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Echinococcus granulosus in Australia, widespread and doing well!

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Abstract

Echinococcus granulosus is the only member of the Genus *Echinococcus* to occur in Australia. The major biomass of *E. granulosus* occurs in wildlife. The wildlife transmission cycle is predominantly perpetuated via a predator/prey interaction between wild dogs (dingoes and dingo/domestic dog hybrids) and macropodid marsupials (wallabies and kangaroos). Other wildlife hosts include foxes, wombats and feral pigs. This wildlife reservoir for *E. granulosus* "spills over" to help maintain a domestic cycle through *E. granulosus*-infected wild dogs defecating on pasture, transmitting infection to livestock and some farmers and hunters feeding hydatid-infected offal of macropodids or feral pigs to domestic dogs. The potential transmission risk to humans using public picnic and camping areas in parks and forests, especially in the southeastern Australia, could be substantially reduced through regular distribution of baits containing praziquantel. Encroachment of wild dogs and foxes into urban centers presents a new potential path of transmission from wildlife to humans.

Keywords: *Echinococcus granulosus*; Australia; Wildlife; Wild dogs; Dingoes; Kangaroos; Wallabies; Domestic dogs; Thylacines; Human; Infection; Control

1. Introduction

Echinococcus granulosus can be found on all continents of the world, an impressive feat for a parasite with limited means of locomotion that originated in the northern hemisphere. The international migration of *E. granulosus* to the continents of the southern hemisphere was achieved in association with translocation of domestic animals (sheep and dogs) during various phases of European colonisation.

Sheep first arrived in Australia in 1788 but the earliest introductions were unsuccessful. However, Spanish merinos adapted well and by 1860 Australia had a population of 20 million merinos [1]. Through complete ignorance of the transmission pattern and public health importance of *E. granulosus* plus the abundance of potential animal hosts, *E. granulosus* spread quickly in livestock and dogs in Australia and by the1860s, human hydatidosis was a major public health issue in the new colony [1].

Of great importance for the establishment and perpetuation of *E. granulosus* in Australia was the ability of the parasite to also incorporate Australian native wildlife into its transmission pattern. Non-marsupial dingoes (*Canis lupus dingo*), the top-order predator present in Australia at the time of European settlement, had arrived 4000–5000 years previously from southeastern Asia and displaced the thylacine (*Thylacinus cynocephalus*), the original marsupial top-order predator [2]. The importance of the dingo, in respect of *E. granulosus* transmission, was that it was a canid, highly susceptible to infection with *E. granulosus* and large enough to predate on sheep. The dominant native herbivorous fauna in Australia at the time of European settlement were macropodid marsupials (kangaroos and wallabies) that had evolved in isolation in Australia and were highly susceptible to infection with *E. granulosus*. Transmission of *E. granulosus* into wildlife is likely to have occurred first through macropodids becoming infected by accidental ingestion of eggs of *E. granulosus* passed by domestic dogs, and dingoes predating on hydatid-infected sheep. It has been proposed that transmission of *E. granulosus* to Australian wildlife was greatly assisted by transhumant grazing of sheep, an agricultural practice that persisted in eastern Australia until 1972 [3].

A major recent achievement in the control of *E. granulosus* in Australia has been the provisional eradication of *E. granulosus* from Tasmania. This impressive achievement was

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the result of more than 30 years of concerted, well-funded and organised hydatid control, backed up by state legislation [4].The most important factors contributing to the success of the Tasmanian campaign were that wildlife never became involved in transmission and, as an island, the control area was manageable and movements of animals into Tasmania could easily be controlled [1].

Domestic dogs and livestock still become infected with *E. granulosus* on mainland Australia but the prevalence is lower than 50 years ago [1]. However, the main source of infection for domestic animals today is via wildlife [3] rather than through a domestic animal transmission pattern. Therefore, the emphasis of this paper will be on transmission of *E. granulosus* within the wildlife reservoir, including circumstances where the wildlife reservoir may "overflow" into domestic animals.

2. *E. granulosus* transmission in wildlife

The transmission pattern for *E. granulosus* in Australian wildlife is maintained through a predator/prey interaction between wild dogs (dingoes and dingo/domestic dog [*Canis familiaris*] hybrids), foxes (*Vulpes vulpes*) and macropodid marsupials [5], wombats (*Wombatus ursinus*) and feral pigs (*Sus scrofa*). Data indicate *E. granulosus* can utilise whatever hosts are available, transmitting between wildlife and domestic animals and also to humans [3].

2.1. Wild dogs

Dingo hybrids are similarly susceptibility to *E. granulosus* as pure-bred dingoes [5,6]. The prevalence of *E. granulosus* in wild dogs, particularly in eastern Australia, is high with prevalence levels ranging between 25% and 100% in Victoria and New South Wales [5] and between 76% and 100% in eastern Queensland [7–9]. The worm burdens in wild dogs in southeastern Australia are commonly up to 10,000 worms but burdens greater than 50,000 to 100,000 worms occur regularly [5]. Heavier burdens, up to 300,000 worms, have been recorded [6]. Wild dogs represent the most important definitive host for transmission of *E. granulosus* in Australia today.

2.2. Wild dogs in urban areas

A recent development in the behaviour of wild dogs in Queensland has been incursions of wild dogs, some *E. granulosus* infected, into urban habitats, Townsville [10], northwestern Brisbane (Jenkins and Shield, unpublished data) and the Sunshine Coast (Jenkins and Allen, unpublished data). These "urban" wild dogs scavenge rubbish bins, defecate in gardens and have been reported killing domestic pets. Apart from the public nuisance, the presence of *E. granulosus*-infected wild dogs in residential areas is a potentially important public health issue. Brown and Copeman [10] reported *E. granulosus* in 6 of 20 wild dogs examined from Townsville and Jenkins and Allen (unpublished data) have found 11 infected of 44 wild dogs examined from the Sunshine Coast. Worm burden data were unavailable from the Townsville wild dogs, but the worm burdens in the 11 Gold Coast dogs ranged between 120 and 10,950 worms.

2.3. Macropodids

Kangaroos and wallabies are the most widespread wildlife intermediate hosts for *E. granulosus* in eastern Australia, consisting of three main species, eastern grey kangaroos (*Macropus giganteus*), red-necked wallabies (*Macropus rufogriseus*) and swamp wallabies (*Wallabia bicolor*). Of all intermediate macropod hosts examined in southeastern Australia, the highest prevalence of infection (over 60%) and the highest cyst fertility has been found in swamp wallabies [5]. Swamp wallabies are of importance in the transmission pattern of *E. granulosus* because they are a favoured food item of wild dogs [5]. The site of predilection for *E. granulosus* metacestodes in macropodids is in the lungs, which may render infected animals more susceptible to predation, through compromised lung function [6]. Durie and Riek [7] reported catching a sick red-necked wallaby by hand, that was later found infected with a large lung hydatid cyst. The authors believed the cyst to be the cause of the incapacity of this animal. Johnson et al. [11] reported deaths of Queensland rock wallabies and nailtail wallabies due to pulmonary hydatidosis and most recently (2004), pulmonary hydatidosis has also been reported as the cause of death of brush-tailed rock wallabies in two different, closely monitored colonies in Queensland (Barnes, personal communication).

Swamp wallabies are common throughout eastern Australia, particularly along The Great Dividing Range and they are pivotal in the successful transmission of *E. granulosus* in wildlife [3]. However, their importance as an intermediate host may vary in some local areas. South of Charters Towers, North Queensland, where swamp wallabies were rare, Banks [8] found a high prevalence of hydatid infection (22%) in black-striped wallabies (*Macropus dorsalis*). A range of other macropodid marsupial species are also susceptible to hydatidosis. These include the bridled nailtail wallabies (*Onychogalea fraenata*), rock wallabies (*Petrogale persephone*; *Petrogale mareeba*), red-necked wallabies (*M. rufogriseus*), whiptail wallabies (*Macropus parryi*) and pademelons (*Thylogale stigmatica)* [3].

2.4. Wombats

Hydatidosis has only been reported in wombats from Victoria [12]. The cysts recovered from the Victorian wombats, as with macropods, contained many protoscoleces and were all located in the lungs. Although wombats are also a favoured dietary item of dingoes, the apparent low prevalence or absence of hydatid infection in wombats from many areas suggests they may be considered as an intermediate host of only local importance.

3. Introduced wildlife

The introduction of rabbits (*Oryctolagus cunniculus*) and foxes (*V. vulpes*) into Australia and the establishment of feral