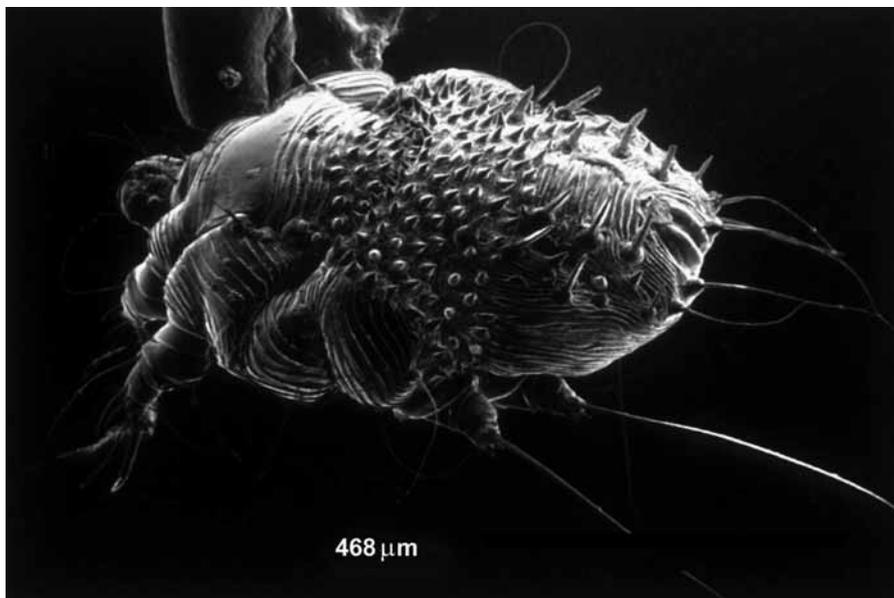




Sarcoptes scabiei: an important exotic pathogen of wombats

Sarcoptes scabiei is a parasitic astigmatid mite, which causes scabies in people and sarcoptic mange in mammals (Figure 1). Importantly, it is an emerging disease in wildlife throughout the world¹. The mite originates from a human ancestor and is thought to have spread to domestic and then free-living animals^{2,3}. Based on the recent emergence of sarcoptic mange in Australian wildlife and Aboriginal communities, it is thought that *Sarcoptes scabiei* was probably introduced to Australia by the Europeans and their animals^{3,4}. The mitochondrial genetic similarity of mites from Australian wildlife and domestic animals supports this^{3,5}. In Australian wildlife, sarcoptic mange has been reported in the common wombat *Vombatus ursinus*, southern hairy-nosed wombat *Lasiorchinus latifrons*, koala *Phascolarctos cinereus*, common ringtail possum *Pseudocheirus peregrinus* and in 2003 in the agile wallaby *Macropus agilis*^{4,6}. Compared with other native species, sarcoptic mange has by far its greatest impact on wombats, particularly common wombats, and is capable of causing high morbidity and mortality rates⁷.

Figure 1. Scanning electron micrograph of an adult female, *Sarcoptes scabiei* var. *wombati* (length of body 468 μ m). Note the lack of a clearing in the field of dorsal scales.



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Epidemiology in wombat populations

Sarcoptic mange generally occurs at low prevalence (0 - 15%) in common wombat populations throughout southeast Australia^{7,8}. Its low prevalence is attributed to high mortality and immunity rates, resulting in the removal of susceptible individuals from populations. It rarely occurs in southern hairy-nosed wombats, which are found in South Australia and Western Australia^{4,7}. The difference in incidence may be attributed to differences in species susceptibility or differences in the environment. Southern hairy-nosed wombats inhabit more hot and arid areas compared with common wombats. These conditions are less

favourable for survival of the mite when off the host. It is thought that the duration of mite survival off the host is a key component affecting transmission between wombats because wombats are generally antisocial and avoid contact with one another⁹. Wombats rely on burrows for diurnal shelter and transmission may occur when wombats share burrows. Burrows enhance the survival of mites when off the host by providing a stable temperate environment.

Epidemics of sarcoptic mange occur sporadically within wombat populations and appear to be mainly associated with introduction of *S. scabiei* into naive populations or to occur during times of nutritional stress such as drought, which are thought to lower immunity. There are also anecdotal reports of higher prevalences in winter, possibly associated with increased mite survival off the host and in populations at high density, possibly associated with increased burrow sharing and transmission. Foxes and dogs may be important in introducing *S. scabiei* into wombat populations, but are not important in maintaining its endemicity⁷. There appears to be no sex or age predilection for sarcoptic mange in wombats¹⁰.

Clinical signs and diagnosis

Clinical signs of sarcoptic mange in wombats are erythema, followed by parakeratosis and hair loss and are correlated with intensity of infection (Figure 2)^{11,12}. Incubation period for erythema to develop is around 14 days but occurs within 24 hours upon re-infection. The rate of development of other clinical signs is related to the dose of mites and the degree of immunity. Severe mange may take several months to develop¹². Trauma from fighting and heavy parasitism with other mites such as *Acaroptes vombatus* can have similar clinical signs of scale and hair loss (LF Skerratt, unpublished observations).



However, thick parakeratotic scale (up to 1cm thick) is pathognomic for sarcoptic mange. Diagnosis is confirmed by the presence of numerous *S. scabiei* within the bottom layer of parakeratotic scale. The presence of sarcoptic mange in wombat populations usually becomes obvious when wombats with severe mange start feeding during the day¹¹.

Pathogenesis and immunity

Sarcoptic mange causes emaciation and death in wombats through a combination of increasing the energy requirements of the host whilst reducing the ability of the wombat to meet these additional energy demands due to the debilitating effects of the disease. Wombats with severe sarcoptic mange have restricted movement, vision and hearing. The delayed and immediate immune responses appear to limit mite population growth. An acquired immune response may increase the ability of a wombat to limit mite population growth¹³.

Treatment

There are acaricides such as the avermectins, which are easily applied topically. However, these topical applications may not be totally effective if the wombat has moderate to severe sarcoptic mange. This is because parakeratotic scale acts as a barrier to the acaricide, preventing it from reaching the

superficial layers of the epidermis where most mites reside (LF Skerratt, *unpublished observations*)¹⁴. In addition, topical acaricides that are supposed to be absorbed systemically, and then redistributed to other areas of the skin, will fail if they are prevented from being absorbed by parakeratotic scale and a thickened epidermis¹⁴. Injection of acaricides is the preferred method of drug delivery. Treating with two acaricides, one systemic and the other topical, appears to be very effective in reducing intensity of infection and eliminating infection¹⁰. Mechanical removal of parakeratotic scale and mites by washing the wombat with a keratolytic shampoo is also effective in reducing the intensity of infection¹⁰. This should not be attempted in debilitated free-living animals since they may die from such a procedure (LF Skerratt, *unpublished observations*). Treatment with long-acting antibiotics is also indicated in wombats with moderate to severe sarcoptic mange as they are predisposed to bacterial infections of internal organs¹¹.

Conservation, welfare and management

Sarcoptic mange represents a threat for wombat populations. Whilst enzootic sarcoptic mange may slow or halt population growth, epidemics of sarcoptic mange have the ability to dramatically reduce the abundance of

wombats^{4,7}. In agricultural areas, where wombats are considered pests, epizootics of sarcoptic mange in wombats may be viewed by farmers as beneficial. However, epizootics of sarcoptic mange together with other concomitant causes of mortality, may lead to the extirpation of small, isolated wombat populations

Wildlife carers, naturalists, wildlife biologists and rural landowners often associate an outbreak of sarcoptic mange with a decline in their local wombat abundance. However, most conservation authorities do not regard sarcoptic mange as a threat to the conservation of wombats. Although sarcoptic mange is widespread in common wombats, they are abundant in Victoria, New South Wales and Tasmania and are regarded as pests in many agricultural areas^{7,15}. Common wombats are rare in Queensland and South Australia^{15,16}. South Australia has been the only state that has funded a survey of the distribution and prevalence of sarcoptic mange in wombats⁷, possibly because common wombats are regarded as vulnerable in South Australia¹⁵. Although sarcoptic mange does not occur in the endangered northern hairy-nosed wombat (*Lasiornhinus krefftii*), there are concerns about its possible introduction.

In the past, control techniques for sarcoptic mange in wombat populations have been limited to the culling of severely affected animals. These animals have been culled mainly for welfare reasons because of the obvious debilitating effects of severe sarcoptic mange⁴. However, since severely affected animals are a major source of mites¹¹, culling may also reduce the transmission rate of mites and hence reduce the spread of sarcoptic mange. Recently, there have been attempts by wildlife carers to control sarcoptic mange in wombat populations with acaricides. The effectiveness of these control programs needs to be determined.

Human health implications

Generally, human infection with mites from wombats appears to result in self-limiting disease. Treatment with 5% permethrin can reduce duration of clinical signs of zoonotic infection by two weeks¹⁷.

Figure 2. Adult, male common wombat (*Vombatus ursinus*), from Christmas Hills, Victoria with severe parakeratotic sarcoptic mange showing typical distribution of parakeratotic scale, hair loss and excoriation.





Future directions

Our understanding of the epidemiology of sarcoptic mange in wombat populations is mostly based on anecdotal information, one PhD study and extrapolating from knowledge derived from studies on other species. It is important that observational and experimental studies are carried out to test many of the assumptions derived from this evidence as well as provide a deeper understanding. In addition, modern molecular epidemiological techniques could be used to examine the role of foxes and dogs in spreading mites between wombat populations.

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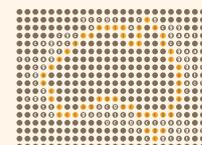
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