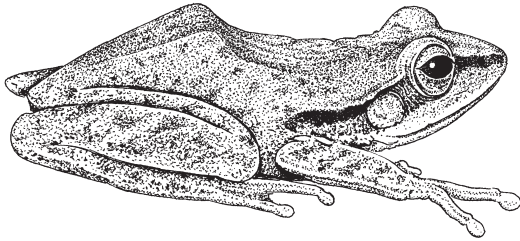
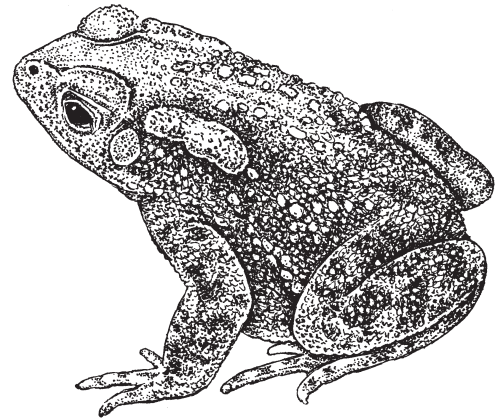


Frogs & Toads



Tree Frog



Common Toad

Can you tell a frog from a toad? Don't worry if you can't, because here in the tropics sometimes not even experienced naturalists can do so at first glance, so often do their characteristics overlap. The only invariable difference is that toads have a pair of modified salivary glands containing a mild toxin – the parotid glands – visible behind the head, one on each side. Otherwise, as a broad rule of thumb it can generally be said that frogs are better jumpers, have more powerful back legs, lay their eggs in concentrated masses, mostly have a row of small teeth-like projections in their upper jaw (normally absent in toads), and are more noisy and more colourful, whereas toads tend to be generally slower, crawl or hop rather than jump, generally have more rounded heads, often – but not always – have a drier and rougher skin, and lay their eggs in strings, sometimes up to 2m long. They also get around more than frogs, in a migratory-territorial sense, often straying far from water.

Distribution / habitats

Frogs and toads belong to a primitive group of vertebrate amphibians, the first land animals, which date back more than 300 million years and are known as the anurans or “tail-less ones”. Worldwide there are over 3,500 species, the majority found in moist habitats in the tropics, though some species have adapted and are found in unusual or more extreme circumstances, ranging from trees to underground to north of the Arctic Circle, or even in deserts. None live in the sea.

Mating time

The mating time of frogs and toads is unmistakable. Come the first good rain of the monsoon and suddenly every pond, pool or tank is alive with a ‘chorus’ (the official term) of males, all croaking, trilling or thundering away like mad, trying to attract females, who are generally responsive to the loudest calls. One especially noisy variety – surely of sporting nature? – even seems to call the ladies with a deafening version of “*kabaddi, kabaddi, kabaddi*”. Sometimes small pools will be the scene of virtual mating orgies, with large assemblies of over-excited males ready to latch on to anything resembling a female. I've even seen two males leap simultaneously from opposite directions onto a lone female, who dived at the last instant leaving the gents in an embarrassing embrace with each other. Meanwhile, at the same pool, I also saw another old gentleman toad, massive and solemn looking, finally appear to lose patience with a competing upstart young croaker in the water before him, and deliberately jump onto him “sploosh!” Thereafter, at least for a short time, there was silence from the latter.

Once locked on to a female (a state known as axillary amplexus, Latin for ‘embrace’) the males are extremely reluctant to let go, even under life-threatening circumstances. They kick out with their hind legs to push competitors away, but will not



release their mate for more meaningful conflict. The actual mating act is prolonged, as the male doesn't penetrate the female and simply releases sperm over the eggs as they emerge. Typically, a toad lays fewer eggs than a frog, usually anything from 4,000 to 12,000 a year, while a female bullfrog may lay from 18,000 to 20,000 eggs in a season.

Sounds / calls

The mating calls of frogs and toads (each species has its own call), which in a tropical swamp containing many different species may include groans, metallic clicks, mewls, wails, belches and whinnies sufficient to oblige a man to shout to communicate (the calls of some species are so loud they can be heard over a kilometre away), are not their only vocalisations. There are five other known types of call, namely release calls, warning calls, rain calls, screams and territorial calls, all of which – except for the scream – are made with their mouth closed, using so-called vocal sacs.

Release calls seem to function as a signal by which males can distinguish the sex of a partner. Such a call probably occurred on the occasion described above, involving the two embraced males, because in their over-excitement males often clasp anything resembling a female in size. If it happens to be another male the latter emits a croak or chirp – a sort of warning vocalisation – and the clasping male releases him. A female will remain demurely silent.

Warning calls serve a similar function, but are much softer.

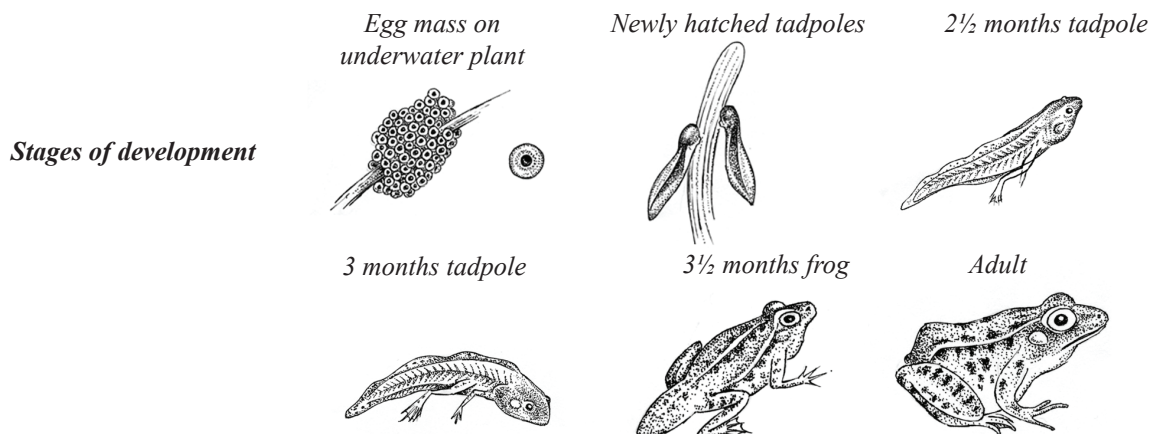
Rain calls occur in many species. These are sporadic calls, often like feeble or partial renditions of the mating call, but made outside the mating season. They usually occur with a rise in humidity prior to rain, though the sound can also be triggered by other external stimuli, such as the sound of music at a particular pitch, or even aircraft droning overhead. The common toad of India is one such caller.

Screams are essentially loud cries issued by injured or grasped frogs when they want to warn others of danger, though outright pain or fear may also be involved.

Finally, territorial calls. Frogs that spend most of their time hunting in a small area have been known to give voice to short calls of a quite different nature to any of the above. Produced almost at random, without stimulus, it seems that such calls may be territorial.

Development / metamorphosis

Following mating, within a few days of the female laying her eggs, which float and are usually laid at night, the larvae – known as tadpoles – emerge from the eggs. First they remain immobile, eating the remnants of the egg's yolk sac, but within a few days they start swimming around and breathing – entirely underwater – via gills, like fish. In the case of species that lay their eggs in moving water, the tadpoles have mouths like suckers, enabling them to cling to rocks against the force of the current.



Although the tadpole phase can be as short as a week or two in some species, and in others may include an extended period of winter hibernation in colder climates, in most species it continues for around two months, during which time the tadpole remains more or less the same in outer appearance. Towards the end of this time it starts to form legs, commencing with the back legs, then at three months begins to leave its water habitat and spend more time on land. Meanwhile its tail gradually shrinks, then finally disappears. At six months it is unmistakably a fully grown and mature frog. Life expectancy in the wild is normally 4 to 15 years, but well cared for captive frogs and toads have been known to live for up to 40 years.

What has just been described is a typical development cycle, but there are a number of remarkable variations, some covered at the end of this profile, including species (approx 20% of all anurans) that show some degree of parental care.

Diet

Although tadpoles are essentially vegetarian, mature frogs and toads are the very opposite. Like a number of other creatures covered in this book they play an important role in insect control, thanks to a chameleon-like, sticky, V-tipped tongue anchored at the front of their mouth, which they can flick out and back to seize flying as well as stationary prey. Mosquitoes and cockroaches are popular items on their menu, but their tastes go further. In fact both frogs and toads, with just a few exceptions, are fully carnivorous and will eat almost anything they can swallow, such as worms, caterpillars, slugs, and even – in certain species – small mice, nestling birds and young fellow frogs and toads. In such actions, they are helped by an attribute of their tongue, namely a muscular capacity of the sticky end which enables them to wrap it around prey and pull it back into their mouth. Some species may also use their front leg “fingers” to cram food into their mouth.

At this point it is perhaps interesting to note that both frogs and toads are incapable of chewing. This is why toads, when they seize one end of a worm, methodically rake the length of it with their forefeet to first remove any clinging soil particles. The tongue assists the swallowing process by producing a lot of mucus, then moves the food back along the floor of the mouth assisted by the eyes. The eyes? Yes, that may sound extraordinary, but it is a fact that all frogs and toads blink when they swallow, for a physical reason. Their eye sockets have no bony floor, so as they blink the eyeballs are drawn down into the skull and make a bulge in the roof of the mouth, which squeezes the food to the back of the throat for swallowing.

Natural predators and other threats

The reverse of all the above is that both frogs and toads fall prey themselves from egg to adulthood to health problems such as fungal diseases and a wide variety of predators. The eggs are eaten by insect larvae and flatworms; the hatched tadpoles by water beetles, newts, dragonfly larvae, birds and a wide variety of fish; and the mature frogs and toads by many types of bird, animal and reptile predators, especially mongooses and snakes respectively. They are also eaten by humans in countries such as France, China, Indonesia, the Philippines, northern Greece and parts of the American South e.g. Louisiana. India at one time was exporting the edible green frog and Indian bullfrog in millions to some of these countries, but thankfully this practice was stopped by the government, because in some areas it was tipping the balance of nature in favour of frogs' prey species, particularly mosquitoes.

In Asia generally, dried frogs and toads are also used for “medicinal” purposes. Then there are the huge numbers that end up in scientific laboratories around the world, where they are used in various types of research, including cloning (one of the world's first successful cloning experiments, prior to Dolly the Sheep, involved a frog species). From beginning to end the mortality rate is huge, but out of the 20,000 eggs a female frog may lay each season – say 250,000 in her lifetime – theoretically only two need survive to maintain the population level.

Defence

Although heavily preyed upon, frogs and toads are not entirely lacking in defence. Firstly, and especially in the case of frogs, which are equipped with powerful back legs for jumping and muscular front legs to act as shock absorbers on landing, there is their ability to suddenly leap clear of danger. One species is recorded as having covered nearly 4.5m on flat ground in a single incredible leap. Another covered nearly 10m (160 x its body length) in three successive leaps. How do they achieve such leaps? When they squat they stretch elasticated tendons in their legs, which when released give them a huge lift-off. Such athleticism can instantly remove them from the vicinity of a predator.

Their next defence is camouflage, an example being tree dwelling frogs, which are often leaf green or bark coloured. Others – frogs and toads – may be blotched brown and grey, rendering them almost invisible when immobile on the forest floor.

Another defence tactic they use is to escape by burrowing down – usually backwards – into the ground, where they can't be seen or smelled by predators. Certain Indian toads make use of this practice, sometimes even immersing themselves in the soil of potted plants. Some species dig burrows up to a metre deep.

More dramatic defences includethe Common European Toad, which can suddenly inflate its body and stand on tip-toe to dramatically change its appearance in the eyes of a predator; the Fire Bellied Toad, which when alarmed exposes a blazing yellow-black warning pattern on its underside; and some

20 species of Central and South American frogs, plus a toad (Zetek's), which can exude highly toxic substances from their skin if handled, one – the Golden Poison Frog – so deadly that the milligram (a thousandth of a gram) its body typically contains can kill up to 10,000 mice, 10 humans, or 2 African bull elephants, meaning that one gram could kill around 10,000 people. Not surprisingly, such a powerful poison hasn't escaped the ingenious mind of man the hunter. South American Indian tribes deliberately catch these frogs and smear the poison on the tips of their hunting arrows. It is also worth mentioning that most such species of frogs are highly coloured (not just yellow-black, but scarlet, bright green or even purple), the coloration acting as a warning signal to all around them. Meanwhile, for such a warning to be effective it has to be seen, so these species also differ from most frogs and toads in that they are generally fully active by day, confidently moving around the open forest floor without fear of predation.

Breathing, sight and hearing

Most frogs and toads breathe (and take in moisture) through their highly permeable skin by way of a process called cutaneous gas exchange, but they also have lungs to breathe with. During the time they stay submerged underwater or buried in soil (such as during hibernation) they only breathe through their skin.

Regarding sight, the eyes of frogs and toads are fundamentally the same as those of their fish ancestors. In addition to giving them near-360-degree vision, optically they work outside as well as within water, giving them good eyesight provided they can be swept clear of dust and grit. To achieve this, long ago they learned to blink, and also developed a transparent membrane – the nictitating membrane – which can be drawn across the front of the eyeball to keep the surface of the eye moist and protect it underwater.

As to sound, their receiving system now differs radically from that of fish, thanks to the incorporation of an ear drum in an organ known as the 'tympanum', located each side of the head just behind the eyes.

Conservation status

Worldwide, nearly a third of anuran species are now threatened with extinction thanks to habitat loss, poisoning of their environment with man-made pollutants, and spread of the 'chytrid' fungus, which today threatens up to a third of all frog species worldwide. Already 120 species are believed to have become extinct since the 1980s.

The amazing world of frogs and toads

So much, above, for generalities. It is in the more specialised species with their range of extraordinary adaptations and behaviour that studying frogs and toads becomes most fascinating. For example...

The **Paradoxical Frog** is smaller than its tadpole. The latter may grow to 18cms or more, with a dorsal fin like a fish, but the adult frog is only 5cms long. No-one knows why.

The **Spade Foot Toad** of Australia spends up to nine months a year underground between rains. The **Australian Water-Holding Frog** is even more retiring, often spending 2-3 years at a stretch in a small underground chamber with a special water-containing skin layer secreted around it, giving it the appearance of being wrapped in transparent plastic film.

The **Horned Toad** isn't a toad, it's a lizard that can squirt blood from its eyelids when irritated or in defence. The **Horned Frog**, on the other hand, is a frog, and has teeth that enable it to bite.

The **Rain Frog** can't swim, and would drown in water if it didn't have the ability to inflate itself and float to safety. It spends its life underground, except for brief periods prior to or during rain. Even mating and egg-laying occurs underground.

Darwin's Frog goes in for exceptional parental care. The female lays her eggs on moist ground, and the male then watches over them for approximately two weeks until they are ready to hatch. He then takes them into his vocal sac, where the tadpoles remain feeding on their egg yolk. When they are nearly a centimetre in length and looking like miniature froglets, they hop out and swim away.

The **smallest frog in the world** lives in Papua New Guinea, measuring only 7mm. The **biggest** is the **Goliath Frog** of Cameroon and Equatorial Guinea in West Africa, which can measure up to 30cms in body length, weigh over 3kgs, and easily jump 3 metres.

Some species of **Tree Frogs**, which generally have suction cups on their toes to cling to vertical surfaces, also have big webbed feet which act like miniature parachutes, enabling them to "fly" as far as 15 metres between take-off and landing.

The **Pipa Toad** of Suriname spends virtually all its life in water. It is a grotesque creature with no tongue, a flattened body and a squashed-looking head. When they mate, there follows the most extraordinary but



graceful underwater ballet. The female kicks with her legs in such a way that the pair soar upwards in a slow but elegant backwards somersault. As they descend, the female extrudes a few eggs, which are immediately fertilised by the male's sperm, which he discharges into the water at the same time. Then, with delicate movements of his webbed hind feet, toes distended so that they form a fan, he gathers up the eggs and gently spreads them over the female's back, where they stick. Again and again this arching leap is performed, until a hundred or so eggs are fixed in an even carpet on the female's back. After this the skin beneath them begins to swell, and soon the eggs appear to be embedded in it, each egg in its own nursery pouch. A membrane rapidly grows over them, and within 30 hours the eggs have disappeared from sight and the skin on the female's back is once again smooth and unbroken.



India's Marbled Balloon Frog

Beneath the skin the eggs proceed to develop, until after a fortnight the whole of the female's back is rippling with the movement of the tadpoles beneath. Finally, after 24 days, the young break holes in the skin and swim away as fully formed toadlets to seek safe hiding places. Her maternity chore ended, the female then rubs off the old thick skin layer.

The **Wood Frog** of N.America survives north of the Arctic Circle by shutting down all its bodily functions, including the pumping of its heart, and freezing into a solid icy block for several months each winter (it simply thaws out again next spring). It turns in mid air when it leaps, so it lands facing the direction from which it took off.

Hochstetter's Frog of New Zealand and the Caribbean **Whistling Frog** lay only around 8 to 12 eggs at a time, but the young develop fully into frogs within the egg itself in the brief spell of three weeks.

The male of the **Hairy Frog** of West Africa is covered in what looks like hairs, but are filamentous extensions of its skin via which it can breathe underwater.

The female of one South American frog genus, *Gastrotheca*, has a brood pouch on her back with a slit-shaped entrance. When the pair begin to spawn, the male, who is smaller than she is, climbs on her back and clasps her around the throat. She then raises her hind legs so that she is crouching with her nose down and her back tilted up, and one by one begins to extrude eggs. The male fertilises them, and they roll down a moist groove into the female's brood sac. There they develop and hatch. One species of *Gastrotheca* produces around 200 young at a time. These emerge as tadpoles, and are then released directly into water. Another species lays only about 20 eggs, but provides them with more yolk, so they remain within the sac until they become froglets. The female releases them by reaching forward with her hind leg and inserting her longest toe into the sac entrance, which she pulls to enlarge it, enabling the young to clamber out.

India's Balloon Frogs are unusual in that when breeding they inflate their bodies and float on the water surface. They use their bloated body as a resonating chamber to boost their mating calls.

A **Brazilian frog** creates a relatively safe nursery pond at the edge of bigger ponds for its young by piling up a 10cms high dam to separate the young from the main pond. Other species lay eggs in the cups of tree-dwelling plants like Bromeliads, where the young develop to maturity in even greater safety.

The males of **South American poison frogs** are very protective. Firstly they guard the eggs, then when the tadpoles hatch they wriggle to the male and climb on his back, where a heavy mucus secretion holds them in place while they develop.

There are **frogs that breed on tree branches** overhanging water. The female exudes a liquid which she and her mate proceed to whip with their legs into a ball of froth. The eggs are then laid within the froth. In some species, including at least one in the Coromandel region, the froth ball forms a dry crusty outer surface to retain the moisture within. In others the female has to descend to a water source at intervals, take up water, and then urinate over the froth. Following hatching of the eggs, the young develop in the froth until, at the appropriate time, the lower part of the froth ball liquefies and the tadpoles fall into the water below.

The male **Midwife Toad** twines the strings of eggs around his back legs after fertilisation, and shuffles off with them. He continues to carry them for the next few weeks until the moment they are ready to hatch, then sits in the water for an hour or more while the tadpoles emerge and swim free.

Finally, the **Prince Charming Frog**. As most young girls familiar with Western literature are aware, there is a frog which when kissed by a beautiful maiden transforms into a handsome prince. It just needs a loving kiss to release him. I know this sounds extraordinary, but if any young ladies want to test the truth of it – or otherwise – for themselves they could go out to their garden pond and try on an appropriate day – like next April 1st? ☺