

# Salamander News

No. 7

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www.yearofthesalamander.org

## If You Build It, Salamanders Will Come

by John G. Palis, Palis Environmental Consulting



Eastern Tiger Salamander, Union County, Illinois (JG Palis).

Like the bluebells in H.M. Tomlinson's *A Lost Wood*, the Eastern Tiger Salamanders (*Ambystoma tigrinum*) migrating to a breeding pond on a cold, rainy night in March "expected no evil." This was their natal pond, after all, one that has been in use by generations of tiger salamanders before them. But this year was different, this year there was no pond. The farmer, in his quest to increase acreage for commodity crop production, had drained and filled the pond after these salamanders emigrated away as metamorphs in previous summers.

This scenario, no doubt, plays out in similar fashion every spring across the agricultural regions of the

northern hemisphere. Amphibian breeding sites are degraded or destroyed for various reasons, not just to increase agricultural acreage. They are also drained for mosquito control, filled to facilitate housing or business developments, or are used as convenient dumping grounds for logging slash and other organic or inorganic wastes. The end result is the same, another amphibian breeding site lost.

Salamander terrestrial habitat is, of course, also modified for human use. Most North American forests and prairies have been cleared and are now vegetated with "amber waves of grain" or lawn grass, or have been replaced with concrete and asphalt. Some forests have regenerated one or more times since the European colonists first cut them down, but many have been repurposed as tree farms. With all this habitat degradation and loss, one wonders how North American pond-breeding salamanders continue to persist.

The tenacity of the pond-breeding, terrestrial salamanders, here defined as ambystomatids, Eastern Newts (*Notophthalmus viridescens*), and Four-toed Salamanders (*Hemidactylium scutatum*) is, I believe,

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Tiger Salamander farm pond, Iltis-Fletcher Farm, Union County, Illinois (JG Palis).



sponsored by PARC - Partners in Amphibian and Reptile Conservation



## Get Your July Photo Contest Calendar - Free!

Predators take warning: I taste bad! That's the message conveyed by the bright orange coloration of the eft stage of the **Eastern (aka Red-spotted) Newt**, *Notophthalmus viridescens*. **Marty Silver** snapped this winning photo in Tennessee. To get the big picture and see our runner-up, the iconic salamander of vernal pool conservation in North American forests, go to <http://www.parcplace.org/images/stories/YOSal/YoSalCalendarJuly.pdf>.

### Call for Photos for the 2014 Year of the Salamander Calendar Photo Contest

We are seeking close-up, digital photos of salamanders, preferably in their natural habitats or within an educational or conservation context. One winner will be selected each month to be the featured photo as part of the Year of the Salamander online calendar. Runner-up photos will also be included in the calendar. In addition, all submitted images will be considered for use in the Year of the Salamander monthly newsletter and website as well as other Year of the Salamander-related conservation, outreach, and educational efforts. Give us your best shot! For more information and for entry details, please visit <http://www.parcplace.org/images/stories/YOSal/YOSphotocontest.pdf>.

### Are Sirens calling you?

We especially need photos of some of our more elusive salamanders, the sirens, mudpuppies, amphiumas, and torrent salamanders, as well as species in the family Hynobiidae, and *Triturus* newts. If you have a good shot of any of these species that you're willing to enter in the photo contest, send them on in!

## Get your Year of the Salamander 2014 Gear!

Go online to the PARCStore (<http://www.cafepress.com/parcstore>).

Ready to gear up for Year of the Salamander? We've got you covered!

At the Café Press PARCStore, you can find just about any style of t-shirt, sweatshirt, or hoodie, for men, women, or children. But don't stop there - you'll find a messenger bag, field bag, aluminum water bottle, even a beach towel (in case you want to join the salamanders crawling out of that primeval sea).



And take a look at the beautiful **Year of the Salamander Wall Calendar**, full of fantastic salamander photos for every month of your year!

Proceeds from sales go to the Year of the Salamander Conservation grant, managed by Amphibian and Reptile Conservancy, a not-for-profit organization that helps support PARC activities, such as public education, publications, and research.



**July Newsletter Content Coordinator:** Tom Gorman, Virginia Tech

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# Announcing a Year of the Salamander video contest!

## Here's how you can participate!

Partners in Amphibian and Reptile Conservation and conservation groups from around the world have designated 2014 as the Year of the Salamander. Through this unprecedented partnership, organizations and individuals will work together to raise awareness of salamanders as well as scale up global salamander conservation, education and research efforts.

Here's your chance to get involved with the Year of the Salamander **by entering our video contest:**

**Contest: "Salamanders Matter"** video campaign! Make a video that will help raise awareness to the general public about salamanders around the world!

You may want to make a video on:

- Why salamanders are important to people and natural systems;
- What people can do to conserve salamanders;
- Why salamanders are important to you; or
- "Public service announcements" (e.g., watching out for salamanders on the roads during migration).

But you are not limited to just these ideas!

We're looking for videos that not only convey salamander conservation messages, but that also reflect your passion for these amazing species. They can be edited and polished videos, or rough cuts shot from your phone out in the field.

Whether it is animation, live action, an original song, or something completely different, be sure to tell your story in a clear and creative way. Be sure to also come up with a unique and creative name for your video entry.

**Deadline** for the "Salamanders matter" contest is **July 31, 2014.**

Complete guidelines and contest details are posted on the Year of the Salamander webpage ([www.yearofthesalamander.org](http://www.yearofthesalamander.org)). If you have any questions, please email us at: [yearofthesalamander@gmail.com](mailto:yearofthesalamander@gmail.com).



Salamanders Matter

...to aquatic, riparian, and terrestrial ecosystems, and the interconnections among them. A pond-breeding Four-toed Salamander, *Hemidactylum scutatum*, by Noah Charney, Year of the Salamander Photo Contest.



Salamanders are...everywhere!

It may appear that the big emphasis for vernal pool conservation is on the pond-breeding salamanders of northeastern North America, but pond-breeders exist everywhere that there are salamanders. In the Pacific Northwest of the U.S.A. and Canada, pond-breeding species include the Long-toed Salamander (*Ambystoma macrodactylum*, pictured at left), the Northwestern Salamander (*Ambystoma gracile*), and the Rough-skinned Newt (*Taricha granulosa*). In California, you can find the increasingly imperiled California Tiger Salamander (*Ambystoma californiense*) plus the California, Sierra, and Red-bellied Newts (*Taricha torosa*, *T. sierrae* and *T. rivularis*), and in many other parts of the western U.S., the Barred Tiger Salamander (*Ambystoma mavortium*). Photo © Elke Wind.

# Year of the Salamander Collaborating Partners

The Year of the Salamander Planning Team is pleased to welcome the following organizations to our growing list of collaborating partners:

## Opacum Land Trust

[www.opacumlt.org](http://www.opacumlt.org)

Opacum Land Trust is a volunteer-run land conservation organization and works within 13 south-central Massachusetts towns. The land trust is named after the Marbled Salamander (*Ambystoma opacum*), as this threatened species spurred the creation of the land trust in the year 2000. Currently Opacum has permanently protected over 1,000 acres of land. Our flagship property, Opacum Woods in Sturbridge, MA, was acquired to protect habitat for our namesake.



**VERNAL POOL  
ASSOCIATION**  
[www.vernalpool.org](http://www.vernalpool.org)

## Vernal Pool Association

[www.vernalpool.org](http://www.vernalpool.org)

The Vernal Pool Association's goal is to encourage the appreciation, protection, and interdisciplinary study of vernal pools, particularly by students. To meet this objective, we produce educational materials, present workshops and talks, and interact with educators and students both in person and through the internet. We are actively involved with state, federal and private environmental protection and education agencies and organizations. Our website, "The Vernal Pool," is our on-line effort at education and outreach.

## Heritage Conservancy

[www.HeritageConservancy.org](http://www.HeritageConservancy.org)

Based in Doylestown, PA, Heritage Conservancy is a nationally accredited conservator and community-based organization committed to the preservation and protection of significant open spaces, natural resources and historic structures. A champion of conservation best practices, Heritage Conservancy is dedicated to the idea that everyone is responsible for stewardship and seeks to enlighten, engage, and empower others to help achieve this mutual vision. Recognizing the importance of protecting our salamanders, Heritage Conservancy started the Quakertown Swamp Amphibian Rescue Partnership. At the end of every winter, this partnership helps to provide safe passage for salamanders and other amphibians across a busy road in order to get to vernal pools on the other side to breed.



**HARRIS CENTER**  
FOR CONSERVATION EDUCATION

## Harris Center for Conservation Education

[www.harriscenter.org](http://www.harriscenter.org)

The Harris Center for Conservation Education is a non-profit land trust and environmental education organization located in southwestern New Hampshire. We are dedicated to promoting understanding and respect for our natural environment through education of all ages, direct protection and exemplary stewardship of the region's natural resources, and programs that encourage active participation in the great outdoors. Our teacher-naturalists work with 2,500 students in nearly 30 schools each year, integrating place-based nature education (on topics including, but not limited to, salamanders and vernal pools) into K-12 curricula. We also provide over 100 lectures, film showings, and guided outings for the general public each year, including a suite of amphibian-focused programs in the spring. Lastly, our citizen science arm ([www.aveo.org](http://www.aveo.org)) coordinates the locally-celebrated Salamander Crossing Brigades and volunteer vernal pool inventories. Since 2007, our citizen scientists have documented 130 vernal pools, and saved over 15,000 migratory amphibians from the crush of the tire!

We are still recruiting partners! If you are interested in contributing to the Year of the Salamander efforts, please send an email to [yearofthesalamander@gmail.com](mailto:yearofthesalamander@gmail.com) with a brief description of your organization and its efforts. Our full list of partners can be found at <http://www.parcplace.org/news-a-events/2014-year-of-the-salamander/68-uncategorised/281-year-of-the-salamander-partners.html>

*If You Build It, Salamanders Will Come*, cont. from p. 1



Drained farm pond being filled, Union County, Illinois (JG Palis).

genetically inherent. There has been a long history of salamander habitat coming and going, predating human alterations to the landscape. Extensive portions of northern regions of North America, for example, have been covered with sheets of ice a mile or more thick for thousands of years. During these glaciation events, salamanders were forced southward, only to recolonize the glaciated areas after the ice retreated. Recolonization was likely facilitated by the creation of numerous wetlands as glaciers retreated, providing a vast network of breeding sites via which salamander populations expanded northward.

With the colonization of North America by humans came a novel and relatively rapid landscape-altering force. Humans are adept at altering both terrestrial and aquatic natural habitats to suit their own needs. These changes occur, as Rachel Carson wrote, at the “heedless pace of man rather than the deliberate pace of nature.” Oftentimes, as described above, this results in a loss of salamander habitat. But other times, salamanders benefit from the hand of man, employing their ancient habit of recolonizing formerly inhospitable space.

Here in Illinois, where I live, one is hard-pressed to find ground unaltered by the hand of man, and finding a natural, untouched wetland is nigh impossible. And yet, we have an impressive list of terrestrial, pond-breeding salamanders inhabiting the state including Jefferson’s Salamander (*Ambystoma jeffersonianum*), Blue-spotted Salamander (*Ambystoma laterale*), Spotted Salamander (*Ambystoma maculatum*), Marbled Salamander (*Ambystoma opacum*), Smallmouth Salamander (*Ambystoma texanum*), tiger salamander, Mole Salamander (*Ambystoma talpoideum*), Eastern Newt, and

Four-toed Salamander. Remarkable, I think, for a state dominated by agriculture (77.5% of the state).

Humans often inadvertently create salamander breeding habitat while engineering the landscape. Roadside ditches, irrigation ponds, borrow pits, and even idle sewage lagoons can provide suitable breeding habitat. Ponds, created for livestock or wildlife, are also colonized by salamanders (provided predatory fishes are not introduced), as are road-ruts, created when vehicles are driven on muddy dirt roads.

Biologists are beginning to critically examine whether or not these various forms of human-made water bodies—created wetlands in particular—provide suitable salamander breeding habitat; oftentimes they do. For example, in a recent review of 37 such studies (Brown et al. 2012. *International Journal of Ecology*. doi: 10.1155/2012/989872), the authors concluded that created and restored wetlands “can be valuable tools for amphibian conservation.” Amphibian colonization and successful use of created wetlands for reproduction



Created wetland, Horseshoe Lake Fish & Wildlife Area, Alexander County, Illinois (JG Palis).



Marbled Salamander & Mole Salamander wildlife pond, Cypress Pond State Natural Area, Johnson County, Illinois (JG Palis).

was influenced positively by proximity to amphibian source-populations, intermediate hydroperiod, presence of aquatic vegetation, and gently sloping banks which provide nearshore shallows. Presence of predatory fishes negatively affected amphibian species richness. Fortunately, as studies have shown, salamanders will recolonize following the removal of fishes.

Wetland creation appears to be becoming popular in some parts of the USA, especially with the advent of the Natural Resource Conservation Service's Wetland Reserve Program (WRP). Under particular conditions, a landowner can enroll his or her property into the program and, with financial and expert assistance of the NRCS, can create one or more shallow-water wetlands on the property. Often these wetlands are created with flood control or waterfowl population-enhancement in mind. It matters not to the salamanders (or those of us who enjoy interacting with salamanders) why the wetland was created, it just matters that a wetland now exists where one did not exist before.

With the advent of the WRP and similar pond/wetland creation programs (e.g., [www.wetlandsandstreamrestoration.org](http://www.wetlandsandstreamrestoration.org)), we can reimagine the opening scenario. The tiger salamanders, on their way to their non-existent natal pond, encounter a newly created wetland; a wetland having the aforementioned ideal traits. They now have a new place to establish themselves, to pioneer generations of salamanders to come.



Frozen-over wildlife pond, Shawnee National Forest, Union County, Illinois (JG Palis).



Follow all of the Year of the Salamander news and happenings on Facebook (<https://www.facebook.com/YearOfTheSalamander2014>) and Twitter (@YOSal2014).



## Upcoming Meetings & Events

**Conservation Genetics of Salamanders course**, July 7-19, Highlands Biological Station, Highlands, NC. More info at [www.highlandsbiological.org](http://www.highlandsbiological.org)

**Sabino Canyon Lizard Walk**, July 12, 8 am, Sabino Canyon Recreation Area, Tucson, AZ. Meet at the visitors' center.

**Salamanders and Frogs!**, July 19, 10 am, presentation by Dr. Mary Beth Kolozsvary, Thacher Park and Nature Center, Voorheesville, NY. Search for live amphibians in woodland pools and streams! Limit 15 people, call 518-872-0800 to register.

**Salamander Day**, July 20, 1-4 pm, Sessions Woods Conservation Education Center, Burlington, CT. Family-friendly activities, talks, and live salamanders. Optional preregistration, call 860-675-8130. See [<link>](#) for more info.

**2014 Joint Meeting of Ichthyologists and Herpetologists (SSAR/ASIH)**, July 30 – August 3, Chattanooga, TN. More info at [www.dce.k-state.edu/conf/jointmeeting/](http://www.dce.k-state.edu/conf/jointmeeting/)

**NEPARC annual meeting**, August 13 - 15, 2014, Allegany State Park, Salamanca, NY

**Stream & Marsh Exploration**, September 13, 10 am, Sessions Woods Conservation Education Center, Burlington, CT. Hillary Clifton will introduce you to the creatures of the Sessions Woods streams and beaver marsh, including salamanders. Pre-register at 860-675-8130. See [<link>](#) for more info.

**Great Smoky Mountains Salamander Ball**, September 13, Knoxville Zoo, Knoxville, TN. More info at [www.dlia.org/newsdlia-events](http://www.dlia.org/newsdlia-events)

## Seduced by Salamanders

by Susan Walls, U.S. Geological Survey, Amphibian Research and Monitoring Initiative

As I struggle to lift the cumbersome dipnet from the water, the pungent smell of rotten eggs makes me grimace. Yuck—who would have thought that a bunch of leaves and mud could smell so bad! I quickly forget about the smell, however, as I spot an alien creature writhing amidst the leaves, twigs, and crayfish in the bottom of the net. By the process of elimination I assume it is a fish. But its tiny little legs and the long, fleshy, feather-type structures that extend from the sides of its head stymie me. The sides of its body are flecked with gold. A dark stripe extends through each eye. I gently roll it over in my hands and reveal the contrasting pattern of dark bands on its glistening surface. Am I sure this isn't a fish? If it is, why doesn't it have scales? And fish don't have legs! I am completely stumped by this first of many encounters with a larval Mole Salamander, *Ambystoma talpoideum*, which happens to belong to a family of the same name (mole salamanders or Ambystomatidae).



Paedomorphic Mole Salamander (*Ambystoma talpoideum*). Paedomorphosis, the phenomenon of an individual reaching sexual maturity in the aquatic habitat while retaining morphological features characteristic of a larva (e.g., external gills), occurs facultatively in this species. Photo: Dirk Stevenson.

Ten years earlier, salamanders were the farthest thing from my mind as my 5th-grade science teacher, Mrs. Saunders, waltzed into the classroom of rowdy 10-year-olds and announced that we were going to do something different that day. She approached the lab bench at the front of the room, lit a Bunsen burner, stuffed a test tube full of dirt, leaves and twigs, held the test tube over the open flame and, in story book fashion, explained how the heat and pressure of the earth—given sufficient geological time—gradually transform these ingredients into coal. After allowing the test tube to cool, she tapped it on the side of the lab bench and, as she finished her



A shallow, ephemeral woodland pond in which three species of ambystomatid salamanders are known to breed. Such ponds are favorable breeding sites because they are highly productive and their temporary hydrology eliminates predatory fishes. Photo: Susan Walls.

elaborate story, out popped a lump of “coal”. At that very instant, my spark for science was ignited; I was awakened to the thrill of scientific discovery. Many years later I would discover that larval salamanders are ideal for studying how natural systems work. If Mrs. Saunders could only know the impact she had that day.

I am standing in this shallow pond with a dipnet in my hands as part of the requirements of my college Field Ecology class. I am studying the reproductive ecology of amphipods—a group of freshwater crustaceans that resemble miniature shrimp—as my part of the class field project. I am scooping through the mud and leaves on the bottom of our study pond in search of these crustaceans when I excitedly exclaim that I've discovered a new type of “fish”. Once my professor recovers from his amusement, he explains the mystery of the dual life cycle that most amphibious creatures experience. I learn two very important facts that day—first, that amphibians do more exciting things than just sit on lily pads and eat flies and, second—that one should never publicly announce the discovery of a new creature unless they know with certainty what the heck they're talking about.

Amphipods and other small invertebrates flourish in these small, temporary woodland ponds that don't hold water long enough to support populations of predatory fish. The aquatic larvae of all salamanders in the mole salamander family eat tiny crustaceans, thus capitalizing on the high biological productivity—the profusion of



**Left:** Developing larval Marbled Salamanders (*Ambystoma opacum*), still encased in their common egg capsule. “Twinning”, as shown here, has been reported in the Eastern Tiger Salamander (*Ambystoma tigrinum*) and in captive-bred Axolotls (Mexican Salamander, *Ambystoma mexicanum*). However, as far as we know, this phenomenon has not been reported in a natural population of the Marbled Salamander. Photo: Susan Walls.



**Right:** Developing embryo of the Spotted Salamander, *Ambystoma maculatum*. The light greenish hue evident throughout the inner egg membrane is cast by the symbiotic green alga, *Oophila amblystomatis*. This alga is often found in developing embryos of other aquatic-breeding amphibians as well, but it is especially prevalent in embryos of Spotted Salamanders. Photo: Susan Walls.

small invertebrates that live in these ephemeral bodies of water. Adults of most ambystomatids march down to the breeding pond en masse from their underground terrestrial refugia after seasonal rains in the middle of winter or early spring, depending on the location and the species. A frenzy of males vies for the attention of individual females, attempting to seduce them with their elaborate dance (aptly described as a “waltz”) on the bottom of the pond.

The December following my first encounter with a larval salamander, I revisited the same pond on a very cold, rainy night. The light of my headlamp revealed that the small, shallow pond was literally bubbling with activity. I excitedly raced back to the car, grabbed a dipnet, and dragged it across the bottom of the pond. As I lifted the net out of the water, dozens of adult Spotted Salamanders (*Ambystoma maculatum*), another species belonging to the Ambystomatidae, poured over its sides. For the first—and, thusfar, only—time in my life, I was fortunate to be at the pond right at the peak of breeding activity of these explosive breeders. As I scooped up handfuls of purplish brown creatures with vivid yellow and orange spots and large, black eyes, I knew that I was smitten for life.

The aftermath of the intense salamander orgy is apparent at dawn when the shallow regions of the pond bottom are littered with white, cottony phallic-shaped structures known as spermatophores. Unsurprisingly, these structures are the product of evolution, nature’s way of ensuring internal fertilization in a primitive vertebrate that lacks copulatory structures. After plucking off the cap of a suitor’s spermatophore with her cloacal lips, the female salamander deposits her fertilized eggs in either a gelatinous mass or singly (depending on the species) on submergent vegetation, woody debris,

pine needles, and other suitable oviposition sites. Within hours, a miracle of nature unfolds: each fertilized ovum begins to cleave, quickly advances to a blastula, then elongates to resemble a larval salamander. Once external gills develop, examination of a living embryo with a dissecting microscope reveals red blood cells—vital transporters of dissolved oxygen—circulating through the gills like tiny bumper cars.

The embryos of at least one species, the Spotted Salamander, have maximized their oxygen uptake (and, thus, their growth) by partnering with another organism—a unique green alga, *Oophila amblystomatis* (aptly named after its salamander symbiont). Yet another fascinating product of evolution, the alga garners safe refuge within the innermost egg membrane of the developing larva, as well as the nitrogenous waste needed for sustenance. In return for its hospitality, the larval salamander gains its own oxygen factory: the algal cells are fruitful and multiply, casting a greenish hue throughout the interior of the egg membrane. Amazingly, the intricacies of this symbiotic relationship remain an unresolved mystery.



Terrestrial adult stage of the Mole Salamander. At metamorphosis, aquatic larvae undergo morphological and physiological changes and migrate from their natal pond into the surrounding terrestrial habitat, where they mature into adults like this one. Photo: Dan Holland.

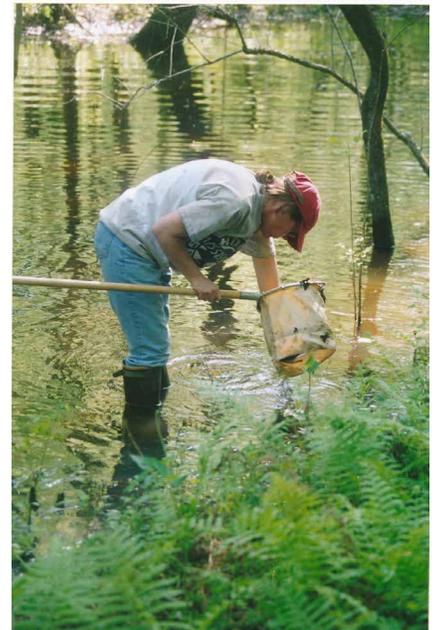


The Marbled Salamander (*Ambystoma opacum*), one of only three ambystomatid salamanders known to lay their eggs on land instead of in a water-filled pond. In autumn, females of this species deposit their eggs in the dry basin of temporary ponds, then sit on or near the eggs until winter rains fill the ponds, causing the well-developed larvae to hatch. Photo: Dan Holland.

The strange and seductive ritual of salamander breeding that awakened my interest in this unique group of amphibians only exists in a remote, ephemeral environment of forested wetlands, which has been shrinking for years due to urban and agricultural development. As these types of land use continue to cannibalize more and more of the woodland habitat that is home for these animals, some members of the mole salamander family are potentially in trouble. Several species—including unisexual forms that have arisen through hybridization of species—have restricted ranges, are relatively rare, and are considered to be vulnerable to extinction. Like other animals, populations of several species of mole salamanders have been extirpated or drastically reduced in size, primarily because of loss of habitat. Four species, along with three “distinct population segments” (DPS) of a fifth (the Frosted and Reticulated Flatwoods Salamanders [*Ambystoma cingulatum* and *A. bishopi*], the Santa Cruz Long-toed Salamander, the Sonora Tiger Salamander [*A. macrodactylum croceum*], and the Central California, Santa Barbara County and Sonoma County DPS of the California Tiger Salamander, *A. californiense*) are already listed as federally threatened or endangered. Buffer zones of at least 500 meters around wetlands provide protection of breeding ponds and terrestrial habitats occupied by adults and metamorphosed juveniles and are needed to help conserve these species.

The imminent demise of my favorite group of amphibians led me to take a more proactive role in their conservation by working to establish the status of amphibian populations and attempting to gain an understanding of the factors influencing population change. More than thirty years after Mrs. Saunders lit my Bunsen burner, I traded in my career as an academic amphibian ecologist to join the ranks of the Department of Interior’s Amphibian Research and Monitoring Initiative (ARMI). As a research wildlife biologist with the U.S. Geological Survey, I now conduct a long-term monitoring program for amphibians in Alabama, Florida, Georgia, North and South Carolina, and Tennessee.

Additionally, I seek answers to the vital question of what elements of an amphibian’s environment influence change in populations. I am no longer at the front of the classroom as a teacher, educating others about the diversity of our natural world, its importance to our daily lives and our inseparable connectedness to it. However, I remain an ardent student in nature’s classroom, where every encounter with a salamander—especially a mole salamander—excites me as much as it did in my undergraduate days many years ago.



The author dipnetting for larval amphibians during one of her studies. Photographer unknown.

## Outreach and Education Materials – NOW AVAILABLE!

For educators and naturalists, we now have outreach and education products that were created specifically for the Year of the Salamander on our website ([www.yearofthesalamander.org](http://www.yearofthesalamander.org))! We have *face painting templates and notecards, a slide show and script, posters, and an educational packet* for naturalists and teachers. We will continue to update the page with additional materials, as well as links to other educational resources. **Please check it out!**

If you have unit materials, educational program information, or PowerPoint presentations you are willing to share them, please send them to [yearofthesalamander@gmail.com](mailto:yearofthesalamander@gmail.com). We are also hoping to include videos! Please provide your name, the name of your school/nature center or organization, and location. If you did not create the materials, please be sure to tell us where you found them.

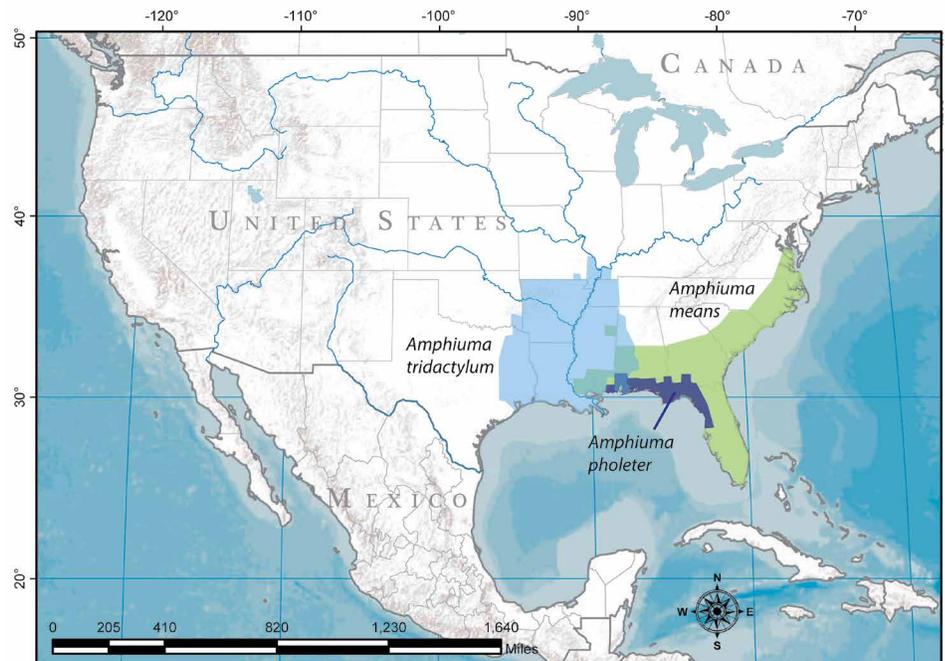
## Family of the Month: Amphiumidae

The Two-toed Amphiuma (*Amphiuma means*) is a member of the family Amphiumidae, and occurs in or near wetland habitats of the southeastern United States. Reaching up to 1 m (3.3 feet) long, Amphiumas have elongated, slender bodies with reduced limbs, and are often mistaken for eels or snakes—deceptive common names include conger eel, congo eel, congo snake, lamprey eel, and ditch eel, although they are in fact salamanders. The Two-toed Amphiuma is the largest and most widespread of the three species of Amphiuma. Larvae have external gills at hatching, but these are soon resorbed and develop into gill slits. Adults also have lungs, and although predominantly aquatic, they will venture onto land for purposes of dispersal. A variety of invertebrate and vertebrate prey is eaten, including earthworms, insects, crayfish, fish, frogs, and other salamanders. When their aquatic habitat dries, Amphiumas can burrow into mud and form a cocoon of mucus as protection from the dry conditions and emerge when water returns.

Ranges of all three species of amphiumas. The range of *Amphiuma pholeter* (the One-toed Amphiuma) overlaps that of *A. means*; in a small area of Alabama, all three species overlap. Map by Kathryn Ronnenberg, USDA Forest Service, PNW Research Station.



*Amphiuma means*, the Two-toed Amphiuma - you can see why they could be mistaken for eels. Photo © KM Stohlgren.



### Family: Amphiumidae

Also known as:	Amphiumas
Number of Species:	3 extant species, all in the genus <i>Amphiuma</i>
Region / Habitat:	- found in the southeastern United States - live in swamps, marshes, sloughs, slow-flowing streams, and other aquatic habitats
Physical Characteristics:	- elongated, eel-like bodies with tiny limbs - species can be differentiated by the number of toes (one, two, or three)
Behavior / Development	- nocturnal and predominantly aquatic - females lay their eggs in strings and guard their eggs - larvae have external gills and adults lack external gills, but have gill slits and lungs - defend themselves against predators and people with a powerful bite - have been reported to live up to 27 years
Fun Fact:	Amphiumas have 25% more DNA than humans

# Life in the Logs—the Oregon Slender Salamander

by A.J. Kroll, Weyerhaeuser NR, Federal Way, WA



Figure 1: A pair of Oregon Slender Salamanders found in a log in the Oregon Cascades, USA.

Under the lofty forest canopies of the Pacific Northwest, the Oregon Slender Salamander (*Batrachoseps wrighti*) leads a reclusive life within the decomposing heartwood of downed logs. Searching for this retiring species (Figure 1) is a challenge, given its preference for inhabiting narrow galleries inside Douglas-fir (*Pseudotsuga menziesii*) logs, many of which exceed three feet in diameter. When log interiors are exposed, Slender Salamanders tend to freeze, relying upon their dorsal camouflage, which closely matches decomposing Douglas-fir bark and heartwood, to avoid detection (Figure 2).

The distribution of the Oregon Slender Salamander is generally restricted to forested environments on the west slope of the Oregon Cascades, USA (although a population was recently located in the eastern suburbs of



Figure 2: The dorsal patterns of Oregon Slender Salamanders are an ideal match against a background of decomposing Douglas-fir bark and heartwood, Oregon Cascades, USA.

Portland, OR, and a small portion of its range extends over the Cascade Crest). The species was petitioned for federal listing under the Endangered Species Act in 2012 because its conservation status is considered “sensitive” throughout its range and its current NatureServe status is G2/G3 (Imperiled/Vulnerable). Global demand for forest products is booming, and the majority of the Oregon Slender Salamander’s distribution lies within biologically productive coniferous forests that are managed for commodity production. As a result, managers need information about specific practices that can be employed to mitigate negative effects when they occur. As with many Pacific Northwest salamanders, the Oregon Slender Salamander was long thought to be associated strongly with late-successional forests containing substantial amounts of coarse woody debris (CWD). However, extensive sampling for this species has not occurred on intensively-managed landscapes.



Figure 3: Coarse woody debris (CWD) is a critical component of forest ecosystems, Oregon Cascades, USA.

Coarse woody debris, including snags, downed logs, and stumps, is an important component of ecological processes in forest ecosystems (Figure 3). Although many studies have examined wildlife associations with CWD, relatively few studies quantified relationships between density, distribution, and CWD characteristics (e.g., piece size and decay stage) and maintenance of viable populations of organisms that use these structures. Together with Oregon State University and Port Blakely Tree Farms LP, Weyerhaeuser NR is conducting a long-term experimental study to determine how Oregon Slender Salamanders respond to forest harvesting and to

retention of CWD. In order to gather this information, sampling for Oregon Slender Salamanders occurs at two spatial scales: larger forest stands (~40 acres in size) and plots (~80 m<sup>2</sup>) within stands. In each plot, biologists search for salamanders beneath cover objects such as moss mats and in the outer portions of downed logs (Figure 4). This design allows researchers to make inferences about where salamanders occur and what habitat structures (logs of different sizes, species, and decay class) they prefer to inhabit. Initial information suggests that Oregon Slender Salamanders are common in stands ~50-70 years of age. For example, the project has found Oregon Slender Salamanders in more than 70 stands, all of which were harvested previously. Additionally, salamanders are more abundant when downed logs are common in a stand. The latter result is not surprising, given the species' apparent reliance on downed logs to provide necessary micro-environments as well as foraging substrates.



Figure 4: Watching the antics of Oregon Slender Salamanders is an entertaining diversion on a fine summer day, Oregon Cascades, USA.

### Year of the Salamander Podcasts Coming Soon!

Podcasts will soon be posted on the Year of the Salamander webpage ([www.yearofthesalamander.org](http://www.yearofthesalamander.org)). Check the site for details in July.

## An Interview with Cathryn (Katie) Greenberg

by Jessica A. Homyack, Weyerhaeuser Company



Katie Greenberg studies the response of wildlife communities, including salamanders, to forest management.

Cathryn (Katie) Greenberg is a Project Leader and Research Ecologist for the USDA Forest Service, Southern Research Station, Upland Hardwood Ecology and Management research work unit at the Bent Creek Experimental Forest in Asheville, North Carolina. She received a PhD from the University of Florida in 1993, a MS in Wildlife Ecology from the University of Tennessee in 1987, and a BA in Philosophy from George Washington University in 1981. Katie has worked for the U.S. Forest Service since 1993 and much of her work there examines the effects of forest management

practices and natural disturbances on plant and animal communities, including salamanders.

***What lessons have you learned from working with salamanders that have affected your research on other organisms?***

In working with reptiles and amphibians (including salamanders) I have learned that there is no such thing as “wildlife,” generically speaking. Each species has its own set of requirements for habitat, microhabitat, breeding, feeding, and other aspects of their lives, and each responds differently to forest disturbances. So, what might not be so great for some salamander species might create optimal conditions for another species, such as a fence lizard or an Indigo Bunting.

***Based on your research, how can land managers ensure their activities are compatible with salamanders, and how resilient are salamanders to forest management or natural disturbances?***

My research so far has focused on how herpetofaunal communities—including salamanders—respond to disturbances in upland forests. So, I can't really speak to effects of forest management activities on stream salamanders; however, if BMPs are followed and riparian buffers are retained, then effects of

sedimentation and water temperature should be greatly reduced. In upland forests, it's been my experience that terrestrial salamanders are relatively resilient to natural disturbances such as large areas of windthrow, and anthropogenic disturbances such as shelterwood regeneration harvests or prescribed burning. Some other studies show decreases in salamanders after harvesting—which you might expect given their sensitivity to moisture and microclimate—but so far, ours have not. It may be that site quality affects how salamanders respond to large disturbances; in moist sites where stump sprouts and other vegetation rebound quickly, dropping leaves to create new leaf litter and creating a shaded microenvironment, perhaps salamanders aren't as affected as they might be on dry sites. In my opinion, as long as management activities, such as timber harvests, occur in relatively small areas and there aren't endangered species onsite, then it's a tradeoff—some species such as (perhaps) salamanders may decrease, but they will recover...and other species, such as disturbance-adapted neomigratory birds, may benefit. I think that keeping a landscape-level perspective is important; it's not possible to manage for all species in the same exact location.

***Effects of fire on herpetofauna and other ecological features have been dominant themes in your research program. What are the biggest challenges to keeping prescribed fire as a management tool in a rapidly changing landscape?***

My colleagues in fire management would say public opinion, land ownership patterns (houses in forested landscapes), and smoke management are some of the biggest obstacles to prescribed burning. Strict prescription parameters or “windows” limit the usefulness of prescribed burning as a precise tool; the burns may or may not get done when, where, or at the intensity prescribed by a land manager; also, some burns are patchy and incomplete, making them a sometimes-crude management tool. In my research with collaborators, we have found that in upland hardwood forests, low-intensity, winter prescribed fire doesn't have a big effect on salamanders or other wildlife. High-severity burns that kill a lot of trees have a measurable effect on birds, but even then only a marginal effect on terrestrial salamanders in hardwood forests... and that might not be compatible with timber objectives. I'm currently collaborating to continue a study of fire effects on herpetofauna after repeated burning and different burn severities, so soon we'll hopefully know more about

that. Of course, not all ecosystems are the same. Fire suppression in most of the Coastal Plain ecosystems would adversely affect many wildlife species where fire maintains “healthy” upland ecosystems. When it comes to prescribed fire as a management tool, having specific objectives is important.

***What role does your employer, the U.S. Forest Service, play in salamander conservation worldwide?***

Some other scientists in the Research branch of the US Forest Service study salamanders, and contribute to their conservation through knowledge development. And, of course, the US Forest Service manages national forests nationwide, providing a land base for salamanders and lots of other plant and animal species that may not fare so well otherwise, given the current rate and sprawl of urban development.

***Do you have a favorite salamander experience?***

I've had a lot of what I (cornily) call “adventures with nature.” Like, catching Marbled Salamanders (*Ambystoma opacum*) far from any known water source, watching a mama bear and 3 cubs that weren't aware of my presence, or saving a rattlesnake from certain death-by-vehicle. It's wonderful being out in the woods, watching the miracle of nature, from salamanders to trilliums to Star-nosed Moles.

***Many of the “giants” of salamander ecology are men. What has it been like to be a female wildlife ecologist?***

I am often one of only a few females in the room when I'm working with land managers, or sometimes even with other wildlife ecologists, especially in the past. A lot of women have entered the field of wildlife in the past



Sampling salamander communities in managed forests often uses drift fence arrays as a passive trapping method. Photo by Aimee Tomcho.

few decades as the definition of “wildlife” has broadened from strictly a game focus to a diversity focus which tends to draw the interest of more women. I don’t really think about male versus female very much. I think that if you do work that’s of interest to others, and you are confident in yourself, then it’s easy to focus on common interests with others rather than differences.

***What advice do you have to budding or seasoned scientists?***

My advice would be to stay broad in your interests, even if you become an expert in a more narrow aspect of ecology. And, hone your naturalist skills as much as you can. Ecologists who study and model ecosystems without a “dirt” understanding of them can get off track and never know it. I don’t think anyone can really understand an organism—like a salamander—without also understanding their context—the forests and other animals.

***How does one make a career out of working with salamanders?***

I’m an ecologist who studies salamanders as one way to gauge effects of forest management on forests and wildlife. For me, just studying salamanders would provide an incomplete picture of how wildlife responds to disturbances. In my career, I have focused on wildlife communities, rather than single species or a single group of species. For others wishing to make a career in wildlife ecology, I’d suggest volunteering on a lot of different studies and projects to make sure you like it, and then to narrow down your interests. Conducting a field study in graduate school would be a good way to start a career, and from there hopefully get hired as a biologist or



Northern Red Salamanders (*Pseudotriton ruber*) are a stunning find for any salamander researcher. Photo by Charlotte Matthews Snoberger.

research ecologist.

***What role have participating in professional societies played in your success as a scientist?***

Professional societies are a wonderful way to meet other scientists who are interested in the same topics; this can lead to new ideas, and productive partnerships and collaborations. They are also a good way for students to meet and talk with other students and professionals. Finally, it’s rejuvenating to be around others in your small “club” of people who think your work is interesting and who also do interesting studies.

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*\*The views and opinions of interviewees are not necessarily shared by all members of PARC or other Year of the Salamander Partners*

## Salamanders as Environmental Sentinels

*by Joseph M. Lewandowski, Maryland Herpetological Society, Baltimore, MD, USA*

Throughout time, environmental signals have been identified to gauge the health and soundness of our natural world. Such predictors have relied on species trends, water and air conditions, or patterns of myriad other environmental parameters. For species indicators, if an individual organism or larger population persists, it suggests that the micro-ecosystem components vital for survival are being maintained and are in a sense “healthy.” Today, there is renewed focus on the value of species indicators, especially where umbrella, flagship, or keystone species may indicate the status of larger more complex ecosystems.

Salamanders are ideal organisms to act as our keystone to determine ecosystem health. First, their fossorial nature and often complex life history places them in extremely close association with numerous microhabitats, including water, air, and soil conditions. In particular, many species have narrow microclimate tolerances, and hence they can be bioindicators of microclimate patterns—a growing concern with climate change predictions. If all microhabitats are optimal, salamanders may thrive. Unlike other organisms that can travel extensive distances should a specific

habitat decline, salamanders don't have that luxury. They are much more prone to suffer the effects of habitat fragmentation, as evidenced by the plethora of species with restricted ranges that are being identified as our molecular genetic techniques have developed in recent decades. As past populations have become isolated due to habitat changes, they have diverged sufficiently to be considered different species today.

Second, salamanders are nested in food webs, being key prey for a range of invertebrate to vertebrate predators, and in turn rely on their own faunal prey base. Changes in salamander numbers may indicate alterations in other food web components. However, the importance of salamanders as central food-web components hints at their functional role in both sequestering nutrients from the environment, and bridging aquatic and terrestrial ecosystems. As young aquatic salamanders grow, they sequester nutrients from aquatic habitats, transforming aquatic flora and fauna to vertebrate biomass. Upon metamorphosis and transition to terrestrial lifestyles, they bring those aquatic organic subsidies to terrestrial systems and enrich dry-land fauna. They are nature's transit system, bringing essential nutrients from water to land.

Recent research examines the functional role of salamanders in the cycling of finer-scale elements from their environment due to their role in the center of the food web, with an eye on the increasingly important element carbon, in particular. Atmospheric carbon is intricately tied to greenhouse gases and climate change. Simply put, more carbon in the air is tied to rising surface temperatures. Research on carbon cycling between the Earth-bound ecosystems and the atmosphere is a hot topic! Salamander habitats are among the most important carbon sequestration systems across all the continents of the world.

Carbon is trapped by standing forests and woodlands, the wood and detrital matter on the ground, the waters of those habitats, and their biota. Salamanders may have a significant role in the carbon cycle of these systems, enabling it to be trapped in detritus and soils by eating the bugs that eat leaf litter, transforming it from tiny prey to their salamander bodies—where it is then available for all land life-forms, in addition to moving it from water to land and back again as their own life cycle fluxes between land and water. The suggestion that salamanders have a role in moderating climate change may seem outlandish, but it is yet another example of how salamanders are intricately woven into the web of life on Earth, and the balance of conditions allowing environmental stability.

It becomes obvious as we proclaim the Year of the Salamander that we strive to understand that as a salamander searches for food, shelter, breeding sites, and optimum habitat, they are analyzing the environmental parameters that lead to a sustainable life. Isn't that what an environmental sentinel is? —A monitor of our environment that warns of imbalance. In more ways than previously recognized, our salamanders are excellent predictors of environmental health. They are a true watchdog of our planet, our life. We only need to pay heed that an alarm is being raised.



Terrestrial salamanders like the Eastern Red-backed Salamander (*Plethodon cinereus*) and its western North American counterpart (*P. vehiculum*) can comprise a large proportion of the vertebrate biomass of the forest floor. The predatory salamanders have a significant impact on the numbers of insects that shred and ingest leaf litter as part of the process of decomposition. Recent research suggests that their voracious appetites may actually slow the release of carbon to the atmosphere. Photo by Jenna Quinn, Year of the Salamander Photo Contest.