

The Secret Lives of Salamanders



The natural history of one of the most common, secretive, rule-bending, and just plain weird animals of Ohio.

by Shane McGuire

When you think of amphibians in Ohio, frogs and toads might come to mind first. Since they are so vocal it's easy to know if they are in your area. In early spring you might hear the high-pitched chorus of the first indicators of spring, the spring peepers, or the American toad's trilling call outside your window.

These creatures are nice to listen to but there are other amphibians that call Ohio home, including 25 salamander species. People are generally unaware of them because they spend their days hiding under leaf litter, rocks, rotting logs, and even underground. Many are just a few inches long but some can reach almost 8 inches in length. They range in colors and can have spots and specks and even stripes.

They vary in other ways too, since they are creatures that seem to like bending the rules. For instance, most land-dwelling animals have lungs. Not so for the lungless salamanders that form one of the two major Ohio salamander families (Plethodonidae). These slender, short-limbed salamanders start off as eggs in water, hatching into juvenile "larvae" equipped with gills. As adults,

they lose their gills and live on land, but rather than developing lungs, they simply switch to absorbing air through their skin. This feature makes them very vulnerable to pollution (and to handling by people).

Most lungless salamanders are law-abiding amphibians and lay eggs in streams, but some non-conforming species lay their eggs away from water in moist mature forests under rotting logs and rocks. The young have gills that they will lose once they reach maturity, though some species will do so just 24 to 48 hours after hatching, making the aquatic phase of their lives very, very short. Other species may take up to four years to do so.

Mole salamanders comprise the other major salamander family in Ohio (Ambystomatidae). Though these large, stout bodied creatures do have lungs, they spend most of their adult lives living underground in mature forests.

The breeding rituals for both mole and lungless salamanders are very.... intriguing. They share some similarities, as we will explore below, but a major dif-

ference for the mole family is their preference for breeding in vernal, or "spring", wetlands. These small wetlands collect standing water during the winter thaw and heavy spring rains. Though soil may remain saturated year-round, in late summer and early fall the standing water disappears, limiting the ability of predators like fish to survive, a key benefit for amphibians.

Every spring, mole salamanders emerge from underground and migrate to the same body of water where they were born (usually a vernal wetland), to find a mate and continue the cycle. Though larvae are born with gills, these disappear as the salamanders mature and lungs develop before they begin their lives underground.

The Two-Lined

For the rest of this article we will explore the most common species in these two families, which are all found at the BFEC. We'll start with the lungless family and the northern two-lined salamander, a small species that reaches just 2 - 3 inches in length. Its color varies from dull greenish yellow to bright yellow, with a distinct brown or

Salamanders you may (or may not*) see at the BFEC

* all of these species live at the BFEC but can be hard to find. We are here to help; join us this spring for a salamander hunt! See page 6 for details.

Eastern two-lined

Family Lungless (Plethodontidae)

ID 2-3 inches long, yellow with black stripes on sides and back

Habitat Stream edges, under logs in moist woods

Breeding January to April

Fun Fact Courtship involves males wrapping their body around the female's head and snout, perhaps for up to an hour (not kidding). Eggs attached to logs or rocks in shallow water on the edge of streams.



by Brian Gratwicke commons.wikimedia.org

Jefferson

Family Mole (Ambystomatidae)

ID 4-7 inches long, purplish with silver specks

Habitat Moist, mature forests with vernal wetlands

Breeding First warmish, rainy night of spring

Fun Fact Have very long back toes and live underground, not to be confused with Hobbits. Migrate to vernal wetlands to breed in early spring, sometimes while snow is still on the ground.



commons.wikimedia.org

Red-backed

Family Lungless (Plethodontidae)

ID 2-3.5 inches long, usually black with red stripe on back

Habitat Moist, mature forests

Breeding Extended season, from October to April

Fun Fact Can defy rules of being an amphibian by reproducing without a body of water; eggs may be laid under rocks or logs on land. Like the eastern two-lined above, they also defy the rules of breathing by having no lungs, preferring instead to breathe through their skin as adults.



by Rklawton via commons.wikimedia.org

Spotted

Family Mole (Ambystomatidae)

ID 6-7 inches long, dark purplish with two rows of yellow spots

Habitat Moist, mature forests with vernal wetlands

Breeding First warmish, rainy night of spring

Fun Fact Like the Jefferson salamander, it leaves its subterranean home in very early spring to breed in vernal wetlands. Each female may be mobbed by up to 50 males trying to impress her.



black line starting behind the eyes and running down each side of its back, ending around the midpoint of the tail. Adults are found in a variety of habitats, most often on the edge of forested streams hiding under rocks and logs. They can also be found in springs and seeps, or even yards away from water in moist mature forests. Like the other salamanders we will discuss here, their diet consists of insects (like beetles and mayflies), spiders, centipedes, earthworms and snails.

Their breeding season is usually from January to April. When the breeding season comes around males get restless and start nudging the females, and here's where it gets a bit unusual. The male will actually wrap its body around the female's head and snout, perhaps for up to an hour, using special glands to release pheromones that affect fe-

male receptivity. Once the male releases, the female will straddle the male's tail and walk behind him; this is called "the straddle walk".

The female will then start moving her head out of phase with her tail. During this time the male releases spermatozoa, which the female then walks over to accept internally. Once fertilized, the female will typically lay 15 to 20 eggs, though sometimes up to 50, in April and May. Eggs are attached under logs or rocks in shallow water on the edge of streams. Some females will guard their eggs until they hatch, which in Ohio is about 60 days. The young hatch with gills and will stay in the larval stage for two or three years. Once mature, they lose their gills, and true to the family name, start breathing through their skin.

The Red-Backed

Another common species in the lungless family is the eastern red-backed salamander. This species is very small, only reaching 2 to 3 1/2 inches in length, and has two color phases. First is the red-backed phase, which features a red stripe starting behind the head, tapering down towards the tail and bordered by a dark pigment. The second color phase is known as the lead-backed phase and is found in many populations. It lacks the red stripe and may have brassy or silver specks on the sides and back.

Eastern red-backed salamanders inhabit moist mature forest, hiding during the day under leaf litter, rocks, and rotting logs. Unlike most salamanders in this family, eastern red-backed salamanders have an extended breeding

season. Breeding usually starts in October and lasts to early April, though females can only reproduce every other year. During the breeding season males track down females and initiate courtship. Males will rub glands on the body and snout of the female, releasing pheromones. Most species in this family do “the straddle walk” led by the male, but for eastern red-backed salamanders the females will lead the straddle walk. Only when the male releases his spermatophores (to be accepted by the female) will he lead.

Eastern red-backed salamanders can defy rules of being amphibians by reproducing without a body of water. After mating, females crawl into burrows under rocks or rotting logs and lay eggs in early summer. They stay and guard the eggs until they hatch 6 to 8 weeks later.

Unlike most young in this family, eastern red-backed salamanders do not go through a free-swimming larval stage. They bear gills while in the egg, but while there, change rapidly into immature adults. After they hatch, gills shrivel up and the young start breathing through their skin within 24 to 48 hours. It usually takes males two years, and females three, to reach breeding maturity.

The Jefferson

The mole salamander family is a little different from the lungless family. Let's start with the Jefferson salamander. Jeffersons are large and have dark purplish bodies with tiny silver specks running down both sides. They can reach 4 to 7 inches in length, and have very long toes compared to other species in this family. They inhabit mature forests that contain the vernal wetlands or streams they require for breeding.

Jeffersons live under the forest floor for most of their adult lives, sometimes several hundred yards from breeding waters. Every spring on the first decently warm, raining night of about 50 degrees Fahrenheit, even if there is still snow or ice present, these creatures will emerge from underground and migrate back to the waters in which they were born to breed. This brief foray above ground provides just about the only time to see this species. They

usually breed in vernal pools (or temporary, forested wetlands) in or around the mature forest where they live but may use streams and ponds as well.

When the adults finally make it to breeding waters the male initiates courtship, climbing on the female's back and wrapping his forelimbs around her. He will rub his chin on the top and sides of her head and snout, along with vibrating his body and undulating his tail.

Once the male dismounts, if the female is ready to breed she will nudge his cloacal region and he will disperse spermatophores, which the female will then walk over to accept. Females will lay their eggs one to several days later, usually on submerged sticks or vegetation. A female lays 180 to 210 eggs, and then both sexes return to the forest floor until next breeding season. The eggs usually hatch 26 to 35 days later. The young larva are born with gills and remain in the water for 2 to 4 months. Once reaching adulthood, with lungs developed, they migrate from wetlands to the forest on rainy or humid nights to begin their lives underground.

The Spotted

Probably the most popular salamander of our 25 species is the spotted salamander. They are easy to identify, growing 6 to 7 inches long with dark purplish bodies and two lines of yellow spots extending from head to the tail.

Just like the Jefferson salamander, you will most likely only see these creatures when they emerge from underground and migrate to their breeding waters in early spring. Spotted salamanders usually breed in shallow vernal pools free of fish, though they have also been observed breeding in roadside ditches, submerged tire tracks, and swamps. (Join the BFEC to see the migration this spring! See more information on page 6).

Vernal (or spring) wetlands like this one are essential breeding grounds for some salamander species like the spotted. They fill with spring rain water but dry out in the fall, making them inhospitable to salamander predators like fish. See salamanders migrating to this wetland this spring! Event details on page 6.

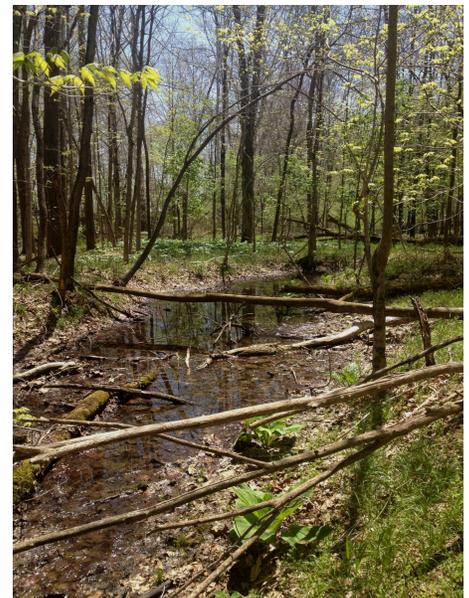
Spotted salamanders migrate a little differently than Jeffersons. Though migration occurs during the same time of year and under the same weather conditions, spotted male salamanders migrate to the breeding waters 1 to 6 days earlier than females. Once the males reach the water they will release their spermatophores on submerged sticks and vegetation. When the females arrive, the males will nudge and push them towards their spermatophores; up to 50 individual males may push one female. After the female accepts a spermatophore she will lay her eggs on submerged sticks and plants, and then return to the forest floor until the next breeding season.

The eggs will hatch 4 to 7 weeks later; young are born with gills and will remain in the larval stage for 2 to 4 months. Once they mature, they lose their gills, develop lungs and migrate to the forest to live underground as adults, though it takes them 2 - 3 years to reach sexual maturity.

Conservation

As you can tell, streams, mature forests and vernal pools play a critical role in salamander survival; humans can have a devastating impact by disrupting these sensitive ecosystems. Agriculture can have a negative impact on salamander population if chemical runoff from farm fields flows into the streams, where it can harm or kill the salamanders that live there. Logging can also

...Continued on page 5



The Earth Beneath Our Feet



by David Heithaus

Allow me to paint a New Year's fantasy: This year on December 31st at precisely 12a.m. (GMT to be fair) world leaders will announce a technological breakthrough that will allow humanity to source abundant energy from the power of goodwill alone; effectively ending the era of sourcing abundant energy from the corpses of dead things in a race to make corpses of all living things. In order to prove the point governments and industries will *give* every human being on earth the required brain jack and universal power cord and all that individuals will have to invest in is being nice. That's it! No more greenhouse gas emissions no more pesky social justice issues, bright future, star-liners and alien babes/hunks/what-have-you here we come...

...in a hundred years or so. In the meantime we can all use our new personalized power cords to zip into our good-will bunkers while the effects of climate change continue to batter us about like the proverbial monkey-in-a-piñata. So where's the holiday-season fantasy? Is this rambling nonsense yet another reading ride on the tree-hugger's holiday guilt train? Patience...

The point that must first be made is that there is no quick and simple technological solution to climate change. We can't just slap solar panels on everything and call it a day. We have col-

lectively broken wind in the car and it's going to take some time for things to air out. Even if my (patent pending) devices existed and we stopped burning fossil fuels tomorrow, there would still be enough carbon dioxide in the atmosphere to keep us on the extreme-weather rollercoaster for many, many... many years. That's the stage we've set, that's the *mise en scène*.

So here's the good news: there's already a mechanism out there that's ready to help get carbon back where carbon belongs; an open window in the car; an air freshener of sorts. It's actually chugging along right now, waiting for us to slow down on one hand and give it a nudge with the other. What is it you ask? Well... it's kind of... everything- even you.

What I'm talking about is the Biosphere: every living thing, alive or dead, past or present and the interactions of these things with the planet's air, rock and water. Yeah. Mind blown.

The Biosphere produces massive amounts of energy, accomplishing more in a year than all of humanity's combined industrial processes. Quietly spread out and invisible to the naked eye chemical bonds are being torn apart and reformed. Matter is changing states. Of these processes, the carbon cycle is one of the most colossal

and the one that can help heal the effects of climate change if we start tinkering with it in a more thoughtful manner.

These days, carbon and carbon dioxide are largely associated with negatives: pollution, greenhouse gasses, climate change. In reality, carbon is the basis for all life as we know it. It is one of the most abundant elements on earth and believe it or not, there is no more today than there was at the dawn of time. Carbon atoms in your body might have once passed through a pterodactyl, a mighty blue whale, a clever mongoose... or a tape worm or Hitler... so don't go too far down that road. In any case, we can no more create additional carbon than we can create bacon that isn't delicious. That's simple physics. What we can do is affect how it cycles through our planet's component parts.

The important thing is to see the carbon cycle, all of nature really, as a set of processes rather than as things or sets of things. The carbon cycle is a factory whose circular conveyor belt packages energy from the sun for use by one type of living thing which in turn packages it for use by another which finally returns the raw materials for the first. It is a never-ending, solar-powered cycle with a finite amount of matter involved- while production fluctuates, it can never truly grow. What humans, as a part of the biosphere, are doing is pushing the cycle in a certain direction at an accelerated pace- we're making an ellipse of the circle.

The carbon cycle rests on the shoulders of one of nature's truly miraculous phenomena: photosynthesis. During photosynthesis, plants take carbon from the air and water from the soil; they wave a wand of sunlight at them to form complex carbon compounds like sugars and oxygen as a byproduct. The energy that powers the process comes from the sun. Essentially, photosynthesis is a molecular re-arranger that manufactures little edible batteries full of solar power. The compounds formed by photosynthesis are the base on which all higher forms of life are constructed.

We are essentially built by plants from sunlight. From the bottom to the top, the food web chows down on these delicious little packets of solar goodness

...Salamanders, continued from page 3

have a huge impact on mole salamanders.

Mole salamanders like the Jefferson and spotted are even more vulnerable, since the habitat that they require – vernal wetlands – are becoming less and less common as they are filled to make way for human development. While populations of spotted salamanders are stable, there are fewer of them now than there were in 1950 (according to the Ohio Biological Survey).

On a good note, humans are starting to realize the importance of these ecosystems, and not just for amphibians. Wetlands also benefit nearby communities by filtering pollutants and pre-

venting flooding by absorbing runoff.

Organizations like the Department of Agriculture have made regulations to limit farm runoff pollution. Landowners can also take care during logging operations to avoid wetlands and leave adjacent mature woods to provide refuge.

At the Brown Family Environmental Center, we are proud to protect habitat for all of the salamanders featured here, plus countless others animals, in vernal wetlands and streams and along the Kokosing River. You can help by supporting the BFEC or other organizations near and far that conserve habitat and ensure the future for these fascinating creatures.



See the Salamanders!



Join the BFEC for a two-part series to learn about salamanders and catch the spring migration!

Part I will be an indoor presentation on February 17 at 6:30pm.

Part II will be a hike on the first warm, rainy night of spring to see mole salamanders on the move migrating to wetlands at the BFEC. Since we can't predict this date more than a day or two in advance, **sign up now** (by emailing Shane McGuire at mcguires@kenyon.edu) to receive a notification when the time comes. Bring your rain boots!



...Earth, continued from page 4

in the form of complex carbon compounds. We are eating the solar power in the form of the sugars and initiating the process opposite to photosynthesis: respiration. Here, oxygen and sugars interact with metabolic enzymes and are converted back into water and carbon dioxide as the energy is released. The release of stored solar energy in respiration fuels every action, emotion and perception we have, allows us to grow and returns some of the raw materials needed for photosynthesis back into the environment.

Some of a plant's carbon finds its way into the soil through the roots or in the form of litter. As plants and animals die, yet more carbon enters the soil where millions of microorganisms incorporate it into soil organic matter- a key component of soil that stabilizes it from weathering while nourishing the plants that grow in it. Carbon comprises over half of all soil organic matter and can last for hundreds of years. Earth's soils were built by life and both the living and the bodies of the dead serve to maintain them and buffer them from the damaging effects of weathering.

This is the carbon cycle: the biosphere continuously cycling matter through birth, growth, death and decay; the world's carbon flowing from the at-

mosphere to living material to the soil itself.

It is the soil that holds the key to reversing climate change as soils hold more carbon than living things and the atmosphere combined. Unfortunately, as we move carbon quickly into the atmosphere through the burning of fossil fuels we are also attacking soil's ability to store it.

Through the spread of human populations, prairies and forests have been steadily converted to plowed cropland and the rich soils that supported them have been increasingly exposed to air and erosion. Carbon held by soil organic matter has been steadily released through oxidation (respiration outside of a living thing; think fire) or was carried away by erosion. In effect, we have been killing our soil and in doing so, shifting the distribution on the world's carbon from the soil and living things into the atmosphere.

This is the standard sad tale but not the one that I would choose to end on. Instead, we should take heart in the Biosphere's ability to reverse soil degradation and our ability to help it along; to breathe life back into dead earth and restore its ability to restrain carbon from leaping quickly back into the sky.

Just as burning former organic matter in the form of fossil fuels increases the rate of carbon moving into the atmosphere; wise land management decisions can promote the photosynthesis that takes it back out and the soil building that keeps it out. As the carbon-rich organic matter is built, drought and erosion-prone dirt will become rich, spongy soil that will further act to slow evaporation and reduce the amount of water vapor in the atmosphere.

Re-thinking the way we manage land has enormous ramifications beyond carbon sequestration. The kinds of techniques that help to promote soil building will also serve to improve human access to clean water and to promote sustainable food systems in doing so enhancing the strength of rural economies. It will improve our health as well as that of our environment.

Through no-till farming practices that consider the soil as a living ingredient to land preservation and habitat restoration projects, we are unique in the biosphere in our ability to accelerate and direct the carbon cycle. We have done so in one direction and face the abyss. Why not see what our big solar-powered brains can do to heal the earth that's closest to us. The earth beneath our feet.



Calendar of Events

All events are free, open to the public, and start from the BFEC Resource Center unless stated otherwise.
9781 Laymon Road, Gambier Ohio | 740-427-5050 | dohertyh@kenyon.edu | bfec.kenyon.edu

Owls of Ohio - Thursday, January 21, 6:30pm

Co-sponsored by the Knox County Park District. Join our night adventure to seek and call for two species of owls that can be seen and heard in the Kokosing valley. Former Metro Park Chief Naturalist Gary Moore will begin with images, legends and lore of the surprising variety of owls that inhabit Ohio. Then we'll hit the nocturnal trail for a 1/2 mile hike with stops to use recorded calls and entice owls to call or come our way.

Salamanders, Part I - Wednesday, February 17, 6:30pm

Salamanders live their reclusive lives in the dark, hiding under logs or tunneling underground. Enjoy a slideshow to learn about these fascinating, delicate creatures and what they need for survival. Plus sign up for Part II of the program: an opportunity to see salamanders at a spring wetland. In the event of inclement weather, the event will be postponed to Wednesday, February 24. Call 740-427-5052 for event status.



Salamanders, Part II - March ???

Spotted salamanders spend most of their lives underground, which makes seeing them very difficult. The best time to give it a try is when they briefly emerge during the first warm, rainy night of spring to converge at wooded wetlands. Sign up to experience the moment! Since we can't predict this date more than a day or two in advance, contact Shane McGuire at 740-427-5055 or mcguires@kenyon.edu to receive a notice when the time is right. On the evening of the outing, meet us at the BFEC Resource Center, then carpool to a trailhead and hike .5 - 1.0 miles to a wooded wetland. Wear your rain boots!

Break at the BFEC - Wednesday, March 30, 3-6pm

Looking for something to do with the kids during spring break? Drop in to explore the center's live animals, net tadpoles in the ponds (weather permitting), climb boulders in the kid's natural play area, make crafts and try a scavenger hunt.

Invasive Plant Liberation Day - Saturday, April 2, 10:30am - 12:30pm

Help free the BFEC preserve from invasive plants! Many small plants and shrubs have been brought to North America from other parts of the globe, and have escaped cultivation to blanket forests across Ohio. Learn to identify invasive species and how they harm forests, then learn best tactics for removing them as you help us pull them out. Bring work gloves; all ages welcome.



Earth Day Festival - Sunday, April 17, 10am - 2pm

Kenyon Athletic Center - 221 Duff Street, Gambier. Keep yourself and the planet healthy - two goals that go hand-in-hand! Enjoy this FREE event with exhibits, vendors, kids' activities, farm marketers, live music & more. The Festival uniquely brings together the best in local resources. Celebrate Earth Day by shopping green and connecting with groups that support healthy living for ourselves and our world. Brought to you by Kenyon College, Knox County Health Department, Knox County Park District, and OSU Extension. More information coming soon at kenyon.edu/earthday.

The Great Migration Bird Walk - Saturday, May 7, 9am

Birds that wintered in the tropics are returning to their temperate homes in Ohio and points further north. If ever there is a time of year to grab binoculars, this is it! Join us for a leisurely hike in search of these species and enjoy spring wildflower along the way. Binoculars provided; hiking boots recommended.

Miller Observatory Open House - Last Fridays, 8 pm

Enjoy the stars with Kenyon Physics Professor Paula Turner. Events are canceled in cloudy weather; email questions to turnerp@kenyon.edu. All ages welcome. From downtown Mt. Vernon, follow SR 229/Gambier St. east 4 miles. Turn left at observatory sign onto an access road prior to SR 308 intersection.

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Our Volunteers

* *In the office, on the trails and in the garden:* Shirley Hughes, Terry Heironimus, Kenyon Greek Council and Zeta Alpha Pi members.
* *Field Trip Volunteers:* thank you the 40 student

and community volunteers who helped us bring 450 elementary students to the center over six weeks.
* *Harvest Festival:* Kenyon Theta Delta Phi, Jim & Terry Heironimus, Drew and Harper Kerkhoff,

Hannah Levy, and Denny Wiegman
* *Christmas Bird Count:* thank you to the 30 volunteers who helped the BFEC take a Knox County bird census on December 20th!

Our Donors

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Do you need *more* reasons to give in honor of the BFEC's 20th Anniversary?

Ok, here's the most important one: feel the satisfaction of being a part of our critical mission of conservation and connecting people with nature. Plus, receive preferred access to popular workshops, a hard copy of our newsletters, and 10% discount on bird seed. Mail the form below or **donate online** at support-bfec.kenyon.edu. Thank you!

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Brown Family Environmental Center at Kenyon College

9781 Laymon Road, Gambier, Ohio 43022 ~ (740) 427-5050 ~ bfec.kenyon.edu



Our Mission

The BFEC at Kenyon College exists to engage Central Ohioans of all ages with nature, and to support the goals of Kenyon College by conserving the natural diversity of the Kokosing River valley and providing opportunities for education and research.

Our Staff

Heather Doherty, director
David Heithaus, director of facilities

Jill Kerkhoff, facilities & volunteer coordinator
Shane McGuire, land manager naturalist

Upcoming Events

Thursday	January 21	Owls of Ohio
Wednesday	February 17	Salamanders, Part I
Wednesday	March 30	Break at the BFEC
Saturday	April 2	Invasive Plant Liberation Day

Events details inside and at bfec.kenyon.edu



Earth Day Festival Sunday, April 17

Do you know a vendor or organization with a cause or product dedicated to health or the environment? Event organizers are seeking exhibitors - for registration information visit kenyon.edu/earthday

Brown Family Environmental Center
at Kenyon College
P.O. Box 508, Gambier, Ohio 43022



