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## Possums and *Mycobacterium bovis*

### Fact Sheet

April 2017

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#### Introductory statement

*Mycobacterium bovis* is not present in Australia but is a significant disease issue in feral brushtail possums (*Trichosurus vulpecula*) in New Zealand. Tuberculosis has never been reported in Australian brushtail possums. Given Australia's strict quarantine system and tight border controls, it is extremely unlikely that *M. bovis* will be introduced by infected possums being brought into Australia from New Zealand (NZ). Surveillance of health and disease issues in brushtail possums in Australia remains an important component of Australia's animal disease surveillance system.

#### Aetiology

Tuberculosis in brushtail possums is caused by *Mycobacterium bovis* a slow growing, nonsporing, nonmotile, Gram positive acid fast bacterium.

#### Natural hosts

Cattle are the natural hosts of *M. bovis* (Coleman and Caley 2000). In the NZ situation, possums are considered a true maintenance host for *M. bovis*. Possums have been shown to be exquisitely sensitive to infection with *M. bovis* (Nugent et al. 2015).

#### World distribution

*Mycobacterium bovis* is widespread through many areas of the world, however Australia is free of *M. bovis*. Brushtail possums have been found to be infected with *M. bovis* but only in NZ.

#### Occurrences in Australia

Australia has been free of bovine tuberculosis (*M. bovis*) since 2002. The disease was eradicated as a result of an extensive eradication program that began in the 1970s.

Tuberculosis has never been diagnosed in Australia's possums, even prior to eradication of *M. bovis* when possums were sympatric with *M. bovis*-infected cattle<sup>1</sup>. Australia has had ongoing surveillance

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<sup>1</sup> More information about important diseases affecting Australian livestock can be found at the Animal Health Australia website ([www.animalhealthaustralia.com.au](http://www.animalhealthaustralia.com.au)).

and monitoring programs to ensure that any incursion of bovine tuberculosis would be promptly detected.

## Epidemiology

*Mycobacterium bovis* was introduced into NZ via cattle in the 1830s-1840s. Brushtail possums were first introduced to NZ in the 1850s, however the first cases of *M. bovis* in possums in NZ were not recorded until 1967. It has been suggested that *M. bovis* did not spill over into possums directly from cattle in NZ, but rather indirectly via *M. bovis* infected wild deer. The advent of commercial deer hunting in the 1960s resulted in potentially infective carcase and offal being left in the field, allowing possums exposure to the organism (Nugent et al. 2015). By 2009, it was estimated that tuberculosis infected possums occupied 38% of New Zealand's 6.24 million hectares (Nugent et al. 2015). Of the infected cattle herds, 75% are in areas occupied by infected possum populations.

Possums are considered to be the primary wildlife reservoir of *M. bovis* in NZ and are considered extremely susceptible to *M. bovis* infection, with as few as 20 colony-forming units leading to disease. The primary route by which possums become infected is still unclear, but is most likely due to direct transmission between animals, via a number of routes, most probably by percutaneous infection of limbs with small numbers of organisms, sometimes via the respiratory route and less commonly by ingestion of infected material (Nugent et al. 2015). Infectious agent is most significantly shed in respiratory secretions and exudate from draining sinuses, although individual possums probably only become "infectious" later in the course of disease. Shedding in urine and faeces is considered epidemiologically unimportant. Environmental contamination is less important as the bacteria survive for two to three weeks in possum dens but only two days in open environments. Transmission via the den is no longer considered an important route of infection (Nugent et al. 2015).

Infection in possums is independent of age but more prevalent in males than females. Prevalence in possum populations averages 5% but can vary from 1% to 60% with the higher prevalence tending to occur in possums foraging on pasture adjacent to forest. This is likely because possum abundance and concentration decreases further into the forest reducing opportunities for transmission. Transmission to livestock is considered likely to occur through cattle and deer approaching and investigating, sniffing or licking diseased or dead possums (Buddle and Young 2000, Coleman and Caley 2000). Ferrets and pigs may be infected by direct ingestion of infected possum carcasses (Nugent et al. 2015).

The disease has never been seen in possums in Australia, presumably due to differing epidemiological factors in the Australian environment, possibly lower population density and different denning behaviour. Population density in Australia varies from 4.0 per hectare in Tasmania to 0.2 per hectare elsewhere (Kerle 2001). In contrast possum population density in NZ ranges from 0.5 to 25.0 per hectare with densities above 15.0 per hectare recorded from forest near pasture edges (Efford 2000). Additionally, the potential spillover route from infected wild deer, via commercial hunting, is less likely to have occurred in the Australian context.

## Clinical signs

Affected possums become lethargic, lose weight and develop discharging fistulae. Possums can survive for more than a year post infection, however most naturally infected individuals die within six months (Nugent et al. 2015).

## Diagnosis

A preliminary diagnosis can be made by finding enlarged superficial lymph nodes and discharging fistulae. This is confirmed by cytology, stains and culture. There are no serological tests available at this stage.

## Laboratory diagnostic specimens and procedures

A complete necropsy should be performed. Samples of lesions should be submitted fresh for culture, cytology and in formalin for histopathology.

An acid-fast stain on formalin fixed tissue will generally reveal large numbers of organisms within lesions. *M. bovis* grows slowly on selective culture media. Cultures are incubated for eight weeks with growth usually becoming visible after three to six weeks. Molecular diagnostic techniques such as PCR may also be used.

## Pathology

Naturally infected possums most frequently have only a single, or low numbers of gross lesion. Lesions are most commonly found in the lungs or associated lymph nodes and axillary and inguinal lymph nodes, with lesser involvement of the spleen, liver and kidneys. Abscesses are thin walled and filled with caseous material and may intermittently discharge their contents to the exterior via sinuses. Histologically, nodules consist of a central zone of necrosis surrounded by mixed inflammatory cells and large numbers of intracellular acid fast organisms with much fewer extracellular bacteria. Possums are unable to wall off lesions so fibroplasia, mineralisation and multinucleate giant cells are rare (Ladds 2009, Buddle and Young 2000, Coleman and Caley 2000).

## Differential diagnoses

Differential diagnoses include other pyogenic diseases caused by bacteria such as *Corynebacteria*, and diseases causing pulmonary nodules such as adiaspiromycosis (Ladds 2009, Clifton-Hadley et al 2001).

## Treatment

Diseased possums in New Zealand are not treated.

## Prevention and control

There are estimated to be around 30 million possums in New Zealand, although the actual carrying capacity is believed to be closer to 48 million (Warburton et al. 2009). New Zealand has a national program to eradicate *M. bovis* from free-ranging possum populations and approximately \$NZ50

million dollars is spent annually on possum control (Livingstone et al. 2015; Nugent et al. 2015). Current control programs focus on reducing the density of susceptible hosts to below the disease persistence threshold for at least five years, through lethal culling of possums, primarily via aerial baiting. Other strategies include creating specific geographic buffer zones around farmland, free of possums. Forecast modelling has been used to guide targets for possum population thresholds. New Zealand has reported a 95% decrease in the number of infected cattle and deer herds (from a peak in 1994) and the eradication of *M. bovis* from infected possum populations from 830,000 hectares. The country is considered within target of achieving national eradication of *M. bovis*, and significantly in advance of the 40–50-year timeline which was forecast in 2011 (Livingstone et al. 2015).

Vaccination of possums using the BCG vaccine has been investigated. It does not offer complete protection but reduces the severity of the disease. Research indicates that vaccinated possums have a significant level of protection two and six months' post vaccination but not at 12 months (Buddle and Young 2000).

## Research

Significant resources have been invested over decades to understand the epidemiology of *M. bovis* in the NZ context. Ongoing investment is required to further refine objectives and understanding (Livingstone et al. 2015; Nugent et al. 2015).

## 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>.

Mycobacterial diseases are included in the list of diseases captured in eWHIS. There are no reports of *M. bovis* or tubercule forming mycobacteria in any wild animal from Australia's States and Territories in the national database and *M. bovis* has never been identified in possums in Australia.

*Mycobacterium bovis* is exotic to Australia and any suspicious cases of tuberculous disease in possums (or other wildlife) should be reported to the **Emergency Animal Disease Hotline (1800 675 888)**.

## Statistics

No cases of *M. bovis* tuberculosis have been identified from brushtail possums in Australia.

## Human health implications

Worldwide *M. bovis* is responsible for 100,000 to 200,000 human deaths annually. However, in New Zealand *M. bovis* only accounts for between 1% and 5% of human tuberculosis cases diagnosed annually because of milk pasteurisation and tuberculosis control programs in cattle.

## Conclusions

*Mycobacterium bovis* is a serious disease of possums, cattle and deer in NZ, and, in that context, possums are considered a true reservoir for the organism. Tuberculosis has never been reported in Australian brushtail possums and it is very unlikely that *M. bovis* could be introduced by infected possums from New Zealand. Ongoing surveillance of brushtail possums in Australia is necessary to assure trading partners of Australia's disease free status and to maintain the capacity to detect any early cases in possums should the disease appear.

## Acknowledgements

We are grateful to the people who contributed to this fact sheet.

*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.*

Updated: April 2017

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