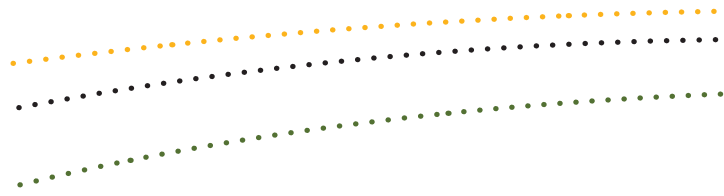




Australian Government

Department of Sustainability, Environment,  
Water, Population and Communities



# CHYTRIDIOMYCOSIS (AMPHIBIAN CHYTRID FUNGUS DISEASE)

Chytridiomycosis is an infectious disease that affects amphibians worldwide. It is caused by the chytrid fungus (*Batrachochytrium dendrobatidis*), a fungus capable of causing sporadic deaths in some amphibian populations and 100 per cent mortality in others. The disease has been implicated in the mass die-offs and species extinctions of frogs since the 1990s. However, its origin and true impact on frog populations remains uncertain and continues to be investigated.

## History

First discovered in dead and dying frogs in Queensland in 1993, chytridiomycosis is a highly infectious disease of amphibians, caused by the amphibian chytrid fungus *Batrachochytrium dendrobatidis* (*B. dendrobatidis*). Research since then has shown that the fungus is widespread across Australia and has been present in the country since the 1970s. The disease is also found in Africa, the Americas, Europe, New Zealand and Asia.

Chytridiomycosis has been found in all Australian states and in the Australian Capital Territory, but not in the Northern Territory. Currently, it appears to be confined to the relatively cool and wet areas of Australia, such as along the Great Dividing Range and adjacent coastal areas in

the eastern mainland states of Queensland, New South Wales, Victoria, eastern and central Tasmania, southern South Australia, and south-western Western Australia.

Only very few areas of suitable host environment remain uninfected in Australia—including the World Heritage Area in south-west Tasmania and the Iron Range on Cape York. There are also some pockets of disease-free areas existing within infected regions due to the isolated nature of these amphibian populations.

Chytridiomycosis/*B. dendrobatidis* is listed as a notifiable disease in Australia's National List of Reportable Diseases of Aquatic Animals and by the World Organisation for Animal Health (OIE, formerly Office International des Epizooties) in the Aquatic Animal Health Code.



Fletcher's frog *Lechriodus fletcheri*, which occurs throughout New South Wales and eastern Queensland, has been recorded as being infected with chytrid fungus (H B Hines).

## Ecology

Chytrid fungi typically live in water or soil, although some are parasites of plants and insects. They reproduce asexually and have spores that 'swim' through the water. Only the amphibian chytrid fungus is known to infect vertebrate species. Individual frogs are thought to contract the disease when their skin comes into contact with water containing spores from infected animals.

Chytridiomycosis mostly affects amphibian species associated with permanent water, such as streams, moist bogs or soaks and ponds. The disease is strongly mitigated by high temperatures and disease outbreaks have been observed to occur seasonally. However, much is still unknown about the fungus and the disease in the wild, including reasons for the death of hosts, how the fungus survives in the absence of amphibian populations and how it spreads. Interactions between the fungus and environmental factors are known to be important. For example, Australian upland frog populations have suffered the greatest number of declines and extinctions, leading to the suggestion that environmental stress, perhaps from climate change or increased exposure to ultraviolet radiation, may be reducing resistance to infection.

## Impact

The fungus invades the surface layers of the frog's skin, causing damage to the outer keratin layer. Amphibian skin is unique because it is physiologically active, allowing the skin to tightly regulate respiration, water, and electrolytes. It is not yet known exactly how the fungus kills amphibians but it is thought that it may cause mortality through disrupting the normal function of the skin resulting in electrolyte depletion and osmotic imbalance.



The small ground-dwelling Southern corroboree frog *Pseudophryne corroboree* is on the brink of extinction. This species has been severely impacted by the spread of the deadly chytrid fungus and is listed as critically endangered under the EPBC Act (Steve Wilson).



Symptoms of the terminal stages of chytridiomycosis include the half-closed eyes and generally depressed attitude seen in this frog, and an accumulation of cast-off skin (the greyish crescent shape near the top rear end of the frog) (Lee Berger).

In some frog populations, the disease causes 100 per cent mortality, while only causing some deaths in other populations. Some amphibian species are highly susceptible and die quickly whilst others seem to be less susceptible. With antifungal and supportive treatment adult frogs and tadpoles can fully recover from the disease.

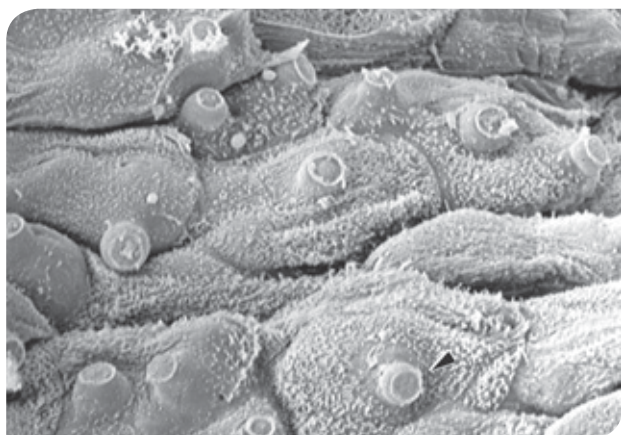
In Australia, the fungus has been directly implicated in the extinction of at least four species and the dramatic decline of at least 10 others, including *Litoria nannotis* (waterfall frog), *Litoria rheocola* (common mistfrog), *Litoria spenceri* (spotted tree frog) and *Nycitmystes dayi* (lace-eyed tree frog). The four species listed as extinct are from Queensland and include *Rheobatrachus silus* (southern gastric-brooding frog, last seen 1981), *Rheobatrachus vitellinus* (northern gastric-brooding frog, 1985), *Taudactylus acutirostris* (sharp-snouted day frog, 1997) and *Taudactylus diurnus* (southern day frog, 1979). Many persisting species remain at lower abundance and smaller distributions than the levels recorded before the species were affected by chytridiomycosis, some are continuing to decline and significant mortality from the disease is ongoing even decades after introduction.

## Control

There are no proven methods to control the disease in the wild to date. For amphibian species currently listed as endangered, emergency measures are needed to increase population sizes via reintroductions, translocation and the establishment of captive disease-free assurance colonies. Since *B. dendrobatidis* is now widely distributed in Australia, control efforts should be aimed at protecting uninfected areas. As strains vary in virulence, reducing the risk of spread between infected areas is also important. Developing a greater understanding of how the impact of chytridiomycosis in infected wild populations can be better mitigated would help in controlling the threat of the disease.

Monitoring and surveillance is necessary to:

- monitor the impact of the disease on frog populations
- detect new outbreaks in currently uninfected populations or locations of unknown disease status
- establish restricted and control areas to which quarantine and movement restrictions are applied
- establish infected and non-infected areas/zones
- monitor the progress and success of a control strategy.



The surface of the epithelium (outer layer of skin) of a frog with chytridiomycosis shows discharge tubes of spores of the fungus *Batrachochytrium dendrobatidis* emerging from the surface (Lee Berger).

## Research

Further knowledge is needed to effectively mitigate the impacts of chytridiomycosis on wild amphibian populations and, therefore, research into the characteristics of the virus is continuing. Some of the priority areas requiring further research include assisted selection for innate immunity, control of reservoir species, habitat modification and bio-augmentation.

### How the Australian Government is dealing with a national problem

Infection of amphibians with chytrid fungus resulting in chytridiomycosis is listed as a key threatening process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Under the EPBC Act, the Australian Government, in consultation with the states and territories, has developed the *Threat Abatement Plan for Infection of Amphibians with Chytrid Fungus Resulting in Chytridiomycosis*, which aims to reduce the impact of chytridiomycosis on native frog species.

The threat abatement plan establishes a framework that will enable the best use of any resources made available for chytridiomycosis management. The Australian Government will continue to work with the states and territories in dealing with this national problem.

The Australian Government has funded many threat abatement projects addressing the impacts of chytrid fungus and information on these projects can be found at:

[www.environment.gov.au/biodiversity/invasive/projects/index.html](http://www.environment.gov.au/biodiversity/invasive/projects/index.html)

More information about the threat abatement plan for chytrid fungus can be found at:

[www.environment.gov.au/biodiversity/threatened/publications/tap/chytrid.html](http://www.environment.gov.au/biodiversity/threatened/publications/tap/chytrid.html)

## Hygiene and handling protocols for the control for chytrid fungus in amphibians

It is important to recognise that humans may contribute to the transmission or spread of the chytrid fungus within and among amphibian populations. For this reason, the Australian Government commissioned leading amphibian experts from James Cook University to develop hygiene and handling protocols for people working with Australian amphibians.

These protocols are intended for use nationally by conservation agencies, zoos, scientific research staff, industry organisations (e.g. the pet industry), wildlife consultants, fauna surveyors, students, frog keepers, wildlife rescue and carer groups, frog interest groups/societies and other key interest groups who regularly deal with or are likely to encounter frogs.

The document, *Hygiene protocols for the control of diseases in Australian frogs*, can be found on the department's website at: [www.environment.gov.au/biodiversity/invasive/publications/pubs/frogs-hygiene-protocols.pdf](http://www.environment.gov.au/biodiversity/invasive/publications/pubs/frogs-hygiene-protocols.pdf)

## Frequently asked questions

### What should I do if I come across an accidentally relocated frog or amphibian?

An accidentally relocated amphibian is an individual (native or introduced species) that has been unintentionally transported from one place to another. This can happen with the transport of landscaping supplies or, more commonly, in boxes of produce such as bananas—hence the commonly used term *banana box frogs*.

DO NOT release any accidentally relocated frogs into the wild. These frogs can be collected by a licensed wildlife carer organisation. For contact details of these organisations in your area, please contact your state environment department or check their website.

### How should I handle a displaced frog if I need to?

All species of frogs should be handled with washed single-use vinyl gloves. If gloves are not readily available, a single-use, lightweight plastic bag will suffice. Cleaning of hands and handling equipment should be carried out with a disinfectant.

### How do I house amphibians temporarily if I need to?

Individuals should be housed in single-use containers, such as plastic bags, for a short time only. Temporary housing items should be disinfected before and after use.

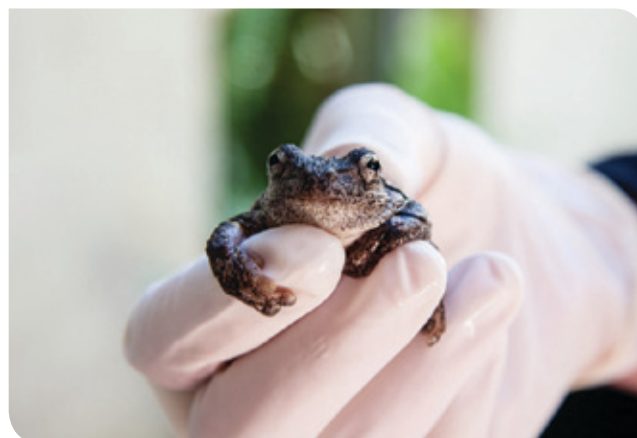
### What should I do if I find dead frogs in the wild?

If you observe mass mortalities of frogs please notify your state environment department.

Dead amphibians or live animals showing clinical signs of chytrid disease should be collected—using gloves—and sent for disease diagnosis. More information on handling sick and dead amphibians is available on the James Cook University website at: [www.jcu.edu.au/school/phtm/PHTM/frogs/pmfrog.htm](http://www.jcu.edu.au/school/phtm/PHTM/frogs/pmfrog.htm)

### How can I help stop the spread of chytrid disease?

You should only purchase amphibians from licensed suppliers who are certified chytrid free. Do not release any pets into the environment under any circumstances. Tadpoles and frogs must not be moved between habitats as this is a major cause of the spread of the deadly chytrid disease.



The hygienic handling of amphibians is important in preventing the spread of the deadly chytrid fungus. This photo shows a Peron's tree frog *Litoria peronii* being handled according to correct hygiene protocols (Peter Treyde).