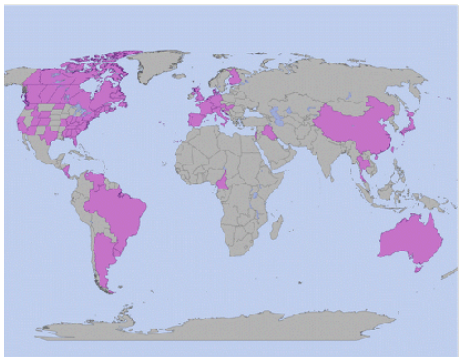
RANAVIRUS

Tadpole (American bullfrog, Rana catesbeiana) from Georgia (USA) with a likely Ranavirus infection. Photo by Alan Cressler

MARCH**2022**

CAUSE

Ranavirus (family ***Iridoviridae***), is a double stranded DNA virus that can cause severe infections in a number of cold-blooded taxa, including amphibians, reptiles, and fish. There are several different species of Ranavirus that can cause varying levels of disease in the infected animals. Some of the best known Ranavirus include: epizootic hematopoietic necrosis virus and largemouth bass virus (both piscine ranavirus), frog virus-3 and tadpole edema virus (in frogs), and ***Ambystoma tigrinum*** virus in tiger salamanders.



Global distribution of known Ranavirus cases (2015). Image credit: From Duffus et al., 2015.

SIGNIFICANCE

Ranavirus is believed to be the cause of several recent mass mortality events in amphibian populations across the globe. With a mortality rate of 90%-100%, the disease has the potential to eliminate entire species if not controlled. Scientists in the United States have identified Ranavirus to be associated with mortality in over 25 states in 20 different species of turtles and amphibians. Ranavirus outbreaks can affect multiple species at the same time and are often associated with acute die-offs and population declines of wild amphibians.

Ranavirus are considered a Notifiable Pathogen by the OIE (the World Organization for Animal Health). Reports can be made through the Partners in Amphibian and Reptile Conservation's Disease Task Team's Herpetofaunal Disease Alert System (HDAS), herp_disease_alert@parcplace.org.

Box turtle with clinical signs of Ranavirus, including swollen eyelids, nasal discharge, and yellow/ opaque plaques in the mouth. Photo Credit: Clinic for the Rehabilitation of Wildlife (CROW): http://crowclinic.org/articles/warning-signs

SPECIES AFFECTED

Ranavirus affect amphibians, reptiles, and fish, though susceptibility varies by species. Natural infections have been identified in at least 91 species representing 14 families. The most commonly infected and impacted family is the Ranidae. In the United States, the USGS National Wildlife Health Center has identified Ranavirus in at least 16 species of frogs, 1 species of toad, and 6 species of salamanders, including the true frog, the tree frog, and the mole salamander.

Ranavirus can also severely affect both captive and wild populations of eastern box turtles and true tortoises and has been diagnosed in snakes and

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lizards. The viruses have been linked to infections and mortality in several species of bony fish, including the pallid sturgeon and the threespine stickleback. Ranavirus can affect animals at all life stages, though in general, mortality rates are highest if the animal contracts the virus during a juvenal or larval stage (hatchlings and metamorphs).

At this time, Ranavirus is not known to infect humans or other warmblooded species.

DISTRIBUTION

Ranavirus have a truly global distribution; infections and associated mortalities have been documented in North and South America, Europe, Asia, Australia and Africa.

In the United States, confirmed cases have been documented in the northeast, southeast, midwest, southwest, and northwest. There have also been cases in parts of southern Canada.

TRANSMISSION

Transmission of Ranavirus occurs horizontally, through direct contact, ingestion of the virus, ingestion of infected animals, or exposure to infected soil or water sources. Vertical transmission is thought to occur but remains unverified. Substantial evidence exists for interclass transmission among amphibians, reptiles, and fish during a disease outbreak. Mortality events may be seasonal based on the susceptibility of the infected hosts and life stage(s) present. Disease and associated mortality may occur in as little as 3 days post-infection, though it may also take up to several weeks.

Ranavirus are highly persistent and are able to remain infectious in the environment for an extended period of time, likely surviving for months in water under favorable conditions.

CLINICAL SIGNS

Frequently, the first sign of an outbreak of Ranavirus is the sudden onset of illness and death in large numbers of amphibians and/ or reptiles over a 1-5 day period. Clinical signs in amphibians include mild to severe hemorrhages in the skin, especially near the base of the hind limbs and the vent opening, lethargy, weak or erratic swimming, buoyancy problems, gasping for air, and mild to severe fluid accumulation under the skin of the abdomen or hind legs. At necropsy, there may be fluid accumulation in the body cavity and hemorrhages on the surfaces of the heart, stomach, and liver. Occasionally, the liver or spleen are affected and ulcers in the skin and palate may be observed. In turtles, clinical signs include weakness, swollen eyelids, discharge from the nose and mouth, ulcers on the feet, and dull white or thick yellow plaque on the tongue, palate, pharynx, and esophagus.

DIAGNOSIS

Ranavirus infection and disease can be diagnosed through primary isolation and cell culture of the virus, molecular identification (PCR and sequencing), and light or electron microscopy.

TREATMENT

To date, there is no treatment or vaccine for Ranavirus.

MANAGEMENT

Ranavirus can easily be spread during anthropogenic activities, especially during fieldwork and animal handling. Since there is no treatment for Ranavirus, management is focused on biosecurity, quarantine, and decontamination to prevent the spread of the virus to other animals and new environments. Any infected animals should be quarantined to prevent infection of other animals. Water from captive facilities and home aquariums should be disinfected prior to disposal to prevent the virus from spreading into new water sources. All equipment, surfaces, and storage tanks in captive facilities should be disinfected after use. Wildlife biologists, veterinarians, rehabilitators, and anyone involved in amphibian or reptilian fieldwork should employ strict biosecurity protocols and clean and disinfect all equipment and clothes before and after working at a field site. Gray *et al.*, 2017 provides an extremely useful overview and table of commonly used, researched disinfectants.

SUGGESTED READING

American College of Veterinary Pathologists. 2015. Ranavirus Fact Sheet.Gray, M.J., Miller, D.L., Hoverman, J.T. 2009. Ecology and pathology of amphibian ranaviruses. Diseases of Aquatic Organisms. 87(3): 243-266

Gray et al. 2017. Pathogen surveillance in herpetofaunal populations: Guidance on study design, sample collection, biosecurity, and intervention strategies. Herpetological Review 48(2): 334-351.

Global Ranavirus Consortium

Gray MJ. And V. Gregory Chinchar. 2015. Ranaviruses: Lethal Pathogens of Ectothermic Vertebrates. Springer.

Duffus et al. 2015. Distribution and Host Range of Ranaviruses. In MJ Gray and VG Chinchar (Ed.). *Ranaviruses: Lethal Pathogens of Ectothermic Vertebrates*. (pp. 9-57). Springer Open: DOI: 10.1007/978-3-319-13755-1_2.