The impact of ticks and tick-borne diseases on native animal species in Australia

Introduction

Ectoparasites are a leading cause of arthropod-borne disease in animals, and humans1,2. Defined as arthropods which spend an entire portion of their life cycle on the host, ectoparasites include the ticks and mites (Acarina), and the lice and fleas of the insect family. Their role in human disease transmission has been well documented, as has their importance in agricultural3,4 and domestic animals. Little however has been done to comprehensively examine the role these organisms may play in disease transmission and their impact upon native Australian fauna. It is important to consider the effects of such disease agents on the survival of both captive and wild native animal populations, particularly as exposure to a novel pathogen may remove endangered animals that are a vital pool of genetic diversity5.

In the late 1980s, captive breeding colonies were established to conserve, isolate and protect at risk populations of Australian native animals, such as the eastern barred bandicoot (Perameles gunnii) and the northern hairy-nosed wombat (Lasiorhinus krefftii)6,7. One aim of this strategy was to build-up population numbers for later re-introduction into the wild1. Many previously unrecognised problems are now becoming apparent in such captive-raised populations and include increased disease exposure and transmission arising from population concentration and abnormal interactions5. Moreover increased stress levels in native animals have shown to increase parasite burdens and result in immunosuppression7. Upon release into the wild, exposure of naïve animals, bred in captivity, to ectoparasite infestation and their pathogens can prove fatal8. Pathogens introduced via domestic or wild, exposure of naïve animals, bred in captivity, to ectoparasite infestation and their pathogens can prove fatal8. Pathogens introduced via domestic or wild, exposure of naïve animals, bred in captivity, to ectoparasite infestation and their pathogens can prove fatal8. Pathogens introduced via domestic or wild, exposure of naïve animals, bred in captivity, to ectoparasite infestation and their pathogens can prove fatal8. Pathogens introduced via domestic or wild, exposure of naïve animals, bred in captivity, to ectoparasite infestation and their pathogens can prove fatal8.

Figure 1. Wild caught common ring-tail possum infested with ‘scrub’ ticks (Ixodes holocyclus). This tick is a known carrier of Rickettsia australis the causative agent of Queensland typhus. Courtesy of Christine Rand.

Australian fauna. By far, most research has been undertaken on ticks, as these pose significant threat to domestic and agricultural animal health. This review focuses on what is known regarding the role of ticks in disease transmission and the implications for our wildlife.

Ticks transmit the largest range of known pathogens, including protozoa, bacteria, rickettsia and viruses, compared to all other arthropods9. What makes ticks significant in their disease transmission is the ability of some species to parasitise and feed on a wide range of host species. Disease in animals of agricultural importance has received significant attention, with efforts focusing primarily on cattle and the cattle tick, Boophilus microplus9. Tick fever is caused by a number of tick-borne protozoal species including Babesia bovis, the most pathogenic, as well as B. bigemina and Anaplasma marginale10. The fourth protozoan, Theileria buffeli (mutens) rarely results in acute disease11.

Babesia species are known to cause haemoprotozoal disease in canines12, with disease severity being dependant on the breed of dog and virulence of the species involved13. B. canis and B. gibsoni have been detected in Australian canines14, but molecular techniques indicate that multiple species exist15. Two Babesia species have been identified in marsupials, the first, B. thyacalis, was described in northern quolls (Dasyurus hallucatus) and has since been isolated from short and long-nosed bandicoots (Isoodon macrourus and Perameles nasuta), where it may be associated with post-mating mortality16. B. tachyglossus has been found in the short-beaked echidna (Tachyglossus aculeatus) but no apparent pathology has been recorded17. Ticks also harbour Ehrlichia species,
many of which have been implicated in haematological disease in several mammalian species worldwide. Ehrlichia platys, (now Anaplasma platys) recently described in canines and transmitted by the brown dog tick Rhipicephalus sanguineus appears to be the dominant species in Australia. Infection with E. canis, is similar in its pathology but has not yet been found in Australian canines. The infection is treatable and rarely fatal. However, Ehrlichia are capable of co-infection with other pathogens such as Babesia canis, increasing overall virulence, and highlighting a potential threat to naïve populations such as the dingo. With domestic dog infections often asymptomatic and a native reservoir yet to be identified, transmission to native species, unless causing severe disease, could go largely unnoticed.

Coxiella burnetti, the causative agent of Q fever, affects mainly those employed in agriculture and veterinary industries, who become infected through inhaling infected material. This organism is carried by the tick vector Amblyomma trigattatum trigattatum which parasitises bandicoots, macropods, domestic animals and birds.

Most of these animals remain asymptomatic, but pathogenicity has been recorded in sheep and is known to affect sheep production. The vector distribution has recently expanded, and is thought to be the result of climate change and human and domestic animal encroachment into previously isolated areas.

Rickettsiae are well known tick-borne pathogens of humans. Queensland tick typhus is caused by R. australis and transmitted by Ixodes holocyclus and I. tasmani. The ticks parasitise domestic dogs and native rodents and bandicoots, which are thought to be reservoirs for the rickettsiae. Asymptomatic canine populations may act as a source of infection for susceptible animal species.

Tick paralysis of humans and domestic animals by neurotoxins in the saliva of the ‘scrub tick’ (Ixodes holocyclus), is a common complication of tick bites. Susceptible animals are those that have not been habituated to tick exposure and may experience cardiovascular abnormalities causing paralysis and death. Marsupials appear to be unaffected by the toxin, however the spectacled flying fox (Pteropus conspicillatus) population in northern Queensland has rapidly declined as a consequence of increased infestation by the tick. Climate and environment change, as well as habitat destruction are thought to be responsible for the increased exposure of the spectacled flying fox to the scrub tick.

In addition to transmission of infectious agents, ticks can cause a number of secondary complications. Anaemia, resulting from heavy infestation, is not only commonly seen in livestock such as cattle, but also in native species such as koalas (Phascolarctos cinereus). The effects of long-term infestation in koalas is unknown, however a study in northern brown bandicoots (Isodon macrourus)
has shown that long-term exposure can result in lowered growth rates and haematocrit values, as well as an increase in immune response. The inevitable exposure of wild and re-released captive-bred populations to tick infestation and the associated complications requires consideration when developing long-term animal management plans.

**Conclusion**

The potential for indigenous and introduced ectoparasites, responsible for the infestation of native species (Figure 1), to act as a source of novel or emerging infectious pathogens of wildlife. Philosophical Transactions of the Royal Society of London 356:1001-1012.

Immunosuppression associated with normal ectoparasite infestation may even enhance pathogen transmission and this, coupled with exposure to novel parasites and their agents, may have a strong impact on the long-term survivability of rare and endangered native animals. The effects ectoparasites could have on already fragile populations, through infestation and which infectious organisms are present and capable of circulation, requires serious consideration when addressing long-term management strategies for rare and endangered species.

This review has highlighted what is and isn’t known regarding the role of ticks in transmission of disease in native animal populations. Even less is known regarding the role of other ectoparasites, the mites, lice and fleas. This is an area in need of greater research focus.

**References**


