



## Amphibian Chytridiomycosis

### Agent

Amphibian chytridiomycosis is caused by infection with one of two species of chytrid fungi: *Batrachochytrium dendrobatidis* (Bd) or *Batrachochytrium salamandrivorans* (Bsal). Chytridiomycosis affects the skin of metamorphosed (adult) amphibians and, in the case of Bd, can also affect the keratinised mouthparts of amphibian larvae that have these, such as common frog and toad tadpoles. Since its discovery in the mid-1990s, Bd has been implicated in the decline of around 500 species of amphibian around the world and the extinction of at least 90 species. Bsal was discovered as recently as 2013 and has been associated with illness, mortality and population declines in salamander and newt populations in mainland Europe.

### Species affected

#### Bd

All types of amphibian (frogs, toads, newts, salamanders and caecilians) are susceptible to infection with Bd, but it doesn't always cause disease in the animals it infects. Toads in the *Bufo* 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*).

#### Bsal

Unlike Bd, which appears to be able to infect and cause disease in virtually any type of amphibian, Bsal is only known to cause disease in newts and salamanders, although some frogs and toads seem to be able to carry the fungus without getting sick.

Bsal infection has so far been reported in free-living newt and salamander populations in the Netherlands, Germany, Belgium and Spain, as well as in its presumed native range of East Asia. The Bsal fungus was originally identified in a fire salamander (*Salamandra salamandra*) population in the Netherlands, which has now declined by 99.9% due to chytridiomycosis. Other species which have been found to be infected in the wild include alpine newts (*Ichthyosaura alpestris*), smooth newts (*Lissotriton vulgaris*) and palmate newts (*Lissotriton helveticus*).

Bsal infection has also been found in captive amphibian collections in several countries in Europe, including Great Britain. Screening worldwide is not yet routine so the true distribution of Bsal amongst wild and captive amphibians is currently unknown. All three species of native British newt are known to be susceptible to infection with Bsal and at least one, the great-crested newt (*Triturus cristatus*), can die from the disease.

### Clinical signs

#### Bd

Incidents of amphibian chytridiomycosis can vary in appearance, from a single dead individual to hundreds of dead amphibians.

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 seen during the day. In many 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 even cause death. Mass mortalities of tadpoles, however, are not seen with Bd infection.

In national surveys conducted in 2008 and 2011, we detected Bd infection in amphibians at many sites across Great Britain, but the extent of disease and its impacts on amphibian populations in Great Britain remain unknown.

## Bsal

Bsal is only known to cause disease in metamorphosed newts and salamanders. Affected animals may have multiple erosive or ulcerative skin lesions (i.e. skin sores or ulcers), which can occur anywhere on the body. Sick newts or salamanders may also stop eating, have difficulty shedding their skin or move with an irregular, wobbly gait. Affected amphibians, however, may only appear to be thin and can even be found dead with no obvious outward signs of disease.

## 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 and within moisture on plants and in soil, so it is likely that animals become infected by sharing a pond or other damp areas with infected animals. Direct contact between amphibians is another likely mode of disease transmission which can happen, for example, when amphibians gather in damp refugia (hiding places).

It is not yet clear how long these chytrid fungi can survive in the environment, and it likely depends on a wide range of factors such as temperature. It has been suggested that Bd and Bsal might be spread via contaminated material on people’s boots and equipment, and possibly also by birds, livestock and invertebrates moving between water sources. The international trade in amphibians is strongly implicated in the spread of chytrid fungi.

In addition to motile spores, Bsal (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 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. It is unclear how long these encysted spores remain infectious; however, laboratory experiments suggest it may be at least a month.

## Distribution

### Bd

Since it was first discovered in the mid-1990s, Bd has been found in wild and captive amphibians on every continent where amphibians exist. It is thought that the most virulent strains of Bd emerged from South-East Asia and spread across the planet as a result of the global amphibian trade.

In Great Britain, Bd was first detected in 2004 at a site in the south east of England and has since been detected at numerous other sites across the country.

### Bsal

Bsal was first reported in a population of fire salamanders (*Salamandra salamandra*) in the Netherlands, where it is thought to have arrived no later than 2010. In Europe, it has since been detected in wild amphibians in Belgium, Germany and Spain. Bsal appears to be endemic (i.e. present at low levels) amongst wild salamanders in Vietnam, Japan, Thailand and China. This, along with the knowledge that East Asian amphibians are resistant to disease caused by Bsal, suggests that the pathogen originates from East Asia.

Current evidence indicates that Bsal has not yet entered free-living amphibian populations in Great Britain. We analysed around 2000 skin swabs taken from newts during a nationwide survey in 2011 and all samples tested negative for Bsal, suggesting that the fungus had not reached wild newt populations before 2011. Since 2013, all amphibians submitted to GWH for post-mortem examination have also tested negative. Bsal has, however, been detected in captive amphibians in Great Britain, making it vitally important to do all we can to prevent the transmission of Bsal

from captive to wild amphibians. Please see our [Amphibian Disease Alert](#) for more information on how to protect our native amphibians from Bsal and other amphibian pathogens.

## 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 Bsal 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 using antifungal medication, treatment in the wild on a large scale is not currently a feasible long-term solution. 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 chytrid fungi 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.

Bsal has been identified in captive amphibian collections in Great Britain but has not yet been detected in wild amphibians. Strict biosecurity measures should be followed by captive amphibian keepers to safeguard the health of captive and wild amphibians. Some of these measures are listed below and the full list can be found in our [Amphibian Disease Alert](#):

- Never transfer wild amphibians between sites or from captivity into the wild \*
- Manage all amphibians as if they are infected.
- Quarantine and screen new arrivals for chytrid infection.
- Know the health status of your collection.
- Avoid keeping amphibians in outdoor enclosures.
- Do not clean tanks or vivaria outside.
- Dispose of dead animals by incineration or deep burial to prohibit scavenging.
- Disinfect all wastewater and used substrate from amphibian enclosures (see our 'Disposal of wastewater' guide).

\* The only exceptions to this are translocations which are conducted for development mitigation or conservation breeding initiatives and are subject to disease risk analysis and management.

Additionally, international travellers who are likely to visit habitats used by native British amphibians should take care to remove 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 Bsal as part of our ongoing surveillance for these pathogens.

## Further information

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## Scientific publications

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