

Selected Emerging Diseases of Amphibia

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KEYWORDS

• Amphibian • Viral • Fungal • Parasitic • Bacterial • Emerging • Disease

KEY POINTS

- *Batrachochytrium dendrobatidis* (Bd) and ranavirus are the most significant infectious diseases contributing to global population declines in amphibians.
- Fluid therapy and itraconazole are the mainstays of therapy for Bd infections.
- Ranaviruses infect several species of anurans, larval and adults, and disease susceptibility varies among species.
- Ranavirus polymerase chain reaction (PCR) results samples vary based on sampling methods.
- *Mycobacterium liflandii* and new noncommensal bacterial pathogens have been identified as causes of significant mortality in amphibian collections.
- *Rana* and Bd status can influence species susceptibility to parasitic disease.

Whether in private practice or in a zoologic setting, veterinarians of the exotic animal persuasion are asked to work on amphibians. As with most nondomestic species, many health issues in amphibians are traced back to problems with husbandry and/or nutrition. Because these areas are more adequately addressed in zoos and even by hobbyists and pet stores, however, veterinarians are able to evaluate more thoroughly for true medical issues, with infectious diseases at the forefront. Until recently, many infectious diseases were unknown or even misdiagnosed as caused by opportunistic secondary organisms. The days of a sick frog with hind leg erythema diagnosed as red leg caused by bacterial infection are becoming history. In a recent report, 4 species (*Dendrobates auratus*, *Phyllobates terribilis*, *Pyxicephalus adspersus*, and *Rhacophorus dennysi*) of captive anurans with a clinical history of lethargy and inappetence were found dead with irregular patches of sloughed skin and rare dermal ulcerations. Histologic findings of intracytoplasmic chytrid organisms and bacteria (cultured

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Aeromonas hydrophila) associated with the epidermal lesions and intracytoplasmic inclusion bodies in hepatocytes combined with Real-time-PCR-positive results for both ranavirus and Bd indicate that multiple infectious agents can occur in amphibians, and simply running a bacterial culture may have provided only a tiny part of the picture.¹ The challenge of convincing a client or even a curator to invest in diagnostic testing is often formidable. Likewise, it can be a challenge to collect samples from amphibians in useful quantities for such testing. Amphibians have been proposed as environmental sentinels, but the dearth of research on infectious amphibian diseases is remarkable in opposing support of that statement. This has been slowly changing, and this article is dedicated to exploring the known peer-reviewed research available for practitioners on the topic of emerging infectious amphibian diseases, including viruses, bacteria, fungi, and parasites. Two of these diseases require notification of the World Organisation for Animal Health (Office International des Epizooties [OIE])—Bd and ranaviruses (several species)—because of their contagious nature and capability of causing extinctions of entire species of amphibians.²

FUNGAL DISEASE

Batrachochytrid Dendrobatidis

Bd is a chytrid fungus that has been deemed responsible for causing extinction-level event population declines in amphibians worldwide since its first report in 1998.³ At the 2005 Amphibian Conservation Summit, Bd was described as the “worst infectious disease ever recorded among vertebrates in terms of number of species impacted and its propensity to drive them to extinction.” Ecologists consider Bd the largest infectious disease threat to biodiversity.⁴ Bd has commissioned an immediate global response from the public, scientists, conservationists, and policy makers alike. Multiple conservation organizations share the universal goal of improving understanding of the fungi’s ecology and pathogenesis to implement control of Bd’s devastating effects on amphibian populations.

To understand Bd’s impact, it is important to first appreciate where global amphibian population statistics stand. The International Union for Conservation of Nature (IUCN) has produced the first comprehensive assessment of the conservation status of amphibians (Global Amphibian Assessment: <http://www.iucnredlist.org/initiatives/amphibians/analysis>). The 2008 Global Amphibian Assessment updates reveal staggering data on amphibian population decline (**Box 1**). A global surveillance initiative has been launched to track the reports of Bd worldwide. More than 500 species of amphibians have been infected with Bd among 54 countries (www.spatialepidemiology.net/bd-maps/) and the highest numbers of reports come from North America. Since 2008, The OIE has listed Bd as a reportable disease and provides a freely accessible 2012 *Manual of Diagnostic Tests for Aquatic Animals* with a chapter outlining Bd history, surveillance, diagnostic tests, treatment, and control measures (http://www.oie.int/fileadmin/Home/eng/Health_standards/aahm/2010/2.1.01_INF_BATRACHOCHYRIUM.pdf).

History and Epidemiology

The origins of Bd were hypothesized two theories, the novel pathogen theory and the endemic pathogen theory. Many investigators propose that Bd was a novel pathogen introduced globally by the trade in infected *Xenopus laevis* frogs used for human pregnancy tests from Africa.⁵ More recently, it has been implicated as a novel pathogen spread by the international trade of American bullfrogs (*Lithobates catesbeiana*). The endemic pathogen theory supports that Bd has always been endemic and the

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