Evolution and Taxonomy of Amphibians and Reptiles

Habitats of Amphibians and Reptiles on the Coconino National Forest

Amphibians and Reptiles Depend on Wetlands

Wetlands serve as critical habitat for many species of amphibians and reptiles. Most amphibians lay gelatinous eggs under water, while others, like certain salamanders, lay their eggs on moist land. After the eggs hatch, the baby amphibians enter an aquatic larval stage, which can last from several days to many months. Once the aquatic stage is completed, the amphibians leave the water and enter the terrestrial adult stage of life. Wetlands serve as breeding sites, as a habitat for larval development and as a primary food source for adults. Insects, spiders, snails, worms and small fish are all prey for certain amphibians. For many reptiles, wetlands also serve as primary habitat, supplying them with an ample source of food and habitat for breeding and nursing. Specially adapted reptiles that are able swimmers are likely to be found in wetlands. Some of these include the common snapping turtle, spotted turtle, northern water snake, cottonmouth snake, diamondback water snake and garter snakes.

Amphibians and reptiles depend upon a variety of wetland types. These may include marshes, swamps, bogs and fens (and their associated subclasses). Some wetlands are only wet a portion of the year and are considered “ephemeral” wetlands. These wetlands provide important habitat and breeding grounds. There are often strong ecological connections among wetlands in a landscape. Although some may be permanent and others ephemeral, amphibian populations can depend on multiple wetlands within a given area. To protect these species over the long term, the variety and density of suitable habitat sites within the landscape must be preserved, along with terrestrial corridors that connect the wetlands.

Why are ephemeral wetlands important?

Vernal pools, one type of ephemeral wetland, are of critical importance to amphibian populations. As small, often isolated wetlands, vernal pools are only wet for a portion of the year. Periodic drying creates a fish-free environment for amphibians, many of which have adapted rapid egg and larval stages as a race against the dry season. The absence of fish predators in vernal pools benefits amphibian populations.

Threats to Herps and Wetlands

Population declines and disappearances of amphibians and reptiles leading to widespread scientific and public concern have been well documented. The causes for their decline, while not fully understood, appear connected in varying degrees to the following threats:

- Pollution
- Wetland Destruction or loss
- Global climate
- Invasive species
- Disease and parasites

Follow careful washing procedures when traveling between wetlands.

Outside Winslow

Subalpine Grassland  Great Basin Desert Scrub  Petran Subalpine Conifer Forest
Petran Montane Conifer Forest  Semidesert Grassland
Great Basin Conifer Woodland  Chihuahuan Desert
Madrean Evergreen Woodland  Arizona Upland Sonoran Desert Scrub
Interior Chaparral  Lower Colorado River Sonoran Desert Scrub
Plains and Great Basin Grassland  Alpine Tundra

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AMPHIBIANS OF THE COCONINO NATIONAL FOREST

Arizona treefrog - *Hyla wrightorum*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Bullfrog - *Lithobates catesbeiana* **NON-NATIVE**
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Red-spotted toad - *Anaxyrus punctatus*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Mexican spadefoot - *Spea multiplicata*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Plains spadefoot - *Spea bombifrons*
*Found on these districts: Mogollon Rim & Peaks*

Woodhouse’s toad - *Anaxyrus woodhousii*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Arizona toad - *Anaxyrus microscaphus* **USFS SENSITIVE**
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Canyon tree frog - *Hyla arenicolor*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Western chorus frog - *Pseudacris triseriata*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Great plains toad - *Anaxyrus cognatus*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Bullfrog - *Lithobates catesbeiana* **NON-NATIVE**
*Found on these districts: Red Rock, Mogollon Rim, Peaks*

Woodhouse’s toad - *Anaxyrus woodhousii*
*Found on these districts: Red Rock, Mogollon Rim, Peaks*
Gilled adult-In Arizona we often see “gilled adults”. They look like larvae but are sexually reproductive. It is not well understood why they don’t fully metamorphose into the “traditional salamander adult form”. It is thought to be an evolutionary trait geared for aquatic systems but what the true advantage or trigger for this life form is largely unknown. This form A. mavortium is what is known as a “waterdog”

**BARRED TIGER SALAMANDER** *Ambystoma mavortium nebulosum*

**DESCRIPTION:** As Arizona’s only salamander, this species is unmistakable. Adult, terrestrial tiger salamanders grow to as much as 13.6 inches total length and 6.5 inches snout-vent length. They exhibit varying combinations of dorsal light and dark spots, bars, or reticulation. The Arizona tiger salamander (A. m. nebulosum), known from the Mogollon Rim area and the Colorado Plateau, is typically a dark grayish to olive salamander with irregularly-shaped yellow to olive spots and blotches (but see photo above). The barred tiger salamander (A. m. mavortium), which has been widely introduced by anglers and bait collectors to much of southeastern Arizona and is sometimes encountered elsewhere in southern Arizona, has large, distinct yellowish bars or spots on a dark background. The Sonoran tiger salamander (A. m. stebbinsi), an endangered subspecies from the San Rafael Valley, possesses a unique reticulate pattern on a dark background, but many are indistinguishable from the barred salamander. Larvae and gilled adults, called branchiates or neotenes, are aquatic, olive-gray, and possess three gills on each side of the head. Early in development, larval salamanders lack legs. Arizona and barred branchiate salamanders, and very rarely, Sonoran tiger branchiates, may develop into large (up to 15 inches total length), big-headed, cannibalistic morphs.

**DIET:** Larvae and branchiates feed on a wide variety of invertebrates. Cannibalistic morphs eat larger prey and may preferentially eat their own kind. Terrestrial adults feed on a variety of surface and subterranean invertebrates. Adults and large larvae will eat vertebrates, as well, including tadpoles, lizards, small snakes, and mice.

**REPRODUCTION:** Breeding occurs from mid-winter into late spring; and rarely in late summer. Terrestrial adults typically return to their natal ponds to breed. Females lay 200-2,000 eggs individually or in small groups attached to sticks, aquatic vegetation, debris, or on the substrate. Eggs take 14-50 days to hatch, depending on water temperature. Larvae can metamorphose in as little as 2 months, but growth varies with a number of factors. The larval period is typically longer than 2 months, and some overwinter.

**REMARKS:** The Sonoran tiger salamander was listed as an endangered species under the Endangered Species Act in 1997. A recovery plan was completed in 2002. Threats to its existence include predation by non-native species, particularly fishes; die-offs due to an iridovirus; hybridization with introduced barred salamanders; and drought. This subspecies breeds in cattle tanks and impounded cienegas. Its natural habitats – presumably natural cienegas, springs, and perhaps backwaters of the Santa Cruz River - are now gone or overrun by non-native predators.

**SUBSPECIES FOUND IN AZ:**
- **BARRED TIGER SALAMANDER** *Ambystoma mavortium mavortium*.
- **ARIZONA TIGER SALAMANDER** *Ambystoma mavortium nebulosum*.
- **SONORAN TIGER SALAMANDER** *Ambystoma mavortium stebbinsi*.

This subspecies is found in the San Rafael Valley and adjacent slopes of the Huachuca and Patagonia mountains in eastern Santa Cruz and southwestern Cochise counties in Arizona.

**FEDERALLY PROTECTED**

Ambystoma tigrinum stebbinsi is listed as ENDANGERED under the Endangered Species Act. It is against Federal law to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect this animal or to attempt to engage in any such conduct. More information on federal listing here: [http://www.fws.gov/southwest/es/arizona/Sonora_Sal.htm](http://www.fws.gov/southwest/es/arizona/Sonora_Sal.htm)

**PROTECTED IN AZ**

It is illegal by Arizona State law to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect Ambystoma tigrinum stebbinsi or to attempt to engage in any such conduct.

**Current Issues on the Coconino related to waterdogs:** Waterdogs are commonly used as bait throughout AZ. Many stores sell them unaware of where they came from. Many stock tanks on the forest are illegally stocked with waterdogs for the bait trade. The risks by doing these activities are: 1. possible disease transmission including “Bd” aka chytrid fungus-the fungus being held accountable for a wide array of amphibian declines/extinctions worldwide (waterdogs can carry the fungus without showing signs of illness). 2. Waterdogs are a highly predacious species. When stocked in tanks that have sensitive amphibian species, they may additionally increase the risk of mortality to species we are trying to conserve.

**WHAT CAN YOU DO?**

1. Do not use waterdogs for bait!!

2. If you do use them, make sure you are buying from a reputable seller (most however do not know where they came from)

3. If you see illegal stocking or removal of waterdogs from tanks on the forest, report the activity immediately to your district biologists and/or Arizona Game and Fish.
**Northern leopard frog - Lithobates pipiens**

*Found on the following districts: Red Rock, Mogollon Rim, Peaks*

**DESCRIPTION:** This leopard frog grows to about 4.3 inches in length, and is a green or brown frog with dorsolateral folds and numerous, relatively small dark spots. In southeastern Arizona, frogs are often green, or have green on the head. The Chiricahua leopard frog is distinguished from other Arizona leopard frogs by a combination of characters, including a distinctive salt and pepper pattern on the rear of the thigh of adults and some juveniles, dorsolateral folds that are interrupted and inset towards the rear; stocky body proportions; eyes that are relatively high and upturned on the head; and relatively rough skin on the back and sides. Compared to other leopard frogs, the tadpoles are relatively dark, mottled, and stocky. Tadpoles grow to >3 inches.

**DISTRIBUTION:** The Chiricahua leopard frog occurred historically in the mountains and valleys along the Mogollon Rim east of Camp Verde and the Verde River, but also in southeastern Arizona south of the Gila River from the Baboquivari Mountains east to Peloncillo Mountains. Although still fairly well distributed through this range, the species has disappeared from about 80% of its historical localities in Arizona.

**HABITAT:** Historically it occurred in a variety of wetland habitats, but is now restricted primarily to stock tanks and other man-made waters, as well as headwater streams, cienegas, and springs that lack introduced predators. Breeds in deeper pools and relatively calm water.

**BEHAVIOR:** Can be found active day or night, although they are easier to find and observe at night with a headlamp or flashlight. This is probably the most aquatic of the native leopard frogs, but can move overland and along drainages during summer monsoons.

**DIET:** The Chiricahua leopard frog presumably feeds upon a wide variety of invertebrates as well as some small vertebrates (including juveniles of their own kind).

**REPRODUCTION AND CALLS:** Breeds primarily from April through October, but egg masses are unusual in June. Populations >5,900 ft breed June-August. Spherical egg masses of up to 1,485 eggs are laid in quiet pools, typically attached to vegetation. Tadpoles take 3-9 months to metamorphose, and some overwinter. The advertisement call is a medley of chuckles, snores, and grunts.

**REMARKS:** Causes of decline include drought and non-native predators, but other factors have likely played a role, as well. Although not documented in the species in Arizona, northern leopard frogs in other regions have suffered from the fungal skin disease, chytridomycosis. A 2004 study found that populations west of the Mississippi River and Great Lakes Region are genetically quite different from eastern populations. The western populations have been petitioned to be listed as threatened under the Federal Endangered Species Act.

**PROTECTED**

It is against Arizona State law to harass, harm, pursue, hunt, shoot, wounding, kill, trap, capture, or collect this animal or to attempt to engage in any such conduct.

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**Chiricahua leopard frog - Lithobates chiriacaquensis**

*Found on the following districts: Only extant population on Red Rock RD. Historically, all districts on forest*
LOWLAND LEOPARD FROG  *Lithobates yavapaiensis*

**Found on the following districts:** Red Rock & Mogollon Rim

**DESCRIPTION:** The lowland leopard frog is a relatively small leopard frog - maximum length is about 3.4 inches. It is distinguished from other Arizona leopard frogs by a combination of characters, including dorsolateral folds that are broken and inset towards the rear, a dark brown and tight reticulate pattern on the rear of the thigh, and usually no spots on the snout. Adult males lack prominent vocal sacs. This is typically a brown frog, although some are green, particularly on the head. There is often a yellowish wash to the groin area. Compared to other leopard frogs, the tadpoles are relatively dark, mottled, and stocky. They are similar to Chiricahua leopard frog tadpoles, but browner with a shallower tail. Tadpoles grow to > 3 inches. The lowland leopard frog is very similar to the relict leopard frog; the two may be the same species.

**DISTRIBUTION:** The lowland leopard frog occurred historically from the lower Colorado River east through central Arizona below the Mogollon Rim and southeastern Arizona to New Mexico. The species is now absent from the lower Colorado River and adjacent portions of southeastern California, they are about gone from their limited historical range in New Mexico, and have declined significantly in southeastern Arizona. Although no records exist for the lower Gila River downstream of the Phoenix area, they almost certainly occurred there historically, but are now replaced by the Rio Grande leopard frog and bullfrog. The species is still relatively secure in central Arizona; however, declines and extirpations have occurred in that region as well.

**HABITAT:** This frog currently or historically inhabited big rivers, streams, ciénegas, cattle tanks, agricultural canals and ditches, mine adits, and other aquatic systems from the Yuma Valley at near sea level to almost 6,000 feet, and from Sonoran Desertscrub into pinyon-juniper woodland. Lowland leopard frogs do well in unregulated streams that are subject to periodic floods.

**REPRODUCTION AND CALLS:** Breeds primarily from January through April, and again in late summer or early fall. Egg masses are laid in shallow water and are attached to vegetation, bedrock, or gravel. Tadpoles take 3-9 months to metamorphose, and some overwinter. Adult males give a distinctive advertisement call consisting of a series of chuckles that are not very loud and are similar to that of the Plains and relict leopard frogs.

**REMARKS:** Causes of decline include predation by a number of non-native species, catastrophic flooding and scouring following severe fires, other loss and alteration of habitats; and chytridiomycosis – a fungal skin disease. However, the lowland leopard frog is able to coexist with invasive exotic species better than the Chiricahua leopard frog, probably because it can breed in relatively shallow, flowing water that is marginal habitat for exotics.

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Physiological Traits of Amphibians—Questions answered

Why do frogs bask?
Frogs bask in the sun for thermoregulation. Recently metamorphosed anurans seem especially prone to expose themselves to the sun when there is adequate soil moisture or opportunity to enter water to make up water losses entailed in keeping the skin moist. Some young toads and toad tadpoles are notably diurnal compared with adults. They elevate their body temperature by basking and thereby accelerate feeding, digestion, growth, and in transformed individuals, deposition of fat prior to the onset of winter dormancy.

Do amphibians have a temperature preference?
Most amphibians are capable of activity over a fairly broad range of temperatures between their lethal extremes and in general do not have as narrow thermal limits for normal activities as do most reptiles. There is some evidence however, that many species, including their larvae have thermal “preferenda” or a range of preferred temperatures and that they exhibit considerable behavioral temperature regulation within the constraints by the environment and their physiological requirements. For example, some undergo a daily shift in their thermal preferences. Diurnal species may seek lower temperatures at night and nocturnal ones in the daytime. This is called “voluntary hypothermia” and is associated with in the inactivity seen of some species.

Do frogs drink and regulate water?
Frogs actually don’t “drink” in the traditional sense. They actually get all of their water needs through their skin in the form of permeation usually through what is referred to as the “seat patch”—a small patch of skin under their pelvis. On land they lose water at a very rapid rate (through evaporation) unless in a moist environment, and they must keep the skin moist for breathing. Amphibians also have to deal with taking up too much water. Water moves into the skin via osmosis, moving from a region of low concentration of dissolved salts to high. This is why nearly all amphibians do not occur in salt water. Amphibians utilize a wide variety of methods for regulating water: burrowing, cocoons (dormant aestivating, urea retention—keeping urine at a high concentration, they can absorb water even from soil (common in arid ecosystems), and even their skin color. It has been documented that the “true green” color exhibited by some species enables them to absorb solar radiation more than the drab colored frogs. This could be an advantage to increase growth quicker although the risk of losing water is higher in the “greens”. Towards the end of the summer, one tends to see more “greens” then “drabs” due to the urgency to metamorphose quicker prior to the onset of winter.

Why do we care?
In terms of conservation: Control of body temperature permits the amphibian to adjust its body temperature to fit it’s needs. By seeking somewhat higher temperatures, larval development and growth can be accelerated, growth of juveniles can speed up, digestion and other physiological processes can be enhanced and can some disease can be combated. Conversely, by seeking lower temperatures, recovery from daily or seasonal high metabolic demands can be promoted, and prolonged periods of deprivation and unfavorable conditions tolerated.

When is it too hot and when is it too cold?
Most amphibians cannot tolerate temperatures above 100-110 degrees F. Most species can tolerate temperatures at or slightly below freezing for varying lengths of time. Salamanders have a lower tolerance then frogs and toads. In the Northern leopard frog, water temperatures at hibernal sites may range from 32 F to 36 F, and although the frogs were in a state of torpor (very slow activity), they were capable of swimming when disturbed. Some frogs also exhibit hibernation which is distinguished from short-term torpor referred to in the previous sentence.

I have heard that frogs can “come back to life” after being a “frogcicle”…is this true?
Yes, some amphibians can tolerate varying amounts of freezing of their body fluids for varying lengths of time. They produce their own “antifreeze” by converting liver glycogen to glucose in large amounts in response to ice formation in their tissues. Like glycerol, a “cryoprotectant”, glucose acts to inhibit tissue damage caused by freezing. When frozen, the eyes often look opaque, and breathing and heartbeat are suspended. Recovery can occur if freezing has not been too prolonged or deep and if ice crystal formation is confined to extracellular fluids. When subzero conditions arise, the frog greatly increases its blood glucose level (60X in some cases) by a massive boost in the breakdown of glycogen stored in the liver. Cold tolerance of amphibians may persist for a time after emergence from hibernation. This helps protect the animals against occasional bouts of early spring freezes. In some studies, frozen frogs were dropped into buckets with excess moisture after thawing and were able to hop away!

Are amphibians loyal to their natal breeding sites?
There is some evidence that amphibians are somewhat like salmon—they return to breed in the same place they were born. Recognition may be by familiar odors imprinted in them early in life, perhaps by using site familiarity acquired during transformation and early life on land during the time of dispersal, other topographic features may help them navigate. Thus it is very important to keep known breeding locations in tact as much as possible. It is much harder for an animal that has less dispersal capabilities to find new and adequate breeding sites after their “known” sites have been changed or damaged. It is well thought that much of the habitat left for amphibians is not necessarily suitable habitat at all, but rather all that is left (marginal at best) and since their homing instincts are so strong, they keep coming back even though they are doomed.
The chytrid fungus* affects the keratin in amphibian mouthparts and skin. Its symptoms include: skin sloughing from arms, legs and belly; sluggishness and loss of appetite. It can cause 100% mortality, may be highly virulent and there are large numbers of potential emerging outbreaks. Some species carry it and can transmit it, but don't suffer from the disease. It's believed to have been spread worldwide by the commercial trade in pets. In 2006 100 species were affected. Die-offs have occurred in Africa, Australia, N. America, Central America, S. America and Europe with a mass mortality in Costa Rica. In the Sierras and the entire Western U.S., it's affecting huge areas.

To prevent the spread of the chytrid fungus and Rana virus (another disease of frogs and salamanders), the following should be routine when moving from one body of water to another. For a long stream system, consider sites >1 km apart to be different bodies of water.

1. Clean all visible mud, algae & other debris from all surfaces, using clear water from the potentially contaminated site. A brush may be needed. Field workers using hollow poles should remove all mud packed inside the poles. (Old gun cleaning brushes may be useful.)
2. Thoroughly wet every square centimeter of all surfaces by dipping in a bucket of disinfectant (see below) or by rinsing with a wash bottle stream. (A wash bottle is a flexible, plastic bottle with an external spout connected to a tube that extends to the bottom of the bottle. Squeezing produces a stream of liquid without tipping and which may be efficiently directed at a target. Online sources are given below.) Care should be taken to saturate fabrics such as canvas wader shoes. Felt soles may be penetrated by stepping a few times in a dishpan of disinfectant. Disinfectant: A solution of freshly prepared, 4% household bleach or 0.5% Quat has been recommended. Quat may be less likely to cause deterioration of equipment. Per liter, 4% = 40 ml or cc. Per gallon, 4% = 2/3 cup or 6 fluid ounces. Per liter, 0.5% = 5 ml or cc. Per gallon, 0.5% = 1 Tablespoon + 1 teaspoon or slightly less than 1 fluid ounce. Remember that because Quat is diluted to 0.5% or 1/200; for every gallon of concentrate you order, you’ll get 200 gallons of solution. Quat is available by the product name “HDQ Neutral 128” at http://www.spartanchemcial.com/web/webhome.nsf
3. Allow objects to remain soaking or wetted for 15 min. (which will also kill Rana virus, another amphibian epizootic). Objects may then be rinsed using clean, uncontaminated water. The disinfectant and the water rinse should be disposed of at least 100 m from open water onto a site such as a road surface. Remember to disinfect brushes.

Please avoid driving through water, as your tires could be a vector, too.

Some online sources for 1-liter wash bottles & their prices are:

http://www.usplastic.com/catalog/product.asp?catname=USPlastic&category%5Fname=6252&product%5Fid=14767 $8.22 each
Folding buckets are available at www.Campmor.com (2 gal. $7.99)

From left to right: healthy dart frog, dart frog with Bd, keratin skin cell with Bd infection

Why frogs matter:

Amphibians play an important role in nature as both predator and prey, sustaining the delicate balance of nature. They eat pest insects, benefiting successful agriculture around the world and minimizing the spread of disease, including malaria. The skin of amphibians has substances that protect them from some microbes and viruses, offering possible medical cures for a variety of human diseases, including AIDS. Frogs have had a special place in various human cultures for centuries, cherished as agents of life and good luck.

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“It’s not easy being green”

Amphibians are the canaries in the coal mine, medical marvels, and innocent creatures. They face the most significant mass extinction since the dinosaurs. The main reason they will disappear is because we will choose to allow it. You can be one of the people who stops it. Visit www.amphibianark.org. Learn. Donate. And tell others about it.”