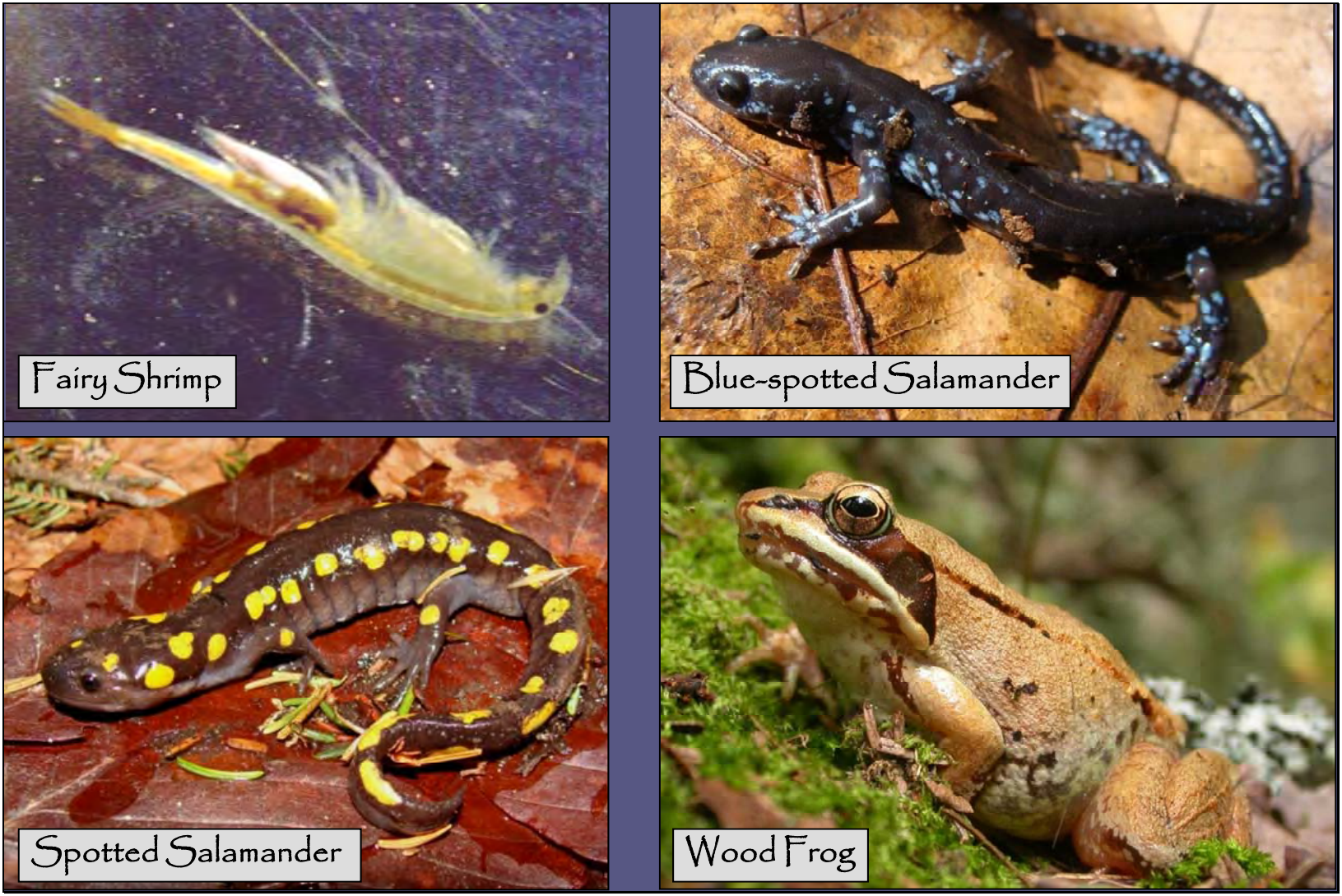
# Vernal Pool Indicator Species

## Amphibian and egg mass identification

These slides were compiled for the purpose of assisting community volunteers involved in the field assessment of vernal pools for determination of Significant Vernal Pools. In the notes section of each slide you will find information pertaining to each of the images included in this presentation. This is not for commercial distribution.

Slide 3




Vernal pool indicator species in Maine: 3 amphibians and 1 charismatic crustacean.

# Characteristics of Vernal Pools

- Small (<0.1 to 2 acres)
- Natural (not farm ponds)
- Temporary to semi-permanent
- No *permanent* inlet or outlet
- Fishless

Breeding habitat for:

Wood Frogs
Spotted Salamanders
Fairy Shrimp
Blue-spotted Salamanders

Vernal pools, generally small in size, often dry by summer's end and then refill in the fall. These are temporary or ephemeral pools. Other pools may hold a small amount of water year round or dry every 2nd or 3rd year (in this case, they are called semi-permanent). In spring, most pools fill with snow melt and rising water tables. Vernal pools may have seasonal inlets and outlets…the key is, does the inlet or outlet allow fish to enter the pool? If not, then it will function as a vernal pool. Inlets and outlets that dry by summer's end usually do not allow fish passage into pools. Most pools occur in shallow depressions on floodplains, in forested wetlands, or in uplands.

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# Vernal Pool Definition

Naturally occurring, temporary to semi-permanent pools occurring in shallow depressions in *forested landscapes*. Vernal pools provide the primary breeding habitat for wood frogs, blue-spotted and spotted salamanders, and fairy shrimp and provide habitat for other wildlife including several endangered and threatened species.

The vernal pool definition used by Maine in the establishment of the Significant Vernal Pool legislation.

Vernal pools are referred to as "naturally occurring", which excludes farm ponds, roadside ditches, skidder ruts, and gravel pits from being regulated. There are some pools that may have been human-made but so much time has elapsed they are called "naturalized." The regulatory status of "naturalized" pools needs to be determined by a professional.

It is difficult to find the endangered and threatened species (spotted turtles and Blanding's turtles, for example) at the time of egg mass surveys as they use pools later in the season.

# Significant Vernal Pool Criteria

Natural Resource Protection Act  Chapter 335  Significant Wildlife Habitat Rules

40 or more wood frog egg masses

20 or more spotted salamander egg masses

10 or more blue spotted egg masses

presence of fairy shrimp

**Significant Vernal Pool Identification Criteria** (from Chapter 335 of Significant Wildlife Habitat Rules)
Significance is determined by either species abundance or rarity of species present.

**Species Abundance Criteria**
Fairy shrimp - Presence in any life stage.
Blue spotted salamanders - Presence of 10 or more egg masses.
Spotted salamanders - Presence of 20 or more egg masses.
Wood frogs - Presence of 40 or more egg masses.

These numbers were determined by statewide surveys of pools and were designed to result in no more than 50% of all pools being significant. Fairy shrimp are relatively rare and hence their presence makes a pool significant. Blue spotted salamanders tend to dominate pools they breed in, so in most cases if a pool contains breeding blue-spotted salamanders, there will likely be hundreds of egg masses.

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# Significant Vernal Pool Criteria

Natural Resource Protection Act  Chapter 335  Significant Wildlife Habitat Rules

Spotted Turtle

Ringed Boghaunter Dragonfly

Blanding's Turtle

**Significant Vernal Pool Identification Criteria** (from Chapter 335 of Significant Wildlife Habitat Rules)
Significance is determined by either species abundance or the presence of rare, threatened, or endangered species.

**Criteria for Rarity – Presence of Rare, Threatened or Endangered Species**
A pool that has documented use in any given year by state-listed rare, endangered or threatened species that commonly require a vernal pool to complete a critical portion of their life-history is a significant vernal pool. Examples of vernal pool dependent state-listed endangered or threatened species include, but are not limited to, Blanding's turtles, Spotted turtles, and Bog haunter dragonflies. In most cases, you will not encounter these species during your early spring visits. They are most likely using pools June through the fall.

# Fairy Shrimp

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Growing up to an inch in length, these crustaceans are often seen swimming upside down in sunny pool shallows. Fairy shrimp tend to be in the more ephemeral pools with shorter hydroperiods (holding water for as little as 6 weeks). Eggs deposited in the spring need to dry and freeze before they hatch when the pool refills in the early spring. In fact, adults may be seen swimming around before the ice has completely melted. Some shrimp may hatch later in the summer, which means that in pools where fairy shrimp occur, it is possible to see them throughout most of the spring and early summer months. Fairy shrimp are much more common in pools in southern New England; in Maine they were only found in 5% of pools surveyed statewide.

Slide 10

Often pinkish-orange in color, fairy shrimp may be seen swimming around on their backs in shallow water. Typically much darker in color, mosquito larvae are most often seen hanging vertically from the water's surface.

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When magnified, these larvae may appear menacing, but the mosquitoes that breed in vernal pools do not carry the West Nile Virus.

There are roughly 42 species on mosquitoes in Maine. Only a few carry the West Nile Virus. Mosquitoes that carry the virus typically breed in two types of habitat 1) in stagnant water found in artificial containers such as bird baths, tires, buckets, kiddy pools, and storm water and catchment basins, and 2) in salt marsh pools that are located above the normal high tide line.

# Wood Frogs

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Wood frogs have a dark face mask above a white lip line. They are a small frog, often less than 2.5 inches long. In Maine, they are the first frogs to emerge from hibernation in upland forests where they have been frozen just below the leaf litter. Warm spring rains thaw the frogs, cueing them to make their way to breeding pools. Wood frogs live 3-5 years and are the most northerly ranging frog in North America.

# Wood Frog Egg Masses

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Newly laid wood frog egg masses are small and compact (about the size of a quarter), but quickly absorb water to reach their maximum size of approximately 5 inches. Looking down at an egg mass, the embryos will look black or dark brown and blend in with the surrounding darkness of the bottom of the pool. The undersides of the egg masses are a contrasting white or cream color. From the perspective of a predator looking up at an egg mass, the light color blends in with the brightness of the sky above. Egg masses are attached to herbaceous vegetation persisting from the previous year (cattails, sedges, grasses) or to woody vegetation (winterberry shrubs are a common attachment site) including sticks and branches that have fallen into the pool.

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Consisting of up to 1000 individual eggs, the exterior of a wood frog egg mass is quite lumpy. Sometimes described as having the appearance of tapioca pudding, or a pile of marbles, wood frog egg masses lack the thick outer jelly coating characteristic of spotted salamander egg masses.

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Frequently attached to vegetation, wood frog egg masses often break the surface of the water and appear bubble-like.

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At a distance, this large communal raft of wood frog egg masses appears bubble-like at the water's surface. Communally laid rafts are thought to create better conditions for development by providing the eggs in the middle with protection from predators and solar warmth. Attached to winterberry shrubs in this photograph, egg masses are often laid in the deeper regions of a pool (at least in populations where some of the frogs are smart).

Slide 19

The best way to count wood frog egg masses is to enter a pool wearing waders or clothing that you don't mind getting wet. (It is important to make sure that you are not wearing any bug spray or sunscreen that may damage the eggs and developing embryos.) To begin you may wish to restrict yourself to a small area, count the number of masses that you can see at the surface, and then gently use your hands to identify and count the underlying masses by touch. Once you have counted 40 masses, you may feel around under the raft to determine whether the density of masses is consistent, and then estimate a total number based upon the area encompassing the 40 masses you already counted.

Slide 20

By the time wood frog embryos are ready to hatch (usually 20 days after deposition), the masses have begun to deteriorate, are no longer spherical in nature, and are much more difficult to count. For the most accurate results, wood frog egg mass counts should be completed within a few days to a week after all of the eggs have been laid (April in Central and Southern Maine; May in northern Maine and the Mountains).

Slide 21


**Fig. 118.**
**WOOD FROG,** *Rana sylvatica* **M333; p. 341**
Total length 1⅝–1⅞ in. (4.2–4.8 cm). Body/tail length ratio 1:1.8. No distinct markings on body. Intestinal coil partially visible. Tail fin rounded dorsally, tapering to a fine point. Faint, small markings on tail fin. Oral disc emarginated; large papillae present. Labial tooth rows ¾.
(From: Conant and Collins. 1991. A Field Guide to Reptiles and Amphibians: Eastern and Central North America)

In the late spring and early summer, pools that contain large numbers of small, dark tadpoles with gold flecks along their sides are likely to be wood frogs. Toad tadpoles are even smaller and blacker and hatch AFTER wood frogs. Green frog and bull frog tadpoles may be present in pools with more permanent hydroperiods, however these two species overwinter in pools prior to metamorphosis and will be MUCH larger than the wood frog tadpoles. Overwintering green and bull frog tadpoles will be swimming around even before the wood frog egg masses are deposited.

Slide 22

Soon after hatching, thousands of wood frog tadpoles may be seen feeding in swarms on phytoplankton and algae near the water's surface. They may also feed on blue-spotted salamander embryos (they are not dedicated vegetarians).

Slide 23

Newly hatched tadpoles are darkly colored and less than 0.5 inches long. As they grow and age, they appear more mottled and olive brown in color. It takes less than 70 days for the tadpoles to develop into metamorphs, or small frogs.

Slide 24

Recently emerged juvenile wood frogs are about the size of your thumbnail. The young metamorphs leave their breeding pools all around the same time, as evidenced in this image of a submerged pitfall trap installed to capture dispersing juveniles. A small pool may produce as many as 10,000 metamorphs in one breeding season.

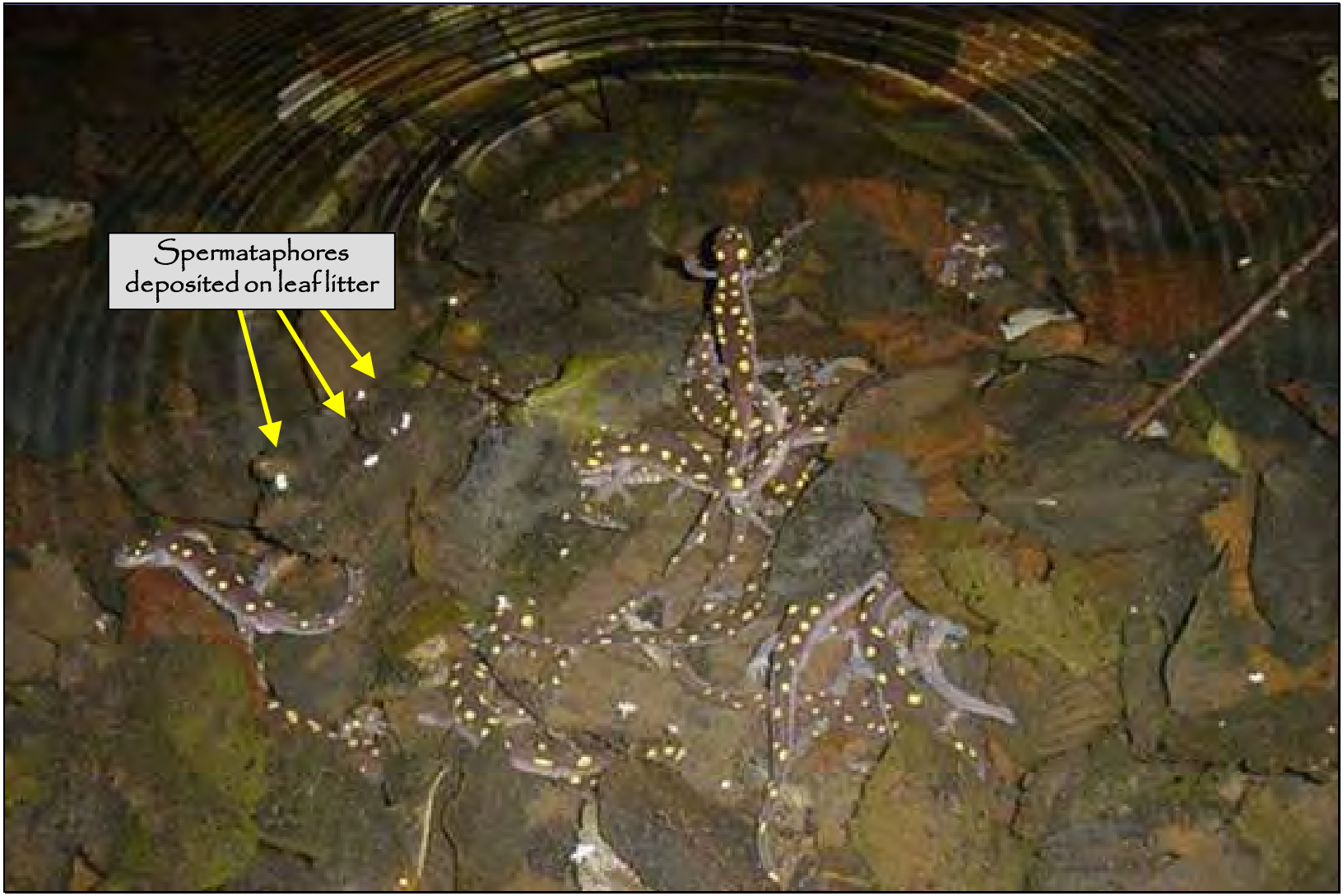
# Summary of wood frog egg mass characteristics

- Spherical masses with lumpy external appearance
- No outer jelly membrane
- Each mass contains close to 1000 eggs
- Masses often have the appearance of bubbles at the surface of the water
- Communal breeders – masses often deposited in large rafts

# Spotted Salamanders


In Maine, spotted salamanders are the only large dark colored salamanders with bright yellow spots.

Slide 28




During the courtship ceremony, male spotted salamanders deposit small jelly encapsulated packets of sperm (called spermatophores) on sticks or leaves at the bottom of the pool. Allured by a male, a female will collect a spermataphore with her cloaca (posterior opening that serves both reproductive and elimination purposes), leading to internal fertilization. If you arrive at a pool and do not see any egg masses, look carefully at the substrate of the pool. If you see what looks like tiny specks of paint on the pool bottom, it is likely that you are too early. The presence of white specks indicates that the male salamanders have arrived and deposited spermatophores, but the females have yet to arrive and/or deposit their eggs.

# Spermataphores deposited along submerged stick

# Spotted Salamander Egg Masses

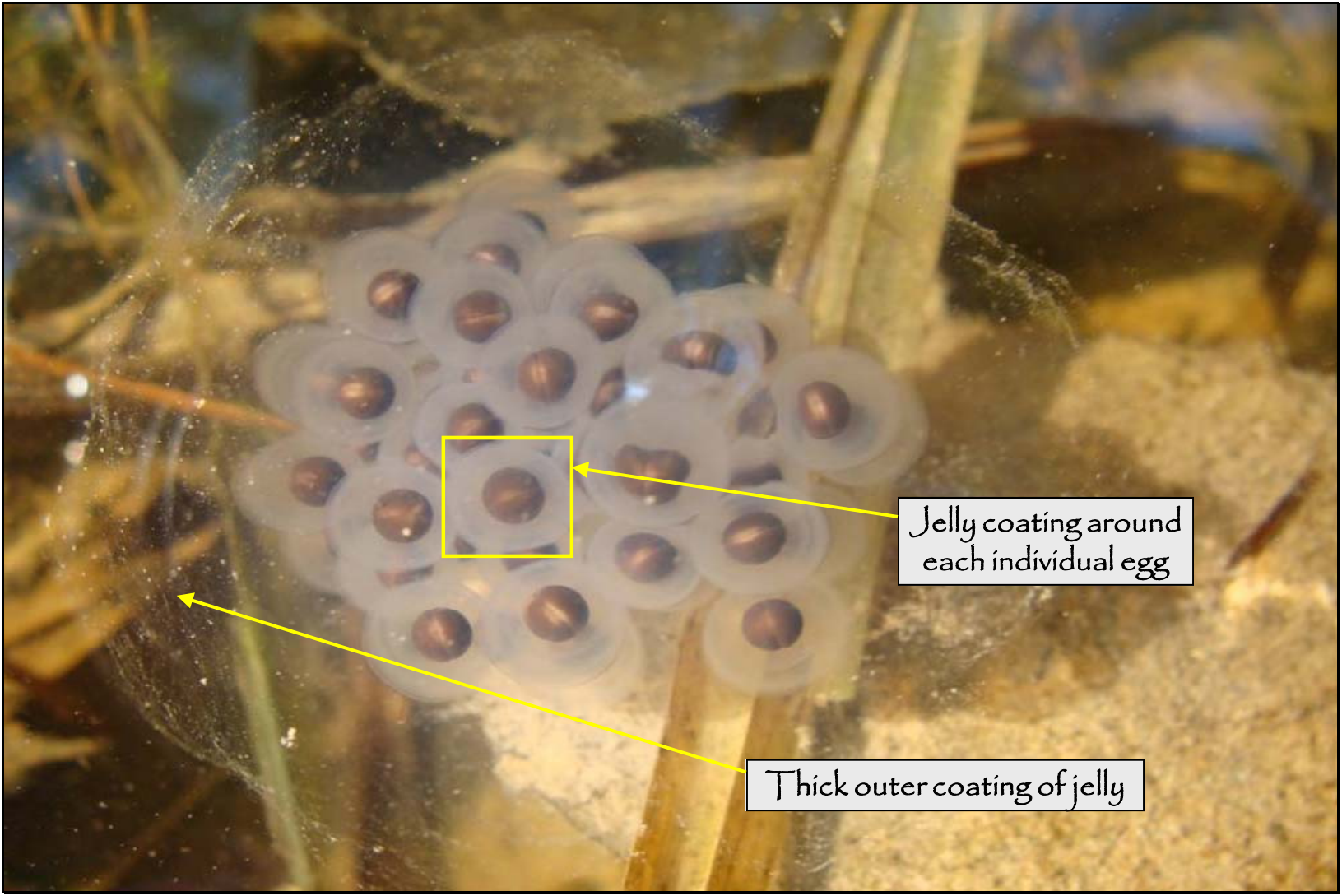
Slide 31

Often attached to vegetation or sticks, spotted salamander egg masses contain between 10 and 100 eggs. The size and shape of spotted salamander egg masses is much more variable than wood frog egg masses.

Slide 32

Although highly variable in size and shape, spotted salamander egg masses tend to be elongated and sometimes kidney-shaped.

Slide 33




In addition to the jelly-like membrane around each individual egg, the entire mass is encapsulated within a thick outer jelly coating.

Slide 34




Genetic variation determines whether the outer gelatinous membrane of a spotted salamander egg mass is clear or cloudy. Green egg masses contain a symbiotic algae (*Oophilia amblystomatis*) that provides oxygen to the egg mass and in turn gains nitrogen and phosphorous from the developing embryos.

Slide 35

Within a given pool, both clear and cloudy egg masses may be found side by side.

Slide 36

The pool in this photo lacked adequate vegetation for egg laying attachment sites and all masses were deposited in one area where submerged sticks were abundant. However, unlike wood frogs, spotted salamanders do not typically deposit their eggs communally in large rafts. It is common to see individual masses and small clusters of masses widely dispersed within a pool. Because of the potential for this extensive distribution, it will require careful searching to locate all masses present. Polarized sunglasses reduce glare and allow for easier viewing.

Slide 37

Unlike female wood frogs, spotted salamanders may lay up to three egg masses. If multiple egg masses are deposited, they usually consist of one larger mass and one or two smaller satellite masses. Even though they vary in size, and some masses may only contain a few eggs, count each individual mass separately.

Slide 38

Once hatched from their eggs, salamander larvae have feathery external gills used for gas exchange in their low oxygen breeding pools.

*Wood Frog*

*Spotted Salamander*

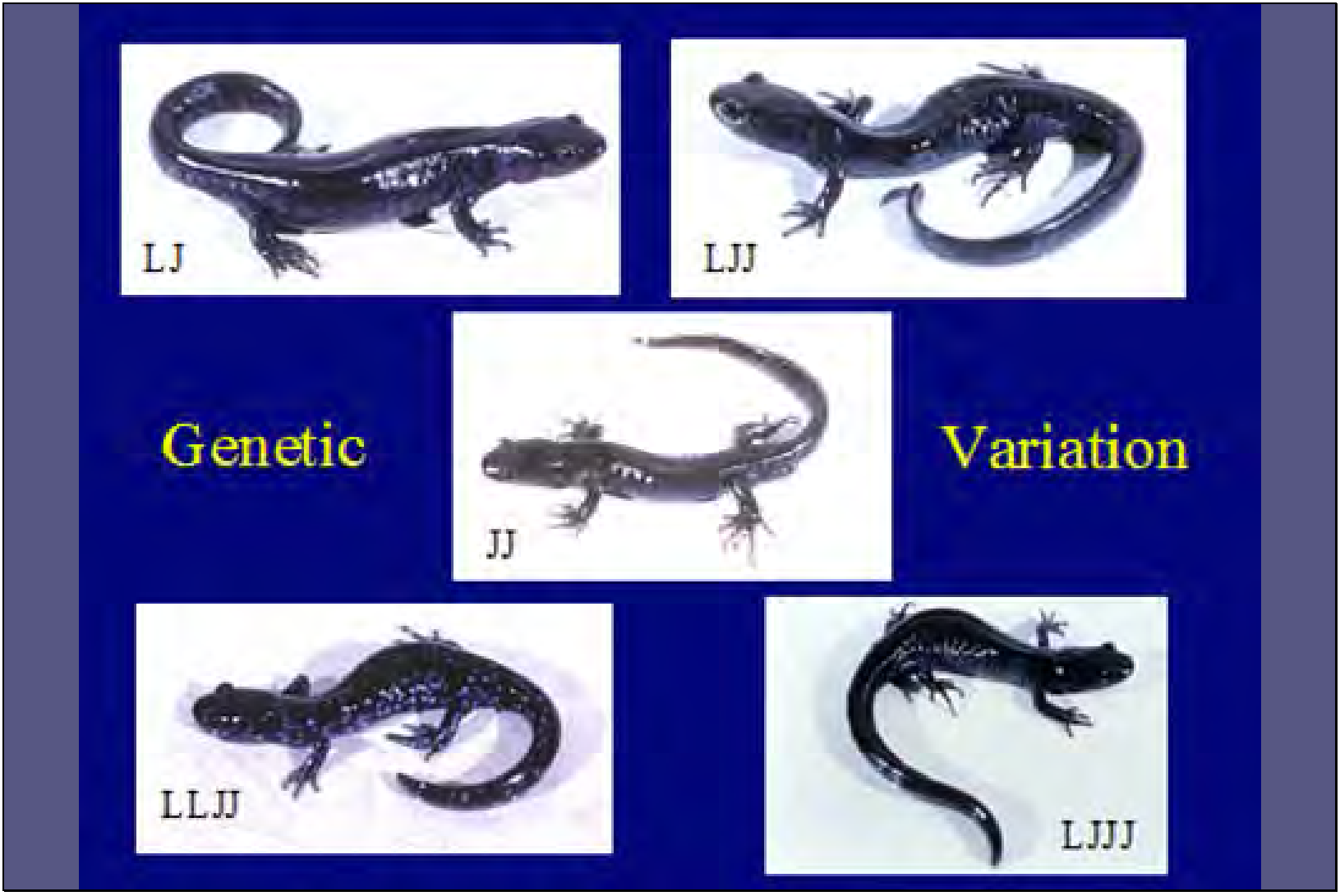
For comparison, the wood frog mass on the left has a lumpy appearance and lacks an outer gelatinous coating. The spotted salamander mass on the right has a more uniform outer surface which is due to an additional protective layer of jelly.

# Summary of spotted salamander egg mass characteristics

- Thick outer jelly membrane
- 10 to 100 eggs per mass
- Often elongate or kidney -shaped
- May be cloudy, clear, or green
- Masses may be widely distributed throughout pool

# Blue-spotted Salamanders

Slide 42




In Maine we have pure blue-spotted salamanders as well as a complicated diversity of genetic variations resulting from the hybridization of blue-spotted and Jefferson salamanders.

Slide 43


Pure blue-spotted salamanders tend to be smaller and darker in color with more abundant and well defined light blue spots.

Slide 44


Hybrids display characteristics of individuals more closely related to Jefferson salamanders and tend to be larger and more brownish-grey in color with light flecks of blue spots. Hybrids and pure individuals may breed in the same pool.

# Blue-spotted Salamander Egg Masses

Slide 46

Unlike the spotted salamander egg mass with its firm outer jelly membrane, blue-spotted egg masses are very drippy in appearance. If you gently poke at each type of egg mass, the spotted salamander eggs will meet your finger with resistance, while a blue-spotted egg mass will feel loose and yield to the slightest pressure, like loose Jell-O.

Slide 47

Blue-spotted eggs may be deposited individually, in small clusters, or as strands beaded along sticks. The nature of the eggs depends on the genetic make-up of the animal. Pure blue-spotted salamanders may lay individual eggs or small strings of eggs (2-10) along a stick. The hybrid mix (blue-spot and Jefferson) have egg masses with more eggs and lots of white, infertile eggs contained within the mass.

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Frequently attached to submerged sticks, blue-spotted eggs can be very difficult to see below the surface of the water. Without gently lifting this stick, you would not be able to tell that below the surface, eggs are attached the full length of each of these branches.

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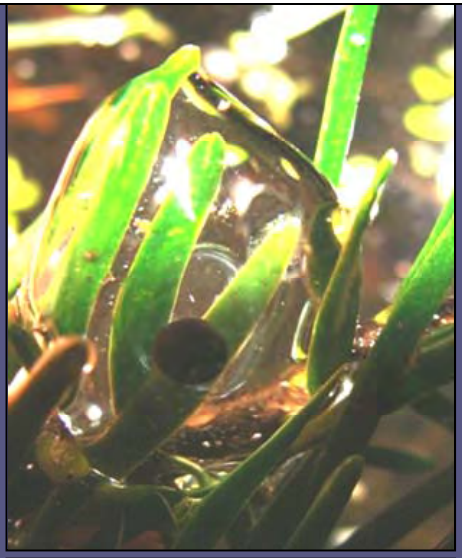
Upon lifting the stick, the egg mass abundance becomes apparent.

Slide 50

It is important to be very cautious when lifting submerged branches above the surface of the water. Blue-spotted eggs are so loose and drippy that when they are not supported by the buoyancy of water, they have the tendency to drip right off the stick.

Slide 51



Pure blue-spotted salamanders tend to lay individual eggs which are either attached to submerged vegetation or deposited on the leaf litter at the bottom of the pool. It will be very difficult to find and count individual eggs, however, if you do find individual eggs, where there is one, there are usually many. Where found, each single egg should be counted as an individual mass.

Slide 52

At the other extreme of difficulty, counting long strings of eggs beaded along a submerged stick can also provide a challenge. Remember that a minimum of 10 blue spotted salamander egg masses meets the criteria for vernal pool significance. The low threshold of 10 masses was used because if you can find ten egg masses, then it is very likely that the pool contains hundreds of blue spotted eggs.

Slide 53

Hybrid blue-spotted salamanders (with Jefferson salamander genes) often produce eggs with infertile cloudy white embryos.

Slide 54

Metamorphs of recently emerged blue-spotted salamanders. Note that you will not be likely to tell the difference between young spotted and blue-spotted salamander larvae or metamorphs.

# Summary of blue spotted salamander egg mass characteristics

- Very loose jelly - can poke finger through it
- Single eggs on leaf litter or up to 10 eggs in mass
- Often attached to submerged sticks
- Hybrid eggs have a high percentage of infertile eggs that are white
- Hard to see in water; may have to lift sticks gently and use polarized sunglasses

# Other Species

## that might be encountered during a vernal pool field assessment

Slide 57


Jefferson salamanders are large (up to 7 inches) grey-brown salamanders that breed in vernal pools in southern New England states, but do not occur in Maine. Like the spotted and blue-spotted salamanders, Jefferson salamanders spend much of their lives underground, and are most likely to be encountered in and around vernal pools during the spring-time breeding season.

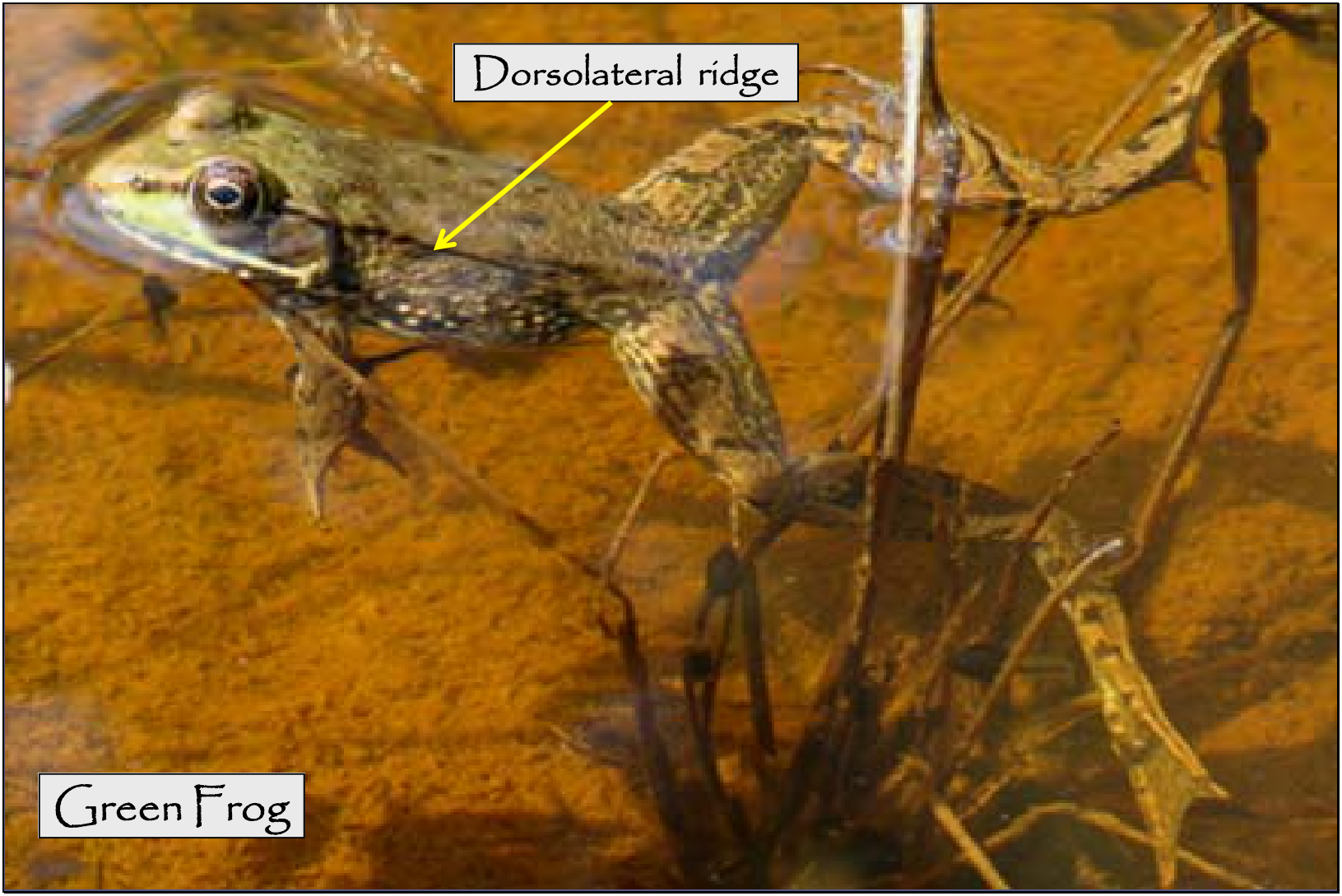
Slide 58


Jefferson salamander egg masses are often deposited in small clusters near the water surface. They have a loose consistency and like blue-spotted and blue-spotted hybrids, their egg masses are often difficult to see below the water surface.

Slide 59


Marbled salamanders occur in southern New England states, but not in Maine. Like spotted, blue-spotted, and Jefferson salamanders, they spend much of their lives underground, but unlike the other salamanders that breed in vernal pools when they fill with water in the spring time, marbled salamanders mate and deposit their eggs under leaf litter on the floor of dried vernal pools in the late summer/early fall. Female marbled salamanders remain with their clutch of eggs until the pool re-fills later in the fall, at which time the egg hatch. Marbled salamander larvae overwinter under the ice and may be seen in southern New England pools before eggs of the other salamanders have hatched.

Slide 60




Green frogs breed in more permanent bodies of water, but often travel to vernal pools to feed. In green frogs, the dorsolateral ridge runs straight down the back.

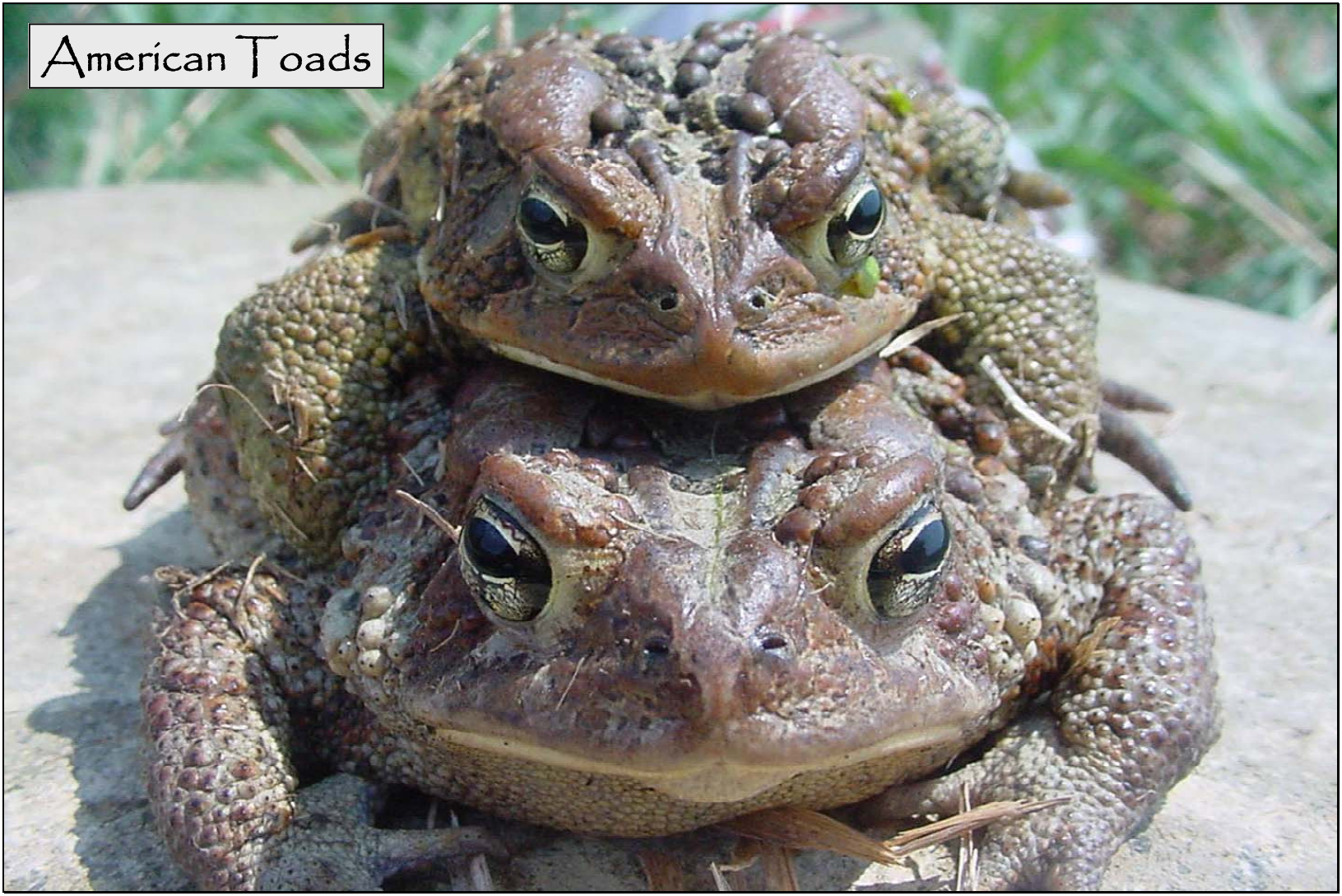
Slide 61


Bull frogs breed in more permanent bodies of water, but are often seen feeding in and around vernal pools. The dorsolateral ridge curves around the ear or tympanum (unlike the green frog).

Slide 62

Occasionally, during exceptionally wet years when dry down is minimal, bull frogs and green frogs may successfully breed in semi-permanent pools. Tadpoles of both of these species remain in their breeding pools for 2 to 3 years prior to metamorphosis. In the spring time when vernal pool field assessments are conducted, large chunky tadpoles (especially ones with back legs!) are likely to be either green frogs or bull frogs.

Slide 63




Rough skinned and covered with warts, American toads may be found in a diversity of habitats including vernal pools. In parts of southern Maine and southern New England, toads breed in sunny vernal pools.

Slide 64


In central and northern Maine, toads typically breed after the early spring time breeding in vernal pools has already occurred. American toads deposit long strings of eggs in the shallows of open temporary pools, ditches, old beaver flowages, flooded gravel pits, and artificial farm ponds.


Spring peepers are also active in the early spring, but are much smaller than wood frogs and have a dark "X" pattern on their backs that distinguishes them from other Maine frogs. Spring peepers also have small round pads on their toes that allows them to climb up vegetation.

Slide 66


Grey tree frogs often call from trees near vernal pools later in the spring, but they typically breed in permanent waters in the early summer. Their color varies with the pattern of the tree trunk they are calling from.

Slide 67


Caddisfly larvae typically build cases to protect themselves. *Ptilostomus* caddisflies tend to build their cases out of leaves. They may prey heavily on spotted salamander egg masses.

Slide 68


Log cabin caddisflies build their protective cases out of sticks.

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Fingernail clams, the size of fingernails, occur in vernal pools and permanent ponds. If you visit a pool at the end of the summer, you can dig around in the leaf litter and find these clams and caddisfly cases. This tells you the site once held water that supported aquatic animals. The site should be checked to see if it is a vernal pool in the spring!

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