



Ranavirus Disease

Agent

There are several different types of ranavirus. Some are more host-specific than others (*i.e.* some infect only one type or species of animal, while others can infect multiple species or types of animals). Different species of amphibians differ in their susceptibility to ranavirus infection and/or ranavirus disease.

Previously, just one group of ranaviruses, referred to as frog virus-3 (FV3) like strains, was known to be present in Great Britain and is thought to have been introduced to Great Britain on multiple occasions since the 1980s, most likely from North America. Recent research, however, has identified a second group of ranaviruses in British amphibians, known as common midwife toad virus-like (CMTV) strains. The origin of these CMTV-like strains is currently unknown – the first case of CMTV-associated disease in a British amphibian dates back to 1995.

Species affected

All species of amphibian in Great Britain are considered to be susceptible to ranavirus infection, but the common frog (*Rana temporaria*) and the common toad (*Bufo bufo*) are most frequently reported with the disease. There is some evidence to suggest that the common toad might be less susceptible to ranavirus disease than the common frog. Generally, tadpoles, metamorphs and adult amphibians are susceptible to ranavirus disease, but in Great Britain, adult amphibians appear to be most commonly affected, with tadpole mortality being rarely reported. Ranaviruses that infect amphibians often can also infect fish and reptiles.

Clinical signs

Ranavirus disease outbreaks can vary from numerous dead amphibians visible in, and surrounding, water bodies to individual sick animals seen. Affected adult amphibians may have reddening of the skin, skin ulceration, bloody mucus in the mouth and might pass blood from the rectum; often there is internal bleeding (which is detected on post-mortem examination). Often, large numbers of dead animals are found with no evidence of disease, but these animals invariably have died of internal bleeding. Individual sick animals usually are lethargic and have skin ulceration or loss of digits (fingers and toes), which sometimes progresses to the loss of entire feet (Figure 1).

Diseased larval amphibians often have swollen bodies and signs of internal bleeding, such as red patches in the tail or body. Death in susceptible amphibians can occur within a few days following infection or may take several weeks.

Many of the signs of ranavirus disease are typical of a disease syndrome which is commonly called “red leg”. Ranaviruses are not the only possible cause of “red leg” in amphibians and other possible causes, such as bacterial infection or normal variation in skin colouration, should be borne in mind.

Whilst ranavirus disease can occur at any time of year when amphibians are active, most outbreaks occur during the warmer summer months. Higher ambient temperatures have been shown to be associated with increased frequency and severity of ranavirus disease outbreaks. If climate change and warming continues, it is predicted that the severity of ranavirus disease outbreaks may increase; that they may occur over a wider geographical range in Great Britain; and with an extended season that could include the spring breeding season and therefore lead to tadpole mortality.

Although suspected in other species (such as the common toad), the negative effect of ranavirus infection at a population level has only been demonstrated in common frogs in England. Here, ranavirus disease has been shown to cause marked declines, and in some cases local extinctions, of common frog populations at infected sites since the 1990s.

Disease transmission

Ranaviruses are highly infectious and are capable of surviving for extended periods of time in the environment, even in dried material. Ranavirus can persist in the aquatic environment outside a host for more than two months. Transmission between individuals occurs by indirect and direct routes, and includes exposure to contaminated water or soil, contact with infected individuals, and ingestion of infected tissue.

The spread of ranaviruses into an area will most probably happen by the movement of infected animals, contaminated water or water plants, or via contaminated equipment, such as boots and fishing nets.

Distribution and origin

Ranavirus disease is known to occur in many parts of the world, including North America, Australia and Europe. In Great Britain, we initially discovered the disease in southern and south east England in the early 1990s. Since then, scientists at the Zoological Society of London and Froglife have continued to investigate the emergence and spread of amphibian ranavirus disease in Great Britain. The disease is thought to have spread through a combination of natural amphibian dispersal and human-assisted movement of infected animals and contaminated materials. A cumulative timeline of disease spread is shown in the maps in Figure 2.

Risk to human health

No known risk to human health.

Risk to domestic animal health

Ranaviruses that infect amphibians often can also infect fish and reptiles. The strain of ranavirus that is known to infect amphibians in Great Britain is also known to cause lethal disease in pet tortoises (*Testudo* spp.). It is possible that the virus can cause disease in a variety of fish species, although this has not yet been confirmed in the wild.

Diagnosis

While there are several characteristic features of ranavirus disease in amphibians, none of them are specific to ranavirus. Additionally, amphibians may die of ranavirus infection without any observable signs of disease. This means that the diagnosis of ranavirus disease can only be made following post-mortem examination with additional specialist laboratory testing.

If you wish to report finding a dead amphibian, or signs of disease in amphibians, please visit www.gardenwildlifehealth.org. Alternatively, if you have further queries or have no internet access, please call the **Garden Wildlife Health** vets on **0207 449 6685**.

Prevention and control

There are no effective measures known for the treatment or control of ranavirus disease. During an outbreak the chances of animals becoming infected should be reduced by removing dead amphibians as soon as possible; the preferred method of disposal being burial as this prevents other animals coming into contact with infected carcasses.

Since there is evidence that higher environmental temperatures lead to increased frequency and severity of ranavirus disease outbreaks, the provision of opportunities for amphibians in garden ponds to regulate their body temperature may be helpful in disease control. Dependent on site, options might include shading, log piles, larger ponds, or areas of deeper water within ponds, to provide a range of available ambient temperatures. The chances of introducing ranavirus disease to a new site can be minimised by avoiding the introduction of potentially-infected material (spawn, tadpoles, amphibians, water or water plants) to new sites and by cleaning and disinfecting boots and equipment that might be used in different ponds or other water bodies.

If you keep captive amphibians, it is important that you ensure good biosecurity practice to minimise risks of virus transmission to wild amphibians. The disease alert document listed below provides information and guidance on what you can do to reduce disease risks to captive and wild amphibians in the UK.

Further information

Guidelines to minimise the risk of amphibian disease (2015):

http://www.gardenwildlifehealth.org/files/2013/06/Amphibian-disease-alert_June-2015.pdf

World Organisation for Animal Health (OIE) Disease card: infection with ranavirus:

http://www.oie.int/fileadmin/Home/eng/Internationa_Standard_Setting/docs/pdf/Ranavirus_card_final.pdf

World Organisation for Animal Health (OIE) Diagnostic manual for aquatic animal diseases:

<http://www.oie.int/doc/ged/D9568.PDF>

Scientific publications

Teacher, A.G.F., Garner, T.W.J., Nichols, R.A. (2009) Evidence for directional selection at a novel Major Histocompatibility Class 1 marker in wild common frogs (*Rana temporaria*) exposed to a viral pathogen. *PLoS ONE* **4**: E4616. DOI:10.1371/journal.pone.00046160

Teacher, A.G.F., Garner, T.W.J., Nichols, R.A. (2009) Population genetic patterns suggest a behavioural change in wild common frogs (*Rana temporaria*) following disease outbreaks (Ranavirus). *Molecular Ecology* **18**: 3163-3172. DOI:10.1111/j.1365-294X.2009.04263.x

Teacher, A.G.F., Cunningham, A.A., Garner, T.W.J. (2010) Assessing the long-term impact of Ranavirus infection in wild common frog populations. *Animal Conservation* **13**: 514-522. DOI:10.1111/j.1469-1795.2010.00373.x

Price, S.J., Garner, T.W.J., Nichols, R.A., Balloux, F., Ayres, C., Mora-Cabello de Alba A., Bosch, J. (2014) Collapse of Amphibian Communities Due to an Introduced Ranavirus. *Current Biology* **24**(21): 2586–2591
DOI:10.1016/j.cub.2014.09.028

North, A.C., Hodgson, D.J., Price, S.J., Griffiths A.G.F. (2015) Anthropogenic and Ecological Drivers of Amphibian Disease (Ranavirosis). *PLoS ONE* **10**(6): e0127037. DOI:10.1371/journal.pone.0127037

Price, S.J., Garner, T.W.J., Cunningham, A.A., Langton, T.E.S., Nichols R.A. (2016) Reconstructing the emergence of a lethal infectious disease of wildlife supports a key role for spread through translocations by humans. *Proceedings of Royal Society B* **283**: 20160952. DOI:10.1098/rspb.2016.0952

Price, S.J., Wadia, A., Wright, O.N., Leung, W.T.M., Cunningham, A.A., Lawson, B. (2017) Screening of a long-term sample set reveals two Ranavirus lineages in British herpetofauna. *PLoS ONE* **12**(9): e0184768. DOI:10.1371/journal.pone.0184768

Price, S.J., Leung, W.T.M., Owen, C., Puschendorf, R., Sergeant, C., Cunningham, A.A., Balloux, F., Garner, T.W.J., Nicholas, R.A. (2019) Effects of historical and projected climate change on the range and impacts of an emerging wildlife disease. *Global Change Biology* DOI:10.1111/gcb.14651

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