Severe Perkinsea Infection

Agent

Severe Perkinsea Infection (SPI) is a newly identified disease of frog and toad (i.e. anuran) tadpoles in the USA, and more recently also in Panama, that is caused by protozoan parasites in the Perkinsea phylum.

Genetic analyses have revealed that the SPI-causing parasites belong to a distinct clade within the Novel Alveolate Group 01 (NAG01) of Perkinsea organisms, which is often referred to as the Pathogenic Perkinsea Clade (PPC). While PPC organisms are almost always associated with SPI, other members of the NAG01 group have been detected in environmental samples and reported in tadpoles without signs of disease (Figure 1.).

Perkinsea organisms	Novel Alveolate Group 01	Pathogenic Perkinsea Clade	Associated with Severe Perkinsea Infection in tadpoles
		Other clades	Not associated with Severe Perkinsea Infection
	Other groups	Other clades	Not associated with Severe Perkinsea Infection

Figure 1. Groups and clades of Perkinsea organisms and their association with Severe Perkinsea Infection.

Species affected

First detected in 1999, SPI is the second-most frequently recorded cause of frog tadpole mortality in the USA after ranavirus disease and numerous anuran species from a diverse range of habitat types have been impacted. Recently, the disease was also found in free-living frog and toad tadpoles in Panama, as well as in a captive population of European tree frogs (*Hyla arborea*) in Great Britain. However, screening has so far been limited and therefore the true distribution of SPI amongst wild and captive amphibians is currently unknown.

The susceptibility of native British amphibians to SPI is as yet unknown.

Clinical signs

Severe Perkinsea Infection is a common cause of multiple mortality events of tadpoles in the USA. Investigations into these events have revealed bloating, inability to dive, unusual behaviours such as swimming in circles or gaping, skin reddening, subcutaneous swelling, areas of white skin discoloration and rapid death to be the most frequently observed clinical signs. Mortality rates of up to 95% have been recorded in some SPI outbreaks.

Infections caused by Perkinsea organisms apparently affect only tadpoles and no adult amphibians have been diagnosed with SPI to date.

Disease transmission

Little is currently known about the transmission of Perkinsea organisms in tadpoles. However, given that the spores are highly resistant and capable of remaining viable for long periods of time despite harsh conditions such as desiccation, an environmental source is considered most likely.

Distribution and origin

The first recorded SPI events occurred on the east and west coasts, and in the Midwest, of the USA. The organism was recently also detected in free-living tadpoles in Panama. However, due to the wide range of species, habitats

and climatic conditions, it has been suggested that this disease may occur elsewhere, and further research is required to identify if this is the case.

No SPI events or PPC organisms have been reported in wild or native amphibians in Great Britain to date; however, it has been found in a captive population of European tree frogs in Great Britain. Further surveillance is required to learn more about the disease conditions affecting British tadpoles.

Risk to human health

No known risk to human health.

Risk to domestic animal health

Depending on the species, frog and toad tadpoles kept in captivity may be susceptible to SPI.

Diagnosis

While there are several characteristic features of SPI in tadpoles, they are not specific enough to confirm a diagnosis. This means that the diagnosis of SPI can only be made following post-mortem examination with additional specialist laboratory testing.

If you wish to report finding a dead tadpole (or tadpoles), or other 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 SPI. During an outbreak, the chances of animals becoming infected may be reduced by removing dead tadpoles as soon as possible; the preferred method of disposal being burial as this prevents other animals coming into contact with infected carcasses.

SPI has recently been detected in a captive European tree frog collection in Great Britain but has not yet been detected in wild amphibians. Strict biosecurity measures should be followed by captive amphibian keepers to safeguard the health of captive and wild amphibians. Some of these measures are given below and the full list can be found in our Amphibian Disease Alert:

- Never release amphibians from captivity into the wild *
- Avoid keeping amphibians in outdoor enclosures.
- Dispose of dead animals by incineration or deep burial to prohibit scavenging.
- Do not clean tanks or vivaria outside.
- Disinfect all wastewater and used substrate from amphibian enclosures (see our 'Disposal of wastewater' guide).

* The only exceptions to this are translocations which are conducted for development mitigation or conservation breeding initiatives and are subject to disease risk analysis and management.

Additionally, international travellers who are likely to visit habitats used by native British amphibians should take care to remove organic material from their footwear, clothes and luggage before re-entering the country and, once cleaned, to disinfect their footwear and any equipment (e.g. fishing rods and lines) that might be used in amphibian sites to avoid inadvertent spread of amphibian diseases.

Further information

Garden Wildlife Health (2020). Amphibian disease alert.
https://www.gardenwildlifehealth.org/wp-content/uploads/sites/12/2020/06/Amphibian_Disease_Alert.pdf

Garden Wildlife Health (2020). Guidelines for safe disposal of waste water and other materials from captive amphibian enclosures.
https://www.gardenwildlifehealth.org/wp-content/uploads/sites/12/2020/06/Amphibian_Waste_Disposal_Guidelines.pdf

ARG UK (2017). ARG UK Advice Note 4: Amphibian Disease Precautions: A Guide for UK Fieldworkers. Amphibian and Reptile Groups of the United Kingdom.
https://www.arc-trust.org/amphibian-disease-precautions

Scientific publications

Smilansky V, Jirků M, Milner DS, Ibáñez R, Gratwicke B, Nicholls A, Lukeš J, Chambouvet A, Richards TA (2021) Expanded host and geographic range of tadpole associations with the Severe Perkinsea Infection group. *Biol Lett* **17**:20210166. doi.org/10.1098/rsbl.2021.0166

Isidoro-Ayza M, Grear DA, Chambouvet A (2018) Pathology and Case Definition of Severe Perkinsea Infection of Frogs. *Vet Pathol* **1**(10). doi.org/10.1177/0300985818798132

Isidoro-Ayza M, Lorch JM, Grear DA, Winzeler M, Calhoun DL, Barichivich WJ (2017) Pathogenic lineage of Perkinsea associated with mass mortality of frogs across the United States. *Sci Rep* **7**:10288. doi.org/10.1038/s41598-017-10456

Chambouvet A, Gower DJ, Jirků M, Yabsley MJ, Davis AK, Leonard G, Maguire F, Doherty-Bone TM, Bittencourt-Silva GB, Wilkinson M, Richards TA (2015) Cryptic infection of a broad taxonomic and geographic diversity of tadpoles by Perkinsea protists. *PNAS* **112**(34): E4743-E4751. doi.org/10.1073/pnas.1500163112

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