 cm markings (hammer and wood piece for installation)
- Acoustic monitor
  - Olympus DM-720 Digital Recorders
  - Olympus me-52w noise canceling microphone

- Wilcor - Universal Waterproof Cell Phone Pouch Case
- Ratchet strap or zip ties
- Cut 2L soda bottle and cap
- Waterproof caulking or sealant
- Onset HOBO® Bluetooth Pendant Temperature Data Logger
- Zip ties
- Smartphone\*
- ThermoPro TP60 Digital Hygrometer Indoor Outdoor Thermometer Humidity Monitor
- VPMon Data sheets
- Writing utensil for recording data (preferably pencil for in the field)
- Sharpie (for marking PVC pipe)
- Measuring stick or tape, or other way to designate 1 m area
- Polarized glasses (optional, recommended)
- Binoculars (optional; for 1<sup>st</sup> field visit)
- Flagging (optional; to mark starting point for egg mass surveys)
- Camera (if volunteer does not have a smartphone or other phone w/ camera)
- Bleach
- Bucket for bleaching boots

\*Smartphones are very helpful but not required. Instructions included in the equipment guide include instructions for smartphone owners as well as for volunteers without smartphones.

## VPMon Equipment Guide



### *PVC Pipe*

A 5' length of PVC pipe will serve as a marker for measuring pool depth and to anchor the Onset HOBO® Bluetooth Pendant Temperature Data Logger.

#### When to install:

Prior to egg mass surveying in your first season of VPMon, install the PVC pipe in the deepest part of the pool basin. Alternately, visit the pool during summer before your first monitoring season – when the pool is dry (or nearly dry) – and install PVC pipe in the deepest part of the pool basin.

#### How to install in water:

The PVC pipe will come pre-marked with markings spaced 5 cm apart. Place the end labelled “Bottom” on the pool floor in the deepest part of the pool. Place a board on top of the top end of the PVC pipe and hammer the PVC pipe into the pool substrate until the pipe feels secure and one of the markings is even with the water level. Measure the water depth using a tape measure or yard stick



and mark the top marking with that measurement using a sharpie. As the pool dries, you will be able to add numbers to the lower markings on the PVC pipe.

How to install in dry pool basin:

Place the end labelled “Bottom” on the pool floor in the deepest part of the pool. Place a board on top of the top end of the PVC pipe and hammer the PVC pipe into the pool substrate until the pipe feels secure and one of the markings is even with the bottom of the pool. Label the 5 cm spaced markings on the pipe.

### *Acoustic Monitor*

For acoustic monitoring, each pool will be monitored using a recording set-up made-up of a Olympus DM-720 Digital Recorders, a Olympus me-52w noise canceling microphone, a 16GB microSD card, a waterproof pouch and a Lithium AAA battery. Using a Lithium battery rather than a normal Alkaline battery is important because Lithium batteries have a longer battery life. Your recorders will come with a Lithium AAA battery when you receive them, but you will need to purchase Lithium batteries for future years. You will receive the recorder with the batteries and the 16GB microSD card already installed.

Acoustic recorder set-up:

After plugging the external microphone into the digital recorders, the recorders should be placed in a Wilcor - Universal Waterproof Cell Phone Pouch Case. Cut the top off of a 2L soda bottle. Using a hammer and nail or drill with an 1/8” drill bit, make a hole in the bottle cap and install the microphone onto the cut top of the soda bottle (see photo). Using a zip tie or strap, mount the acoustic monitoring setup on a tree near the pool’s north edge, ideally within 10 feet of the pool edge. If a tree is not available at the northern most point of the pool, use the nearest most tree to that point. Mount the microphone as high as you can comfortably reach without climbing the tree and be sure to leave a loop in the cord between the microphone and the recorder to prevent water from running down the microphone’s cord into the recording device. Angle the microphone towards the pool. See photo for an example of the setup.

The following are the proper settings for your acoustic recorder. These settings will be pre-programmed for you by the Project Coordinator prior to receiving your device. However, you will need to turn “Preset 1”, “Preset 2”, and “Preset 3” to “On” in the “Timer Rec” menu on the day that you deploy them in the field. To do this, turn the recorder on using the power button on the left hand side of the recorder. Hit the MENU button just below the recorder’s screen.

If your acoustic recorder needs to be re-set for whatever reasons, use the following settings\* and assistance from the online manual for the Olympus DM-720 Digital Recorder:

<http://cdn.lssproducts.com/downloads/Manuals/DM720.pdf>.

\*Acoustic recorder settings:

Time & Date = Current time and date

Battery = Alkaline

Rec Level = High

VCVA = Ignore

Low Cut Filter = ON

Backlight = OFF

LED = OFF

Contrast = Level 2 or 3

Voice Guide = Off

Beep = On

Power Save = 5 Min

Mic Sense = Conference

Rec Mode = PCM, [48.0kHz/16]

Timer Rec =

- Preset 1
  - On/Off = On
  - Day = Everyday
  - Time = 8 pm – 8:10 pm
  - Rec Mode = PCM, [48.0kHz/16]
  - Folder = microSD card, Folder A
  - Rec Level = High
- Preset 2
  - On/Off = On
  - Day = Everyday
  - Time = 9 pm – 9:10 pm
  - Rec Mode = PCM, [48.0kHz/16]
  - Folder = microSD card, Folder B
  - Rec Level = High
- Preset 3
  - On/Off = On
  - Day = Everyday
  - Time = 10 pm – 10:10 pm
  - Rec Mode = PCM, [48.0kHz/16]
  - Folder = microSD card, Folder C
  - Rec Level = High

Collecting recorders:

The recording set up should be collected on the second site visit for egg mass surveying (when surveying for salamander egg masses). Instructions for data processing and submission can be found in the Data Submission section of Appendix A.

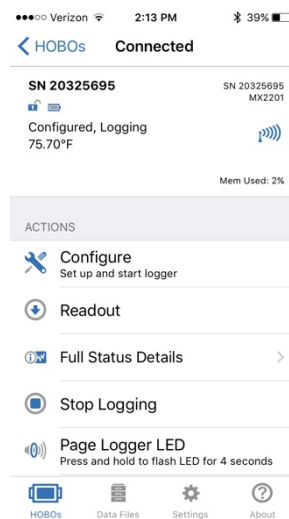
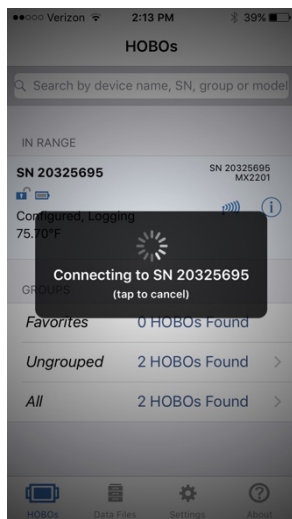
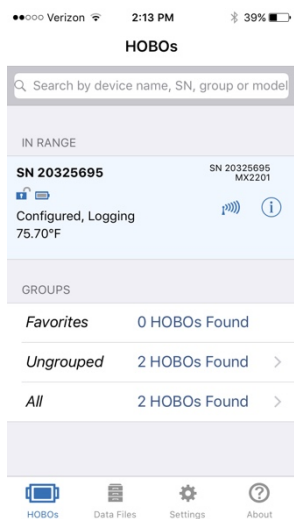
*Onset HOBO® Bluetooth Pendant Temperature Data Logger*

Water temperature will be measured by a Onset HOBO® Bluetooth Pendant Temperature Data Logger. If you own an iPhone or Android smartphone, download the HOBOMobile 1.7 Software App for iOS and Android prior to field monitoring. This app will allow you to download data and program the temperature logger. If you do not own a smartphone or the app will not work on your phone, the Project Coordinator will configure your HOBO logger and you can follow the instructions under “Collecting HOBO logger data (without phone app)” in order to submit your temperature data.



### Connecting your phone to the HOBO logger:

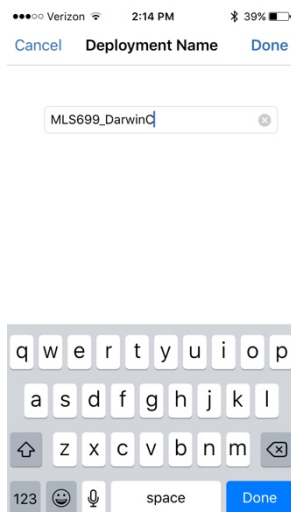
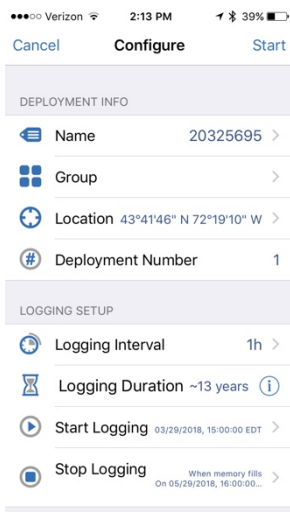
To connect your phone with the logger, enable Bluetooth settings on your phone and open the HOBOMobile app. If at any point, you are asked to allow access to your location while using the app, click “allow” to enable deployment. On the Data Logger itself, press down on the center of the logger to wake it up (both the check mark and the bell symbols should light up red and green respectively when the logger is “awake”). In the app, tap the HOBOs icon at the bottom of the screen and then tap the logger in the list to connect to it. If the logger does not appear in the list, make sure the logger is in range of your device.



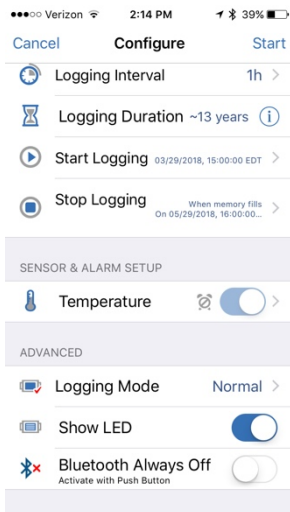
### Configuring the HOBO logger:

Once connected, tap Configure and follow the following steps to configure the logger.

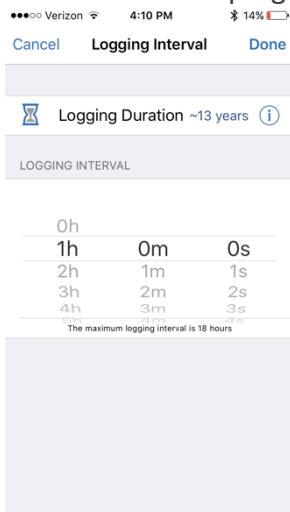
- 1) “Name” to: pools ID\_LastnameFirstinitial. So, if my name is Charles Darwin (I wish) and my pool was pool MLS699, then my “Name” would be MLS699\_DarwinC



2) Make sure that the button for “Bluetooth Always Off” is set to off (white, not blue). In other words, we DO want the Bluetooth to be on.

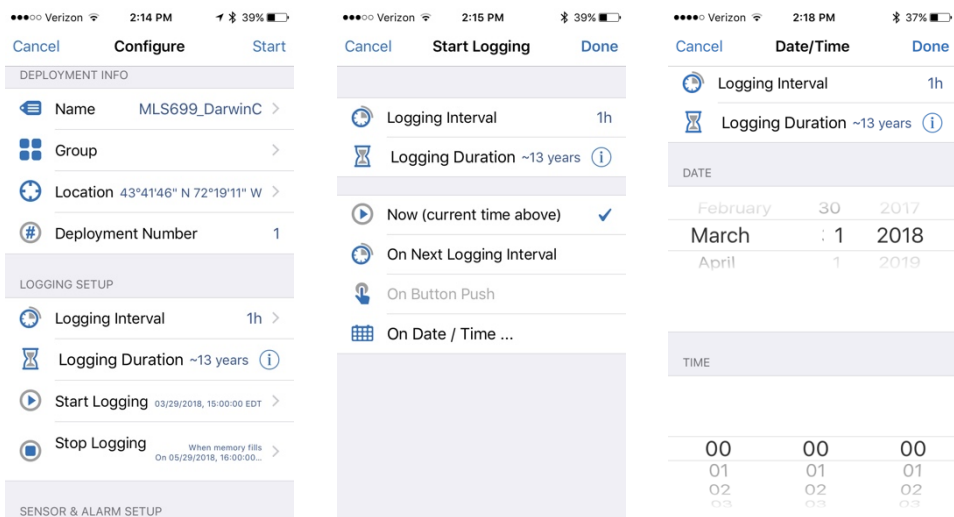


3) In the “Configure” screen, click “Logging Interval.” Set the “Logging Interval” to 1 hour (1h) and click “Done” on the top right.

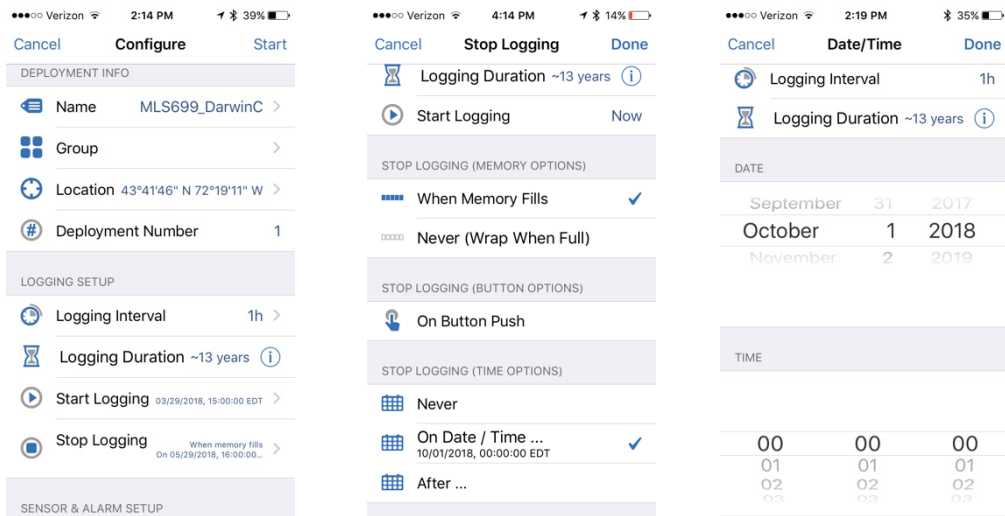




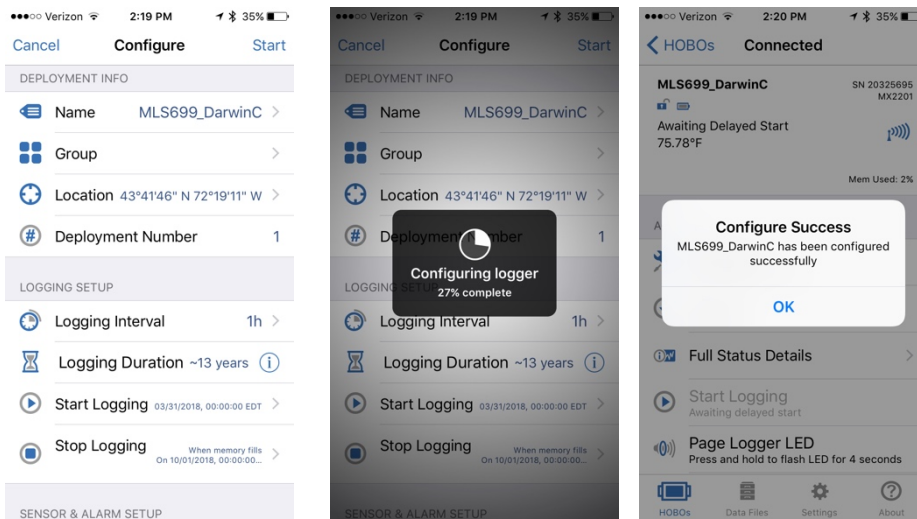
- 4) Set “Start Logging” to March 1; click “Start Logging” and then “On Date/Time...” Choose March 1 of the season you are monitoring in. If you happen to be deploying your HOBO logger after March 1, simply set the date of deployment as the starting date. Then click “Done” on the top right.



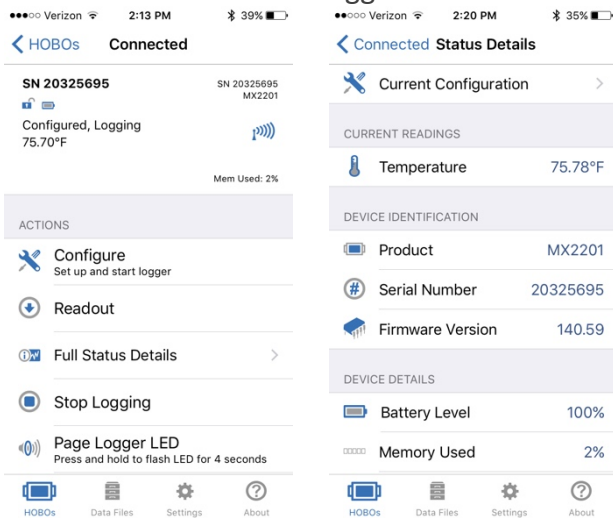
- 5) Set “Stop Logging” to October 1; click “Stop Logging” and then “On Date/Time...” Choose October 1 of the season you are monitoring in. Then click “Done” on the top right. Under “Stop Logging (Memory Options)” make sure “When Memory Fills” is checked. Then click “Done” on the top right.



- 6) All the rest of the settings should remain the same. Once you have changed the Name, Logging Interval and Bluetooth settings, tap Start in the upper right corner of the Configure screen. The logger will begin logging data based on the settings you selected



7) To check HOBO logger memory availability, battery, and configuration setting, click Full Status Details when connected to the HOBO logger.



### Deploying HOBO logger in the field:

Prior to egg mass surveying in your first season of VPMon, install the PVC pipe in the deepest part of the pool basin (see the *Pool Dimensions* section for pipe installation instructions) to anchor the Onset HOBO® Bluetooth Pendant Temperature Data Logger and serve as a marker for measuring pool depth. Alternately, visit the pool during summer before your first monitoring season – when the pool is dry (or nearly dry) – and install PVC pipe in the deepest part of the pool basin. Fix the Data Logger to the PVC pipe using two zip ties (see photo) and slide the Data Logger down to the base of the pipe at the bottom of the pool, so that the logger rests on the pool floor but is not buried in leaf litter.

### Collecting HOBO logger data (with phone app):

On each field visit, use the HOBOMobile app to check the battery and storage on the HOBO logger and to download data from the logger. To download data, click the HOBOs icon at the bottom of the screen, tap the logger in the list to connect to it, and then click “Readout.” The Readout may take a minute to load. Once it has, a screen which says “Readout Success” will appear. Click “Ok” on that screen and then click the

“Data Files” icon at the bottom of the screen. You will be asked if you want to “Close Connection?”. Click “Yes” and your data will appear at the top of the screen. If you have downloaded data previously, those graphs will appear below.

See the Data Submission section of Appendix A for instructions on how to submit HOBO logger data or how to submit temperature data if you do not have a smartphone.

### *Smartphone as GPS*

This section explains how to use your smartphone to identify the GPS coordinates of a pool. Most smartphones have location capabilities even when out of service range. If you have a GPS unit or a preferred smartphone app with which you like to take GPS coordinates, feel free to use that. Just make sure when using a smartphone that the app works when out of service range. The following instructions provide one way to find your GPS location on a iPhone or Android smartphone.

#### iPhone:

To use your iPhone's built in GPS to display the latitude and longitude coordinates of your current location, download the My GPS Coordinates app on your phone. Once you have the app, follow these steps to find your location coordinates in degrees, minutes and seconds:

1. Make sure that Location Services is ON. Navigate to Settings → Privacy → Location Services → ON
2. In the list of apps under Location Services, make sure My GPS Coordinates says While Using the App
3. Press the Home button to exit Settings
4. Open the My GPS Coordinates app and your current GPS coordinates are displayed at the bottom of the screen.

#### Android:

To use your Android's built in GPS to display the latitude and longitude coordinates of your current location, download the My GPS Coordinates app on your phone. Once you have the app, follow these steps to find your location coordinates in degrees, minutes and seconds:

1. Open your device's Settings app.
2. Tap **Security & Location** → **Location**. (If you don't see "Security & Location," tap **Location**.)
3. Turn **Location** on.
4. Tap **Mode**. Then pick: **High accuracy**. This mode uses GPS, Wi-Fi, mobile networks, and sensors to get the highest-accuracy location. It uses Google's Location services to help estimate your device's location faster and more accurately.
5. Press the Home button to exit Settings
6. Open the My GPS Coordinates app and your current GPS coordinates are displayed at the bottom of the screen.

### *ThermoPro TP60 Digital Hygrometer Indoor Outdoor Thermometer Humidity Monitor with Temperature Gauge Humidity Meter*

Do not mix battery types.

# APPENDIX B

## Data Submission

### *VPMon Datasheets*

Scans of all VPMon datasheets should be submitted to [vpmondata@vtecostudies.org](mailto:vpmondata@vtecostudies.org) with subject line "Pool ID\_LastnameFirstinitial." Example: MLS699\_DarwinC. If you are unable to submit the datasheets via email, please send copies of your datasheets to:

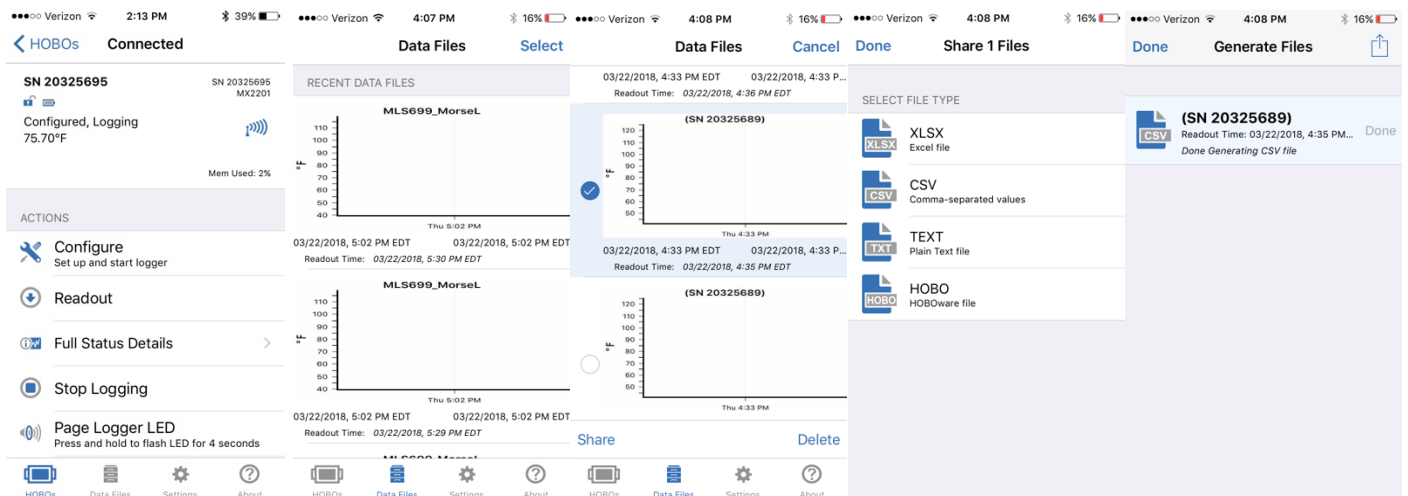
Vermont Center for Ecostudies  
Attn: Vernal Pool Monitoring Project  
PO Box 420  
Norwich, VT 05055

If on your final (4th) field visit to download HOB0 logger data the pool still contains water, record the water level and submit that along with your data sheets either in the content of the email or as a note on your data sheet. Volunteers should keep copies of their datasheets for their own files.

### *Onset HOB0® Bluetooth Pendant Temperature Data Logger Data*

Once you have connection to the internet, follow the following steps to submit your data:

- 1) Click on "Data Files" at the bottom of the screen.
- 2) On the top right, hit "Select" and click on the graph or graphs you want to submit.
- 3) On the bottom left, click "Share" and select CSV file.
- 4) Then hit the share emblem on the top right to share via email.
- 5) Send the graph to [vpmondata@vtecostudies.org](mailto:vpmondata@vtecostudies.org) with subject line "Pool ID\_LastnameFirstinitial."  
Example: MLS699\_DarwinC



Left to right: Steps 1 – 5 for submitting HOB0 Logger data



Collecting HOBO logger data (without phone app):

If you do not have a cell phone or are unable to use the app, please contact the Vernal Pool Monitoring Project Coordinator.

## *iNaturalist Data*

Using the iNaturalist website:

Use the website [iNaturalist.org](https://www.inaturalist.org) to submit your field data from egg mass surveys and macroinvertebrate surveys, as well as observations of spermatophores or amphibian disease. For how-to video on data submission to VPMon using the iNaturalist website, visit

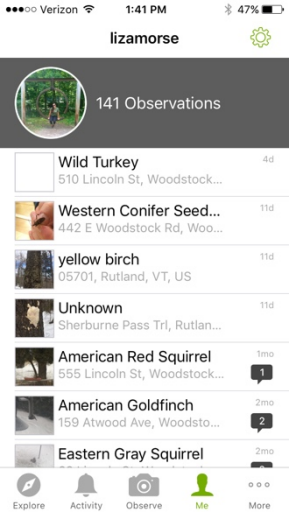
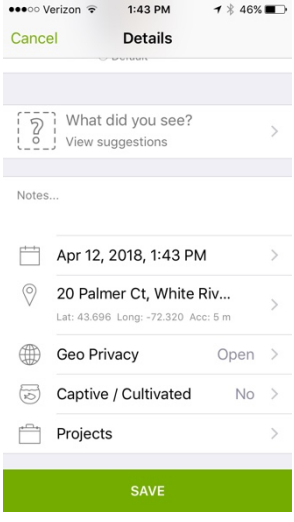

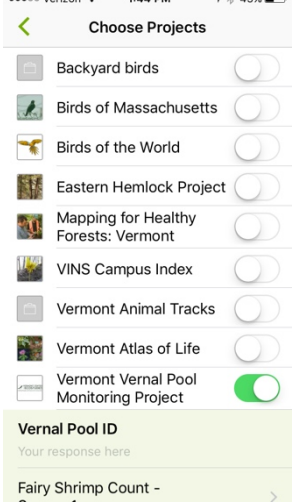
<https://www.youtube.com/watch?v=lzudHRrwT4s&t=5s>.

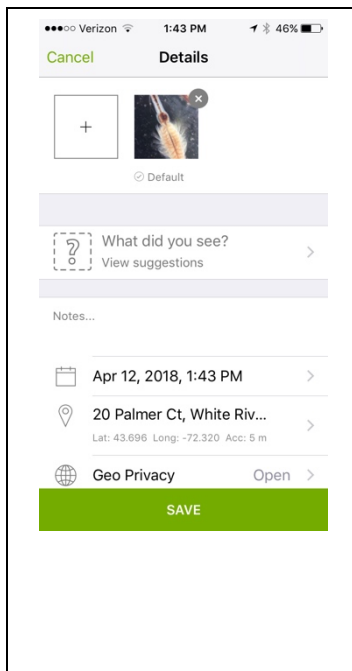
1. If you haven't already created an iNaturalist Account, create one before submitting any data
2. On your computer, log in to your iNaturalist account
3. Your first step as a VPMon volunteer is to accept the invitation to join the project
4. A notification to join the project should appear on your home screen. Within that notification will be a button that says "Join Project." Click the button in order to join project, and then click on the project heading to visit the project page.
5. When you visit the project page, you should see a photo with a red banner which says "Add Observations." Click "Add observations" and you will be taken to a page where you will be able to submit your observations.
6. In the top, enter what you saw:
  - a. If it's an egg mass, enter the observation as the species that laid said egg mass:
    - i. Wood Frog
    - ii. Spotted Salamander
    - iii. Jefferson Salamander
    - iv. Blue-Spotted Salamander
  - b. If it is a spermatophore, enter the observation as "Mole Salamanders: Genus Ambystoma"
  - c. If it is one of the invertebrate groups enter the observation as "Eubranchipus (Genus)" for fairy shrimp and "Caddisflies (Caddisfly) Order Trichoptera" for caddisfly larvae.
7. Under "When did you see it?" enter the time of your field visit.
8. Under "Where were you?" add the latitude and longitude of your pool in decimal degrees.
9. Under "Add media" click choose files to select the photo or photos to upload. You are only required to submit one photo for each observation type (ie fairy shrimp, caddisfly larvae, egg masses, amphibian disease, or spermatophores). For egg mass photos, submit one photo per species documented. For macroinvertebrate surveys (fairy shrimp and caddisfly larvae) you only need to submit one photo from one of your four sample squares, but you must include counts from all four squares in that observation.
10. Scroll down the project's fields to enter supplementary data and enter the Vernal Pool ID. This refers to your pools specific ID number. This is a required entry and will be the same for all your data at this pool.
11. Then enter the data related to the observation and ignore all the other fields. For example, if you are submitting a photo of Spotted Salamander egg masses, fill in the Egg Mass(es) field with the total count of Spotted Salamander egg masses from your survey.

12. To finish, click “Save Observation” at the bottom of the page.

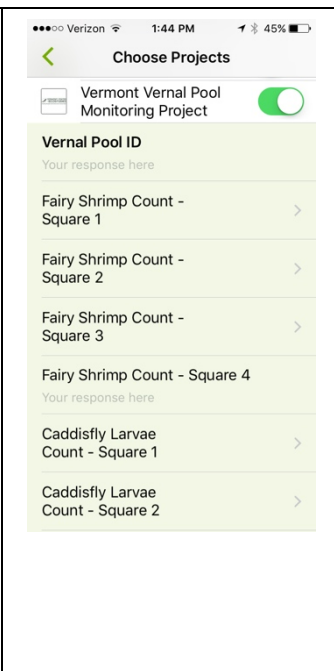
Using the iNaturalist app:

For smartphone users, you can submit observations right in the field. If you are out of service range or if you prefer not to use data, you can take observations with the app and submit them once connected to wifi. To prevent iNaturalist from automatically uploading your observations (and using data), tap the “Me” button at the bottom of the screen and then click on the Setting icon ⚙️ in the top right corner of the screen. In “Settings” make sure that “Automatic upload” is unchecked. If you decide to disable “Automatic upload” you will need to go back into iNaturalist once you have wifi and upload the observations you made in the field. The observations will be saved in iNaturalist and you must simply click them to upload them once connected to wifi.

	<p><b>Step 1:</b> Open iNaturalist. Tap “Observe” at the bottom of the screen.</p>		<p><b>Step 4:</b> After verifying that the time, date and location information are correct, Click “Projects” listed at the bottom.</p>
	<p><b>Step 2:</b> Take your photo and click “Next.”</p>		<p><b>Step 5:</b> Turn on “Vermont Vernal Pool Monitoring Project.” A drop down list of data fields should appear.</p>



**Step 3:**  
 Click “What did you see?” and enter the name of the species, genus, or order. See “Using the iNaturalist website” for proper species, genus, or order name for each type of submission (egg mass, macro, etc.).



**Step 6:**  
 Enter the Vernal Pool ID (required field) and any other information pertaining to the specific observation. For example, if this photo is of caddisfly larvae, only fill out the fields pertaining to Caddisfly Larvae Counts and no other fields. Tap the green arrow at the top left of the screen and then hit the green “Save” button at the bottom of the screen.

*Acoustic Monitor Data*

Upon returning from the field, volunteers should download and save the recording data from the microSD card. Like the HOBO logger data, the recording data should be named: pools ID\_LastnameFirstinitial. The recording data will be distinguishable from the HOBO logger data by the file extension (.wav versus .csv). Volunteers should send in their microSD cards in between two small pieces of cardboard which are taped and then placed in a padded envelope. Volunteers should send their envelope to:

Vermont Center for Ecostudies  
 Attn: Vernal Pool Monitoring Project  
 PO Box 420  
 Norwich, VT 05055

# Vermont Vernal Pool Monitoring Project

## Instructions for Completing the Vernal Pool Monitoring Data Sheet



### **Pool & Observer Information**

#### *Field Visit*

Check which of the three VPMon annual field visits this data sheet describes.

#### *Date*

Field monitoring date.

#### *Time*

Identify start time of field monitoring (ie when you arrive at the pool and begin data collection).

#### *Pool ID*

If the pool was previously mapped as part of the Vernal Pool Mapping Project, it will have a Pool ID. The ID will be 3 letters followed by numbers. For example SDF34 or MLS23. If this was a previously unmapped pool you will be assigned a code by the Project Coordinator.

#### *Town*

Town where vernal pool is located.

#### *GPS Coordinates*

Record GPS coordinates of your pool only on your first visit to the pool prior to installation of the PVC pipe to measure water level. In areas with multiple pools, this ensures that you are visiting the correct pool. In future visits, the presence of the PVC pipe will indicate that you are at the correct pool.

#### *Is Pool Mapped?*

Check “Yes – by VPMon volunteer,” “Yes – mapped as part of VPMP”, or “Not mapped.” If your pool has not been mapped, you will need to complete a Vernal Pool Mapping Project Vernal Pool Field-Verification Data Sheet.

#### *Observer Name*

Be sure observer names are listed in accordance with egg mass counts attributed to Observer 1 and Observer 2 (See Amphibian & Macroinvertebrate Survey section of data sheet).

### **Physical Parameters**

#### *% Ice Out*

If on your first field visit to deploy the acoustic monitors, some of the pool has open water, estimate the percentage of the pool that is open water.

#### *Water Temperature*

Mark whether or not you were able to download temperature data on your field visit. If you are using a smartphone in the field, download water temperature data using the HOBOMobile app. For details on how to download data using the HOBOMobile app or if you cannot download data using the app, see the

# Vermont Vernal Pool Monitoring Project

## Instructions for Completing the Vernal Pool Monitoring Data Sheet



Vermont Vernal Pool Monitoring Project manual for further instructions. If you use the app but faced technical difficulties, be sure to note that in the “Physical Parameter Notes” section of the data sheet.

### *Water Level*

Use the marked PVC pipe to measure the water level of the pool. Markings are spaced 5 cm apart. Round up or down to the nearest mark. On your first visit to install the PVC pipe you will need to measure the water level using a measuring tape or meter stick.

### *Vegetation - % Cover*

On your 3<sup>rd</sup> field visit, use the “Veg. - % Cover” scale found at the bottom of your data sheet to estimate percent cover for each of the following categories: submerged aquatic vegetation, floating, emergent vegetation, shrubs, and trees. Percent cover should account for any vegetation that covers or shades the pool (ie tree canopy) whether or not the vegetation emerges from the pool itself. If trees and other vegetation are not fully leafed out, simply estimate actual percent cover but do not attempt to predict percent cover under full leaf out.

### *Physical Parameter Notes*

Any additional notes on physical parameters of the pool you care to add.

## **Weather**

### *Humidity*

Place the ThermoPro and its remote sensor on opposite sides of the pool at the beginning of the field visit, avoiding areas of direct sunlight and making sure both are within 200 feet of one another. Prior to departing the field at the end of the visit, record humidity readings listed on the ThermoPro and its remote sensor.

### *Air Temperature*

When recording humidity, also record temperature readings listed on the ThermoPro and its remote sensor.

### *Wind (Beaufort Force)*

Record wind speed according to the Beaufort Scale (see scale at bottom of data sheet).

### *Weather Notes*

Any additional notes on weather condition you care to add.

## **Amphibian & Macroinvertebrate Surveys**

### *Egg Mass Survey*

If on your 1<sup>st</sup> field visit, some open water is present on the pool, search the open area(s) of the pool for signs of breeding. Count any egg masses visible within the open water area. Binoculars may be helpful for counting and identifying egg masses far from the edge of the pool. For every species recorded as having egg masses present in the pool, one egg mass should be photographed for submission to the VPMon iNaturalist project. This survey can be completed by one volunteer.



# Vermont Vernal Pool Monitoring Project

## Instructions for Completing the Vernal Pool Monitoring Data Sheet



For 2<sup>nd</sup> and 3<sup>rd</sup> field visits, volunteers will be using what is called a double-observer independent protocol. Volunteers may visit the pool independently or together but must both visit the pool but on the same day. This means that both volunteers will do a survey but that surveys will be independent from one another. If volunteers are visiting the pool independently, there are no special precautions that need to be taken when surveying for egg masses except that the first volunteer to survey the pool should not share their findings with the second volunteer until after the second volunteer has completed their survey. If volunteers visit the pool together, counts need to be conducted independently and separately – when one volunteer is counting, the other should not be watching. This is very important to avoid biasing the second observer's counts.

To survey the pool, mark the starting point and walk the entire perimeter of the pool. While walking the perimeter, record every egg mass by species within one meter of pool's edge on the data sheet. If Wood Frog egg masses have formed into a mat/raft and are uncountable, record the estimated dimensions of the raft in meters in the "Amphibian/Macroinvertebrate Notes" section. For every species recorded as having egg masses present in the pool, one egg mass should be photographed for submission to the VPMon iNaturalist project.

### *Macroinvertebrate Survey\**

If on your 1<sup>st</sup> field visit some open water is present on pool, count the number of fairy shrimp or caddisfly larvae present in the open water portion of the pool to the best of your ability and record the number in the "Total" section. On your 2<sup>nd</sup> and 3<sup>rd</sup> field visits, using a tape measure or walking stick marked at a meter in length, survey a square meter area for fairy shrimp and caddisfly larvae at each of the cardinal directions (or estimated cardinal directions) around the pool. In "Square 1" on your data sheet, record the count for the northern sample square and make your way clockwise around the pool, recording your counts until you finish with "Square 4" to the west. Count all fairy shrimp and caddisfly larvae present in each square to the best of your ability. Take one picture of each organism for submission to iNaturalist (see Appendix A of the VPMon manual for data submission instructions). Macroinvertebrate surveys can be completed by one volunteer.

\*Same protocol for Fairy Shrimp and Caddisfly Larvae.

### *Date Acoustic Monitor Deployed/Collected*

Record the date of when you deploy and collect your acoustic monitor.

### *Visual Impairment Level*

Estimate proportion of your search area for both macroinvertebrate & egg mass surveys that is visually impaired due to water depth, surface reflection, particulate matter, algae, etc. and record visibility impairment using the Visual Impairment Level scale at the bottom of the data sheet. If you do an egg mass survey on your first field visit when only part of the pool has open water, estimate the proportion of the open water that is visually impaired. In this case the visual impairment level for both egg mass and macroinvertebrate surveys will be the same (because the survey areas are the same). If you use polarized glasses be sure to note that, although do not use polarized glasses while estimating visual impairment level.

# Vermont Vernal Pool Monitoring Project

## Instructions for Completing the *Vernal Pool Monitoring Data Sheet*



### *Spermatophores Found?*

As you walk the perimeter of the pool, note whether or not spermatophores are present. If spermatophores are present, one photograph documenting the spermatophores should be taken and submitted to the VPMon iNaturalist project. This survey can be completed by one volunteer.

### *Amphibian/Macroinvertebrate Notes*

Note any presence of amphibian disease (see Vermont Vernal Pool Monitoring Project manual for list of diseases and symptoms). If any evidence of disease is present, at least one photograph should be taken and submitted to the VPMon iNaturalist project. Record any additional notes or observations you may have from surveys.