

Amphibian chytridiomycosis



Wetlands
inhabited by
amphibians

Wildlife ✓

Livestock ✗

Human ✗



Synonyms: Chytrid, chytrid fungus, chytrid disease, B.d, *Batrachochytrium dendrobatidis*

KEY FACTS

What is amphibian chytridiomycosis?

A disease of amphibians caused by the fungus *Batrachochytrium dendrobatidis*. The fungus affects the keratinised tissues of amphibians *i.e.* the skin of adult amphibians and the mouthparts of tadpoles of most species of anuran amphibians (frogs and toads). The disease has become a major cause of amphibian mortality and morbidity worldwide over the last decade, leading to catastrophic declines in populations in North America, South America, Central America, Europe, Australia and the Caribbean. The disease does not affect livestock or humans, their only role being as carriers of the fungus on *e.g.* feet, equipment or clothing.

Causal agent

The fungus *B. dendrobatidis*.

Species affected

Most species of amphibian, although its severity can range from no clinical signs to acute mortality, depending on the amphibian species, the infectious dose, the strain of fungus and the environmental conditions. The disease has been described in a wide variety of anurans (frogs and toads) and caudates (salamanders and newts), but not yet in caecilians.

Geographic distribution

The disease occurs in every continent where there are amphibians *i.e.* all continents except Antarctica.

Environment

Any environment inhabited by amphibians. This disease has occurred at varying altitudes and degrees of humidity in areas of standing water. It affects aquatic, terrestrial and arboreal amphibians. It has also occurred in more arid areas inhabited by salamanders *e.g.* in Europe.

TRANSMISSION AND SPREAD

Vector(s)

Although the fungus is not vector-borne, it may be spread mechanically by movement of infected amphibians, contaminated water or mud, or *via* fomites (inanimate objects such as footwear, nets and other equipment).

How is the disease transmitted to animals?

The fungus has two life stages, an intra-cellular sporangium and a free-swimming zoospore. Zoospores are released from the skin (or mouthparts) of an infected animal and move through the water, or remain in a damp environment, until they come into contact with another (or the same) amphibian, which they then infect.

How does the disease spread between groups of animals?

Movement of amphibians or spread of contaminated material (including water, mud or fomites) between groups.

How is the disease transmitted to humans?

The disease is not transmitted to humans.

IDENTIFICATION AND RESPONSE

Field signs

Field signs can vary: there may be numerous dead amphibians visible in and surrounding water bodies, or no dead amphibians visible (especially in areas where they are swiftly scavenged). The causative fungus has different impacts in different amphibian species (e.g. infected American bullfrogs *Lithobates catesbeianus* have been shown to not display clinical signs in most cases), therefore, an absence of diseased/dead amphibians does not mean that a population is uninfected. Some of the most common signs in individuals are reddened or otherwise discoloured skin, excessive shedding of skin, abnormal postures, such as a preference for keeping the skin of the belly away from the ground, unnatural behaviours such as a nocturnal species that suddenly becomes active during the day, or seizures. Many of these signs are said to be “non-specific” and many different amphibian diseases have signs similar to those of chytridiomycosis.

Recommended action if suspected

Contact and seek assistance from appropriate animal health professionals. *B. dendrobatidis* infection is a notifiable disease and suspected cases must be reported to local and national authorities and the OIE.

Diagnosis

Diagnosis is carried out by taking samples using swabs: swabbing the skin of the back legs, drink patch (i.e. ventral pelvic skin) and tail (in caudates) of adults and of the mouthparts of larvae in live amphibians. These are then analysed for the presence of *B. dendrobatidis* using real-time PCR. The skin of dead amphibians can be similarly swabbed and freshly-dead specimens can be submitted for *post mortem* examination, including histology, in specialist laboratories.

Before collecting or sending any samples from animals with a suspected disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorised or suitably qualified laboratories to prevent the spread of the disease. Although the fungus that causes amphibian chytridiomycosis is not known to be zoonotic, routine hygiene precautions are recommended when handling animals. Also, suitable precautions must be taken to avoid cross-contamination of samples or cross-infection of animals.



(Left) Trapping newts for chytrid fungus surveillance: high standards of biosecurity must be observed, e.g. using site-specific equipment and thoroughly disinfecting and drying all equipment after use. (Right) Swabbing the drink patch (ventral pelvic skin) of a smooth newt *Lissotriton vulgaris* for chytrid surveillance. Note the use of clean gloves when handling each animal to reduce the chances of transfer of infection (WWT).

PREVENTION AND CONTROL IN WETLANDS

Environment Ensure that the site is regularly scanned for dead amphibians or signs of non-native species. If either are found, they should be sampled for *B. dendrobatidis* infection. Ideally, population monitoring and *B. dendrobatidis* infection surveillance should be conducted at any site containing a reasonable population of amphibians, especially if endangered species are present.

Livestock The disease does not affect livestock, however, ensure that livestock moving between sites (especially those travelling from known infected sites) do not mechanically spread infection by carrying infected material on their feet or coats. Ensure that feet are clean and dry before transport. Use foot baths and leave animals in a dry area after the bath for their feet to fully dry before transport.

Wildlife Do not allow the introduction of non-native amphibian species to the site. Ideally avoid amphibian re-introductions unless as part of well managed re-introduction programmes with rigorous biosecurity and infection screening protocols.

Adopt a biosecure approach to managing your wetland:

► **Section 3.2.4. Biosecurity**

People coming into contact with water or amphibians should ensure where possible that their equipment and footwear/clothing has been cleaned and fully dried before use if it has previously been used at another site.

To properly clean footwear and equipment:

- First use a brush to clean off organic material *e.g.* mud and grass.
- Rinse with clean water.
- Soak in fungicidal disinfectant for one minute.
- Rinse with clean water and allow to dry. Drying thoroughly is important and will act to kill any chytrid present.

If any clothing is particularly soiled during activities, then wash it at 40°C with detergent to remove any contamination with chytrid.

Ideally use different sets of footwear for different sites.

► **Case study 3-4. Managing chytridiomycosis in wetlands (Section 3.2.4)**

Humans The disease is not transmitted to humans.

IMPORTANCE

Effect on wildlife Only amphibians are affected. Significance varies greatly from no obvious signs to extremely severe effects leading to extinction of affected populations or species. This is the most important disease for amphibians.

Effect on livestock None

Effect on humans None

Economic importance Of economic importance due to its impact on the commercial amphibian trade, particularly the pet and scientific trades, and on the harvesting of wild amphibians for the food trade in some areas. The likely declines and extinctions of multiple species will have long-term ecological impacts and as yet unknown economic ramifications.

FURTHER INFORMATION

Useful publications and websites

- ☐ Woodhams, D.C., Bosch, J., Briggs, C.J., Cashins, S., Davis, L.R., Lauer, A., Muths, E., Puschendorf, R., Schmidt, B.R., Sheafor, B. & Voyles, J. (2011). **Mitigating amphibian disease: strategies to maintain wild populations and control chytridiomycosis.** *Frontiers in Zoology*, 8, 8. www.frontiersinzoology.com/content/pdf/1742-9994-8-8.pdf [Accessed March 2012].
- ☐ World Organisation for Animal Health (OIE). **Disease information card – infection with *Batrachochytrium dendrobatidis*.** http://www.oie.int/fileadmin/Home/eng/International_Standard_Setting/docs/pdf/Chytridio_card-final.pdf [Accessed March 2012].
- ☐ Amphibian and Reptile Groups of the UK. **Amphibian disease precautions: a guide for UK fieldworkers.** ARG-UK advice note 4. Version 1, Feb 2008. <http://static.zsl.org/files/biosecurity-arguk4-511.PDF> [Accessed March 2012].
- ☐ IUCN/SSC Conservation Breeding Specialist Group (CBSG), Apple Valley, MN. **A manual for control of infectious diseases in amphibian survival assurance colonies and reintroduction programs.** Pessier, A.P. & Mendelson, J.R. (eds.) (2010). http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf [Accessed March 2012].
- ☞ Amphibian Ark. **Chytrid fungus.** www.amphibianark.org/the-crisis/chytrid-fungus/ [Accessed March 2012].
- ☞ Zoological Society of London. **The 2011 UK chytrid survey.** www.zsl.org/conservation/regions/uk-europe/ukchytridiomycosis,842,AR.html [Accessed March 2012].
- ☞ James Cook University, Australia. **Summary of formidable infectious diseases of amphibians.** www.jcu.edu.au/school/phtm/PHTM/frogs/formidable.htm [Accessed March 2012].
- ☞ James Cook University, Australia. **Amphibian diseases homepage.** www.jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm [Accessed March 2012].
- ☞ Amphibiaweb. **An overview of chytridiomycosis.** amphibiaweb.org/chytrid/chytridiomycosis.html [Accessed March 2012].
- ☞ European Association of Zoos and Aquaria. **EAZWV transmissible disease fact sheet No. 130.** [http://www.eaza.net/activities/tdfactsheets/130%20Chytridiomycosis%20\(Amphibi an\).doc.pdf](http://www.eaza.net/activities/tdfactsheets/130%20Chytridiomycosis%20(Amphibi an).doc.pdf) [Accessed March 2012].

Contacts

✉ Diagnostic laboratories (contact before sample submission).

- **Histology:** any specialised laboratories
- **qPCR:** Institute of Zoology: Zoological Society of London, Regent's Park, London NW1 4RY, UK. matthew.perkins@ioz.ac.uk
- **PCR:** Exomed, Erich-Kurz-Str. 7, 10319 Berlin, Germany. mutschmann@exomed.de
- **PCR:** Tobias Eisenberg, Landesbetrieb Hessisches Landeslabor, Schubert Str. 60 - Haus 13, 35392, Giessen, Germany.
- **Pisces Molecular,** 2200 Central Avenue, Suite F, Boulder, CO 80301, USA. jwood@pisces-molecular.com.
- **School of Biological Sciences, Center for Integrated Biotechnology,** Washington State University, Pullman, WA 99164-4236, USA. astorfer@wsu.edu.
- **Wildlife Disease Laboratories, Institute for Conservation Research** San Diego Zoo. apessier@sandiegozoo.org
- **Center for Wildlife Disease, University of South Dakota, Biology Department,** 414 E. Clark Street, Vermillion, SD 57069, USA. Jacob.Kerby@usd.edu