

# *Besnoitia* in Australian wildlife, including macropod protozoal rhinitis

## Fact sheet

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### Key points

- *Besnoitia* spp. are protozoa that infect a wide range of vertebrates including mammals, reptiles and birds.
- *Besnoitia* may cause disease (besnoitiosis) in herbivore species, including cattle (*B. besnoiti*), horses (*B. bennetti*) and goats (*B. caprae*).
- The only *Besnoitia* species confirmed to be present in Australia is *B. wallacei*, in rats in Tasmania.
- An uncharacterised *Besnoitia*-like organism has been associated with nasal bleeding in captive and free-ranging kangaroos, a syndrome known as **macropod protozoal rhinitis** (MPR).
- The significance of *Besnoitia* sp. in Australian native wildlife remains unknown. Reporting of cases of disease associated with *Besnoitia*-like organisms in Australian wildlife is encouraged.

### Aetiology

*Besnoitia* are a genus of cyst-forming protozoal parasites closely related to *Toxoplasma gondii* and *Neospora caninum*, in the family *Sarcocystidae*. *Besnoitia* species have a two-host cycle with a carnivore definitive host [DH] and a herbivore intermediate host [IH]. Besnoitiosis is the name for the disease in the intermediate host.

### One Health implications

**Wildlife and the environment:** *Besnoitia* may be associated with the potentially fatal syndrome of macropod protozoal rhinitis. The significance of *Besnoitia* sp. in Australian native wildlife remains unknown and further work is required to better understand this syndrome.

**Domestic animals:** *Besnoitia* spp. can cause disease in livestock species, but these species of *Besnoitia* are not present in Australia.

**Human health:** *Besnoitia* species are not considered to be zoonotic.

### Natural hosts

The DH for several *Besnoitia* species is known to be the cat (*Felis catus*). The DHs of many species of *Besnoitia* are still unknown, but are presumed to be carnivore species <sup>[1]</sup>.

Globally, *Besnoitia* spp. have been found in a wide variety of vertebrate IH including wild and domestic ungulates, rodents, opossums and lizards [2]. Clinical disease has only been recognised in the herbivore IH [1].

## World distribution

Species of *Besnoitia* occur in many areas of the world.

## Occurrences in Australia

In Tasmania, free-living black rats (*Rattus rattus*) are considered the IH for *B. wallacei*; the DH is the cat [3, 4]. No other species of *Besnoitia* are confirmed to occur in Australia.

## Macropod protozoal rhinitis – a possible *Besnoitia* infection

A syndrome termed **macropod protozoal rhinitis** (MPR) has been described in small numbers of kangaroos [5]. *Besnoitia*-like organisms have been identified on histopathology and cytology of nasal cavity tissues in affected animals. Affected macropods are primarily juvenile western grey kangaroos (*Macropus fuliginosus*) in care, but it has also been reported in red kangaroos (*M. rufus*) in care (W. Boardman pers. comm.). Cases have been reported from WA [5, 6], SA [7, 8] and Qld (S. Besier pers. comm.). Attempts to culture and confirm the identity of the organism are ongoing but have not been successful to date. There are fewer than 10 cases recorded in eWHIS.

## Epidemiology

In a typical *Besnoitia* transmission pathway, the DH becomes infected by ingesting tissue cysts within the carcass of an IH. The IH can become infected after ingesting sporulated oocysts excreted in the faeces of the DH, or after mechanical (by biting arthropods) and direct transmission of the protozoa from other infected IH [9]. Oocysts ingested by the IH may develop into cysts within the tissues and organs.

***Besnoitia wallacei***: the lifecycle in Australia involves the cat as the DH and the black rat as the IH [4]. It is not known if this or other species of *Besnoitia* occur in Australian native fauna.

**Macropod protozoal rhinitis**: although it is believed that a *Besnoitia*-like organism may be the cause of MPR, transmission pathways and epidemiology are not known. If a *Besnoitia* spp. is responsible, it may be assumed that a carnivore is the DH. The roles of vectors and horizontal transmission between kangaroos in the transmission of MPR are not known.

MPR has been observed primarily in immature western grey kangaroos in care during hand-rearing. It is reported in both males and females. Animals are normally aged around 10 to 18 months of age. There is some evidence of a seasonal occurrence [6].

## Clinical signs

In bovine besnoitiosis, the acute phase of disease is associated with proliferation of the parasite in the blood vessels, causing pyrexia and fluid leakage (oedema) of the limbs, head and neck. Oedema of the respiratory tract may cause respiratory signs. Chronic disease occurs with the

formation of parasitic tissue cysts in connective tissues causing skin thickening (scleroderma), skin nodules (particularly of the legs, ears and back) and cysts in the scleral conjunctiva, vulva and nasal mucous tissues. Death may occur in both acute and chronic phases of disease <sup>[9]</sup>.

Nasal bleeding and rhinitis have been described in WG kangaroos affected by MPR <sup>[6]</sup>. Initially the clinical signs are mild with occasional blood-tinged mucus being discharged from the nostrils. In some cases, this advances to the occasional discharge of frank blood. Often nasal bleeding is self-limiting but in some cases nasal blood loss leads to anaemia, exsanguination and death.

## Diagnosis

Diagnosis of besnoitiosis in cattle is based on clinical inspection to identify typical clinical signs and external lesions, supplemented by herd serology (IFAT, ELISA, Western Blot or MAT) or PCR to detect subclinical infections. A combination of serological tests is recommended, especially for individual animals, to improve sensitivity and specificity <sup>[10]</sup>. Confirmatory diagnosis involves cytology or histology of lesions to identify organisms or tissue cysts <sup>[9]</sup>.

In the DH, oocysts may be present in faecal samples and may be detected by direct microscopy or faecal flotation.

In macropods with MPR, *Besnoitia*-like cysts or parasites may be visible on cytology of nasal smears or flushes, or on histopathology of turbinate biopsies.

## Laboratory diagnostic specimens

Recommended samples for diagnosis of MPR are:

- fresh nasal flushes and nasal swabs for cytology, PCR and culture
- turbinate biopsies fixed in 10% formalin for histology
- formalin-fixed samples of gastrointestinal tract, lung, trachea and grossly visible tissue cysts
- fresh tissue samples for molecular characterisation.

## Pathology

The acute phase of *B. besnoiti* infection in IH is characterized by the presence of tachyzoites, which proliferate mainly in the endothelial cells of blood vessels. Tachyzoites are also able to invade and multiply in white blood cells. In later phases of infection, tissue cysts develop, with a wall formed of at least three layers; the outer layer consists of connective tissue-like material, the intermediate layer contains the cytoplasm of the typically multinucleated host cell, and the inner layer surrounds the encysted stages – the bradyzoites. The tissue cyst-containing cells are generally fibroblasts, myofibroblasts, tissue repair fibroblasts, endothelial cells, or smooth muscle cells <sup>[9]</sup>.

In macropods with MPR, macroscopic lesions may be evident in the turbinates, nasal septum, larynx and trachea associated with copious haemorrhage. On histopathology, *Besnoitia*-like cysts or parasites may be visible in the epithelial and sub-epithelial tissues, associated with erosion and ulceration <sup>[6, 11]</sup>.

## Differential diagnoses

In bovids, other skin diseases such as dermatophytosis, photosensitisation and mange may cause similar lesions to besnoitiosis <sup>[9]</sup>.

Differentials for MPR include other causes of rhinitis and nasal bleeding, particularly trauma, foreign bodies and snake bite.

## Treatment, prevention and control

No effective treatment for besnoitiosis has been reported. Prevention and control in livestock includes methods to test and remove clinically-infected individuals or herds, and testing individuals prior to addition to a clean herd <sup>[9]</sup>.

Supportive treatment of kangaroos affected by MPR to mitigate the effects of blood loss is warranted.

## Research

The lifecycle of many *Besnoitia* species is yet to be determined. It would be useful to speciate any organisms associated with disease in Australian wildlife. MPR should be considered as a differential in events involving nasal bleeding in macropods. Investigations of unusual or significant wildlife disease events may be eligible for National Significant Disease Investigation funding <https://wildlifehealthaustralia.com.au/Our-Work/Surveillance/National-Significant-Disease-Investigation-Program>. To apply, contact WHA or your state/territory WHA Coordinator (see <https://wildlifehealthaustralia.com.au/Incidents/WHA-Coordinator-Contacts>).

## Surveillance and management

Wildlife Health Australia administers Australia's general wildlife health surveillance system, in partnership with government and non-government agencies. Wildlife health data is collected into a national database, the electronic Wildlife Health Information System (eWHIS). Information is reported by a variety of sources including government agencies, zoo based wildlife hospitals, sentinel veterinary clinics, universities, wildlife rehabilitators, and a range of other organisations and individuals. Targeted surveillance data is also collected by WHA. See the WHA website for more information <https://wildlifehealthaustralia.com.au/Our-Work/Surveillance> and <https://wildlifehealthaustralia.com.au/Our-Work/Surveillance/eWHIS-Wildlife-Health-Information-System>.

The findings of *Besnoitia*-like organisms, or *Besnoitia* spp. in samples from wildlife in Australia are considered interesting and unusual and are logged in eWHIS. We are interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. If you can help, please contact us at [admin@wildlifehealthaustralia.com.au](mailto:admin@wildlifehealthaustralia.com.au).

## Acknowledgements

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*Wildlife Health Australia recognises the Traditional Custodians of Country throughout Australia. We respectfully acknowledge Aboriginal and Torres Strait Islander peoples' continuing connection to land, sea, wildlife and community. We pay our respects to them and their cultures, and to their Elders past and present.*

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## References and other information

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