PARASITIC WORMS IN REPTILES FROM TASMANIA AND THE ISLANDS OF BASS STRAIT

by Hugh I. Jones

(with two text-figures and one table)

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The endoparasitic worms in reptiles from Tasmania and the islands of Bass Strait were recorded from dissections of nine *Tympanocryptis diemensis*, six *Tiliqua nigrolutea*, 20 *Cyclodomorphus casuarinae*, 15 *Egernia whitii*, 17 *Austrelaps superbus*, 24 *Notechis ater*, seven *Drysdalia coronoides* and four *Pelamis platurus*. Thirteen species of worms were recorded, namely, the pentastomes *Waddycephalus superbus* and *Waddycephalus* ?sp. nov., an unidentified oxyurid nematode species, the nematodes *Maxvachonia brygooi*, *M. chabaudi*, *Strongyluris paronai*, *Moaciria* sp., *Paraheterotyphlum australe*, *Ophidascaris pyrrhus*, *Kreisiella* sp., *Abbreviata antarctica*, the trematode *Dolichoperoides macalpini* and the cestode *Oochoristica vacuolata*. The roundworm *O. pyrrhus* was most prevalent, occurring almost entirely in the Black Tiger Snake, *N. ater.* The fluke *D. macalpini* was found, often at high intensity, in the Black Tiger Snake and in the Copperhead, *A. superbus.* No other worms occurred in more than two of any host species, and, apart from *A. antarctica* and *S. paronai,* all nematodes were at an intensity of four or less worms per host. Six of the 13 helminth species were recovered only from the Bass Strait islands. Previous studies in mainland Australia demonstrate that the reptile species examined in the present study (*N. ater*), or related species in the same genera (*Tiliqua*, *Cyclodomorphus*, *Egernia*, *Drysdalia*), may support a greater range and number of nematodes. The possible reasons for the lower worm numbers in Tasmania include the effects of a cool and damp climate on the distribution of the worms' intermediate hosts and on the survival of free-living stages of the parasites, and geographical isolation.
Key Words: Tasmania, reptiles, pentastomes, nematodes, cestodes, trematodes.

INTRODUCTION

Tasmania and the Bass Strait islands possess a depauperate reptile fauna. This is a consequence of their cool-temperate to cold-temperate climate and periods of isolation from the Australian mainland during interglacial periods (Rawlinson 1974). During the last ice age, Tasmania was joined by a land-bridge to Australia for a period of about 7000 years from 21 750 to 14 750 years BP, and the Tasmanian climate would have been colder than at present (Rawlinson 1974). Seventeen species of terrestrial reptile occur in Tasmania: one agamid lizard (*Tympanocryptis diemensis* (Gray, 1841)), 13 scincid species (of which the nine species in the genus *Pseudomoia* are closely-related small skinks, confined principally to southeastern Australia (Cogger 1992)), and the snakes *Austrelaps superbus* (Günther, 1841), *Notechis ater* (Krefft, 1866) and *Drysdalia coronoides* (Günther, 1858) (Elapidae). In addition, *Pelamis platurus* (Linnaeus, 1766), the most widely-distributed of sea snakes, is occasionally washed up on Tasmanian shores.

Several species of helminth have been recorded from reptiles in Tasmania, but there has not hitherto been a systematic survey of reptilian helminth parasites. Information on the pathology caused to reptiles in the wild by such parasites, and the effects such morbidity may have on the hosts' survival, is limited. This study was undertaken to ascertain the species of worms present, their prevalence and geographical distribution within Tasmania, and the relation of these parameters to the same or related hosts on the Australian mainland.

MATERIAL AND METHODS

In total 86 reptiles, representing six species of lizard, all three terrestrial endemic snakes and one species of sea snake, were examined in the collections of the Tasmanian Museum and Art Gallery in Hobart (TMAG) and the Queen Victoria Museum and Art Gallery in Launceston (QVMAG). In addition, nematodes from three *Notechis ater* and one *Austrelaps superbus* were identified from specimens in the Australian National Wildlife Collection (housed in CSIRO Sustainable Ecosystems in Canberra), and the records from another ten *N. ater* and two *A. superbus* in the same collection, all collected from Bass Strait islands, were forwarded by Dr D. M. Spratt. All species of Tasmanian and Bass Strait reptiles except the small skinks in the genera *Pseudomoia* (eight species), *Lerista bougainvillii* (Gray, 1839) and *Eulamprus tympanum* (Lönnberg & Andersson, 1913) (which is confined in this region to a single Bass Strait island, Rodondo Island, close to the Victorian mainland), were examined.

Material dissected

Agamidae: *Tympanocryptis diemensis* (TMAG: C25, C50, C195, C196; QVMAG: Q1986.3.53, Q1972.3.112, Q1972.3.112, Q1981.3.90, Q1981.3.28), Scincidae: *Tiliqua nigrolutea* (Quoy & Gaimard, 1824) (TMAG: C128, C321, C392, C805, C1000, C1001), *Cyclodomorphus casuarinae* (Duméril & Bibron, 1839) (TMAG: C44, C115, C116, C117, C120, C121a, C121b, C122, C123, C126, C258, C273, C305, C318, C329, C333, C1/377; QVMAG: Q1969.3.8, Q1969.3.13, Q1979.3.39), *Egernia whitii* (Lacépède, 1804)(QVMAG: Q1970.3.80 (three specimens), 1962.3.29, 1990.3.5, 1990.3.6, 1990.3.7. 1990.3.25, 1990.3.26, 1990.3.28, 1990.3.56, 1990.3.57, 1990.3.58, 1990.3.59, 1990.3.60), Elapidae: *Austrelaps superbus* (TMAG: C153, C154, C157, C160, C162. C163, C165, C330, C340,

C809; QVMAG: Q1972/3/191, Q1973/3/9, Q1973/3/21, Q1986A), *Notechis ater* (TMAG: C271, C272, C131, C132, C144, C145, C146, C147, C148, C149; QVMAG: Q1958/3/13), *Drysdalia coronoides* (TMAG: C20, C166, C171, C172, C166, C324; QVMAG: Q1988/3/16), and Hydrophiidae: *Pelamis platurus* (TMAG: C173, C174, C176, C325). From CSIRO, nematodes were examined from one *A. superbus* (N3188) and from three *N. ater* (N3187, N2852a and 2852b); helminth and collection data of these hosts and of *N. ater* PM 96/87 (four snakes), PM 157/87 (two snakes), PM 69/88 (five snakes) and *A. superbus* PM85/90 and 86/90, are included. The reptile hosts had been collected predominantly from the settled areas in or close to Hobart (including South Bruny Island), towns on the north coast, Maria Island on the east coast, and Flinders, King, Chappell, Passage and Sisters islands in Bass Strait.

Accession numbers of worms examined

Ophidascaris pyrrhus: TMAG K2797, K2798, K2799, K2800, K 2801; QVM 18:3965; CSIRO N2852a, 2852b. *Paraheterotyphlum australe*: TMAG K2802, K2803. *Moaciria* sp: TMAG K2796. *Maxvachonia chabaudi* QVM 18:3963, 18:3964. *Abbreviata antarctica*: CSIRO N3187, N3188. *Dolichoperoides macalpini*: TMAG K2804, K2805, K2806, K2807, K2808; QVM 18:3966, 18:3967, 18:2968, 18: 3969, 18:3970, 18: 3971. *Waddycephalus superbus*: QVM 10:25348.

All specimens had been fixed in 10% formaldehyde and preserved in 70% ethanol; some were in poor condition, thus affecting the recovery of parasites. All worms recovered from the internal organs were cleaned. Nematodes and pentastomes were cleared for examination in chlorolactophenol and stored in 70% alcohol with 10% glycerine. Trematodes were stained using Chubb's stain (Chubb 1962). Lungs from three *A. superbus* (hosts C809, 1086A, 1973/3/21) with attached trematodes *Dolichoperoides macalpini*, and the stomach of one *N. ater* (C144) with burrowing *Ophidascaris pyrrhus* were serially sectioned at 5μ, and stained with haematoxylin and eosin. Helminths have been returned to their respective collections. Reptile nomenclature follows Cogger (1992).

RESULTS

In all 36 reptiles (36.7%) were infected with parasitic worms, of 13 species. These comprised two pentastomes, one cestode, one trematode and nine species of nematode. The findings were as follows (see table 1).

Waddycephalus superbus Riley & Self, 1981 (Pentastomida: Porocephalidae) was recovered from the lungs of three Copperhead snakes, *A. superbus*, in numbers from 2–7, from King Island (one host) and Flinders Island (two hosts). Seven specimens of an apparently unknown species of *Waddycephalus* were recovered from a Black Tiger Snake, *N. ater*, from Lucrana, Flinders Island.

Oxyuridae ?gen., ?sp. Three immature and female nematodes in poor condition in the family Oxyuridae were found in each of two Oak Skinks, *Cyclodomorphus casuarinae*, from Maria Island and from near Hobart. Four and two female *Maxvachonia chabaudi* Mawson, 1972 (Nematoda: Cosmocercidae) were recovered respectively from 2/15 White's Skink, *Egernia whitii*, examined, from Passage Island, Bass Strait, and a single *M. brygooi* Mawson, 1972 was collected from *A. superbus* from Emita on Flinders Island. A single female *Moaciria sp.* (Nematoda: Heterakidae) was recovered from the skink *E. whitii* from Chappell Island, and one female from the skink *C. casuarinae* from Hobart.

One male and one immature female *Paraheterotyphlum australe* Johnston & Mawson, 1948 (Nematoda: Anisakidae)

TABLE 1
Parasitic worms recovered from eight species of reptile from Tasmania and Bass Strait islands

Parasites	Hosts							
	Tympanocryptis diemensis (N: 9)	*Tiliqua nigrolutea* (N: 6)	*Cyclodomorphus casuarinae* (N: 20)	*Egernia whitii* (N: 15)	*Austrelaps superbus* (N: 17)	*Notechis ater* (N: 24)	*Drysdalia coronoides* (N: 7)	*Pelamis platurus* (N: 4)
Waddycephalus superbus					2*			
Waddycephalus ?sp. nov.						1		
Oxyuridae ?gen. ?sp.			2					
Maxvachonia brygooi					1			
Maxvachonia chabaudi				2				
Strongyluris paronai					1			
Moaciria sp.			1	1				
Paraheterotyphlum australe								2
Ophidascaris pyrrhus					1	16		
Kreisiella sp.	1				2			
Abbreviata antarctica					2			
Dolichoperoides macalpini					8	8		
Oochoristica vacuolata				2	1			

* Numbers refer to the number of reptiles infected with each species of helminth.

were recovered from 2/4 sea snakes, *Pelamis platurus*, which had been recovered from the shores of Flinders Island (one) and beaches in southern and southeastern Tasmania (three).

Ophidascaris pyrrhus Johnston & Mawson, 1942 (Nematoda: Ascarididae) was both the most prevalent nematode recovered and, by virtue of its size, the most conspicuous. It was present in 16/24 *N. ater* examined. All hosts on the Tasmanian mainland (including Bruny Island) and 5/12 *N. ater* from Chappell Island were infected (fig. 1). It was also recorded in a single *A. superbus*, from West Point Lighthouse in northwestern Tasmania, and appears to be distributed throughout the island. Most were threaded through the stomach wall, with the two ends within the stomach lumen, and as a result many could not be recovered entire. Numbers present ranged from one to 24, and their lengths were up to 150 mm.

A single female *Kreisiella* sp. (Nematoda: Physalopteridae) was collected from a dragon lizard, *Tympanocryptis diemensis*, from near Devonport, northern Tasmania. Its suboptimal condition and the absence of males precluded identification to species.

Abbreviata antartica von Linstow, 1899 (Nematoda: Physalopteridae) infected two snakes from Flinders Island: one *Austrelaps superbus* from Emita contained 57 worms, and one *N. ater* from Lucrana contained 15 worms.

Dolichoperoides macalpini (Nichol, 1918) (Trematoda: Dolichoperidae) was confined to two species of snake, occurring in 8/17 *A. superbus* and 8/24 *N. ater*. This trematode also had a wide geographical distribution, including King and Flinders islands (fig. 2), although it was absent from all 12 *N. ater* collected on Chappell Island. Most worms were present in the lungs and trachea, with smaller numbers in the upper oesophagus and stomach (possibly due to movements after death of host). Numbers ranged from two to >50.

The tapeworm *Oochoristica vacuolata* Hickman, 1954 (Cestoda: Anoplocephalidae) was recovered from 2/15 *E. whitii* examined, from Chappell Island in Bass Strait, each lizard having two worms in the intestine and from one *A. superbus*.

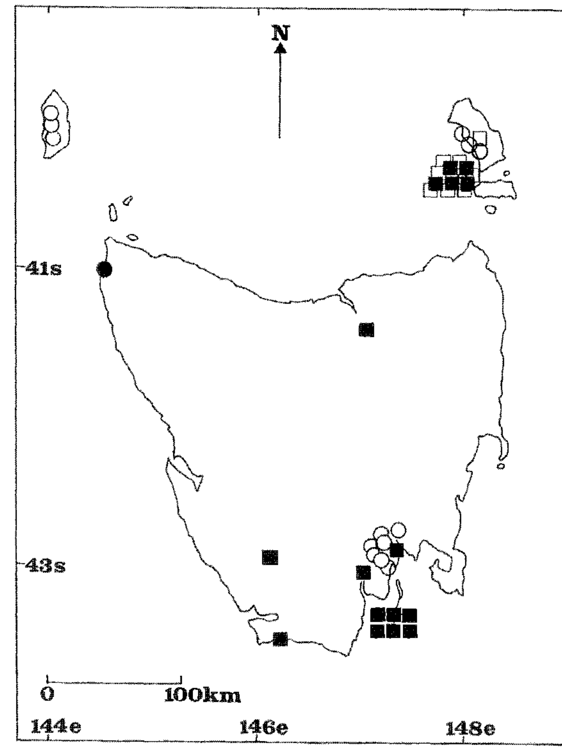

FIG. 1 — Distribution of the nematode Ophidascaris pyrrhus *in the Black Tiger Snake* Notechis ater *(squares) and in the Copperhead* Austrelaps superbus *(circles). Black, infection present; white, no infection (no locality data were available for three* A. superbus*).*

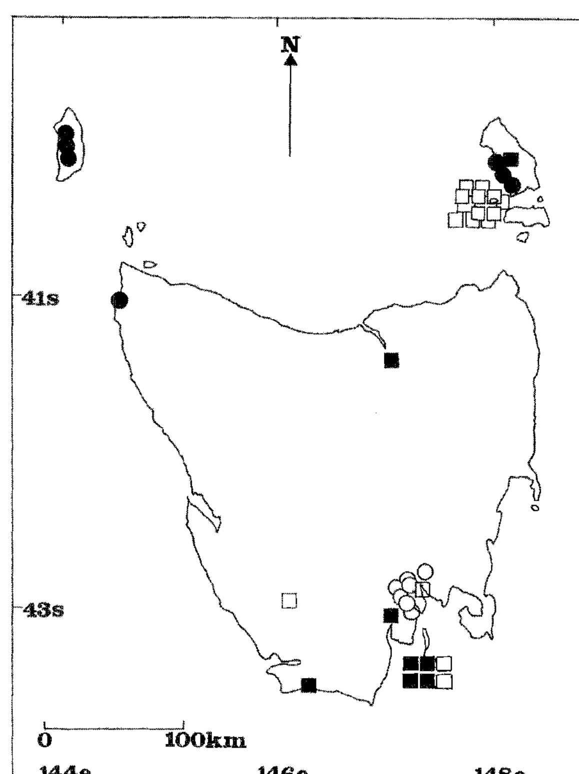

FIG. 2 — Distribution of the fluke Dolichoperoides macalpini *in the Black Tiger Snake* Notechis ater *(squares) and in the Copperhead* Austrelaps superbus *(circles). Black, infection present; white, no infection (no locality data were available for three* A. superbus*).*

Pathology

Sections of stomach from *N. ater* containing transverse sections of *O. pyrrhus* revealed that the tunnels of these worms lie in the submucosa. They were surrounded by concentric layers of collagen fibres, with little cellular infiltration, which extended to and replaced the overlying mucous membrane lining the stomach lumen.

No midline dorso-ventral sections of *D. macalpini* were obtained from segments of lung from three *A. superbus*. A thin layer of mucus surrounded the worms, and in two cases there was a large effusion of blood around the worms. The normal ciliated pseudostratified epithelium of the smaller bronchiole lining was replaced, when in contact with the spinous epidermis of the trematode, with flattened squamous cells. Apart from one small clump of lymphocytes adjacent to one worm, there was no appreciable histiocyte or other inflammatory cell infiltration, or any fibrous proliferation. Haemolysed blood was present in the oral sucker cavity of one worm.

DISCUSSION

The pentastome *A. superbus*, the trematode *D. macalpini* and the cestode *O. vacuolata* have all been reported previously from Tasmania, and *W. superbus* and *O. vacuolata* were described from there. *W. superbus* is found only in Tasmanian and Bass Strait island populations of *A. superbus* (Riley *et al.* 1985), and was minutely described by Spencer (1893), under the name of *Pentastomum teretiusculum*, from this species of snake from King Island. *Oochoristica vacuolata* was described from *E. whitii* from Hobart by Hickman (1954), who found it to be common in this host species in Tasmania.

Ophidascaris pyrrhus appears to be widespread in Australian elapid snakes in southern Australia. It was described from *Pseudechis porphyriacus* from New South Wales (Johnston & Mawson 1942), and an ascarid nematode presumed to be this species was collected from *A. superbus* in Victoria (McAlpine 1891a). Jones (1980) reported it from several species of elapid snakes in Western Australia, mainly in the more temperate southwest of that state, and found, as in the present study, that *N. ater* had the highest prevalence and intensity of infection.

The low infection of reptiles collected in the vicinity of Hobart may indicate that intermediate hosts of the parasites are present in diminished numbers or are absent in this ecologically-perturbed environment.

Other species of parasitic worms appear to be uncommon in these species of reptile in Tasmania. Mawson (1972) commented that *Maxvachonia* is geographically widespread but nowhere common, and these findings bear out this observation; *M. chabaudi* has been most commonly recorded from skinks, including *E. whitii* from South Australia (Mawson 1972), and *Ctenotus uber* and *Unechis nigriceps* from Victoria and South Australia (Watherow, pers. comm.). *M. brygooi* occurs in *Cyclodomorphus branchialis* in Western Australia (Jones 1992). These are the first records of this genus from Tasmania.

Three species of *Moaciria* have been described from Australia, all from the west (Jones 1979); one was recovered from a skink and two from snakes (which may have been spurious infections). It has also been reported from Papua New Guinea (Gibbons 1979, Jones 1983). The two infected skinks reported here, *C. casuarinae* and *E. whitii*, are new host and geographical records.

The two oxyurids from *C. casuarinae* could not be identified to species. The oxyurid nematodes *Pharyngodon tiliquae* Baylis, 1930, *P. australis* Johnston & Mawson, 1942 and *Thelandros trachysauri* Johnston & Mawson, 1947 have been previously reported from the skink genera *Tiliqua* and *Cyclodomorphus* in southern and eastern Australia, and *P. tiliquae*, *T. trachysauri* and *Parapharyngodon fitzroyi* from these two skink genera in Western Australia (Jones 1992). A female *Kreisiella* sp. was described from New Britain by Kreis (1940), under the name *Physaloptera heterocephala*, from *Gonyocephalus modestus* (Agamidae). It is widespread in smaller lizards, principally skinks, in Western Australia (Jones 1995), achieving highest numbers in *Egernia inornata*. This record extends the known geographical and host range of the nematode.

Nematodes in the genus *Abbreviata* were not recovered from any reptiles in mainland Tasmania; only two snakes were found infected on Flinders Island. *Abbreviata* species are widespread on the Australian mainland among larger reptiles, and although they attain highest prevalence and intensity in the hot dry inland areas of Australia in the larger species of *Varanus* monitor lizards (which are absent from Tasmania and the Bass Strait islands), they are widespread in *V. varius* and *V. gouldii* in southern and cooler areas of the mainland, including Kangaroo Island (Johnston & Mawson 1941; Jones unpub. data). They also occur in the larger elapid snakes, including *N. ater* (2/23) and *Drysdalia coronata* (4/22) in Western Australia (Jones 1978). Larval physalopterids, presumed to be predominantly *Abbreviata* spp., are a conspicuous finding in a wide variety of smaller reptiles in mainland Australia (Jones 1995), but none was seen in the present study. No *Abbreviata* were recovered from *T. nigrolutea*, but *A. antarctica* is present at high prevalence (79%) and intensity in the related *T. scincoides* in Western Australia, mainly in the southwest (Jones 1992). The presence of nematodes of this genus in the same species of reptile (*N. ater*) or reptile species in the same genus (*Drysdalia coronata*, *T. scincoides*), on the Australian mainland, therefore indicates that the absence of *Abbreviata* spp. from mainland Tasmania is not due to the absence of suitable reptile hosts. Their absence may be related to the absence or scarcity of suitable intermediate hosts, to the inability of free-living (egg) stages to survive in the cooler, wetter climate, or to the lower abundance of susceptible reptile hosts (Rawlinson 1974) for transmission to occur. This cannot be ascertained until life-cycles have been elucidated for species of *Abbreviata* in Australia.

Paraheterotyphlum australe was described from *Pelamis platurus* by Johnston & Mawson (1948), and re-described by Sprent (1978). It also occurs in several other sea snakes, whose principal diet is fish, and which are probable intermediate hosts.

Dolichoperoides macalpini is a common parasite of *N. scutatus* in southeastern Australia. The mention of trematodes present in "vast numbers in the trachea and gullet" of *A. superbus* taken in Victoria (McAlpine 1891b) probably refers to this species. It occurs principally in swampy areas in Tasmania, and its life-cycle, which involves the snails *Ameria* spp. and frogs *Limnodynastes* spp., was elucidated by Johnston & Angel (1940) from specimens collected on Flinders Island. Its absence from all 12 *N. ater* collected on Chappell Island is interesting, and may indicate the absence of frog intermediate hosts on this island, but this cannot be ascertained.

Apart from the nematode *O. pyrrhus* in *N. ater*, and the trematode *D. macalpini* in this snake and in *A. superbus*, the reptiles in this region display a low prevalence, intensity and diversity of parasitic helminths. Six of the 13 species of worms (two *Waddycephalus* spp., *Maxvachonia brygooi*, *M. chabaudi*, *Strongyluris paronai* and *Abbreviata antarctica*) were recorded only in the Bass Strait islands (though *W. superbus* occurs in Tasmania; Riley *et al.* 1985). This is of interest as Flinders and others islands in the Furneaux Group are considerably more distant from the mainland than from Tasmania, the climate is not markedly more benign than in northeastern Tasmania, and it is believed that both Tasmania and the Bass Strait islands have been separated from continental Australia for similar periods of time (Hope 1974). However, the samples, both of hosts and of parasites, are relatively small, and further studies are necessary to validate and amplify these findings. It is probable that *M. brygooi* and *S. paronai*, which are found predominantly in smaller lizards, were spurious infections in *A. superbus* on Flinders Island, and were acquired from their prey. No helminths were found in two reptiles species examined (*Tiliqua nigrolutea* and *Drysdalia coronoides*), and a single worm was recovered from *Tympanocryptis diemensis*. The same or closely-related reptile species on the Australian mainland often support a more diverse nematode fauna, with higher prevalence and intensity of infection. A comparable systematic study of the helminth fauna of reptiles in climatically similar areas of the adjacent mainland may shed light on the relative importance of climate and isolation in determining the composition and prevalence of parasitic worms in Tasmania's reptiles.

Since the large snakes examined in this study are kept in captivity for the production of antivenenes, diseases which may affect their venom production have long been known. Fairley & Splatt (1929) reported that the fluke *Dolichopera* (=*Dolichoperoides*) *macalpini* is the most serious infection encountered, leading to emaciation, anaemia and sometimes death of the snakes in captivity. It is assumed (though it is not possible to ascertain) that all the snakes examined in the present study had been caught in the wild. None had the appearance of being emaciated, and the extent to which infection with *Dolichoperoides* or *Ophidascaris* adversely affects their health in the wild remains problematical, despite the fact that seven *N. ater* and one *A. superbus* had concurrent infection with both species of worm.

CONCLUSIONS

The reptile fauna of Tasmania and the islands of Bass Strait displays low prevalence and intensity of parasitic worms. This is probably a consequence of several factors; the reptiles themselves exhibit low species diversity, and the abundance of these ectotherms in the cool and wet climate of Tasmania may itself be less than on the adjacent mainland, and thus influence the chances of parasite transmission. The common trematode *D. macalpini* requires amphibian intermediate hosts and so could be expected to thrive in this climate. The life-cycle of the other common parasite, *O. pyrrhus*, is not known, though it is widespread throughout the southern, and cooler and wetter, parts of mainland Australia. Therefore until more is known of the life-cycles of the worms, especially the species and distribution of intermediate hosts, and the relative effects of climate and geographical isolation on their biology, further conclusions cannot be drawn.

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