GEORGIA

Adopt-A-Stream

Department of Natural Resources
Environmental Protection Division
Winter 2006

Amphibian Monitoring

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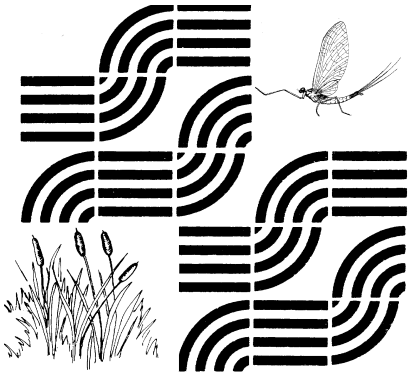
Writers/Editors
Georgia Adopt-A-Stream staff
Lucrecia Vizcaino
Tara K. Muenz and Lora L. Smith, Jones Ecological Research Center



Georgia Adopt-A-Stream
4220 International Parkway, Suite 101
Atlanta, Georgia 30354
(404) 675-1639 or 1636
www.riversalive.org/aas.htm

Introduction

What is an Amphibian?

There are three main groups of amphibians:

- *Anura* (frogs and toads)
- *Caudata* (salamanders and newts)
- *Gymnophiona* (caecilians, which are worm-like amphibians)

Amphibian means double life. Many species have two phases during their life cycle, the first one, as larvae, they spend in an aquatic (water) environment while their adult stage, they spend in a terrestrial (land) environment. For example, tadpoles are a larval stage of frogs and toads.

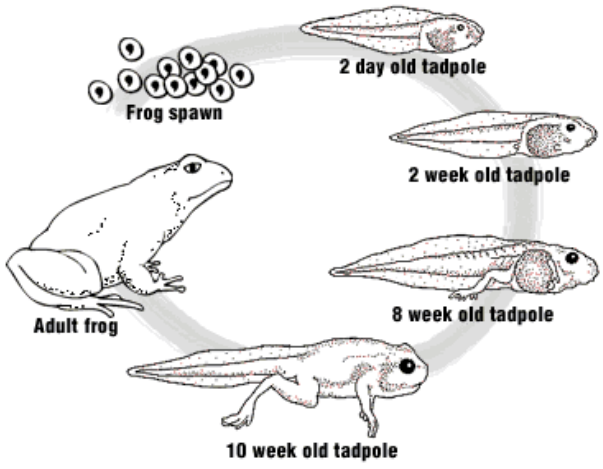
Amphibians are cold-blooded (or *poikilothermic*) vertebrates, which means they cannot generate body heat on their own. They regulate their body temperature by moving into areas that provide the right temperature for their survival. They hide under rotten logs for insulation to keep from freezing. Amphibians, unlike reptiles, do not have scales and generally return to water to breed.

Scientists have recognized more than 4,000 species of amphibians. Frogs and toads are the most abundant of all amphibians, with 3,500 species. You can differentiate a frog from a toad in that frogs have smooth skin and long limbs and toads, in contrast, have warty skin and short limbs.

About the Biology and Ecology of Amphibians

Life Cycle

Most amphibians undergo a process called *metamorphosis*. After hatching into a larval form, they endure a dramatic change in anatomy, diet, and lifestyle. During this time, amphibian larvae slowly change from fishlike, water-dwelling animals to animals better suited for life on land. In addition to developing lungs, salamanders and frogs grow limbs during metamorphosis. Most amphibians lose their gills, and the tails of frogs and toads disappear. The length of time required for metamorphosis varies widely among different species.



Many amphibians exhibit biphasic life cycles with metamorphosis separating the larval ("tadpoles" in frogs) and adult stages. Some species, such as the slimy salamander, do not have a free-living larval stage, essentially completing metamorphosis within the egg. Still other species, such as the sirens, have

abandoned metamorphosis altogether, retaining the larval morphology and aquatic habitat throughout their lives while reproducing like "normal" adults.

Little is known about the longevity of most amphibians in the wild, but studies of captive animals show that some can be extremely long-lived. Some captive salamanders have survived for 20 to 25 years, and a few have lived for more than 50 years. Captive frogs have shorter life spans, typically living for 1 to 10 years. Some toads have survived in captivity for more than 30 years.

Range and Habitat

The most widespread of all amphibians are the frogs, which inhabit every continent except Antarctica. Salamanders are found in the western hemisphere, from North America to the northern part of South America. Caecilians have a more limited range; they are found in Central and South America, parts of Southeast Asia, and from India and Sri Lanka to the Philippines.

Amphibians live in many environments, including grasslands, rain forests, conifer forests, alpine areas, and even deserts, although most species require freshwater habitats such as ponds, swamps, streams, or other wet environments for breeding. Remarkably, many amphibians are adept at finding moisture in seemingly dry environments.

Physical Characteristics

Amphibians range in size from the Japanese giant salamander, which can exceed 1.5 m (5 ft) in length, to tiny frogs, such as the gold frog, that reach only 1 cm (about 0.4 in). Most salamanders are between 5 and 20 cm (2 and 8 in) long, and most frogs measure between 2 and 8 cm (0.8 and 3 in). Caecilians are more variable in size—most species are between 10 and 50 cm (4 and 20 in), but some grow as long as 1 m (3 ft).

Amphibian larvae are aquatic and have many features in common with fish. Frog larvae, which are sometimes called pollywogs or tadpoles live in water and have internal gills that enable them to obtain oxygen from water. Salamander larvae have busy external gills. Larvae of both groups have tails that they use for swimming. Most amphibian larvae have tiny tooth-like structures. Adult amphibians typically have limbs that enable them to move about on land as well as in the water. Frogs and toads have hind legs that are longer and stronger than their fore legs for use in jumping, their primary mode of locomotion on land. Aquatic species have webbed hind toes for swimming. In contrast, most salamanders have four short legs and a long tail, which they use for balance while walking on land and to propel them through the water when swimming. Caecilians have no limbs at all. They burrow in the soil by using their strong skulls as battering rams and

swim by moving their muscular bodies back and forth like eels. Most adult amphibians retain their teeth, but in some species, teeth are reduced in size or not present at all.

Internal Anatomy and Skin

Amphibian internal anatomy is similar to that of other vertebrates. Adult amphibians typically have lungs, rather than gills, for breathing oxygen, but some water-dwelling species have both lungs and gills, and others obtain all the oxygen they need to survive through their permeable skin.

Amphibians are cold-blooded, or more correctly, poikilotherms—that is, they are not able to generate their own body heat. Instead, their body temperature is determined by their surroundings. In cold weather, many species become sluggish, and some enter a state of reduced activity, or *torpor*, which is similar to hibernation.

Always hairless and rarely scaled, amphibian skin provides the animals with protective coloring, a way to absorb water and oxygen from their environment, and a defense against arid conditions and hungry predators. Some amphibians are brilliantly hued, while others display coloring that blends with their habitat. Amphibians owe their diverse coloration to both pigment granules in the upper layer of skin and specialized pigment-containing cells called chromatophores in the skin's lower layer. Many amphibians change their skin color by concentrating or dispersing the various pigments in the chromatophores. This behavior helps them to adjust their body temperature because light colors reflect heat more than dark colors, and it also acts as a camouflaging mechanism, helping them to escape notice by predators.

Amphibians use their permeable skin to obtain both oxygen and water from their environment. Their skin also contains numerous glands that produce secretions that prevent them from drying out or are toxic or unpalatable to predators.

Vocalizations

Amphibians lack external ears but have well-developed internal ears. Male anurans (frogs) produce a wide variety of vocalizations, which they use in mating and territorial interactions. Each frog species has a unique vocalization, which makes it easy to recognize them. Neither salamanders nor caecilians have a true voice box, but when threatened, some salamanders can produce yelps or barking sounds.

Behavior

Much of an amphibian's lifestyle is dictated by the necessity of keeping its skin moist and preventing its body temperature from becoming too hot or too cold. Some species

bask in the sun in order to raise their body temperature. In hotter climates, many adult amphibians are active at night rather than in the day to avoid excessive heat and guard against water loss. In cold areas, amphibians become torpid, or inactive, during the cooler months. Nearly all adult amphibians are carnivorous; their diet includes insects, spiders, crustaceans, worms, small reptiles, and sometimes, smaller amphibians.

Amphibians are particularly vulnerable to predators, which include a host of small mammals, birds, lizards, snakes, turtles, and even larger amphibians. When facing a predator, many amphibians:

- Pretend to be dead; or rely on cryptic coloration to hide
- Rely on toxins in their skin to give them a bad taste or make them poisonous to predators
- Make use of their impressive tails in defense (Salamanders)
- Leap away from predators using their strong hind legs (Frogs)
- Puff up their bodies so that they appear much larger than their real size (Frogs and Toads)

Reproduction

Little is known about courtship among the secretive caecilians; much more is known about the reproductive behavior of salamanders and frogs. Male salamanders often emit odors to attract a female's attention. If a female looks their way, these males may display bright colors and complex postures. Frogs gather in huge numbers—sometimes thousands of individuals—when conditions are right for breeding. Male frogs rely on their calls which are familiar to humans as *croaks* but may also consist of *clicks*, *whistles*, or *trills* to attract females and keep other males away.

Amphibian eggs are not protected by a waterproof shell like those of birds or reptiles; instead each egg is surrounded by a clear, protective, jellylike substance called a capsule. The eggs need to be placed in water, or in a damp place, to prevent the developing embryo from drying out. Many amphibians lay their eggs directly in water, but some frogs and salamanders, and nearly all caecilians, lay their eggs on land in moist places such as leaf litter, burrows or cracks in the ground, and beneath logs or rocks.

Most amphibians that lay their eggs in water leave them unattended, but in species that deposit their eggs on land, a parent commonly guards the eggs to prevent predation. Many species of frogs show remarkable forms of parental care.

Risks to Amphibians

Amphibians have survived more than 300 million years through drastic environmental changes that led to the demise of dinosaurs and many other species. Yet scientists are alarmed by the recent rapid decline of amphibians in many parts of the world. One study, which monitored more than 900 amphibian populations from 1950 to 1997, found that amphibian populations have been declining at an average rate of 4 percent per year for the past 40 years. These declines are evident in places as widely separated as

North America, South America, and Australia, and have prompted international concern. Declines in amphibian populations may be due in part to natural fluctuations, but they more likely suggest that humans are changing the environment more rapidly than amphibians can adapt. One such change is the destruction and modification of amphibian habitats, such as the cutting down of forests and the draining of wetlands.

Their complex life cycle and permeable skin make amphibians particularly sensitive to environmental disturbances such as drought and pollutants. This sensitivity makes them excellent biological indicators—organisms whose well-being provides clues to the health of an ecosystem.

Mysteriously, many amphibian populations are dwindling—or even disappearing—in areas where their habitat is not being destroyed. In Australia, two species of gastric brooding frogs have not been detected since the early 1980s, yet their habitat remains relatively pristine. The golden toad of Costa Rica has not been seen since 1989, even though its high-elevation rain forest habitat has been protected as a national reserve since the 1970s. Similarly, the red-legged frog has vanished from large areas of the North American Pacific Coast, where it was once abundant. Another disturbing development is that large numbers of amphibians, especially frogs, are being found with misshapen, extra, or missing limbs.

No single factor has been identified as the cause of these disturbing trends. Instead, a variety of factors may be responsible. These may include disease from viral, bacterial, or fungal pathogens; global warming; and increased levels of the ultraviolet-B component of sunlight hitting the Earth as a result of depletion of the protective ozone layer. Ultraviolet-B light is particularly suspect in the decline of those amphibians that lay their eggs in shallow water, because such eggs are exposed to sunlight for long periods. At a more local level, chemical pollutants, such as acid rain, pesticides, herbicides, and fertilizers, may be harming amphibians. In some regions, the introduction of nonnative competitors and predators has contributed to amphibian population declines. It is likely that an interaction of some or all of these factors may be exacerbating conditions for amphibians.

Species richness in the country-the southeast-Georgia

The continental United States is home to at least 260 amphibian species: 90 frog and toad species, and 170 species of salamanders. The Southeastern USA is unique in that it harbors many amphibians, with over 144 species living in a variety of freshwater

habitats. In particular, Georgia has 32 species of frogs and toads in five families. They range in size from the little Grass Frog, 11 mm (0.44 in) long, to the large Bullfrog that reaches a record length of 203 mm (8 in). There are 55 salamander species identified in the state, with new species still being identified.

Monitoring activities

In Georgia, amphibian monitoring activities by volunteers is in its infancy. Without a nationally established protocol for monitoring amphibians other than identification of anuran (frogs and toads) calls, the Georgia volunteer monitoring program will consist of assessing amphibian populations of tree frogs and stream salamanders. This is a pilot program that hopes to engage volunteers in the process of learning about amphibian populations.

The Georgia Herp Altas program has relied heavily on volunteer assistance. This program is coordinated through the Georgia Department of Natural Resources Wildlife Resources Divisions Nongame-Endangered Wildlife Program.

There are two national frog and toad monitoring programs, the North American Amphibian Monitoring Program (NAAMP), coordinated by USGS and Frogwatch USA, coordinated by the National Wildlife Federation. Both programs involve volunteers in the identification of frogs and toads by their calls and vocalizations. NAAMP requires that states appoint a statewide leader to coordinate the program. Any volunteer who expresses an interest can contact Frogwatch USA to find out how to participate.

You can now learn the sounds frogs and toads in Georgia make with the new "Calls of the Wild - Vocalizations of Georgia's Frogs" Compact Disk produced by the Georgia Department of Natural Resources, Wildlife Resources Division (DNR/WRD). This CD presents the unique calls of all 31 species. Informative narration is provided for each of the individual species recordings, and a 16-page booklet loaded with information including natural history, range maps and physical characteristics for each species accompanies the CD. To order your copy of "Calls of the Wild" send $14.45 per CD to: GA DNR/WRD, Nongame Wildlife & Natural Heritage Section, 116 Rum Creek Drive, Forsyth, GA 31029, ATTN: Georgia's "Calls of the Wild" CD, or for more information call 478-994-1438. Make your check payable to the WILDLIFE CONSERVATION FUND. Georgia residents add $.91 per CD for applicable sales tax (total cost of $15.36 per CD for Georgia residents).

Conservation activities

Georgia Adopt-A-Stream provides volunteers with a variety of conservation activities. *Getting to Know Your Watershed* focuses on map assessments and a watershed survey as evaluation tools. *Visual Stream Monitoring* introduces a diversity of low-cost, hands-on methods for analyzing the physical health of your adopted stream.

Different levels of involvement offer different levels of activity. At the most basic level, volunteers register with Georgia Adopt-A-Stream, conduct a watershed assessment and perform visual surveys of their adopted stream. Optional participation includes biological and/or chemical monitoring, and/or a habitat enhancement project.

- Watershed Assessment — Once a year
- Visual Monitoring — 4 times a year (quarterly)
- Biological Monitoring — 4 times a year (quarterly)
- Physical/Chemical Monitoring — 12 times a year (monthly)
- Habitat Enhancement — One time project

Biological and chemical monitoring requires training. Training workshops are available at Adopt-A-Stream Regional Training Centers, some community Adopt-A-Stream programs and State Office. Training includes an overview of the program, monitoring techniques and quality assurance tests.

These activities **help protect water quality and streams** because:

- Regular monitoring provides specific information about the health of your local stream.
- Both long-term trends and immediate changes in water quality can be documented.
- Biological monitoring will detect changes in water quality and habitat and provides an indication of overall stream health.
- Chemical monitoring, however, provides specific information about water quality parameters that are important to aquatic life--such as dissolved oxygen and pH.
- Habitat enhancement projects improve streambanks and/or the streambed. Habitat enhancement projects may stop a streambank from eroding, and therefore decrease the amount of sediment entering a stream or improve an in-stream habitat for fish to feed, hide and lay eggs.

Stream dwelling salamanders can also serve as important ecological indicators of habitat quality. Sometimes in small headwater streams, salamanders replace fish as the top vertebrate predators, serving as another potential tool to assess stream health. In fact, several state monitoring programs have determined that fish indicators are ineffective in headwater streams, where flow is too low to sustain healthy populations. In these areas of low flow, salamanders may provide valuable information. However, more research is needed to determine whether

stream salamanders are effective indicators of ecological conditions across biogeographic regions and gradients of human disturbance.

Web links

http://allaboutfrogs.org/froglnd.shtml
Duellman, E. and Trueb, L. 1994. Biology of Amphibians. The Johns Hopkins University Press. 670pp
http://cgee.hamline.edu/frogs/science/frogfact.html
http://www.mcnair.ucdavis.edu/presentations/1998/ppt/yee/yee1/sld003.htm
http://encarta.msn.com
http://museum.nhm.uga.edu/gawildlife/amphibians/amphibians.html
http://www.amonline.net.au/webinabox/frogs/about/life.htm
http://herpcenter.ipfw.edu/ creation of ponds

More links can be found at www.riversalive.com/amphibians.htm

Published documents

Abundance and Distribution of a Stream Plethondontid Salamander Assemblage in 14 Ecologically Dissimilar Watersheds in the Pennsylvania Central Appalachians, Gian L. Rocco and Robert P. Brooks, December 2000.

Land Manager's Guide to the Amphibians and Reptiles of the South, Lawrence Wilson, 1995

Leaf litterbags: Factors affecting capture of stream-dwelling salamanders, Jayme L. Waldron, C. Kenneth Dodd Jr., Jeffrey D. Corser, 2003

Measuring and monitoring biological diversity: Standard methods for amphibians, by W.R. Heyer, A. Donnelly, R.W. McDiarmid, L.C. Hayek, and M.S. Foster (ed.) Smithsonian Institution Press, Washington, D.C.

Monitoring Amphibians in Great Smoky Mountains National Park, by C. Kenneth Dodd, Jr. US Department of Interior, USGS, Circular 1258

GEORGIA ADOPT-A-STREAM
Amphibian Monitoring Data Sheet
To be conducted quarterly

Return to: GA AAS
4220 International Parkway
Suite 101
Atlanta, GA 30354

AAS group name: _____ County: _____
Group ID number AAS-G Topo Map
Site ID Number AAS-S Quadrant: _____
Investigators: _____
Stream name _____
Date: _____ Time: _____ Picture/Photo Documentation? yes / no
Site/location Description:

Rain in last 24 hours
☐ heavy rain ☐ intermittent rain ☐ steady rain ☐ none

Present Conditions
☐ heavy rain ☐ overcast ☐ steady rain ☐ partly cloudy ☐ intermittent rain ☐ clear/sunny

Amount of rain, if known? _____ Inches in last _____ hours/days

Reach		PVC Pipes (Treefrogs)						Coverboards (Salamanders)							Notes
		H. cinerea	*H. squirella*	*H. chrysoscelis*	*H. femoralis*	*H. gratiosa*	*H. avivoca*								
1 a	0’							/							
b	3’							/							
2 a	0’							/							
b	3’							/							
3 a	0’							/							
b	3’							/							
4 a	0’							/							
b	3’							/							
5 a	0’							/							
b	3’							/							
6 a	0’							/							
b	3’							/							