



## Amphibian Chytridiomycosis

### Agent

Amphibian chytridiomycosis is caused by infection with either *Batrachochytrium dendrobatidis* (Bd) or *Batrachocythrium salamandrivorans* (Bs); both non-hyphal, zoosporic chytrid fungi. They are the only chytrid fungi known to affect vertebrate animals; damaging the skin of metamorphosed amphibians. Bd can also infect the mouthparts of frog and toad tadpoles. Bd has been implicated in amphibian mass die-offs and species extinctions since its discovery in the mid-1990s. In 2013, Bs was discovered; causing death in wild and captive-bred Dutch fire salamander (*Salamandra salamandra*) populations.

### Species affected

#### Bd

All species of amphibian are susceptible to infection with Bd, but it doesn't always cause disease in all amphibians it infects. Toads in the Bufonidae family appear to be more susceptible to chytridiomycosis than ranid frogs and newts. In Great Britain (GB), therefore, the disease is most likely to affect the common toad (*Bufo bufo*) and the natterjack toad (*Epidalea (Bufo) calamita*).

#### Bs

Bs infection has been reported in free-living fire salamanders (*Salamandra salamandra*), alpine newts (*Ichthyosaura alpestris*) and smooth newts (*Lissotriton vulgaris*) in the Netherlands, Belgium and Germany, at sites where deaths and population declines have been recorded. It has recently been found in new locations and in populations where changes in numbers have not yet been detected.

Bs infection has also been found in captive salamanders and newts in Europe, including GB, however screening worldwide is not yet routine so the true distribution of Bs amongst wild and captive amphibians is currently unknown.

Unlike Bd, which appears to be able to infect virtually any amphibian, including frogs, toads, newts, salamanders and caecilians, Bs is known only to infect newts and salamanders.

### Clinical signs

#### Bd

Incidents of amphibian chytridiomycosis can vary from numerous dead amphibians visible in, and surrounding, water bodies to isolated deaths of amphibians either in or away from water. These latter cases are rarely found.

Affected adult amphibians may have reddening of the skin, excessive shedding of skin, skin ulceration (especially at the tips of the toes), abnormal posture, apparent "seizures" or unusual behaviours such as nocturnal species being active during the day. In most cases, however, there are no visible signs of disease and "apparently healthy" animals are found dead.

In tadpoles, the fungus only infects the mouthparts. Often this causes no visible signs of disease, but in severe cases it can stunt the growth of the larvae, prolong the time to metamorphosis or cause death. Mass mortalities of tadpoles, however, are not seen with Bd infection.

In national surveys, we detected Bd infection in amphibians in many sites across Great Britain, but the extent of disease and its impacts on amphibian populations in Great Britain remain unknown.

## Bs

Bs is now thought to have caused a 99.9% decline of some fire salamander populations in the Netherlands. In adult fire salamanders the infection causes deep and superficial skin ulceration, listlessness and incoordination. Bs has now been detected in the wild in mainland Europe outside of Belgium and the Netherlands. As far as we are aware, Bs does not yet infect wild amphibians in the UK.

## Disease transmission

The way the disease is transmitted from one animal to another in the wild is not fully understood. The fungal spores, called “zoospores”, are motile (i.e. swim) in water, including within moisture in plants and soil, and it is likely that animals become infected by sharing a pond or other moist areas with infected animals. Direct contact between uninfected and infected amphibians is another likely method of disease transmission which can happen, for example, when amphibians gather together in damp refugia (hiding places).

It is not yet clear how long the fungi can survive in the environment. Some studies suggest that it can't survive very long at all, whilst others suggest that Bd might be able to survive in water or damp soil for several weeks.

It has been suggested that Bd might be spread in contaminated material on people's boots and equipment, and by birds, livestock and invertebrates moving between water sources. The international trade in amphibians is frequently implicated in the spread of Bd and Bs.

In addition to motile spores, Bs (unlike Bd) produces non-motile, encysted spores that can remain infective for prolonged periods of time and are resistant to adverse environmental conditions. These encysted spores float on the surface of water-bodies and are capable of quickly adhering to the skin of amphibians, the feet of waterfowl or other material they come into contact with, thus promoting the spread of the fungus over large distances.

## Distribution

### Bd

Since it was first discovered in the mid-1990s, Bd has been found in wild and captive amphibians in every continent in the world other than Antarctica (where there are no amphibians!).

In Great Britain, Bd was first detected in 2005 at a site in the south east of England, since when a survey of sites across the country detected infection in multiple ponds across Great Britain.

### Bs

Bs was first isolated in fire salamanders in the Netherlands, from captive animals and a single wild site. In Europe, it has since been detected in wild amphibians in the Netherlands, Belgium and Germany. Retrospective study has shown that Bs was present at the wild Dutch site since at least 2010.

There is evidence to suggest that Bs is endemic amongst salamanders in Vietnam, and these populations may therefore act as reservoirs of infection.

Bs has been detected in captive salamanders in GB but surveillance to date has found no evidence of Bs in wild amphibians in the UK.

## Risk to human health

Neither chytrid fungus infects mammals, so there is no known risk to human health.

## Risk to domestic animal health

No known risk to domestic animal health other than pet amphibians.

## Diagnosis

While there are several reported features of Bd and Bs infection, none of them are specific on their own and in most cases affected animals exhibit no visible signs of disease. The diagnosis of amphibian chytridiomycosis, therefore, can only be made by post-mortem examination followed by specialist laboratory testing.

If you wish to report finding a dead amphibian, or signs of disease in amphibians, please visit [www.gardenwildlifehealth.org](http://www.gardenwildlifehealth.org). Alternatively, if you have further queries or have no internet access, please call the **Garden Wildlife Health** vets on **0207 449 6685**.

## Prevention and control

Whilst amphibian chytridiomycosis may be treated in captivity, treatment in the wild on a large scale is not currently feasible long-term. This is because the treatment, which is toxic to the environment, cannot easily be adequately targeted to diseased animals in a field setting. Even if this is possible, reinfection from non-target amphibians or from the environment occurs.

It is important that the spread of the disease to new areas or ponds is prevented as much as possible. This includes minimising the movement of potentially-infected material (spawn, tadpoles, amphibians, water or water plants) between ponds, and by cleaning and disinfecting boots and equipment that might be used in different ponds or other water bodies.

Bs has been identified in captive salamanders and newts in Great Britain but has not yet been detected in wild amphibians. Strict biosecurity should be practised by owners of captive amphibians adopting sensible precautions to safeguard the health of captive and wild amphibians, including:

- Avoid release of non-native amphibians
- Do not release amphibians anywhere except at the place of capture
- Avoid keeping captive amphibians in enclosures with outdoor access where they may come into contact with wild amphibians
- Disinfect waste water and substrate before disposal
- Treat dead or sick amphibians as a high infection risk and do not handle unless necessary

Additionally, international travellers who are likely to visit habitats used by native British amphibians should take care to remove clean organic material from their clothes and luggage before re-entering the country and, once cleaned, to disinfect their footwear and any equipment (e.g. fishing rods and lines) that might be used in amphibian sites.

At present, all amphibian carcasses submitted for post-mortem examination to Garden Wildlife Health are routinely tested for Bd and Bs as part of our ongoing surveillance for these pathogens.

## Further information

ARG UK (2017). ARG UK Advice Note 4: Amphibian Disease Precautions: A Guide for UK Fieldworkers. Amphibian and Reptile Groups of the United Kingdom.

<https://www.arc-trust.org/amphibian-disease-precautions>

Garden Wildlife Health (2015). Amphibian disease alert.

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