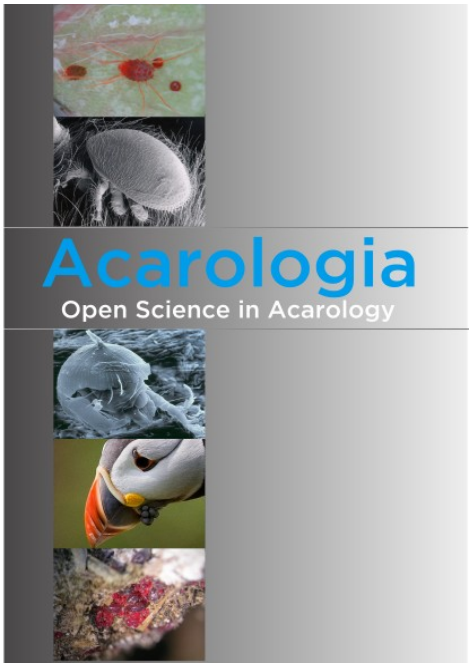

Acarologia

A quarterly journal of acarology, since 1959
Publishing on all aspects of the Acari

All information:
http://www1.montpellier.inra.fr/CBGP/acarologia/
acarologia-contact@supagro.fr

OPEN ACCESS

Acarologia is proudly non-profit,
with no page charges and free open access

Please help us maintain this system by
encouraging your institutes to subscribe to the print version of the journal
and by sending us your high quality research on the Acari.

Subscriptions: Year 2021 (Volume 61): 450 €
http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php
Previous volumes (2010-2020): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d'avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

INVESTISSEMENTS D'AVENIR

agropolis fondation
Supporting agricultural research for sustainable development

Acarologia
Open Science in Acarology

Three instances of reptile ticks parasitising humans

Gerrut Norval[a] , Robert D. Sharrad[a] , Michael G. Gardner[a,b]

[a] College of Science and Engineering, Flinders University, Adelaide 5042, South Australia, Australia.
[b] Evolutionary Biology Unit, South Australian Museum, North Terrace, Adelaide 5000, South Australia, Australia.

Short note

ABSTRACT

All ticks are haematophagous, and many exhibit some level of host specificity as adults, usually parasitizing only certain types of hosts. *Amblyomma limbatum* and *Bothriocroton hydrosauri* are generally accepted to be ectoparasites of reptiles. Herein, three instances of parasitism on humans by these ticks are reported. The observations confirm that these species will parasitize humans and provide new information about life stages and attachment sites.

Keywords *Amblyomma limbatum*; Australia; *Bothriocroton hydrosauri*; human parasitism; reptile ticks

Ticks are parasitic arthropods that are generally haematophagous in all three active life stages; larval, nymphal and adult instars (Oliver, 1989). Although the males of some *Ixodes* species may occasionally parasitize engorged conspecific females (Moorhouse and Heath, 1975; Ntiamoa-Baidu, 1986; Durden *et al.*, 2018), ticks are primarily parasites of all vertebrate groups, except fish (Oliver, 1989).

Tick species exhibit degrees of host specificity due to various morphological adaptations and behaviours to locate hosts and feed efficiently (Oliver, 1989; McCoy *et al.*, 2013). Some species, such as *Haemaphysalis longicornis* Neumann, 1901, will parasitize a large variety of host species (Hoogstraal *et al.*, 1968; Barker and Walker, 2014). Other tick species tend to favour different host types at different stages of their life cycle. For instance, *Amblyomma longirostre* (Koch, 1844) has only been recorded to parasitize birds during the larval stage, but nymphs will also infest some mammals, and adults primarily parasitize particular rodent species (Nava *et al.*, 2010). Several species tend to parasitize only certain vertebrate classes or orders such as *Amblyomma helvolum* Koch, 1844, which only exploit reptiles (Simmons *et al.*, 2002). Others are very host specific and usually will only parasitize one or a small number of similar host species. Thus, *Argas* (*Microargas*) *transversus* Banks, 1902, only feeds on Galapagos giant tortoises (Hoogstraal and Kohls, 1966; Hoogstraal *et al.*, 1973). However, apparently host-specific species are still occasionally collected from atypical hosts, such as *Amblyomma* (formerly classified as *Aponomma*) *sphenodonti* (Dunmbleton 1943) that almost exclusively parasitizes tuataras, *Sphenodon punctatus* (Gray, 1842), but is occasionally also found on other sympatric reptiles (Heath, 2006b). Herein, we report three instances of human parasitism by ticks that usually infest reptiles.

- **Case 1** On November 6th, 1972, upon concluding fieldwork at Mt Mary in the Mid North region of South Australia, RDS found a male of an ixodid attached to the inside of his left elbow. The tick was left in place for observation, but it was removed approximately 24 hours later on November 7th as the attachment site had become inflamed and painful. RDS had also developed a headache, although it cannot be confirmed that it was related to the tick bite. The attachment site remained inflamed for another two days. Using the keys in Roberts (1970), the tick was identified as a male of *Amblyomma limbatum* Neumann,

Received 07 April 2020
Accepted 13 August 2020
Published 02 September 2020

Corresponding author
Gerrut Norval:
gerrut.norval@flinders.edu.au

Academic editor
McCoy, Karen

DOI
10.24349/acarologia/20204389

ISSN 0044-586X (print)
ISSN 2107-7207 (electronic)

How to cite this article Norval G. *et al.* (2020), Three instances of reptile ticks parasitising humans. **Acarologia 60(3): 607-611; DOI 10.24349/acarologia/20204389**

1899. The tick specimen was subsequently lost and therefore could not be deposited in a museum collection.

- **Case 2** On November 9th, 2017, a day after returning from a study site near Mt Mary, GN found a nymphal tick attached to the dorsal aspect of the first segment of his left big toe. The tick was removed and preserved in 70% ethanol. There were signs of localized minor inflammation (red skin discoloration and tenderness) at the site of the bite, which persisted for three days. Using the keys and descriptions in Roberts (1970) and Andrews *et al.* (2006), the tick was identified as a nymph of *Bothriocroton hydrosauri* (Denny, 1843), formerly classified as *Aponomma hydrosauri*, and was subsequently deposited in the parasites collection of South Australian Museum, Adelaide, South Australia (voucher number J 21395).

- **Case 3** On November 9th, 2019, a resident of Bower, a small town near Mt Mary, noticed some discomfort on the inside of the right foot just below the ankle, and closer inspection revealed that it was a tick. She removed the tick and sent it to the South Australian Museum for species identification. There were signs of localized minor inflammation at the site of the bite, which persisted for ten days. Using the keys and descriptions in Roberts (1970) and Andrews *et al.* (2006), the tick was identified as an un-engorged female of *B. hydrosauri* and was subsequently deposited in the parasites collection of South Australian Museum, Adelaide, South Australia (voucher number J 21415).

Amblyomma limbatum and *B. hydrosauri* are reptile ticks with parapatric distributions; the former occurs throughout the arid and semi-arid parts of Australia, whereas the latter is restricted to the wetter parts of southern New South Wales, Victoria, Tasmania, southeastern South Australia and parts of southwestern Western Australia (Smyth, 1973; Barker and Walker, 2014). Our observations not only confirm that *A. limbatum* and *B. hydrosauri* will parasitize humans, but we also provide new information about life stages and attachment sites. Both these tick species have previously been reported to occasionally parasitize humans (Table 1), but as stated by Guglielmone and Robbins (2018), little information was provided, so it is not clear which life stages were involved nor where they attached. The risk of transmission of tick-borne pathogens can increase the longer an infected tick remains attached (e.g. Eisen, 2018). As a result, immature life stages, which may not initially be detected due to their small size, and/or ticks attached on parts of the body where they are not easily noticed can be more likely to infect the host with tick-borne pathogens. In this way, information about life stages and attachment sites are vital for establishing prevention strategies and should be systematically reported.

Although ticks may occasionally attach and attempt to feed on atypical hosts, this does not necessarily mean they can successfully engorge and survive. For instance, larvae, nymphs and adults of the seabird tick, *Ixodes laridis* Heath & Palma, 2017 (reported as *Ixodes eudyptidis*),

Table 1 A summary of the reported instances of *Amblyomma limbatum* and *Bothriocroton hydrosauri* biting humans.

Collection Period	Locality	Number of specimens	Life Stage	Attachment Site	Reference
A. limbatum					
3-year	Bernier and Dorre Islands, WA	8	Not stated	Not stated	Bennett et al. (2011)
B. hydrosauri					
2-year	Flinders Island, TAS	1	Not stated	Not stated	Stewart (1991)
		1	Not stated	Groin	Graves et al. (1993)
1-year		2	Not stated	Not stated	Graves and Stenos (2003)
	New Zealand*	1	Nymph	Not stated	Heath and Hardwick (2011); A.C.G. Heath pers. comm.

* traveler that arrived from Australia

were fed on laboratory white mice, and although not all individuals survived, some did and one female even produced fertile eggs (Heath, 2006a). However, less than 1% of the larvae of the echidna tick, *Bothriocroton tachyglossi* Roberts, 1953, attached when they were experimentally exposed to sleepy lizards, *Tiliqua rugosa* (Gray, 1825), and none successfully engorged (Andrews *et al.*, 2006). In two of the instances described herein, the ticks survived for at least a day, and all the indications were that they were feeding successfully. *Amblyomma limbatum* and *B. hydrosauri* are primarily reptile ticks, and even though the latter species has been reported to parasitize horses, *Equus caballus* Linnaeus, 1758, and domestic cattle, *Bos taurus* Linnaeus, 1758, these records are more likely attributable to *B. tachyglossi* (Roberts, 1953; Andrews *et al.*, 2006; Barker and Walker, 2014; Barker *et al.*, 2014). The prevalence of parasitism on mammalian hosts by *A. limbatum* and *B. hydrosauri* therefore appears to be rare and are likely instances of accidental host use.

In addition to anemia and other conditions such as dermatosis, tick may also cause tick paralysis and/or otoacariasis in their hosts. However, their main risk to public health and agriculture stems from their role as vectors of various bacterial, filarial, fungal, protozoan and viral pathogens (Lapage, 1963; Hoogstraal, 1985; Roberts and Janovy, 2005). *Amblyomma limbatum* and *B. hydrosauri* are both known vectors for the haemogregarine parasite *Hemolivia mariae* Smallridge and Paperna, 1997 (Smallridge and Paperna, 1997). Both the Flinders Island spotted fever agent, *Rickettsia honei* Stenos, Roux, Walker, and Raoult, 1998, and an undescribed *Rickettsia* species, which is present in the Mt Mary region (Staines *et al.*, 2020), have been detected in *B. hydrosauri* (Stenos *et al.*, 2003; Whiley *et al.*, 2016), making this tick species of particular public health concern (Stenos *et al.*, 1998; Stenos *et al.*, 2003).

In order to gain a better understanding of tick host specialization, it is necessary to shift from merely recording the variety of hosts utilized by a tick species throughout its geographic range, to reporting host use on a more localized scale (McCoy *et al.*, 2013). Such information can be instrumental in highlighting localities where particular tick species pose a risk to public health and/or livestock. Here, we described instances of *A. limbatum* and *B. hydrosauri* parasitizing humans. However, in order to determine whether these were merely accidental host choices, additional information is required. Empirical studies related to the prevalence of parasitism of mammalian hosts by the different life stages of *A. limbatum* and *B. hydrosauri* and their ability to use these hosts to complete their life cycles are warranted. Finally, we encourage the reporting and submission of tick specimens found on atypical hosts to academic institutions or museums for species verification and for improving our knowledge on host specialization in this group of parasites.

Acknowledgements

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome. The observations presented herein were made by RDS while a PhD student at the University of Adelaide, and GN while conducting research for his current PhD studies at Flinders University. GN's research in 2017 was partly funded by a grant from the Royal Society of South Australia. We would like to thank Jae Dalgleish and Dr. Matthew Shaw (South Australian Museum) for providing information about case 3, and Dr. Allen C.G. Heath for the addition pertaining to the tick bite record from New Zealand.

References

Andrews R.H., Beveridge I., Bull C.M., Chilton N.B., Dixon B., Petney T.N. 2006. Systematic status of *Aponomma tachyglossi* Roberts (Acari: Ixodidae) from echidnas, *Tachyglossus aculeatus*, from Queensland, Australia. Syst. Appl. Acarol. 11: 23-39. doi:10.11158/saa.11.1.3

Barker S.C., Walker A.R. 2014. Ticks of Australia. The species that infest domestic animals and humans. Zootaxa, 3816: 1-144. doi:10.11646/zootaxa.3816.1.1

Barker S.C., Walker A.R., Campelo D. 2014. A list of the 70 species of Australian ticks; diagnostic guides to and species accounts of *Ixodes holocyclus* (paralysis tick), *Ixodes cornuatus* (southern paralysis tick) and *Rhipicephalus australis* (Australian cattle tick); and consideration of the place of Australia in the evolution of ticks with comments on four controversial ideas. Int. J. Parasitol., 44: 941-953. doi:10.1016/j.ijpara.2014.08.008

Bennett M.D., Woolford L., Banazis M.J., O'Hara J., Warren K.S., Nicholls P.K., Sims C., Fenwick S.G. 2011. *Coxiella burnetti* in western barred bandicoots (*Perameles bougainville*) from Bernier and Dorre Islands in Western Australia. EcoHealth, 8: 519-524. doi:10.1007/s10393-011-0729-3

Durden L.A., Gerlach R.F., Beckmen K.B., Greiman S.E. 2018. Hyperparasitism and non-nidicolous mating by male *Ixodes angustus* ticks (Acari: Ixodidae). J. Med. Entomol., 55: 766-768. doi:10.1093/jme/tjy012

Eisen L. 2018. Pathogen transmission in relation to duration of attachment by *Ixodes scapularis* ticks. Ticks Tick. Borne. Dis., 9: 535-542. doi:10.1016/j.ttbdis.2018.01.002

Graves S., Stenos J. 2003. *Rickettsia honei*: a spotted fever group *Rickettsia* on three continents. Ann. N. Y. Acad. Sci., 990: 62-66. doi:10.1111/j.1749-6632.2003.tb07338.x

Graves S.R., Stewart L., Stenos J., Stewart R.S., Schmidt E., Hudson S., Banks J., Huang Z., Dwyer B. 1993. Spotted fever group rickettsial infection in south-eastern Australia: isolation of rickettsiae. Comp. Immunol. Microbiol. Infect. Dis., 16: 223-233. doi:10.1016/0147-9571(93)90149-Y

Guglielmone A.A., Robbins R.G. 2018. Hard Ticks (Acari: Ixodida: Ixodidae) Parasitizing Humans: A Global Overview. Cham, Switzerland: Springer International Publishing. pp. 314. doi:10.1007/978-3-319-95552-0

Heath A.C.G. 2006a. Observations on *Ixodes eudyptidis* Maskell (Acari: Ixodidae), *Ornithodoros capensis* Neumann (Acari: Argasidae), and other tick parasites of sea birds in New Zealand. Syst. Appl. Acarol., 11: 131-140. doi:10.11158/saa.11.2.1

Heath A.C.G. 2006b. A reptile tick, *Aponomma sphenodonti* Dumbleton (Acari: Ixodidae), parasitic on the tuatara, *Sphenodon punctatus* Gray (Reptilia: Rhyncocephalia), in New Zealand: observations on its life history and biology. Syst. Appl. Acarol., 11: 3-12. doi:10.11158/saa.11.1.1

Heath A.C.G., Hardwick S. 2011. The role of humans in the importation of ticks to New Zealand: a threat to public health and biosecurity. N. Z. Med. J., 124: 67-82. https://assets-global.website-files.com/5e332a62c703f653182faf47/5e332a62c703f686112fdd4f_content.pdf

Hoogstraal H. 1985. Argasid and nuttalliellid ticks as parasites and vectors. Adv. Parasitol., 24: 135-238. doi:10.1016/S0065-308X(08)60563-1

Hoogstraal H., Clifford C.M., Keirans J.E. 1973. *Argas* (*Microargas*) *transversus* (Ixodoidea: Argasidae) of Galápagos giant tortoises: description of the female and nymph. Ann. Entomol. Soc. Am., 66: 727-732. doi:10.1093/aesa/66.4.727

Hoogstraal H., Kohls G.M. 1966. *Argas* (*Microargas*) *transversus* Banks (new subgenus) (Ixodoidea, Argasidae), a diminutive parasite of the Galapagos giant tortoise: redescription of the holotype male and description of the larva. Ann. Entomol. Soc. Am., 59: 247-252. doi:10.1093/aesa/59.2.247

Hoogstraal H., Roberts F.H.S., Kohls G.M., Tipton V.J. 1968. Review of *Haemaphysalis* (*Kaiseriana*) *longicornis* Neumann (resurrected) of Australia, New Zealand, New Caledonia, Fiji, Japan, Korea, and Northeastern China and USSR, and its parthenogenetic and bisexual populations (Ixodoidea, Ixodidae). J. Parasitol., 54: 1197-1213. doi:10.2307/3276992

Lapage G. 1963. Animals Parasitic in Man. New York, U.S.A.: Dover Publications, Inc. pp. 320.

McCoy K.D., Léger E., Dietrich M. 2013. Host specialization in ticks and transmission of tick-borne diseases: a review. Front. Cell. Infect. Microbiol., 3. doi:10.3389/fcimb.2013.00057

Moorhouse D.E., Heath A.C.G. 1975. Parasitism of female ticks by males of the genus *Ixodes*. J. Med. Entomol., 12: 571-572. doi:10.1093/jmedent/12.5.571

Nava S., Velazco P.M., Guglielmone A.A. 2010. First record of *Amblyomma longirostre* (Koch, 1844) (Acari: Ixodidae) from Peru, with a review of this tick's host relationships. Syst. Appl. Acarol., 15: 21-30. doi:10.11158/saa.15.1.2

Ntiamoa-Baidu Y. 1986. Parasitism of female *Ixodes* (*Afrixodes*) *moreli* (Acari: Ixodidae) by males. J. Med. Entomol., 23: 484-488. doi:10.1093/jmedent/23.5.484

Oliver J.H. 1989. Biology and systematics of ticks (Acari: Ixodida). Annu. Rev. Ecol. Syst., 20: 397-430. doi:10.1146/annurev.es.20.110189.002145

Roberts F.H.S. 1953. The Australian species of *Aponomma* and *Amblyomma* (Ixodoidea). Aust. J. Zool., 1: 111-161. doi:10.1071/Z09530111

Roberts F.H.S. 1970. Australian Ticks. Melbourne, Australia: CSIRO. pp. 267.

Roberts L.S., Janovy J. 2005. Foundations of Parasitology. New York, U.S.A.: MacGraw-Hill Publishing Company. pp. 702.

Simmons L.-A., Stadler C.K., Burridge M.J. 2002. Introduction of the exotic tick *Amblyomma helvolum* Koch (Acari: Ixodidae) into the United States on imported cobras (Squamata: Elapidae). Int. J. Acarology, 28: 45-48. doi:10.1080/01647950208684279

Smallridge C., Paperna I. 1997. The tick-transmitted haemogregarinid of the Australian sleepy lizard *Tiliqua rugosa* belongs to the genus *Hemolivia*. Parasite, 4: 359-363. doi:10.1051/parasite/1997044359

Smyth M. 1973. The distribution of three species of reptile ticks, *Aponomma hydrosauri* (Denny), *Amblyomma albolimbatum* Neumann, and *Amb. limbatum* Neumann I. Distribution and hosts. Aust. J. Zool., 21: 9-101. doi:10.1071/Z09730091

Staines M., Bradford T., Graves S.R., Bull S., Gardner M.G. 2020. Proposing a new hypothesis: *Rickettsia* spp. as a mechanism maintaining parapatry between two Australian reptile tick species. Austral Ecol., 45: 488-492. doi:10.1111/aec.12897

Stenos J., Graves S., Popov V.L., Walker D.H. 2003. *Aponomma hydrosauri*, the reptile-associated tick reservoir of *Rickettsia honei* on Flinders Island, Australia. Am. J. Trop. Med. Hyg., 69: 314-317. doi:10.4269/ajtmh.2003.69.314

Stenos J., Roux V., Walker D., Raoult D. 1998. *Rickettsia honei* sp. nov., the aetiological agent of Flinders Island spotted fever in Australia. Int. J. Syst. Evol. Microbiol., 48: 1399-1404. doi:10.1099/00207713-48-4-1399

Stewart R.S. 1991. Flinders Island spotted fever: a newly recognised endemic focus of tick typhus in Bass Strait. Part 1. Clinical and epidemiological features. Med. J. Aust., 154: 94-99. doi:10.5694/j.1326-5377.1991.tb120993.x

Whiley H., Custance G., Graves S., Stenos J., Taylor M., Ross K., Gardner M.G. 2016. *Rickettsia* detected in the reptile tick *Bothriocroton hydrosauri* from the lizard *Tiliqua rugosa* in South Australia. Pathogens, 5: 41. doi:10.3390/pathogens5020041