

= Common toad =

The common toad , European toad or in Anglophone parts of Europe , simply the toad (*Bufo bufo* , from Latin *bufo* " toad ") , is an amphibian found throughout most of Europe (with the exception of Ireland , Iceland , and some Mediterranean islands) , in the western part of North Asia , and in a small portion of Northwest Africa . It is one of a group of closely related animals that are descended from a common ancestral line of toads and which form a species complex . The toad is an inconspicuous animal as it usually lies hidden during the day . It becomes active at dusk and spends the night hunting for the invertebrates on which it feeds . It moves with a slow ungainly walk or short jumps and has greyish brown skin covered with wart @-@ like lumps .

Although toads are usually solitary animals , in the breeding season , large numbers of toads converge on certain breeding ponds , where the males compete to mate with the females . Eggs are laid in gelatinous strings in the water and later hatch out into tadpoles . After several months of growth and development , these sprout limbs and undergo metamorphosis into tiny toads . The juveniles emerge from the water and remain largely terrestrial for the rest of their lives .

The common toad seems to be in decline in part of its range but overall is listed as being of " least concern " in the IUCN Red List of Threatened Species . It is threatened by habitat loss , especially by drainage of its breeding sites , and some toads get killed on the roads as they make their annual migrations . It has long been associated in popular culture and literature with witchcraft .

= = Taxonomy = =

The common toad was first given the name *Rana bufo* by the Swedish biologist Carl Linnaeus in the 10th edition of *Systema Naturae* in 1758 . In this work , he placed all the frogs and toads in the single genus *Rana* . It later became apparent that this genus should be subdivided , and in 1768 , the Austrian naturalist Josephus Nicolaus Laurenti placed the common toad in the genus *Bufo* , naming it *Bufo bufo* . The toads in this genus are included in the family *Bufo*nidae , the true toads .

Various subspecies of *Bufo bufo* have been recognized over the years . The Caucasian toad is found in the mountainous regions of the Caucasus and was at one time classified as *Bufo bufo verrucosissima* . It has a larger genome and differs from *Bufo bufo* morphologically and is now accepted as *Bufo verrucosissimus* . The spiny toad was classified as *Bufo bufo spinosus* . It is found in the Mediterranean area and grows to a larger size and has a spinier skin than its more northern counterparts with which it intergrades . It is now accepted as *Bufo spinosus* . The Gredos toad , *Bufo bufo gredosicola* , is restricted to the Sierra de Gredos , a mountain range in central Spain . It has exceptionally large paratoid glands and its colour tends to be blotched rather than uniform . It is now considered to be a synonym of *Bufo spinosus* .

Bufo bufo is part of a species complex , a group of closely related species which cannot be clearly demarcated . Several modern species are believed to form an ancient group of related taxa from preglacial times . These are the spiny toad (*Bufo spinosus*) , the Caucasian toad (*Bufo verrucosissimus*) and the Japanese common toad (*Bufo japonicus*) . The European common toad (*Bufo bufo*) seems to have arisen more recently . It is believed that the range of the ancestral form extended into Asia but that isolation between the eastern and western species complexes occurred as a result of the development of the Central Asian Deserts during the Middle Miocene . The exact taxonomic relationships between these species remains unclear . A serological investigation into toad populations in Turkey undertaken in 2001 examined the blood serum proteins of *Bufo verrucosissimus* and *Bufo spinosus* . It found that the differences between the two were not significant and that therefore the former should be synonymized with the latter .

A study published in 2012 examined the phylogenetic relationships between the Eurasian and North African species in the *Bufo bufo* group and indicated a long evolutionary history for the group . Nine to thirteen million years ago , *Bufo eichwaldi* , a recently described species from south Azerbaijan and Iran , split from the main lineage . Further divisions occurred with *Bufo spinosus* splitting off about five million years ago when the Pyrenees were being uplifted , an event which isolated the populations in the Iberian Peninsula from those in the rest of Europe . The remaining

European lineage split into *Bufo bufo* and *Bufo verrucosissimus* less than three million years ago during the Pleistocene . Very occasionally the common toad hybridizes with the natterjack toad (*Bufo calamita*) or the European green toad (*Bufo viridis*) .

= = Description = =

The common toad can reach about 15 cm (6 in) in length . Females are normally stouter than males and southern specimens tend to be larger than northern ones . The head is broad with a wide mouth below the terminal snout which has two small nostrils . There are no teeth . The bulbous , protruding eyes have yellow or copper coloured irises and horizontal slit @-@ shaped pupils . Just behind the eyes are two bulging regions , the paratoid glands , which are positioned obliquely . They contain a noxious substance , bufotoxin , which is used to deter potential predators . The head joins the body without a noticeable neck and there is no external vocal sac . The body is broad and squat and positioned close to the ground . The fore limbs are short with the toes of the fore feet turning inwards . At breeding time , the male develops nuptial pads on the first three fingers . He uses these to grasp the female when mating . The hind legs are short relative to other frogs ' legs and the hind feet have long , unwebbed toes . There is no tail . The skin is dry and covered with small wart @-@ like lumps . The colour is a fairly uniform shade of brown , olive @-@ brown or greyish @-@ brown , sometimes partly blotched or banded with a darker shade . The common toad tends to be sexually dimorphic with the females being browner and the males greyer . The underside is a dirty white speckled with grey and black patches .

Other species with which the common toad could be confused include the natterjack toad (*Bufo calamita*) and the European green toad (*Bufo viridis*) . The former is usually smaller and has a yellow band running down its back while the latter has a distinctive mottled pattern . The paratoid glands of both are parallel rather than slanting as in the common toad . The common frog (*Rana temporaria*) is also similar in appearance but it has a less rounded snout , damp smooth skin , and usually moves by leaping .

Common toads can live for many years and have survived for fifty years in captivity . In the wild , common toads are thought to live for about ten to twelve years . Their age can be determined by counting the number of annual growth rings in the bones of their phalanges .

= = Distribution and habitat = =

After the common frog (*Rana temporaria*) , the edible frog (*Pelophylax esculentus*) and the smooth newt (*Lissotriton vulgaris*) , the common toad is the fourth most common amphibian in Europe . It is found throughout the continent with the exception of Iceland , the cold northern parts of Scandinavia , Ireland and a number of Mediterranean islands . These include Malta , Crete , Corsica , Sardinia and the Balearic Islands . Its easterly range extends to Irkutsk in Siberia and its southerly range includes parts of northwestern Africa in the northern mountain ranges of Morocco , Algeria and Tunisia . A closely related variant lives in eastern Asia including Japan . The common toad is found at altitudes of up to 2 @, @ 500 metres (8 @, @ 200 ft) in the southern part of its range . It is largely found in forested areas with coniferous , deciduous and mixed woodland , especially in wet locations . It also inhabits open countryside , fields , copses , parks and gardens , and often occurs in dry areas well away from standing water .

= = Behaviour and lifecycle = =

The common toad usually moves by walking rather slowly or in short shuffling jumps involving all four legs . It spends the day concealed in a lair that it has hollowed out under foliage or beneath a root or a stone where its colouring makes it inconspicuous . It emerges at dusk and may travel some distance in the dark while hunting . It is most active in wet weather . By morning it has returned to its base and may occupy the same place for several months . It is voracious and eats woodlice , slugs , beetles , caterpillars , flies , earthworms and even small mice . Small , fast moving prey may be

caught by a flick of the tongue while larger items are grabbed with the jaws . Having no teeth , it swallows food whole in a series of gulps . It does not recognise its prey as such but will try to consume any small , dark coloured , moving object it encounters at night . A research study showed that it would snap at a moving 1 cm (0 @. @ 4 in) piece of black paper as if it were prey but would disregard a larger moving piece . Toads seem to use visual cues for feeding and can see their prey at very low light intensities where humans are unable to discern anything . Periodically , the common toad sheds its skin . This comes away in tattered pieces and is then consumed .

When attacked , the common toad adopts a characteristic stance , inflating its body and standing with its hindquarters raised and its head lowered . Its chief means of defence lies in the foul tasting secretion that is produced by its paratoid glands and other glands on its skin . This contains a toxin called bufagin and is enough to deter many predators although grass snakes seem to be unaffected by it . Other predators of adult toads include hedgehogs , rats and mink , and even domestic cats . Birds that feed on toads include herons , crows and birds of prey . Crows have been observed to puncture the skin with their beak and then peck out the animal 's liver , thus avoiding the toxin . The tadpoles also exude noxious substances which deter fishes from eating them but not the great crested newt . Aquatic invertebrates that feed on toad tadpoles include dragonfly larvae , diving beetles and water boatmen . These usually avoid the noxious secretion by puncturing the tadpole 's skin and sucking out its juices .

A parasitic fly , *Lucilia bufonivora* , attacks adult common toads . It lays its eggs on the toad 's skin and when these hatch , the larvae crawl into the toad 's nostrils and eat its flesh internally with lethal consequences . The European fingernail clam (*Sphaerium corneum*) is unusual in that it can climb up water plants and move around on its muscular foot . It sometimes clings to the toe of a common toad and this is believed to be one of the means by which it disperses to new locations .

In 2007 , researchers using a remotely operated underwater vehicle to survey Loch Ness , Scotland , observed a common toad moving along the bottom of the lake at a depth of 324 feet (99 m) . They were surprised to find that an air @-@ breathing animal could survive in such a location .

== = Reproduction == =

The common toad emerges from hibernation in spring and there is a mass migration towards the breeding sites . The toads converge on certain ponds that they favour while avoiding other stretches of water that seem eminently suitable . Adults use the same location year after year and over 80 % of males marked as juveniles have been found to return to the pond at which they were spawned . They find their way to these mainly by using olfactory and magnetic cues . Toads experimentally moved elsewhere and fitted with tracking devices have been found to be able to locate their chosen breeding pond when the displacement exceeded three kilometres (two miles) .

The males arrive first and remain in the location for several weeks while the females only stay long enough to mate and spawn . Rather than fighting for the right to mate with a female , male toads may settle disputes by means of the pitch of their voice . Croaking provides a reliable sign of body size and hence of prowess . Nevertheless , fights occur in some instances . In a study at one pond where males outnumbered females by four or five to one , it was found that 38 % of the males won the right to mate by defeating rivals in combat or by displacing other males already mounted on females . Male toads generally outnumber female toads at breeding ponds . A Swedish study found that female mortality was higher than that of males and that 41 % of females did not come to the breeding pond in the spring and missed a year before reproducing again .

The males mount the females ' backs , grasping them with their fore limbs under the armpits in a grip that is known as amplexus . The males are very enthusiastic , will try to grasp fish or inanimate objects and often mount the backs of other males . Sometimes several toads form a heap , each male trying to grasp the female at the base . It is a stressful period and mortality is high among breeding toads . A successful male stays in amplexus for several days and , as the female lays a long , double string of small black eggs , he fertilises them with his sperm . As the pair wander piggyback around the shallow edges of the pond , the gelatinous egg strings , which may contain 3000 to 6000 eggs and be 3 to 4 @. @ 5 metres (10 to 15 ft) in length , get tangled in plant stalks .

The strings of eggs absorb water and swell in size , and small tadpoles hatch out after two to three weeks . At first they cling to the remains of the strings and feed on the jelly . They later attach themselves to the underside of the leaves of water weed before becoming free swimming . The tadpoles at first look similar to those of the common frog (*Rana temporaria*) but they are a darker colour , being blackish above and dark grey below . They can be distinguished from the tadpoles of other species by the fact that the mouth is the same width as the space between the eyes , and this is twice as large as the distance between the nostrils . Over the course of a few weeks their legs develop and their tail gradually gets reabsorbed . By twelve weeks of age they are miniature toads measuring about 1 @. @ 5 cm (0 @. @ 6 in) long and ready to leave the pond .

= = = Development and growth = = =

The common toad reaches maturity at three to seven years old but there is great variability between populations . Juveniles are often parasitised by the lung nematode *Rhabdias bufonis* . This slows growth rates and reduces stamina and fitness . Larger juveniles at metamorphosis always outgrow smaller ones that have been reared in more crowded ponds . Even when they have heavy worm burdens , large juveniles grow faster than smaller individuals with light worm burdens . After several months of heavy worm infection , some juveniles in a study were only half as heavy as control juveniles . Their parasite @-@ induced anorexia caused a decrease in food intake and some died . Another study investigated whether the use of nitrogenous fertilisers affects the development of common toad tadpoles . The toadlets were kept in very dilute solutions of ammonium nitrate of various strengths . It was found that at certain concentrations , which were well above any normally found in the field , growth was increased and metamorphosis accelerated , but at others , there was no significant difference between the experimental tadpoles and controls . Nevertheless , certain unusual swimming patterns and a few deformities were found among the experimental animals .

A comparison was made between the growth rate of newly metamorphosed juveniles from different altitudes and latitudes , the specimens studied being from Norway , Germany , Switzerland , the Netherlands and France . At first the growth rates for males and females was identical . By the time they became mature their growth rate had slowed down to about 21 % of the initial rate and they had reached 95 % of their expected adult size . Some females that were on a biennial breeding cycle carried on growing rapidly for a longer time . Adjusting for differences in temperature and the length of the growing season , the toads grew and matured at much the same rate from the four colder localities . These juveniles reached maturity after 1 @. @ 09 years for males and 1 @. @ 55 years for females . However , the young toads from lowland France grew faster and longer to a much greater size taking an average 1 @. @ 77 years for males and 2 @. @ 49 years for females before reaching maturity .

= = = Conservation = = =

The IUCN Red List of Threatened Species considers the common toad as being of " least concern " . This is because it has a wide distribution and is , over most of its range , a common species . It is not particularly threatened by habitat loss because it is adaptable and is found in deciduous and coniferous forests , scrubland , meadows , parks and gardens . It prefers damp areas with dense foliage . The major threats it faces include loss of habitat locally , the drainage of wetlands where it breeds , agricultural activities , pollution and mortality on roads . Chytridiomycosis , an infectious disease of amphibians , has been reported in common toads in Spain and the United Kingdom and may affect some populations .

There are parts of its range where the common toad seems to be in decline . In Spain , increased aridity and habitat loss have led to a diminution in numbers and it is regarded as " near threatened " . A population in the Sierra de Gredos mountain range is facing predation by otters and increased competition from the frog *Pelophylax perezi* . Both otter and frog seem to be extending their ranges to higher altitudes . The common toad cannot be legally sold or traded in the United Kingdom but there is a slow decline in toad numbers and it has therefore been declared a Biodiversity Action Plan

priority species . In Russia , it is considered to be a " Rare Species " in the provinces of Bashkiria , Tataria , Yamal @-@ Nenets Autonomous County and Irkutsk , but during the 1990s , it became more abundant in Moscow Province .

It has been found that urban populations of common toad occupying small areas and isolated by development show a lower level of genetic diversity and reduced fitness as compared to nearby rural populations . The researchers demonstrated this by genetic analysis and by noting the greater number of physical abnormalities among urban as against rural tadpoles when raised in a controlled environment . It was considered that long term depletion in numbers and habitat fragmentation can reduce population persistence in such urban environments .

= = = Roadkill = = =

Many toads are killed by traffic while migrating to their breeding grounds . In Europe they have the highest rate of mortality from roadkill among amphibians . Many of the deaths take place on stretches of road where streams flow underneath showing that migration routes often follow water courses . In some places in Germany , Belgium , Great Britain , Northern Italy and Poland , special tunnels have been constructed so that toads can cross under roads in safety . In other places , local wildlife groups run " toad patrols " , carrying the amphibians across roads at busy crossing points in buckets . The toads start moving at dusk and for them to travel far , the temperature needs to remain above 5 ° C (41 ° F) . On a warm wet night they may continue moving all night but if it cools down , they may stop earlier . An estimate was made of the significance of roadkill in toad populations in the Netherlands . The number of females killed in the spring migration on a quiet country road (ten vehicles per hour) was compared with the number of strings of eggs laid in nearby fens . A 30 % mortality rate was found , with the rate for deaths among males likely to be of a similar order .

= = Bufotoxin = =

The main toxic substance found in the parotoid gland and skin of the common toad is called bufotoxin . It was first isolated by Heinrich Wieland and his colleagues in 1922 and they succeeded in identifying its structure about 20 years later . Meanwhile , other workers succeeded in isolating the same compound and its parent steroid bufotalin from the Japanese toad (*Bufo japonicus*) . By 1986 , researchers at the Arizona State University had succeeded in synthesizing the toad venom constituents bufotalin , bufalitinol and bufotoxin . The chemical formula of bufotoxin is $C_{40}H_{60}N_4O_{10}$. Its physical effects resemble those of digitalis which in small doses increases the strength with which the heart muscle contracts and which is used in the treatment of congestive heart failure . The skin of one toad contains enough toxin to cause serious symptoms or even death in animals and man . Clinical effects include severe irritation and pain to eyes , mouth , nose and throat , cardiovascular and respiratory symptoms , paralysis and seizures , increased salivation , vomiting , hyperkalemia , cyanosis and hallucinations . There is no known anti @-@ venom . Treatment consists of supporting respiratory and cardiovascular functions , prevention of absorption and electrocardiography to monitor the condition . Atropine , phenytoin , cholestyramine and lidocaine may prove useful in its management .

= = Cultural significance = =

The toad has long been considered to be an animal of ill omen or a connection to a spirit world . This may have its origins in the fact that it is at home both on land and in the water . It may cause repugnance because of its blackish , wart @-@ like skin , its slow movements and the way it emerges from some dark hole . In Europe in the Middle Ages , the toad was associated with the Devil , for whom a coat @-@ of @-@ arms was invented emblazoned with three toads . It was known that the toad could poison people and , as the witch 's familiar , it was thought to possess magical powers . Even ordinary people made use of dried toads , their bile , faeces and blood . In

some areas , the finding of a toad in a house was considered evidence that a witch was present . In the Basque Country , the familiars were believed to be toads wearing elegant robes . These were herded by children who were being trained as witches . Between 1610 and 1612 , the Spanish inquisitor Alonso de Salazar Frías investigated witchcraft in the region and searched the houses of suspected witches for dressed toads . He found none . These witches were reputed to use undomesticated toads as ingredients in their liniments and brews .

An English folk tale tells how an old woman , a supposed witch , cursed her landlord and all his possessions when he demanded the unpaid rent for her cottage . Soon afterwards , a large toad fell on his wife and caused her to collapse . The toad was thrown into the fire but escaped with severe burns . Meanwhile , the old witch 's cottage had caught fire and she was badly burnt . By next day , both toad and witch had died , and it was found that the woman 's burns exactly mirrored those of the toad .

The saliva of the toad was considered poisonous and was known as " sweltered venom " and it was believed that it could spit or vomit poisonous fire . Toads were associated with devils and demons and in *Paradise Lost* , John Milton depicted Satan as a toad when he poured poison into Eve 's ear . The First Witch in Shakespeare 's *Macbeth* gave instructions on using a toad in the concoction of spells :

It was also believed that there was a jewel inside a toad 's head , a " toadstone " , that when worn as a necklace or ring would warn the wearer of attempts to poison them . Shakespeare mentioned this in *As You Like It* :

Mr. Toad Esq. is one of the main characters in the children 's novel *The Wind in the Willows* , by Kenneth Grahame . This has been dramatized by several authors including A. A. Milne who called his play *Toad of Toad Hall* . Mr. Toad is a very conceited , anthropomorphic toad and in the book he composes a ditty in his own praise which starts like this :

George Orwell in his essay *Some Thoughts on the Common Toad* described the emergence of the common toad from hibernation as one of the most moving signs of spring .