

*Batrachochytrium dendrobatidis* [简体中文](#)

System: Undefined

[正體中文](#)

Kingdom	Phylum	Class	Order	Family
Fungi	Chytridiomycota	Chytridiomycetes	Chytridiales	

**Common name** chytrid frog fungi (English), Chytrid-Pilz (German), chytridiomycosis (English), frog chytrid fungus (English)

**Synonym**

**Similar species**

**Summary**

*Batrachochytrium dendrobatidis* is a non-hyphal parasitic chytrid fungus that has been associated with population declines in endemic amphibian species in upland montane rain forests in Australia and Panama. It causes cutaneous mycosis (fungal infection of the skin), or more specifically chytridiomycosis, in wild and captive amphibians. First described in 1998, the fungus is the only chytrid known to parasitise vertebrates. *B. dendrobatidis* can remain viable in the environment (especially aquatic environments) for weeks on its own, and may persist in latent infections.



[view this species on IUCN Red List](#)

## Species Description

**Fungal Morphology:** *Batrachochytrium dendrobatidis* is a zoosporic chytrid fungus that causes chytridiomycosis (a fungal infection of the skin) in amphibians and grows solely within keratinised cells. Diagnosis is by identification of characteristic intracellular flask-shaped sporangia (spore containing bodies) and septate thalli. The fungus grows in the superficial keratinised layers of the epidermis (known as the stratum corneum and stratum granulosum). The normal thickness of the stratum corneum is between 2µm to 5µm, but a heavy infection by the chytrid parasite may cause it to thicken to up to 60 µm. The fungus also infects the mouthparts of tadpoles (which are keratinised) but does not infect the epidermis of tadpoles (which lacks keratin). The fungus produces inoperculate, smooth-walled zoosporangia (zoospore containing bodies), which are spherical to subspherical in shape. Each zoosporangium (10µm to 40µm in diameter) produces a single discharge tube, which penetrates (and protrudes out of) the skin. Eventually the plug that blocks the release of immature zoospores is shed and the mature zoospores are released. The zoospores (0.7µm to 6µm in diameter) are elongate to ovoid in shape. Each possesses a single posterior flagellum, rendering it motile in water (Mazzoni *et al.* 2003; Daszak *et al.* 1999; Berger, *et al.* 1998; Berger *et al.* 1998, Berger, Speare and Hyatt, 2000, in Daszak *et al.* 1999; Speare *et al.* 2001; Weldon *et al.* 2003).

To view a scanning electron micrograph of infected skin of a wild frog (*Litoria lesueuri*) please see: [\n\nDaszak \*et al.\* 1999. \*Emerging Infectious Diseases and Amphibian Population Declines.\*\n\n](#)

To view histological sections of infected skin of *Bufo haematiticus* and *Atelopus varius* (showing the sporangia and discharge tubes of the fungus) please see: [Daszak \*et al.\* 1999. \*Emerging Infectious Diseases and Amphibian Population Declines.\*\n\n](#)

To view a histological section of severely infected skin of a wild frog (*Litoria caerulea*) please see: [\n\nBerger \*et al.\* 1998. \*Chytridiomycosis causes amphibian mortality.\*\n\n](#)

\n\nClick here to see information about [Symptoms of the disease caused by \*Batrachochytrium dendrobatidis\*.](#)

**Pathogenesis of chytridiomycosis:** Authors of a recent study, Voyles *et al.* (2009) have found that *B. dendrobatidis*, causes such severe electrolyte imbalances that the frog's heart stops. The skin of amphibians maintain proper osmotic balance inside the animal and regulate respiration. The authors found that the skin of infected frogs was less adept at transporting sodium and chloride ions. Sodium and potassium concentrations in the blood of infected frogs dropped, more so as the infection intensified and the animals' hearts began to beat irregularly and ultimately stopped.

## Notes

Salamanders can act as host reservoirs of chytrid infection in frogs, and vice versa (Davidson *et al.* 2003).

## Lifecycle Stages

*Batrachochytrium dendrobatidis* has two life stages: a spherical reproductive sessile zoosporangium and a motile zoospore. The motile zoospore directs itself and attaches to the keratinised outer layers of its host. It then absorbs its tail and buries itself below the surface of the skin. It matures into a zoosporangia with rhizoids within about four days and produces and releases up to 300 zoospores into the external environment (via a discharge tube). The cycle is initiated again once a suitable substrate (in the same or a different host) is found. The presence of the fungus in the keratinised mouthparts of frog tadpoles (without actually killing them) supports the role of larvae as reservoirs for the pathogen. (The larvae of amphibian species may survive for as long as 3 years before metamorphosing.) Syntopic salamanders and frogs may also act as reciprocal pathogen reservoirs for chytrid infections. It has been suggested that *B. dendrobatidis* may not be an obligate amphibian parasite, possibly living in other non-amphibian hosts or even saprophytically (off dead tissue) (Michigan Frog Survey, 2003; Speare *et al.* 2001; Daszak *et al.* 1999; Davidson *et al.* 2003).

As of yet, no resting structures (either asexual or sexual) have been identified for *B. dendrobatidis*. The fact that sexual reproduction in chytrid fungi has been associated with the production of resistant, thick-walled resting spores has led to the hypothesis that the production of airborne spores explains the widespread distribution of *B. dendrobatidis* in relatively pristine areas. However recent research has found evidence that shows that the population structure of *B. dendrobatidis* is largely clonal, supporting the hypothesis that the fungus lacks a sexual stage (as is the case for many chytrid fungi). This suggests that dispersal by human (or perhaps other long distance travellers, such as birds), rather than natural causes, are more likely to be the cause of the pathogen's entry into pristine areas (Morehouse *et al.* 2003; Berger *et al.* 1999, Daszak *et al.* 1999, in Morehouse *et al.* 2003).

## Habitat Description

Chytridiomycosis has now been reported from 38 amphibian species in 12 families, including ranid and hylid frogs, bufonid toads, and plethodontid salamanders. Although chytridiomycosis is found in a range of species and habitats (including African frogs in lowland regions in Africa) it has caused population declines of amphibians species confined to montane rain forests (Weldon *et al.* 2004; Daszak *et al.* 1999). The fungus prefers lower temperatures which may explain the high prevalence of the fungus in high elevations in the tropics. In culture conditions optimum growth occurred at 23°C, with slower growth occurring at 28°C and (reversible) cessation of growth occurring at 29°C (Longcore, Pessier, Nichols, 1999, in Daszak *et al.* 1999).

## Reproduction

*Batrachochytrium dendrobatidis* is diploid and primarily reproduces asexually (and clonally) by producing aquatic unflagellated zoospores in a zoosporangium (Johnson and Speare, 2003).

## Nutrition

Its occurrence solely in keratinised tissues suggests that it uses amphibian keratin as a nutrient. *Batrachochytrium dendrobatidis* will grow for at least one generation on cleaned epidermal keratin or on amphibians that have died of the infection. The fungus may also be cultured *in vitro* on tryptone agar without the addition of keratin or its derivatives (Daszak *et al.* 1999; Longcore, Pessier and Nichols, 1999, Pessier *et al.* 1999, in Daszak *et al.* 1999).



# GLOBAL INVASIVE SPECIES DATABASE

FULL ACCOUNT FOR: *Batrachochytrium dendrobatidis*

## General Impacts

*Batrachochytrium dendrobatidis* has been found to affect at least 93 amphibian species from the orders Anura (frogs and toads) and Caudata (salamanders) in all the continents except Asia. It is thought to be one of the main causes of the global decline in frog populations since the 1960s, and the dramatic population crashes from the 1970s onwards (Parris and Beaudoin, 2004). The chytrid fungus kills frogs within 10 to 18 days (Michigan Frog Survey, 2003), although it is not known how. It may be physical, affecting respiration by altering the frog's skin, or the fungus may give off a toxin (Michigan Frog Survey, 2003). Tadpoles are not affected, although the fungus may infect the keratinised mouthparts (Berger *et al.* 1999).

For a summary on the impacts of *B. dendrobatidis* please follow this link [impacts](#).

Key findings of the [The Global Amphibian Assessment](#) has revealed that one-third (32%) of the world's amphibian species are threatened, representing 1,896 species. Threats include viral diseases, habitat loss, drought, pollution, and hunting for food. The biggest single threat appears to be *B. dendrobatidis*.

A [search](#) on the database using "diseases" as a keyword in "all" habitat types, biogeographic realm and countries results in a list of 547 species impacted by diseases (IUCN, Conservation International, and NatureServe. 2006).

## Management Info

Preventative measures: Knowledge of the infectiveness and spread of *Batrachochytrium dendrobatidis* is relevant to all control strategies, particularly in the development of preventative measures. The infective unit of the fungus is the zoospore. Infection by the fungus (and thus spread of the disease) requires water because the zoospore does not tolerate dehydration. *B. dendrobatidis* remains viable for up to 3 weeks in tap water, up to 4 weeks in deionised water and even longer in lake water. Infection by an extremely small inoculum (100 zoospores) is sufficient to cause a fatal infection (Berger *et al.* in Speare *et al.* 2001; Johnson and Speare, 2003; Berger, Speare and Hyatt, 2000, in Daszak *et al.* 1999).

Please see [main preventative management strategies](#) for a summary under the following headings: improving diagnostics and knowledge of epidemiology, developing trade and quarantine regulations, raising awareness and control options.

[The Amphibian Conservation Action Plan \(ACAP\)](#) is designed to provide guidance for implementing amphibian conservation and research initiatives at all scales from global down to local. Chapter 4 outlines action steps relating to the detection and control of chytridiomycosis.

**Principal source:** Berger *et al.* 1999. Chytrid fungi and amphibian declines: Overview, Implications and Future Directions.

[Berger \*et al.\* 1998. Chytridiomycosis Causes Amphibian Mortality Associated With Population Declines in the Rain Forests of Australia and Central America.](#)

[Daszak \*et al.\* 1999. Emerging Infectious Diseases and Amphibian Population Declines](#)

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## ALIEN RANGE

[85] AUSTRALIA

[4] COSTA RICA

[2] GERMANY

[1] ITALY

[3] MEXICO

[2] CANADA

[4] ECUADOR

[1] GHANA

[2] KENYA

[5] NEW ZEALAND

[3] PANAMA  
[1] SPAIN  
[14] UNITED STATES  
[1] VENEZUELA

[9] SOUTH AFRICA  
[1] SWAZILAND  
[2] URUGUAY  
[1] WEST AFRICA

**Red List assessed species 512: EX = 8; CR = 196; EN = 126; VU = 63; NT = 29; DD = 36; LC = 54;**

[Adelotus brevis](#) NT  
[Agalychnis moreletii](#) CR  
[Alytes cisternasii](#) NT  
[Aplastodiscus callipygius](#) LC  
[Aromobates alboguttatus](#) EN  
[Aromobates nocturnus](#) CR  
[Atelopus angelito](#) CR  
[Atelopus arthuri](#) CR  
[Atelopus bomolochos](#) CR  
[Atelopus carauta](#) CR  
[Atelopus carrikeri](#) CR  
[Atelopus chiriquiensis](#) CR  
[Atelopus chrysocorallus](#) CR  
[Atelopus cruciger](#) CR  
[Atelopus ebenoides](#) CR  
[Atelopus epikeisthos](#) CR  
[Atelopus eusebianus](#) CR  
[Atelopus famelicus](#) CR  
[Atelopus flavescens](#) VU  
[Atelopus galactogaster](#) CR  
[Atelopus guanujo](#) CR  
[Atelopus halihelos](#) CR  
[Atelopus laetissimus](#) CR  
[Atelopus longibrachius](#) EN  
[Atelopus lozanoi](#) CR  
[Atelopus mandingues](#) CR  
[Atelopus minutulus](#) CR  
[Atelopus monohernandezii](#) CR  
[Atelopus muisca](#) CR  
[Atelopus nanay](#) CR  
[Atelopus nicefori](#) CR  
[Atelopus oxapampae](#) EN  
[Atelopus pachydermus](#) CR  
[Atelopus patazensis](#) CR  
[Atelopus peruensis](#) CR  
[Atelopus petruizi](#) CR  
[Atelopus pinangoi](#) CR  
[Atelopus pulcher](#) CR  
[Atelopus reticulatus](#) CR  
[Atelopus seminiferus](#) CR  
[Atelopus sernai](#) CR  
[Atelopus siranus](#) DD  
[Atelopus soriano](#) CR  
[Atelopus spurrelli](#) VU  
[Atelopus tamaense](#) CR  
[Atelopus varius](#) CR  
[Atelopus zeteki](#) CR  
[Bokermannohyla claresignata](#) DD  
[Agalychnis annae](#) EN  
[Allobates olfersioides](#) VU  
[Anaxyrus canorus](#) EN  
[Aplastodiscus flumineus](#) DD  
[Aromobates leopardalis](#) CR  
[Atelopus andinus](#) CR  
[Atelopus arsyecue](#) CR  
[Atelopus balios](#) CR  
[Atelopus boulengeri](#) CR  
[Atelopus carbonerensis](#) CR  
[Atelopus certus](#) EN  
[Atelopus chochoensis](#) CR  
[Atelopus coynei](#) CR  
[Atelopus dimorphus](#) EN  
[Atelopus elegans](#) CR  
[Atelopus erythropus](#) CR  
[Atelopus exiguus](#) CR  
[Atelopus farci](#) CR  
[Atelopus franciscus](#) VU  
[Atelopus glyphus](#) CR  
[Atelopus guitarraensis](#) CR  
[Atelopus ignescens](#) EX  
[Atelopus limosus](#) EN  
[Atelopus longirostris](#) EX  
[Atelopus lynchi](#) CR  
[Atelopus mindoensis](#) CR  
[Atelopus mittermeieri](#) EN  
[Atelopus mucubajiensis](#) CR  
[Atelopus nahumae](#) CR  
[Atelopus nepiozomus](#) CR  
[Atelopus onorei](#) CR  
[Atelopus oxyrhynchus](#) CR  
[Atelopus palmatus](#) DD  
[Atelopus pedimarmoratus](#) CR  
[Atelopus petersi](#) CR  
[Atelopus pictiventris](#) CR  
[Atelopus planispina](#) CR  
[Atelopus quimbaya](#) CR  
[Atelopus sanjosei](#) DD  
[Atelopus senex](#) CR  
[Atelopus simulatus](#) CR  
[Atelopus sonsonensis](#) CR  
[Atelopus spumarius](#) VU  
[Atelopus subornatus](#) CR  
[Atelopus tricolor](#) VU  
[Atelopus walkeri](#) CR  
[Bokermannohyla circumdata](#) LC  
[Bokermannohyla hylax](#) LC

<a href="#">Bolitoglossa conanti</a> EN	<a href="#">Bolitoglossa copia</a> DD
<a href="#">Bolitoglossa dofleini</a> NT	<a href="#">Bolitoglossa magnifica</a> EN
<a href="#">Bolitoglossa pesrubra</a> VU	<a href="#">Bolitoglossa sombra</a> VU
<a href="#">Bolitoglossa sooyorum</a> EN	<a href="#">Bolitoglossa subpalmata</a> EN
<a href="#">Bombina pachypus</a> EN	<a href="#">Bromeliohyla bromeliacia</a> EN
<a href="#">Bromeliohyla dendroscarta</a> CR	<a href="#">Bufo bufo</a> LC
<a href="#">Centrolene audax</a> EN	<a href="#">Centrolene ballux</a> CR
<a href="#">Centrolene buckleyi</a> VU	<a href="#">Centrolene geckoideum</a> VU
<a href="#">Centrolene gemmatum</a> CR	<a href="#">Centrolene heloderma</a> CR
<a href="#">Centrolene lynchi</a> EN	<a href="#">Centrolene medemi</a> DD
<a href="#">Centrolene peristictum</a> VU	<a href="#">Centrolene pipilatum</a> EN
<a href="#">Centrolene scirtetes</a> DD	<a href="#">Charadrahyla altipotens</a> CR
<a href="#">Charadrahyla nephila</a> VU	<a href="#">Charadrahyla trux</a> CR
<a href="#">Chiropterotriton cracens</a> EN	<a href="#">Chiropterotriton multidentatus</a> EN
<a href="#">Craugastor anciano</a> CR	<a href="#">Craugastor andi</a> CR
<a href="#">Craugastor angelicus</a> CR	<a href="#">Craugastor azueroensis</a> EN
<a href="#">Craugastor berkenbuschii</a> NT	<a href="#">Craugastor brocchi</a> VU
<a href="#">Craugastor catalinae</a> CR	<a href="#">Craugastor charadra</a> EN
<a href="#">Craugastor chrysozetetes</a> EX	<a href="#">Craugastor cruzi</a> CR
<a href="#">Craugastor daryi</a> EN	<a href="#">Craugastor emcelae</a> CR
<a href="#">Craugastor emleni</a> CR	<a href="#">Craugastor epochthidius</a> CR
<a href="#">Craugastor escoces</a> EX	<a href="#">Craugastor fecundus</a> CR
<a href="#">Craugastor fleischmanni</a> CR	<a href="#">Craugastor greggi</a> CR
<a href="#">Craugastor guerreroensis</a> CR	<a href="#">Craugastor inachus</a> EN
<a href="#">Craugastor laevisimus</a> EN	<a href="#">Craugastor laticeps</a> NT
<a href="#">Craugastor lineatus</a> CR	<a href="#">Craugastor melanostictus</a> LC
<a href="#">Craugastor merendonensis</a> CR	<a href="#">Craugastor mexicanus</a> LC
<a href="#">Craugastor milesi</a> CR	<a href="#">Craugastor obesus</a> EN
<a href="#">Craugastor olanchano</a> CR	<a href="#">Craugastor omoaensis</a> CR
<a href="#">Craugastor pechorum</a> EN	<a href="#">Craugastor phasma</a> DD
<a href="#">Craugastor podiciferus</a> NT	<a href="#">Craugastor polymniae</a> CR
<a href="#">Craugastor punctariolus</a> EN	<a href="#">Craugastor ranoides</a> CR
<a href="#">Craugastor rhyacobatrachus</a> EN	<a href="#">Craugastor rostralis</a> NT
<a href="#">Craugastor rugulosus</a> LC	<a href="#">Craugastor rupinius</a> LC
<a href="#">Craugastor sabrinus</a> EN	<a href="#">Craugastor saltuarius</a> CR
<a href="#">Craugastor sandersoni</a> EN	<a href="#">Craugastor stadelmani</a> CR
<a href="#">Craugastor tabasarae</a> CR	<a href="#">Craugastor taurus</a> CR
<a href="#">Craugastor trachydermus</a> CR	<a href="#">Crania georgiana</a> LC
<a href="#">Crania pseudinsignifera</a> LC	<a href="#">Crossodactylus dispar</a> DD
<a href="#">Crossodactylus gaudichaudii</a> LC	<a href="#">Cycloramphus boraceiensis</a> LC
<a href="#">Cycloramphus ohausi</a> DD	<a href="#">Cycloramphus semipalmatus</a> NT
<a href="#">Duellmanohyla chamulae</a> EN	<a href="#">Duellmanohyla ignicolor</a> EN
<a href="#">Duellmanohyla lythrodes</a> EN	<a href="#">Duellmanohyla salvavida</a> CR
<a href="#">Duellmanohyla schmidtorum</a> VU	<a href="#">Duellmanohyla soralia</a> CR
<a href="#">Duellmanohyla uranochroa</a> CR	<a href="#">Ecnomiohyla echinata</a> CR
<a href="#">Ecnomiohyla rabborum</a> CR	<a href="#">Eleutherodactylus barlagnei</a> EN
<a href="#">Eleutherodactylus cooki</a> VU	<a href="#">Eleutherodactylus gryllus</a> EN
<a href="#">Eleutherodactylus hedricki</a> EN	<a href="#">Eleutherodactylus jasperii</a> CR
<a href="#">Eleutherodactylus karlschmidti</a> CR	<a href="#">Eleutherodactylus longipes</a> VU
<a href="#">Eleutherodactylus orcutti</a> CR	<a href="#">Eleutherodactylus patriciae</a> EN
<a href="#">Eleutherodactylus portoricensis</a> EN	<a href="#">Eleutherodactylus richmondi</a> CR
<a href="#">Eleutherodactylus ruthae</a> EN	<a href="#">Eleutherodactylus schmidti</a> CR
<a href="#">Eleutherodactylus semipalmatus</a> CR	<a href="#">Eleutherodactylus symingtoni</a> CR
<a href="#">Eleutherodactylus turquinensis</a> CR	<a href="#">Eleutherodactylus unicolor</a> VU

<a href="#">Eleutherodactylus wightmanae</a> EN	<a href="#">Epipedobates tricolor</a> EN
<a href="#">Euproctus platycephalus</a> EN	<a href="#">Exerodonta juanitae</a> VU
<a href="#">Exerodonta melanomma</a> VU	<a href="#">Exerodonta pinorum</a> VU
<a href="#">Gastrotheca cornuta</a> EN	<a href="#">Gastrotheca dendronastes</a> VU
<a href="#">Gastrotheca guentheri</a> VU	<a href="#">Gastrotheca litonedis</a> EN
<a href="#">Gastrotheca orophylax</a> EN	<a href="#">Gastrotheca ovifera</a> EN
<a href="#">Gastrotheca piperata</a> LC	<a href="#">Gastrotheca plumbea</a> VU
<a href="#">Gastrotheca pseustes</a> EN	<a href="#">Gastrotheca riobambae</a> EN
<a href="#">Gastrotheca splendens</a> EN	<a href="#">Geocrinia rosea</a> LC
<a href="#">Heleioporus australiacus</a> VU	<a href="#">Heleioporus eyrei</a> LC
<a href="#">Hyalinobatrachium fleischmanni</a> LC	<a href="#">Hyalinobatrachium guairarepanense</a> EN
<a href="#">Hyla bocourti</a> CR	<a href="#">Hylarana chalconota</a> LC
<a href="#">Hylodes dactylocinus</a> DD	<a href="#">Hylodes magalhaesi</a> DD
<a href="#">Hylodes meridionalis</a> LC	<a href="#">Hylodes perplicatus</a> LC
<a href="#">Hylodes phyllodes</a> LC	<a href="#">Hylomantis lemur</a> CR
<a href="#">Hyloscirtus armatus</a> LC	<a href="#">Hyloscirtus bogotensis</a> NT
<a href="#">Hyloscirtus colymba</a> CR	<a href="#">Hyloscirtus lindae</a> VU
<a href="#">Hyloscirtus pantostictus</a> EN	<a href="#">Hyloscirtus platydactylus</a> VU
<a href="#">Hyloscirtus ptychodactylus</a> CR	<a href="#">Hyloscirtus staufferorum</a> EN
<a href="#">Hyloscirtus torrenticola</a> VU	<a href="#">Hyloxalus anthracinus</a> CR
<a href="#">Hyloxalus bocagei</a> LC	<a href="#">Hyloxalus breviquartus</a> DD
<a href="#">Hyloxalus chocoensis</a> DD	<a href="#">Hyloxalus delatorreae</a> CR
<a href="#">Hyloxalus elachyhistus</a> EN	<a href="#">Hyloxalus lehmanni</a> NT
<a href="#">Hyloxalus pulchellus</a> VU	<a href="#">Hyloxalus vertebralis</a> CR
<a href="#">Hypodactylus dolops</a> VU	<a href="#">Hypsiboas cymbalum</a> CR
<a href="#">Incilius cycladen</a> VU	<a href="#">Incilius fastidiosus</a> CR
<a href="#">Incilius holdridgei</a> EX	<a href="#">Incilius melanochlorus</a> LC
<a href="#">Incilius periglenes</a> EX	<a href="#">Incilius peripatetes</a> CR
<a href="#">Incilius porteri</a> DD	<a href="#">Incilius tacanensis</a> EN
<a href="#">Incilius tutelarius</a> EN	<a href="#">Isthmohyla angustilineata</a> CR
<a href="#">Isthmohyla calypsa</a> CR	<a href="#">Isthmohyla debilis</a> CR
<a href="#">Isthmohyla graceae</a> CR	<a href="#">Isthmohyla pictipes</a> EN
<a href="#">Isthmohyla tica</a> CR	<a href="#">Isthmohyla xanthosticta</a> DD
<a href="#">Leiopelma archeyi</a> CR	<a href="#">Leiopelma hamiltoni</a> EN
<a href="#">Leiopelma hochstetteri</a> VU	<a href="#">Leptobranchium hasseltii</a> LC
<a href="#">Leptodactylus fallax</a> CR	<a href="#">Limnodynastes dumerilii</a> LC
<a href="#">Lithobates chiricahuensis</a> VU	<a href="#">Lithobates omiltemanus</a> CR
<a href="#">Lithobates sierramadrensis</a> VU	<a href="#">Lithobates subaquavocalis</a> CR
<a href="#">Lithobates tarahumarae</a> VU	<a href="#">Lithobates taylori</a> LC
<a href="#">Lithobates vibicarius</a> CR	<a href="#">Lithobates warszewitschii</a> LC
<a href="#">Lithobates yavapaiensis</a> LC	<a href="#">Litoria adelaidensis</a> LC
<a href="#">Litoria aurea</a> VU	<a href="#">Litoria booroolongensis</a> CR
<a href="#">Litoria caerulea</a> LC	<a href="#">Litoria castanea</a> CR
<a href="#">Litoria chloris</a> LC	<a href="#">Litoria dayi</a> EN
<a href="#">Litoria ewingii</a> LC	<a href="#">Litoria genimaculata</a> LC
<a href="#">Litoria lesueurii</a> LC	<a href="#">Litoria lorica</a> CR
<a href="#">Litoria moorei</a> LC	<a href="#">Litoria myola</a> CR
<a href="#">Litoria nannotis</a> EN	<a href="#">Litoria nudidigita</a> LC
<a href="#">Litoria nyakalensis</a> CR	<a href="#">Litoria pearsoniana</a> NT
<a href="#">Litoria phyllochroa</a> LC	<a href="#">Litoria piperata</a> CR
<a href="#">Litoria raniformis</a> EN	<a href="#">Litoria rheocola</a> EN
<a href="#">Litoria spenceri</a> CR	<a href="#">Litoria verreauxii</a> LC
<a href="#">Mannophryne caquetio</a> CR	<a href="#">Mannophryne cordilleriana</a> CR
<a href="#">Mannophryne herminae</a> NT	<a href="#">Mannophryne lamarcai</a> CR

<a href="#">Mannophryne neblina</a> <b>CR</b>	<a href="#">Mannophryne oblitterata</a> <b>DD</b>
<a href="#">Mannophryne olmonae</a> <b>CR</b>	<a href="#">Mannophryne riveroi</a> <b>EN</b>
<a href="#">Megaelosia massarti</a> <b>DD</b>	<a href="#">Megastomatohyla pellita</a> <b>CR</b>
<a href="#">Mesotriton alpestris</a> <b>LC</b>	<a href="#">Mixophyes balbus</a> <b>VU</b>
<a href="#">Mixophyes fasciolatus</a> <b>LC</b>	<a href="#">Mixophyes fleayi</a> <b>EN</b>
<a href="#">Nymphargus griffithsi</a> <b>VU</b>	<a href="#">Nymphargus megacheirus</a> <b>EN</b>
<a href="#">Oedipina</a> <b>EN</b>	<a href="#">Oophaga arborea</a> <b>EN</b>
<a href="#">Osteopilus pulchrilineatus</a> <b>EN</b>	<a href="#">Osteopilus vastus</a> <b>EN</b>
<a href="#">Paratelmatobius lutzii</a> <b>DD</b>	<a href="#">Paratelmatobius mantiqueira</a> <b>DD</b>
<a href="#">Pelobates fuscus</a> <b>LC</b>	<a href="#">Philoria frosti</a> <b>CR</b>
<a href="#">Phrynomedusa appendiculata</a> <b>NT</b>	<a href="#">Phyllobates bicolor</a> <b>NT</b>
<a href="#">Phyllomedusa ecuatoriana</a> <b>EN</b>	<a href="#">Physalaemus barrioi</a> <b>DD</b>
<a href="#">Physalaemus moreirae</a> <b>DD</b>	<a href="#">Plectrohyla acanthodes</a> <b>CR</b>
<a href="#">Plectrohyla ameibothalame</a> <b>DD</b>	<a href="#">Plectrohyla arborescandens</a> <b>EN</b>
<a href="#">Plectrohyla avia</a> <b>CR</b>	<a href="#">Plectrohyla bistincta</a> <b>LC</b>
<a href="#">Plectrohyla calthula</a> <b>CR</b>	<a href="#">Plectrohyla calvicollina</a> <b>CR</b>
<a href="#">Plectrohyla celata</a> <b>CR</b>	<a href="#">Plectrohyla cembra</a> <b>CR</b>
<a href="#">Plectrohyla charadricola</a> <b>EN</b>	<a href="#">Plectrohyla chryses</a> <b>CR</b>
<a href="#">Plectrohyla chrysopleura</a> <b>CR</b>	<a href="#">Plectrohyla crassa</a> <b>CR</b>
<a href="#">Plectrohyla cyanomma</a> <b>CR</b>	<a href="#">Plectrohyla cyclada</a> <b>EN</b>
<a href="#">Plectrohyla dasypus</a> <b>CR</b>	<a href="#">Plectrohyla ephemera</a> <b>CR</b>
<a href="#">Plectrohyla exquisita</a> <b>CR</b>	<a href="#">Plectrohyla glandulosa</a> <b>EN</b>
<a href="#">Plectrohyla guatemalensis</a> <b>CR</b>	<a href="#">Plectrohyla hartwegi</a> <b>CR</b>
<a href="#">Plectrohyla hazelae</a> <b>CR</b>	<a href="#">Plectrohyla ixil</a> <b>CR</b>
<a href="#">Plectrohyla lacertosa</a> <b>EN</b>	<a href="#">Plectrohyla matudai</a> <b>VU</b>
<a href="#">Plectrohyla mykter</a> <b>EN</b>	<a href="#">Plectrohyla pachyderma</a> <b>CR</b>
<a href="#">Plectrohyla pentheter</a> <b>EN</b>	<a href="#">Plectrohyla pokomchi</a> <b>CR</b>
<a href="#">Plectrohyla psiloderma</a> <b>EN</b>	<a href="#">Plectrohyla pycnochila</a> <b>CR</b>
<a href="#">Plectrohyla quecchi</a> <b>CR</b>	<a href="#">Plectrohyla robertsororum</a> <b>EN</b>
<a href="#">Plectrohyla sabrina</a> <b>CR</b>	<a href="#">Plectrohyla sagorum</a> <b>EN</b>
<a href="#">Plectrohyla siopela</a> <b>CR</b>	<a href="#">Plectrohyla tecunumani</a> <b>CR</b>
<a href="#">Plectrohyla teuchestes</a> <b>CR</b>	<a href="#">Plectrohyla thorectes</a> <b>CR</b>
<a href="#">Pleurodema marmoratum</a> <b>LC</b>	<a href="#">Pristimantis albericoi</a> <b>CR</b>
<a href="#">Pristimantis anotis</a> <b>DD</b>	<a href="#">Pristimantis bicolor</a> <b>VU</b>
<a href="#">Pristimantis calcarulatus</a> <b>VU</b>	<a href="#">Pristimantis caprifer</a> <b>LC</b>
<a href="#">Pristimantis caryophyllaceus</a> <b>NT</b>	<a href="#">Pristimantis chalceus</a> <b>LC</b>
<a href="#">Pristimantis cremnobates</a> <b>EN</b>	<a href="#">Pristimantis crenunguis</a> <b>EN</b>
<a href="#">Pristimantis crucifer</a> <b>VU</b>	<a href="#">Pristimantis diaphonus</a> <b>VU</b>
<a href="#">Pristimantis diogenes</a> <b>VU</b>	<a href="#">Pristimantis duellmani</a> <b>VU</b>
<a href="#">Pristimantis fallax</a> <b>EN</b>	<a href="#">Pristimantis fetusus</a> <b>EN</b>
<a href="#">Pristimantis ginesi</a> <b>EN</b>	<a href="#">Pristimantis gracilis</a> <b>VU</b>
<a href="#">Pristimantis ignicolor</a> <b>EN</b>	<a href="#">Pristimantis incanus</a> <b>EN</b>
<a href="#">Pristimantis jorgevelosai</a> <b>EN</b>	<a href="#">Pristimantis labiosus</a> <b>LC</b>
<a href="#">Pristimantis lancinii</a> <b>EN</b>	<a href="#">Pristimantis lichenoides</a> <b>CR</b>
<a href="#">Pristimantis lymani</a> <b>LC</b>	<a href="#">Pristimantis molybrignus</a> <b>NT</b>
<a href="#">Pristimantis nigrogriseus</a> <b>VU</b>	<a href="#">Pristimantis penelopus</a> <b>VU</b>
<a href="#">Pristimantis prolatus</a> <b>EN</b>	<a href="#">Pristimantis quinquagesimus</a> <b>VU</b>
<a href="#">Pristimantis ruedai</a> <b>VU</b>	<a href="#">Pristimantis sanctaemartae</a> <b>NT</b>
<a href="#">Pristimantis sanguineus</a> <b>NT</b>	<a href="#">Pristimantis savagei</a> <b>NT</b>
<a href="#">Pristimantis scoloblepharus</a> <b>EN</b>	<a href="#">Pristimantis scolodiscus</a> <b>EN</b>
<a href="#">Pristimantis signifer</a> <b>VU</b>	<a href="#">Pristimantis sulculus</a> <b>EN</b>
<a href="#">Pristimantis tamsitti</a> <b>NT</b>	<a href="#">Pristimantis uranobates</a> <b>LC</b>
<a href="#">Pristimantis urichi</a> <b>EN</b>	<a href="#">Pristimantis verecundus</a> <b>VU</b>
<a href="#">Pristimantis vicarius</a> <b>NT</b>	<a href="#">Pristimantis zophus</a> <b>EN</b>

<a href="#">Prostherapis dunni</a> CR	<a href="#">Pseudacris triseriata</a> LC
<a href="#">Pseudoeurycea unguidentis</a> CR	<a href="#">Pseudophryne corroborree</a> CR
<a href="#">Pseudophryne pengillyei</a> EN	<a href="#">Ptychohyla</a> CR
<a href="#">Ptychohyla acrochorda</a> DD	<a href="#">Ptychohyla dendrophasma</a> CR
<a href="#">Ptychohyla erythromma</a> EN	<a href="#">Ptychohyla euthysanota</a> NT
<a href="#">Ptychohyla legleri</a> EN	<a href="#">Ptychohyla leonhardschultzei</a> EN
<a href="#">Ptychohyla macrotympanum</a> CR	<a href="#">Ptychohyla panchoi</a> EN
<a href="#">Ptychohyla salvadorensis</a> EN	<a href="#">Ptychohyla sanctaecrucis</a> CR
<a href="#">Ptychohyla spinipollex</a> EN	<a href="#">Ptychohyla zophodes</a> DD
<a href="#">Rana muscosa</a> EN	<a href="#">Rana sierrae</a> EN
<a href="#">Ranitomeya abdita</a> CR	<a href="#">Rhacophorus margaritifer</a> LC
<a href="#">Rhaebo haematiticus</a> LC	<a href="#">Rheobatrachus vitellinus</a> EX
<a href="#">Rhinella amabilis</a> CR	<a href="#">Rhinella chrysophora</a> EN
<a href="#">Rhinoderma darwini</a> VU	<a href="#">Rhinoderma rufum</a> CR
<a href="#">Scinax albicans</a> LC	<a href="#">Scinax heyeri</a> DD
<a href="#">Silverstoneia nubicola</a> NT	<a href="#">Smilisca cyanosticta</a> NT
<a href="#">Strabomantis cheiroplethus</a> VU	<a href="#">Strabomantis necerus</a> VU
<a href="#">Strabomantis zygodactylus</a> LC	<a href="#">Taudactylus acutirostris</a> CR
<a href="#">Taudactylus diurnus</a> EX	<a href="#">Taudactylus eungellensis</a> CR
<a href="#">Taudactylus liemi</a> NT	<a href="#">Taudactylus pleione</a> CR
<a href="#">Taudactylus rheophilus</a> CR	<a href="#">Telmatobius arequipensis</a> VU
<a href="#">Telmatobius atacamensis</a> CR	<a href="#">Telmatobius atahualpai</a> DD
<a href="#">Telmatobius bolivianus</a> NT	<a href="#">Telmatobius brevipes</a> EN
<a href="#">Telmatobius brevirostris</a> EN	<a href="#">Telmatobius carrillae</a> VU
<a href="#">Telmatobius ceiorum</a> EN	<a href="#">Telmatobius cirrhacelis</a> CR
<a href="#">Telmatobius colanensis</a> EN	<a href="#">Telmatobius contrerasi</a> DD
<a href="#">Telmatobius culeus</a> CR	<a href="#">Telmatobius dankoi</a> DD
<a href="#">Telmatobius degener</a> EN	<a href="#">Telmatobius edaphonastes</a> EN
<a href="#">Telmatobius gigas</a> CR	<a href="#">Telmatobius hauthali</a> VU
<a href="#">Telmatobius hockingi</a> VU	<a href="#">Telmatobius hypselocephalus</a> EN
<a href="#">Telmatobius ignavus</a> EN	<a href="#">Telmatobius intermedius</a> DD
<a href="#">Telmatobius jelskii</a> NT	<a href="#">Telmatobius laticeps</a> EN
<a href="#">Telmatobius latirostris</a> EN	<a href="#">Telmatobius marmoratus</a> VU
<a href="#">Telmatobius mayoloi</a> EN	<a href="#">Telmatobius necopinus</a> EN
<a href="#">Telmatobius niger</a> CR	<a href="#">Telmatobius pefauri</a> CR
<a href="#">Telmatobius peruvianus</a> VU	<a href="#">Telmatobius philippii</a> DD
<a href="#">Telmatobius pinguiculus</a> DD	<a href="#">Telmatobius pisanoi</a> EN
<a href="#">Telmatobius platycephalus</a> EN	<a href="#">Telmatobius schreiteri</a> EN
<a href="#">Telmatobius scrocchii</a> EN	<a href="#">Telmatobius sibiricus</a> EN
<a href="#">Telmatobius simonsi</a> NT	<a href="#">Telmatobius stephani</a> EN
<a href="#">Telmatobius thompsoni</a> EN	<a href="#">Telmatobius timens</a> DD
<a href="#">Telmatobius truebae</a> EN	<a href="#">Telmatobius vellardi</a> CR
<a href="#">Telmatobius verrucosus</a> VU	<a href="#">Telmatobius vilamensis</a> DD
<a href="#">Telmatobius yuracare</a> VU	<a href="#">Telmatobius zapahuirensis</a> CR
<a href="#">Thoropa lutzi</a> EN	<a href="#">Thoropa miliaris</a> LC
<a href="#">Thoropa petropolitana</a> VU	<a href="#">Thoropa saxatilis</a> NT

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Parris, M. J. and D. R. Baud. 2004. Interactive effects of a heavy metal and chytridiomycosis on gray treefrog larvae (*Hyla chrysoscelis*). Copeia 2004: 343-349.

**Summary:** *B. dendrobatidis* impacts on *Hyla* larvae may be somewhat ameliorated in a heavy metal (Cu) aquatic environment. Thus, pathogenic effects may be a result of interactions with other aquatic contaminants.

Parris, M. J. and T. O. Cornelius. 2004. Fungal pathogen causes competitive and developmental stress in larval amphibian communities. *Ecology* 85: 3385-3395.

**Summary:** This paper documents that *B. dendrobatidis* induces competitive effects in the larval environment between a toad (*Bufo*) and treefrog (*Hyla*) species.

Rollins-Smith, L.A., Carey, C., Longcore, J., Doersam, J.K., Boutte, A., Bruzgal, J.E., and Conlon, J.M. 2002. Activity of antimicrobial skin peptides from ranid frogs against *Batrachochytrium dendrobatidis*, the chytrid fungus associated with global amphibian declines. *Developmental and Comparative Immunology*. 26 (5): 471-479.

**Summary:** This paper outlines the role of antimicrobial peptides in deterring chytrid infection.

[Speare R, Berger L. Chytridiomycosis in amphibians in Australia.](#)

**Summary:** Available from: <http://www.jcu.edu.au/school/phtm/PHTM/frogs/chyspec.htm>. [Accessed 9 October 2000] .

[USGS \(U.S. Geological Survey\). 2000. Research Project: Review and Classification of Visitor Impacts to Wildlife Research Methods. U.S. Department of the Interior: Patuxent Wildlife Research Center.](#)

**Summary:** Available from: <http://www.pwrc.usgs.gov/research/sis2000/longco07.htm> [Accessed 7 Dec 2004]

Voyles, Jamie., Sam Young, Lee Berger, Craig Campbell, Wyatt F. Voyles, Anuwat Dinudom, David Cook, Rebecca Webb, Ross A. Alford, Lee F. Skerratt, Rick Speare. 2009. Pathogenesis of Chytridiomycosis, a Cause of Catastrophic Amphibian Declines. *Science*, Vol. 326 No. 5952, October 23, 2009.

**Summary:** The pathogen *Batrachochytrium dendrobatidis* (Bd), which causes the skin disease chytridiomycosis, is one of the few highly virulent fungi in vertebrates and has been implicated in worldwide amphibian declines. However, the mechanism by which Bd causes death has not been determined. We show that Bd infection is associated with pathophysiological changes that lead to mortality in green tree frogs (*Litoria caerulea*). In diseased individuals, electrolyte transport across the epidermis was inhibited by >50%, plasma sodium and potassium concentrations were respectively reduced by ~20% and ~50%, and asystolic cardiac arrest resulted in death. Because the skin is critical in maintaining amphibian homeostasis, disruption to cutaneous function may be the mechanism by which Bd produces morbidity and mortality across a wide range of phylogenetically distant amphibian taxa

[Waldman, B., van de Wolfshaar, K.E., Klena, J.D., Andjic, V., Bishop, P., and Norman, R. J. de B. 2001. Chytridiomycosis in New Zealand frogs. \*Surveillance\*. 28 \(3\): 9-11.](#)

**Summary:** This article gives details about the first case of chytrid fungus in New Zealand, including possible means of introduction and spread.

Available from: [http://ivabs.massey.ac.nz/centres/wildlife/rschrepts/chytrid/chytrid\\_article.pdf](http://ivabs.massey.ac.nz/centres/wildlife/rschrepts/chytrid/chytrid_article.pdf) [Accessed 17 December 2004]

[Weldon C, du Preez LH, Hyatt AD, Muller R, Speare R., 2004. Origin of the amphibian chytrid fungus. \*Emerg Infect Dis\* \[serial on the Internet\]. 2004 Dec.](#)

**Summary:** Available from <http://www.cdc.gov/ncidod/EID/vol10no12/03-0804.htm> [Accessed 14 December 2005]

Woodhams, D.C., Alford, R.A. and Marantelli, G. 2003. Emerging Disease of Amphibians Cured by Elevated Body Temperature, *Diseases of Aquatic Organisms* 55 (1): 65 - 67.

Young, B.E., Lips, K.R., Reaser, J.K., Ibanez, R., Salas, A.W., Rogelio Cedeno, J., Coloma, L.A., Ron, S., La Marca, E., Meyer, J.R., Munoz, A., Bolanos, F., Chaves, G. and Romo, D. 2001. Population declines and priorities for amphibian conservation in Latin America. *Conservation Biology*. 15 (5): 1213-1223.

**Summary:** A discussion of the factors involved in the population declines of amphibians in Latin America.