7 Reasons Amphibians Are Simply Awesome

By Brett Amy Thelen, with Contributions by Dave Huth

Two of AVEO's most prominent citizen science programs – the Salamander Crossing Brigades and the Vernal Pool Project – center around amphibians and their habitat. Why this focus on frogs, toads, and salamanders? They have a profound impact on the ecology of northeastern forests. Their porous skin makes them particularly vulnerable to environmental toxins, so they can serve as "canaries in the coalmine" if we pay close enough attention. They're accessible. They're mysterious. If you've ever gazed into the smiling face of a spotted salamander, you know they're also quite charming. In short, they are awesome. Unconvinced? Read on.

A spotted salamander crossing a road during the spring migration (photo: Larry Clarfeld).

1. Salamanders are (bio)massive.

In ecological terms, biomass is defined as the total mass of living organisms in a given place at a given time. Researchers at the Hubbard Brook Experimental Forest in northern New Hampshire found that the biomass of a single salamander species – the northern redback salamander – was *more than twice that of all birds* in the forest, even during peak bird-breeding season. A Massachusetts study found that the biomass of vernal pool–breeding amphibians in the 53-acre forest surrounding the pool was greater than all the breeding birds and small mammals in the study area *combined*. All those amphibians spend a lot of time preying on forest invertebrates and wandering through underground burrows, which in turn affects nutrient cycling, gas exchange, and decomposition rates in the forest floor. Love our forests? Thank a salamander!

2. Amphibian skin is like science fiction alien skin.

The more you learn about amphibian skin, the more it will amaze you. Ever wonder how aquatic newts, who breathe air through lungs like we do, survive harsh New England winters in ice-covered lakes? How do they come up for air with all that ice overhead? They don't! Instead, they extract oxygen directly from the water by touching it. With their skin.

Even more amazing: some amphibians can sweat poison, and not just any old poison, but some of the most potent neurotoxins known on earth. *From their skin*. This feat is not limited to tropical rain forest species in far-off lands. In fact, the humble red eft, whom you have surely seen wandering through the woods on rainy summer days, produces toxins that, upon entering the digestive tracts of certain predators, block signals from the predators' brains that tell its heart to beat and its lungs to breathe. (Important side note: don't eat red efts!) If you had amphibian skin, you would be an honest-to-goodness superhero.

3. The amphibian life cycle is the closest thing to sorcery you'll ever see.

Amphibians hatch out of eggs as swimming babies that resemble blubbery grapes with tails (frogs and toads) or tiny adults with neck feathers (salamanders). They live like that for months or years, and then they change into something else entirely. Their body parts completely transform. A tadpole has a mouth and digestive tract completely different in form and function from that of a frog; in other words, a

Wood frog, very close up (photo: Dave Huth).

tadpole's guts disappear and are replaced by frog guts. Salamanders lose their feathery external gills and replace them with internal lungs. They also grow legs where there were exactly zero legs before. When you were a mammal baby, did you grow fully functional limbs out of your stomach? We didn't think so.

4. Wood frogs are living ice cubes.

Wood frogs, spring peepers, and gray tree frogs – all common species in our local forests and wetlands – get through the coldest parts of the winter by *freezing solid.* Their heartbeats and breathing stop entirely . . . but they're not dead. They're just waiting out the cold, their cell walls protected by natural antifreeze that they manufacture for the express purpose of making it through the winter. When spring comes, they simply thaw out and hop back to life.

5. Spotted salamanders are living solar panels.

If you stumble upon a vernal pool toward the end of May, you may notice that certain spotted salamander egg masses have a greenish glow to them. That green color comes from algae, which are in a symbiotic relationship with the salamander embryos developing inside each egg. The embryos release waste material, which fertilizes the algae. In turn, the algae photosynthesize, producing oxygen for the embryos to "breathe." In 2011, scientists made a stunning discovery about the algae-salamander connection: this symbiosis not only takes place in salamander eggs, but also *inside salamander cells,* and the algae provide the embryonic cells with glucose as well as oxygen. In other words, the algae act as internal power stations, generating fuel for the growing salamanders. If this sounds strange and fantastical to you, well, that's because it is. Vertebrates have complex immune systems, which typically reject the intrusion of foreign species. In fact, the solar-powered spotted salamander is the only known vertebrate to contain another species inside its cells. The algae aren't essential to salamander survival, but they help: embryos deprived of algae have lower survival rates and exhibit slower growth than their green cousins.

6. Frogs have built-in megaphones.

Anyone who has visited a wetland on a May evening

A gray tree frog perched – where else? – on a tree (photo: Dave Huth).

knows the awesome acoustic power of the wee spring peeper. Adult peepers are only about an inch long, but they have vocal sacs in their chins that expand with every "peep," amplifying the intensity of each call. Groups of spring peepers, peeping together in chorus, have been measured at 120 decibels, as loud as a rock concert and louder than a jackhammer!

7. Amphibians regenerate.

If a salamander loses its tail to a predator, the tail will *grow back.* And not just tails. Also legs, jaws, and internal organs. Also *eyeballs.* Some salamanders are so good at this that, when threatened by a potential predator, they *cut off their own tails* by flexing their muscles really hard. Are they *magic?* No, they are simply *awesome.*

Want to learn more about our amphibian-related citizen science programs? Visit www.aveo.org or drop me a line at thelen@harriscenter.org.

ESI, Inspired by Meade

By Susie Spikol Faber

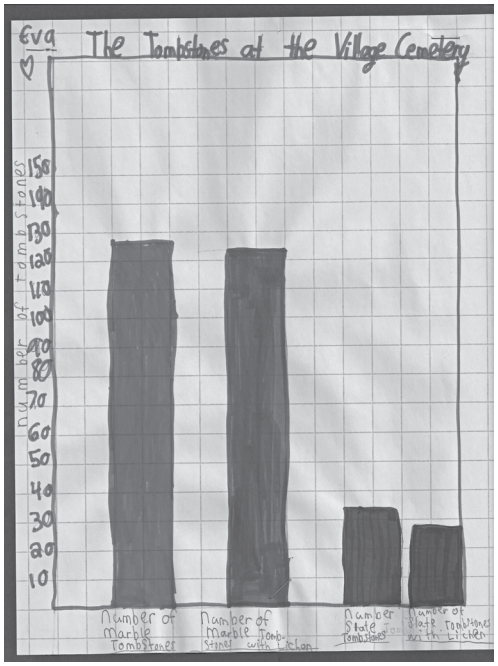
During the winter of 1992, I took my first tracking class; it snowed every weekend in February and the tracking was astounding. I also had some strange karma with otters that winter. Every time I went outside to track, I didn't just see otter tracks, I saw actual otters. And although these memories include waist-deep wild snow, sliding chortling otters, and quiet hours spent following a set of fox tracks, what I really remember is being breathtakingly inspired by my teacher, Meade Cadot.

Teacher, tracker, punster, and guitar-strumming singer of such New England mammal classics as the "Quillpig Jig," Meade Cadot led a class that woke me up to the natural world as few other classes ever had. This was because of his persistent and contagious enthusiasm for his subject, the mammals of New England. Meade tromped with us from the highlands to the wetlands in search of the signs and trails of the wild mammals of the Monadnocks – from porcupines to bobcats and beavers to moose. He came to each class packed with information, and he drew out his students with questions and stories. He put us in the tracker's snowshoes by simply leading the way and every now and then pointing out something that carried us forward in our learning. He'd pull from his pockets little bits of natural history; once, when we were out in a beech grove, he pulled a bear claw out of his pocket and showed how the territorial scratches on the trees around us were made. Thanks to Meade Cadot, I'm now a lifelong scat-collecting tracker, and grateful for every minute of it.

Meade Cadot taught me not only how to track, but also how to teach. I learned how to teach with joy and appreciation, with humor, knowledge, and humility. I also discovered that as an adult I could learn about something with an eagerness and vitality that felt fresh, filling me with energy and curiosity.

For the past six years, the essence of what it felt like to be in Meade's class has been inspiring the Harris Center's *Environmental Studies Institute* (ESI), a series of courses designed for adults, taught by people passionate about the natural history and ecology of our world. Since the first course in February 2008 – a discussion group looking at the issues of global sustainability – ESI courses have offered opportunities for people to look deeper and more thoroughly into the world around them. Topics have included owls of New England, Aldo Leopold, mushrooms, sustainable agriculture, insects, and New Hampshire predators, to name only a few. Among the instructors and presenters have been such experts and luminaries as authors Tom Wessels and Sy Montgomery, mushroom expert Dr. Rick Van de Poll, and, of course, the singing scat collector and tracker – Meade Cadot!

Come try out an ESI course. You too might get caught up in your own curiosity, and find a whole new world opening up to you. You could learn about the birds of the world or stay closer to home and discover the ecology and history of Mount Monadnock. Call the Harris Center for more information or visit our website at www.harriscenter.org to see the current listings for ESI. And, if you get a chance, try to catch any hike in our outings calendar that Meade is leading. He's still the bobcat's meow!



Inquiry in a Graveyard?

By Jamie Hutchinson

A cemetery isn't the typical place you would expect to find an elementary school class hanging out, but for fourth-graders in Jaffrey Grade School, it's the perfect place to study the weathering of rocks. Students first began visiting the Village Cemetery through lessons created by Harris Center teacher/naturalist Dori Drachman. This past November, I continued these inquiry-based projects with Marianne Sorrentino's fourth-grade students, who developed and carried out their own investigation related to weathering.

The inquiry-based lessons began in the classroom with the students conducting various experiments to explore the effects of chemical and mechanical weathering on rocks. With this background knowledge in hand, they walked the short distance to the Village Cemetery to observe and compare the effects of weathering on the slate and marble tombstones they found there. The students sketched tombstones of their choosing, recorded observations, and formed questions based on their observations. Among these observations: "a lot of tombstones are broken or cracked"; "some tombstones are hard to read"; "a lot of tombstones have lichen or moss growing on them"; "some tombstones look dirty"; "the marble tombstones feel rough and the slate tombstones feel smooth." These initial observations led to some very thoughtful questions.

The next step in our project was deciding which of these questions we could investigate, determining which questions could be answered by looking in a book and which required us to conduct observational research at the cemetery. The students came up with a number of options for the investigation, but settled on this one: "Are there more marble or slate tombstones with lichen and/or moss growing on them?"

At this point, the fourth-grade scientists had more work to do before heading back to the cemetery. As a class, they decided on the steps they needed to take, the materials they required, and how they could share this information with others. Finally, it was time to return to the cemetery. With clipboards, data sheets, pencils, and cameras in hand, the students identified slate and marble tombstones, and noted the presence of lichen and/or moss. After compiling all the data, it was determined that a higher proportion of the marble tombstones have lichen and/or moss growing on them than do the slate ones. The students shared their results through photographs, bar graphs, and written descriptions of how lichen and moss aid in the weathering process. Another result was a classroom full of students excited about stones and weathering, the role of lichens and moss in the process, and the cemetery they got to explore!

Marsha Baker, Supernova!

By Meade Cadot

This spring marked the 10th anniversary of Marsha Baker's passing – but the tremendous support and energy she gave the Harris Center has just now reached its glowing climax. Here's a bit of history about this shining star of the Supersanctuary.

Marsha first became a member back in the late 1980s – and shined her first bright light on us in the fall of 1990. She had already had her first bout with cancer, but in spite of that decided to participate in a "Pedal for Power" bicycling marathon – pedaling all the way from Maine to Florida! Imagine our surprise when, as a Thanksgiving gift, she presented us with a check for $1,546 – pledges raised for her expedition.

But that was only the beginning! Her passion was helping our wildlife neighbors in the Supersanctuary. For us to work on the critters' behalf, she understood that we needed support for our education programs and a workable home base. To those ends she made generous and substantial contributions to both the endowment for our school programs (in 1996) and to our capital campaign for the 2002-03 grand transformation of the Harris Center: from a 1920s-30s uninsulated summer house to the innovative, energy-efficient, and bright headquarters that we thrive in today.

Marsha was also a supporter of habitat protection through land conservation. In 1995 she joined with her family – Virginia, Lee, and Jeannette Baker – in funding the initial protection of land at Rye Pond, including the N.H. Natural Heritage-recognized 26-acre "acid fen" area, with its frontage on Route 123 in the northeast corner of Nelson. Over subsequent years, her family – notably her mother, Virginia Baker – helped add an additional 200 acres of contiguous protected land in Antrim and Stoddard. In 2007, the Bakers also participated in the campaign to acquire what we now call the Robb Reservoir Reservation, which includes the northern 6-acre portion of Rye Pond, in Stoddard. That same year, the whole Rye Pond area was named the Virginia Baker Natural Area.

In 2003, her last year with us, Marsha was the co-contributor to what we call the Ben Rice Conservation Easement Land – 180 acres on Windy Row in Peterborough. This parcel features wonderful wildlife habitat, including forestland, meadow, and wetland – and abuts approximately 280 acres of additional conserved land.

> *"For all her good deeds, we are sure Marsha rests in peace."*

Marsha Baker, marathon biker and lover of the outdoors.

And now, Marsha's star shines on with a grand bequest! We have recently learned that Marsha directed funds from a trust to the Harris Center and several other conservation groups working in the Monadnock Region. The Harris Center share is a wonderfully generous gift that will build our endowment and help to ensure that our habitat protection and education programs, which Marsha so valued, will continue to forge a bright future for the Monadnock Region.

For all her good deeds, we are sure Marsha rests in peace – and we think of her often as we pass the memorial bench on our entrance deck, which sports a plaque reading "Marsha Baker – She loved the outdoors and all its creatures. 1946-2003."

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