



Why what we do matters

Firstly, Trustee Professor Roger Downie explains the amphibian extinction crisis, and why the situation is so bleak for amphibians across the world.

Where have all the frogs gone? Professor Roger Downie

The known number of amphibian species increases each year, but all over the world, amphibian populations are in decline. Why, and what can be done?

For biologists who study amphibians it is both the best of times and the worst of times, to borrow Dickens's phrase from *A Tale of Two Cities*. On the good side, we now know much more about these animals than ever before and the number of described species is rising steeply each year. On the bad side, these animals are more seriously threatened with extinction than the other groups of land-living vertebrates.

Amphibian diversity

Amphibians were the first vertebrates to live on land as well as water emerging from the waters in the Devonian period (397 million years ago). The groups of amphibians we see today have been detected in the fossil record as far back as 280 million years ago, though molecular dating suggests they originated earlier. They comprise three distinct groups:

- **Anura** (Frogs and toads);
- **Caudata** (Newts and salamanders)
- and **Gymnophiona** (The legless amphibians, also known as apodans or caecilians),

The anurans are the most numerous – 88% of known species. Amphibians are a highly successful group (with more species than mammals) that has exploited the interface between freshwater habitats and land and where many species have evolved to live fully in one or the other.

The rapid rise in described amphibian species (over 100 species added annually in recent years) is partly because biologists are exploring further into tropical forests, where amphibians are very diverse: a 2002 research report added 100 new species in Sri Lanka alone. Another factor is that DNA sequencing results suggest that widely distributed species should be sub-divided.

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Amphibian declines

After worries expressed at the 1989 world herpetology conference, IUCN set up a team of scientists to assess the state of amphibian populations worldwide. Their report (2004) came to the bleak conclusion that 32.5% of amphibian species were threatened with extinction, compared with 12% of birds and 23% of mammals.

The usual reasons for species declines are related to anthropogenic (human caused) changes to their environment, especially loss or change to key features of their habitats, or increasing levels of damaging pollutants. However, it was not obvious why amphibians should be worse affected than mammals and birds. Some amphibian families are worse affected than others and some habitats, especially tropical flowing streams and mountains are especially at risk.

- **Competition from invasive species:** Species introduced to new places can increase in numbers rapidly because the predators and diseases that limit them in their natural homes are lacking. Increases in the numbers of these 'alien' species may threaten 'natives'.
- **Exploitation:** Humans have few uses for amphibians. Frogs' legs are eaten as a delicacy, especially in France, the USA and south-east Asian countries. The number of frogs used sounds a lot: 100 million annually imported into Europe. But this trade is probably sustainable, considering the high reproductive potential of frogs especially in the wet tropics where they are harvested. Another use is as 'pets': kept in home aquaria, especially colourful exotic species. This is unlikely to be a cause of population declines because the numbers taken from the wild are relatively small: the amphibian pet trade largely involves animals bred in captivity. However, exploitation can be major threat in a few specific cases.
- **Pollution:** Living both on land and in water and having thin absorbent skins, amphibians may be particularly susceptible to chemical pollution. However, in natural habitats like ponds, the effects of pollutants are complicated. Investigations of the effects of insecticides in water on amphibians have shown that toad tadpoles survived better, because the insecticides killed off their newt predators; water snail numbers increased, exposing amphibians to higher numbers of the parasites that grow in snails and move on to the amphibians; amphibian immune systems were suppressed, making them more susceptible to diseases.
- **UV-B:** Short wavelength ultraviolet light (UV-B) damages DNA and in many parts of the world, there have been increases in the levels reaching the Earth's surface as a result of anthropogenic damage to the atmosphere's

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ozone layer. Since amphibian eggs are often laid at the surface of water where they are exposed to UV-B, ozone layer damage could be a cause of amphibian declines. However, study of amphibian eggs showed that they produce an enzyme, photolyase, that repairs UV-B induced damage and that eggs laid close to the surface contain more of the enzyme than those laid deeper, where UV-B exposure is less.

- **Disease:** With their thin moist skins, amphibians could be particularly susceptible to attack by disease organisms such as bacteria, viruses and fungi. However, amphibians have survived for many millions of years and could not have achieved this without systems for combating diseases but, just like humans, amphibians can be susceptible to disease epidemics, especially when new forms of disease organisms arise. Amphibians are attacked by a range of viruses (ranaviruses) which have been responsible for outbreaks of mass mortality. The disease that most concerns herpetologists is chytridiomycosis caused by the fungal pathogen *Batrachochytrium dendrobatidis*. It attacks adult amphibian skin and is often fatal. Chytrid disease seems to be relatively new: museum specimens show infected skin from the 1960s, but not before.
- **Habitat loss and change:** Anthropogenic alteration of landscape is not necessarily harmful to amphibians. In the UK, replacement of primeval forest with a patchwork of small farms, each with its pond, probably resulted in increased amphibian populations. Some amphibians have very specific habitat needs, but others are generalists and they adapt well to the presence of people. But, in altering landscape, we need to think about amphibian habitat needs. Most need a breeding pond, but they also need foraging habitat, rich in insects and other invertebrates: if the breeding pond is lost over time, or separated from the foraging habitat by a busy road, this can be disastrous for amphibians.
- **Interactions:** Although some herpetologists think that chytrid disease explains why amphibian declines are worse than for other terrestrial vertebrates, others argue that the explanation is more subtle: chytrid has devastating effects because of other factors. For example, if pollutants such as insecticides suppress amphibian immune systems, amphibians succumb more easily to diseases such as chytrid. Another factor is climate change.

Solving the crisis

What can be done? First, we need more research. In the study that indicated 32.5% of species were threatened, many species were not rated, because there was too little information on their status. This remains true today, especially for the thousand

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or so species added since the assessment was made. So we need data on the population status of many species. Second, more attention needs to be given to amphibian conservation: identifying habitat needs, reducing threats and providing suitable habitat. Some herpetologists believe that the crisis is so acute that we need an 'Amphibian Ark', where the most threatened species can be maintained in captivity for eventual release back to the wild, once conditions improve.

Unfortunately, it's not just amphibians facing these numerous threats. Chair of Trustees Linda Wenlock adds why reptiles are also facing their own extinction crisis.

What about snakes and lizards? By Linda Wenlock

Reptile diversity

Reptiles developed during the Mesozoic period, like all animals that developed in that era, needed new body types to survive and developed thick leathery skin on both their bodies and their eggs, to adapt to the extreme temperature and warm dryer conditions. The reptiles thrived and dominated the landscape in both size and numbers. During this period reptiles were the most numerous vertebrate animals on the earth. Since those times the 17 recognised groups of that era have now reduced to just 4. The four major groups (known as "orders") are as follows:

1. Crocodylia
2. Sphenodontia
3. Squamata
4. Testudines

Reptile declines

Reptiles are declining on a global scale. Specific threats to reptiles can be listed as follows:

- **Competition from invasive species:** Species released into the wild are normally unwanted pets, they may vie for food for a while, but in the UK do not normally survive for long.
- **Exploitation:** The demand for exotic pets is driving the illegal harvest and trade in reptiles from various places across the world. Reptiles are also harvested for their skin – shoes, handbags, wallets. Skins can be sold for high prices
- **Persecution:** In the UK, Adders are sometimes considered as 'dangerous' by the ill-informed, and persecution has been known to occur in some areas in the form of torching various areas of habit to safeguard people and pets. In

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the early 1900's they were killed and hung from the tail on a stick, in belief that if the head and tail met the adder would become alive again.

- **Pollution:** Reptiles are affected by light pollution, Introduced light sources during normally dark periods can disrupt levels of melatonin production. The introduction of chemical pollutants can reduce habitat quality for reptiles. Synthetic and metallic compounds can adversely affect reptiles, chemical pollutants can reduce their ability to catch food and reproduce successfully.
- **Habitat loss and change:** As human use of the environment expands it causes the natural habitats of the various species to become fragmented, basically the habitat becomes islands. This not necessarily harmful as long as the area can sustain the numbers of reptiles and other species involved, and measures are taken when fragmenting these areas to include foraging habitat which is rich in insects and small mammals. Fragmentation of habitats is a particular threat to Adders, for example, with populations becoming isolated and losing genetic diversity.

Solving the crisis

Reptiles are not the most popular species with many of the population, they fear them, and do not understand what use they have. A greater understanding of their needs and knowledge of the species need to be portrayed. Publicity for them is usually adverse publicity – 'Adder bites child', 'Adder bites dog' - it is not portrayed as a defence mechanism for the species; they do not attack, they are protecting themselves. Like amphibians, there is also a need for further research to widen our knowledge about reptiles and what can effectively be done to halt their declines.

For the UK's reptiles, something as simple as making sure gardens still have their own compost heaps would make a difference - nowadays local authorities provide bins and take away the rudiments that would make a 'habitat' for Grass Snakes and Slow-Worms to both feed and breed in.

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