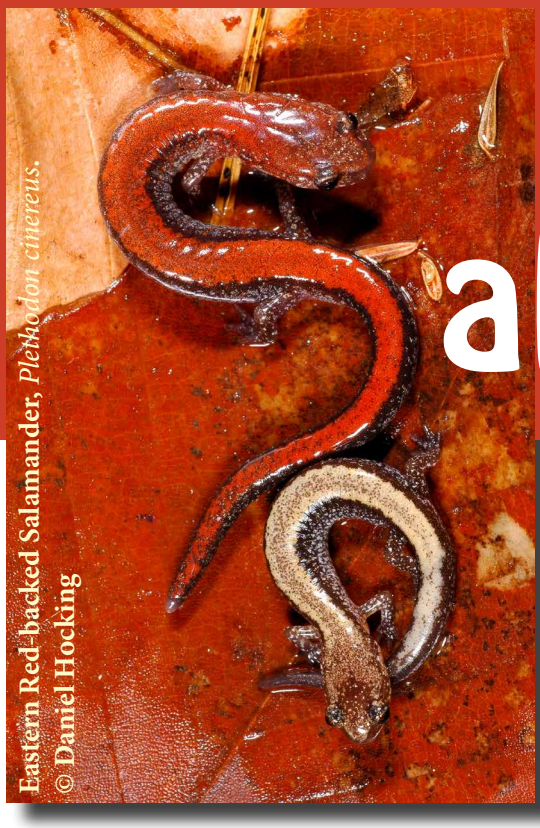


Eastern Red-backed Salamander, *Plethodon cinereus*.
© Daniel Hocking

State of the Salamander

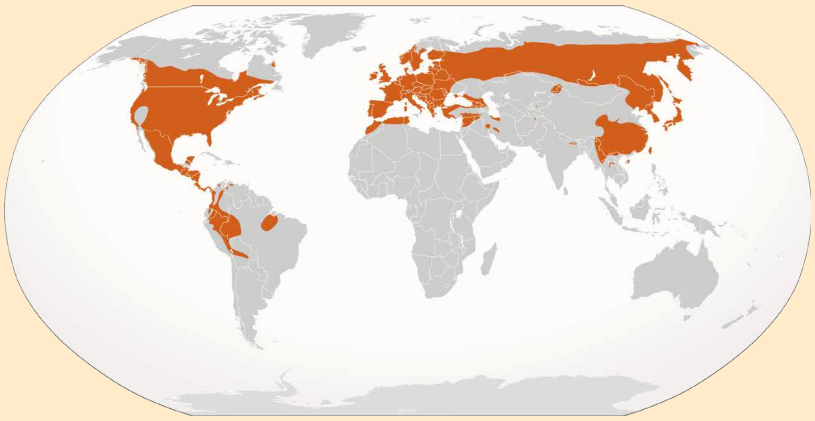
2014 Year of the Salamander

Partners in Amphibian and Reptile Conservation (PARC) is celebrating 2014 as the **Year of the Salamander** to energize salamander education, research, and conservation. This is a worldwide effort, leveraged through the actions of numerous partner organizations and individuals from all walks of life – public to professional. Over the coming year, PARC and its collaborators will be working to raise awareness about:

- the importance of salamanders in natural systems and to humankind;
- diverse ongoing research pathways aimed at better understanding salamanders, their role in ecosystems, and threats to their existence;
- actions being implemented around the world to conserve salamander populations and their habitats;
- education and outreach efforts through a kaleidoscope of individual and group involvement.

Did You Know?

- There are more than 600 species of salamanders worldwide.
- Most salamander species occur in temperate areas of the northern hemisphere.
- USA is a salamander hotspot, with more species than any other country.
- Worldwide, nearly half of salamander species are threatened with extinction.
- Salamanders are central to food webs, connected to many other animal groups.
- Loss of salamanders may indicate poor environmental health.



Map © by TheEmirr/ Maplab/Cypron Map Series, from Wikipedia

Partners in Amphibian and Reptile Conservation Mission:

PARTNERS IN AMPHIBIAN AND REPTILE CONSERVATION

"To conserve amphibians, reptiles and their habitats as integral parts of our ecosystem and culture through proactive and coordinated public-private partnerships." **www.parcplace.org**

For more details on **Year of the Salamander**, visit our website: **www.yearofthesalamander.org**

Join us as a partner, and get involved in celebrating our salamander natural heritage. For information on becoming a partner, please contact us at: **yearofthesalamander@gmail.com**.

The Elusive Salamander

Have these incredible creatures been living under the radar or simply under a rock?

Salamanders are poorly understood and undervalued amphibians. Due to their secretive nature, often hidden from human view, it may come as a surprise that salamanders are one of the most abundant vertebrates found in forest, grassland, and riparian environments. Consequently, salamanders serve as vital components of food webs and are integral to ecosystem stability. While many species can be found on land, others are strictly aquatic, and most serve as a functional link between land and water. Intrigued? Read on!

Long-tailed Salamander, *Eurycea longicauda*

Did You Know?

The Appalachian Mountains are the area of highest salamander diversity anywhere on earth!

Over 50 species of salamanders are found in the southern Appalachians alone, almost 10% of the global diversity of salamanders. Many of these species are endemic—found nowhere else on the planet. The humid, forested conditions of the Appalachians provide a perfect climate for salamanders to thrive. The great age of this landscape helps explain why so many different species of salamanders may be found here: the mountains and ravines of the Appalachians may have helped protect ancient plethodontid salamanders from the effects of the Yucatan meteor proposed as a cause of the K-T extinctions.

Yonahlossee Salamander, Plethodon yonahlossee, *native to the Blue Ridge Mountains, part of the Appalachians.*

Salamanders 101

Most salamanders have moist skin and feel slimy to the touch, as opposed to the dry, scaly skin of lizards (lizards are reptiles, not amphibians). Water is critically important to salamanders, even those species living on land their entire lives, which require moist and shaded habitats so they do not become dehydrated. They are generally most active on cloudy and rainy days or evenings and can be found hiding under rocks or logs on hot, sunny days. Maintaining proper hydration is critical to terrestrial salamanders, which helps explain their generally small home ranges. Aquatic species, although not so concerned with hydration, can be extremely sensitive to temperature and chemical contaminants. They may be elusive like their terrestrial counterparts because they tend to leave the safe areas provided by stones, cobbles, and other debris only at night. All salamanders are carnivores. Terrestrial species eat a wide variety of invertebrates such as insects, slugs, snails, and earthworms. Aquatic species eat leeches, mollusks, crustaceans, and eggs of other amphibians. Larger species of salamander may eat small mammals, frogs, and even other salamanders.

The Northern Dusky Salamander, Desmognathus fuscus, *requires moist microhabitats like forest duff to live and lay its eggs on land.*

Diversity at its Finest

Salamanders can be difficult to identify because they come in a variety of shapes, sizes, and color patterns, and they are an extremely diverse group (Order: Caudata/Urodela) of amphibians. Over 600 different species are assorted into 10 family groups. Some families, like the Proteidae, Sirenidae, and Cryptobranchidae, are fully aquatic and retain larval characteristics as adults (neoteny); some are fully terrestrial and lungless (Plethodontidae), and have no larval form; others may lay eggs in water but usually develop a terrestrial form as adults (Ambystomatidae and Salamandridae). Most salamanders have four short limbs and a long tail, but species differ in form and proportions.

Southern Two-lined Salamander (*Eurycea cirrigera*)

Associated with brooks, springs, seeps, river swamps, and forest floodplains, the Southern Two-lined Salamander ranges from Illinois to northern Florida. Unlike many plethodontids, it lays its eggs in the water, on plants, rocks, or logs.

Mexican Axolotl (*Ambystoma mexicanum*)

Axolotls, unlike the rest of the family Ambystomatidae, are fully aquatic life-long, retaining the gills of the larval stage. Endemic to the lakes near Mexico City, they are critically endangered due to habitat loss. This individual is an albino.

Two-toed Amphiuma (*Amphiuma means*)

Amphiumas (family Amphiumidae) take "short limbs" to an extreme—their legs are so tiny they are practically vestigial. These eel-like aquatic salamanders actually have a rather short tail relative to body length.

Salamanders sending out an SOS!

An alarming 49.8% of salamander species worldwide are listed in Threatened categories or extinct, according to the Red List of Threatened Species™ of the International Union for Conservation of Nature (IUCN). This is a larger proportion than for frogs (31.6%) and other taxonomic groups that often are cited as symbols of the ongoing biodiversity crisis. Why are salamanders so vulnerable?

Common but decreasing in Panama, according to the IUCN, Bolitoglossa schizodactyla *lives only in undegraded lowland and montane forests, which are falling to agriculture, livestock, expanding human settlements, and industry.*

Common Threats to Salamanders

Habitat Loss/Degradation: The biggest issue affecting salamander species today is loss of their natural habitat. Land cleared for agriculture and development has greatly altered areas that were once suitable for salamanders. Deforestation can have a huge effect on salamanders due to both the physical disturbances of harvest and the changes to forest-floor habitats that remain, with reduced shade and cover, and increased sunlight exposure and overall temperatures. Fragmentation of habitats is a secondary effect of our land use, resulting in disruption of population connectivity due to dispersal barriers.

Water Modification: Our activities affect natural water bodies upon which many salamanders rely. The drying of vernal pools and wetlands, changes in water temperature, pH, salinity, and the alteration of water flow can negatively affect salamanders.

This culvert, part of a study on salamander movement, would be impassable in an upstream direction.

*Why did this Spotted Salamander (*Ambystoma maculatum*) cross the road? To get to its breeding pond. But every time it makes the attempt, it's dicing with death.*

Road Mortality: Roads can cause direct mortality, and may bisect stream or pond habitats, and disrupt connectivity among salamander populations.

Chemical Contaminants: Without proper control and care, industrial contaminants, sewage runoff, pesticides, and other oils and chemicals from residential, commercial, and agricultural sites can make their way in surface runoff or through the water table and into salamander habitats. As for all amphibians, salamanders' skin can rapidly absorb these foreign toxic chemicals, which can result in death.

Climate Change: The changes in temperature, humidity levels, desertification, and drought resulting from changing climate can negatively affect salamanders' health and life cycles. Harsher winters and drier summers cause problems during important migration and breeding periods if critical habitats such as vernal pools do not form or dry up too soon, before larvae can metamorphose (change into their adult form).

Chuxiong (Blue-tailed) Fire-bellied Newt, Cynops cyanurus, *native to the Yungui highlands of Yunnan Province.*

Human Exploitation: In certain areas throughout the world, salamanders are captured and sold in the exotic pet trade. While the idea of a pet salamander may seem strange to some, over 20 million amphibians are sold every year in the United States alone. Throughout Asia, species like fire-bellied newts (*Cynops* spp.) are captured, sealed up in small containers, and sold as keychain pets and souvenirs. These salamanders survive a few weeks before they slowly die for lack of food and water. Some salamanders are caught for food, and the Chinese Giant Salamander (*Andrias davidianus*), a delicacy in China, is threatened from over-harvesting. Salamanders are routinely used as bait, which can lead to over-collecting from natural populations, and transfer of diseases into new areas.

Invasive/Introduced Species: Introduced fish populations in ponds and wetlands prey on salamander eggs, larvae, and adults. Local populations of species accustomed to living without these predators may be decimated.

Diseases: Two emerging infectious diseases, the amphibian chytrid fungus and ranavirus, are well-documented in salamanders and may lead to mass mortalities. In 2013, an alarming report from Europe established that a new species of chytrid fungus was having a deadly effect on Fire Salamanders (*Salamandra salamandra*).

Small Animal, Big Value

Why should we care about salamander species?

Aesthetic Value: Although some salamanders are cryptic and rarely seen, many have striking coloration and patterns that make them quite beautiful. Some cave-dwelling species that live in darkness lack pigmentation and appear translucent, whereas other species possess bright oranges, fiery reds, stripes, and spots.

Ecological Value: Salamanders have an incredibly important role in natural ecosystems. They are centrally nested in food webs, supplying an abundant source of energy and nutrients for both terrestrial and aquatic consumers, such as birds, fish, reptiles, and mammals. Salamanders serve as connecting pathways for energy and matter between aquatic and terrestrial ecosystems. Salamanders that burrow underground facilitate soil dynamics. Salamanders also serve as indicator species of the overall health and functioning of an ecosystem.

*Red Salamanders (*Pseudotriton ruber*) are anything but inconspicuous! But you may never see a Georgia Blind Salamander (*Eurycea wallacei*), as its cave habitat is very deilicate and sensitive.*

Educational/Research Value: Salamanders are charismatic and provide an excellent teaching tool for engaging and educating people about the importance of protecting the natural areas on which many associated species rely. So little is known about many salamanders that researchers are still identifying new species. In addition, salamanders serve as model organisms for how a simpler vertebrate body works, and are highly valuable in research on human physiology.

Cultural Value: Over the centuries, countless legends and myths have developed around salamanders. Some legends tie salamanders to the element of fire. These tales may have originated when old logs were thrown on the fire, and salamanders that lived under the bark fled from the heat, giving rise to the idea that salamanders were born from flames. Cultural images of salamanders remain in many societies across the globe.

Medical value: Tiger Salamanders, Ambystoma tigrinum, *eat disease-carrying pests like small rodents and insects.*

Medical Value: Many salamanders consume insects such as mosquitoes and ticks that spread diseases including West Nile virus, yellow fever, Lyme disease, and malaria. Salamanders help keep population levels of these disease carriers in check. In biomedical research, salamander limb regeneration is being studied to understand the mechanisms involved in tissue reformation. Their hormone systems are models for humans. Their toxins and skin microbiota are being explored for pharmaceutical uses.

Intrinsic Value: It is important not to overlook the fact that salamanders matter by just simply existing. They have intrinsic value as an inhabitant of our planet.

Background image: Red-spotted (Eastern) Newt eft, Notophthalmus viridescens, *by Mark Tegges.*

Did You Say a FIVE-FOOT Salamander?!

If you happen to be in China and find a monster crawling out of the water, it may be *Andrias davidianus*, the Chinese Giant Salamander (family Cryptobranchidae). The largest amphibians in the world, averaging over 3 feet long (100 cm), they are capable of living up to 75 years in captivity!

Conservation Efforts and Supporting Organizations

Many groups are working hard to protect salamanders. You can help by participating in and supporting their efforts.

Habitat Protection: Initiatives to manage critical areas of habitat are being undertaken at a variety of scales, from local and regional land trusts, to national governments and international organizations. These efforts include development of conservation easements (or agreements) that protect key habitats for conservation purposes.

Habitat Restoration: Many community-based programs are working to restore damaged habitat. Restoration of streams and protection of watershed areas help provide quality habitat for a variety of salamanders. See the Stanford Habitat Conservation Plan (***http://hcp.stanford.edu***), which includes the California Tiger Salamander as a target species.

Restored Culverts: Improved culvert designs that allow passage of aquatic organisms are now being installed. These benefit salamanders and a host of other organisms.

Salamander Tunnels and Road Crossing Signs: The creation of salamander tunnels under roads and highways that separate habitat areas allows safe passage for salamanders during their breeding migration.

Diseases: Conservation efforts are increasing research worldwide on a variety of salamander diseases. New diseases are being described, such as the fungus *Batrachochytrium salamandrivorans* that is threatening Fire Salamanders in the Netherlands. We can reduce human-mediated transmission of diseases by being more careful as we move animals or water in trade and during fire fighting. Disinfection procedures can be used to decontaminate water or field gear.

"RRTH" Relocation, Repatriation, Translocation, and Headstarting: RRTH activities are the last-gasp approach to rare species conservation due to their high economic cost and often low success. Nevertheless, some captive breeding programs have been successful in reintroducing threatened or endangered species back into their natural habitat. A list of RRTH efforts at the PARC website can provide useful lessons learned to facilitate success with new endeavors. Organizations and research

Habitat restoration: a breeding pond for the Eastern Tiger Salamander, Ambystoma tigrinum, *in New Jersey.*

Salamander tunnels provide safe passage across busy roads.

This salamander is being swabbed for amphibian chytrid fungus testing.

Do salamanders actually use the tunnels? Yes! This tunnel in North Amherst, MA, allows Spotted Salamanders access to and from their vernal pool breeding habitat.

*This rare and striking Luristan Newt (*Neurergus kaiseri*), endemic to the southern Zagros Mountains of Iran, is part of a captive breeding effort.*

teams such as the Reptile, Amphibian, and Fish Conservation Netherlands (RAVON) have set up breeding and captive facilities to help save the rapidly declining Fire Salamander from extinction.

CITES: The Convention on International Trade in Endangered Species of Wild Fauna and Flora is an international agreement that aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. This is especially important as thousands of salamanders are marketed annually.

Chopsticks for Salamanders: This organization works to raise awareness about deforestation for the production of disposable chopsticks. They raise money to support salamander conservation, education, and research. (***www.chopsticksforsalamanders.org***)

Right: Rod Williams and Herbie the Hellbender visit a teacher education workshop to spread the word about Hellbender conservation.

Education and Interpretive Programs: The more the general public knows and cares about salamanders and the important role they play in our ecosystems, the easier it will be to conserve them. Education can happen in many ways: at ecological centers, natural history museums, and even this State of the Salamander document. Websites such as Save the Salamander, created by Matt Ellerbeck, provide information for those interested in salamander conservation and advocacy.

Phillip deMaynadier, Molly Docherty, and a Spotted Salamander teach students about amphibians.

It's Up to Us to Make a Difference

What can YOU do to help in the conservation of salamanders?

- Do not use salamanders as fishing bait.
- Never catch and attempt to keep a wild salamander as a pet.
- If you come across a salamander in the wild, appreciate it by observation only; don't disturb it or the habitat around it. Salamanders have extremely sensitive skin that can be damaged by the oils and chemicals on our hands, and therefore should not be picked up.
- The only time you should ever pick up a salamander is to help it cross a road or high-traffic path. The proper way to do this is by first wetting your hands and then moving it across in the direction that it is headed. However, safety first! Watch for oncoming vehicles.

- Do not use (and urge others not to use) poisons, non-organic pesticides, fungicides, herbicides, harsh insect repellents, and other harmful chemicals during your outings in natural areas, or around your home or business. These chemicals wash away and eventually make their way into nearby habitats where salamanders may dwell.
- In winter, consider using sand on roads and footpaths instead of salt – salamander skin absorbs salt.
- Keep others informed about the risks to and conservation efforts being made for salamanders.
- When camping, be careful when choosing fallen branches, logs, or stumps for fires, as salamanders can often be found hiding in them. A better alternative is to use locally available firewood bundles, or organic compressed paper bricks made of recycled materials.
- Join a herpetological or nature society or club!

© Heidi Bock

Community members learn to use a field guide to identify salamanders.

For More Information on Salamanders:

Visit the United States Fish & Wildlife Service to learn more about endangered salamander species in the U.S. ***www.fws.gov/endangered/***

Log on to the International Union for Conservation of Nature (IUCN) Red List to learn even more about endangered and threatened salamanders: ***www.iucnredlist.org***

Explore AmphibaWeb (***amphibiaweb.org***) for detailed information on salamander species from around the world.

For additional information on the Year of the Salamander campaign, go to ***www.yearofthesalamander.org*** or contact ***yearofthesalamander@gmail.com***

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Do Not Disturb!

Moist, dark microhabitats like cracks in the rocks are great places for salamanders to hide, but these conditions can take many years to create and only seconds to destroy. If you spot a hidden salamander, please don't pry up the rocks to get at it. Leave it in peace.

Green Salamander, *Aneides aeneas*. © Jonathan Mays