

Occurrence of the introduced snake mite, *Ophionyssus natricis* (Gervais, 1844), in the wild in Australia

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Original research

ABSTRACT

The snake mite, *Ophionyssus natricis* (Acari: Macronyssidae), occurs in many parts of the world and is of animal and human health significance. In Australia *Op. natricis* is considered an introduced species in parts of coastal eastern and southern Australia and is thought to be absent in the wild. Herein we report on the occurrence of *Op. natricis* in Adelaide and a rural locality in South Australia on lizards from the genus *Tiliqua*. We also review previous records of this mite species based on published reports and the examination of museum specimens. The results show that the snake mite has been collected on wild hosts at several localities in at least two states and is therefore not restricted to reptiles in captivity.

Keywords Adelaide; *Ophionyssus natricis*; *Tiliqua rugosa*; *Tiliqua scincoides*

Introduction

Of all the mite species that are known to infest reptiles, one of the most problematic is the snake mite, *Ophionyssus natricis* (Gervais, 1844) because it is of animal and human health significance. Snakes and lizards infested by this mite may suffer from abnormal shedding (i.e. dysecdysis), and heavy infestation can cause anemia and even result in mortality (Frank, 1981; Lane and Mader, 1996; Šlapeta *et al.*, 2018). This mite has also been identified as a possible vector of several blood-borne bacterial, filariid and viral pathogens of snakes (Wozniak and DeNardo, 2000), and has also been implicated in instances of dermatitis in humans (Schultz, 1975; Beck, 1996; Amanatfard *et al.*, 2014).

The native range of *Op. natricis* is uncertain. *Ophionyssus natricis* was originally described from specimens taken from snakes in a zoo in Europe and was subsequently also collected from areas around Paris and Rome (Gervais, 1844). However, it has subsequently been reported in many parts of the world from captive snakes and lizards in zoo collections and the pet trade, and even a few instances from reptiles in the wild (Yunker, 1956; Goldberg and Bursey, 1991; Miranda *et al.*, 2017), which indicates that it is easily spread via the movement of animals. In Australia *Op. natricis* is considered an introduced species and has been recorded in parts of coastal eastern and southern Australia (Domrow, 1988). Herein we report infestation by *Op. natricis* of three wild skinks (family: Scincidae) from three localities in South Australia, with comments on the distribution of this parasite in Australia based on museum specimens and published records.

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Methods and results

Observations

Case 1 — On 19 September 2017, seven (four female and three male) sleepy lizards (*Tiliqua rugosa*) were collected from a study site surrounding the Bunday Lutheran Church ruins, ca. 130 km north-northeast of Adelaide City, in a pastoral district in the mid north region of South Australia. The habitat of this study site is a chenopod shrubland, dominated by the shrubs *Atriplex vesicaria*, *Maireana pyramidata* and *Maireana sedifolia*, with scattered stands of the tree *Casuarina pauper*. The lizards were collected as part of an ongoing study into the roles of personality and sociality in the spread of parasites in these lizards (Sih *et al.*, 2018), and were kept individually overnight in sterilised calico bags. The following morning (20 September 2019) after the lizards had been released back into the wild, 14 tiny (ca. 1 mm in length) arthropods were collected from inside one of the fabric bags. The arthropods were preserved in 95% ethanol, and were later determined to be one larva of the ixodid tick *Bothriocroton hydrosauri*, four larvae of the argasid tick *Ornithodoros gurneyi*, and nine females of *Op. natricis*. In a subsequent follow-up investigation between 17 August 2019 and 18 November 2019, 26 *T. rugosa* were caught in the vicinity of the abovementioned study site and four were caught in the vicinity of an earth dam located ca. 3.5 km southwest of the study site. An additional three *T. rugosa* were caught in the outskirts of Eudunda, the nearest town, ca. 35 km southwest of the study site. The lizards were held within a plastic container and brushed with a fine paintbrush (Figure 1) prior to being released at the point of capture. The container was then rinsed out with 70% ethanol, that was poured through a fine (0.25 x 0.25 mm mesh) polyester fabric. The fabric was subsequently examined under a dissection microscope for the presence of *Op. natricis*. None of the examined lizards were found to be infested by snake mites except for one that was collected on 17 August 2019 inside a dried-up earth dam (Figure 2; S33.88845 E139.31065; datum WGS84) at the study site surrounding the Bunday Lutheran Church ruins. Four females of *Op. natricis* (Figure 3) were collected from the lizard, but when it was subsequently recaptured on 18 November 2019 less than 50 m from where it was initially captured (Figure 2), no *Op. natricis* were found. None of the other lizards were captured more than once. The *Op. natricis* specimens were deposited in the Australian National Insect Collection (ANIC), CSIRO, Canberra (voucher numbers ANIC 51-006454 to ANIC 51-006462).

Case 2 — On 12 June 2018, a juvenile eastern bluetongue lizard (*Tiliqua scincoides*) that had been injured by a domestic cat (*Felis catus*), was collected by a wildlife rescuer from the garden of a private residence on Beach Road in Hackham, a suburban neighborhood of Adelaide, and taken to a veterinarian. Several suspected mites were collected, preserved in 95% ethanol, and donated to us to determine the species. These mites were determined to be five females and two males of *Op. natricis*, which were also subsequently deposited in ANIC (females - ANIC 51-0006463 to ANIC 51-006467; males - ANIC 51-006468 and ANIC 51-006469).

Case 3 — On 04 August 2019, another *T. scincoides* that had been injured by a domestic cat, was collected by a wildlife rescuer from the garden of a private residence in Morphett Vale, a suburban neighborhood of Adelaide, and taken to a veterinarian. The lizard was suspected to be infested by *Op. natricis* and was treated accordingly. The kitchen tissue towels that were used as a substrate in the container the lizard was transported in were examined under a dissection microscope and one female of *Op. natricis* was found and subsequently deposited in ANIC (ANIC 51-006513).

Museum records and literature review

We found 42 records of *Op. natricis* specimens collected in Australia from the Northern Territory, Queensland, Victoria and South Australia (Table 1). Six lizard and 13 snake species have been reported as hosts of *Op. natricis* in Australia. Of the 17 records of lizards as hosts of



Figure 1 The sleepy lizards (*Tiliqua rugosa*) were checked for mite by holding them within a plastic container and brushing the areas under their scales with a fine paintbrush (photographed by Jessica Clayton).

this parasite, 52.9% were animals in captivity and of the 24 records of snakes as hosts, 62.5% were animals in captivity. One record was of mite that were collected from the environment.

Discussion

Our record of *Op. natricis* from the mid-north of South Australia shows that this parasite is present on wild populations of *T. rugosa* and that it has become naturalized in the wild in Australia. *Ophionyssus natricis* was first reported from Australia by Womersley (1956), on the basis of specimens from snakes at Sydney, New South Wales, and Malanda, Queensland. Domrow (1985) recorded it on the European green lizard, *Lacerta viridis*, in Melbourne, which suggests a possible pathway for the introduction of the mite into Australia. Domrow (1988) summarised previous records of *Op. natricis* on several species of snakes in Australia and pointed out that the records often came from hosts in captivity. Our summary of known hosts of this mite in Australia supports this conclusion (Table 1). In addition, most records of these mites on free-living reptiles involve animals that were found in the proximity of suburban areas, so the likelihood of these reptiles being escaped pets or that the mite was spread by escaped pets cannot be excluded. Wildlife Health Australia (2018) stated that “there are no confirmed reports of snake mite in free-ranging reptiles in Australia”. The nearest human settlement to our study site in the mid north of South Australia is a small village (Robertstown, 2006 population 318), ca. 17 km away and the nearest town (Eudunda, 2006 population 640) is ca. 35 km away, so the presence of the mite in the study site is unlikely due to a close proximity to pet reptiles. In addition, the likelihood that the infested lizard was a released pet can be ruled out since the lizards we collected are marked with unique toe-clips and have been captured in consecutive years. Our records of *Op. natricis* from the mid-north of South Australia therefore shows

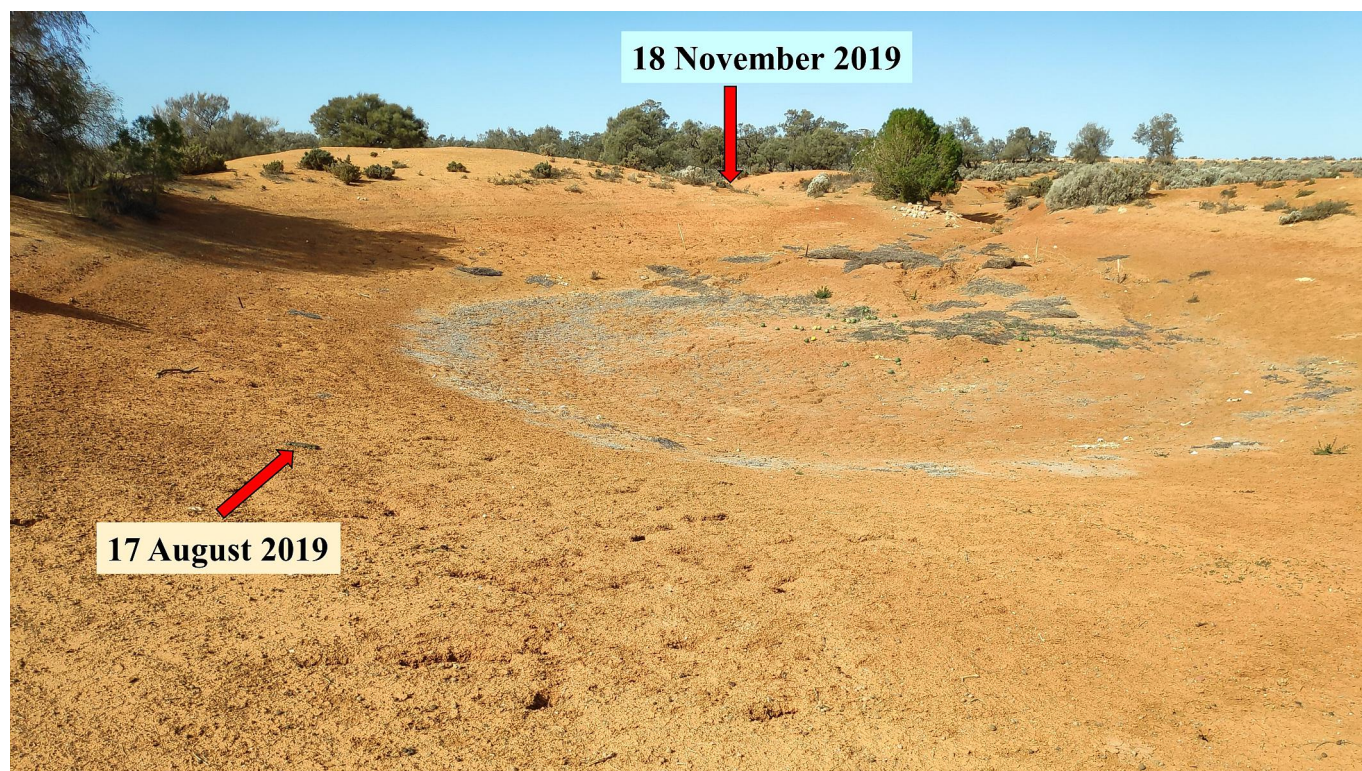


Figure 2 The locality inside the dried-up earth dam where the infested lizard was caught and where it was recaptured four months later (photographed by Gerrut Norval).

that the parasite is present on wild populations of hosts. In addition, the specimens that were collected from moss on Mt. Remarkable near Melbourne in South Australia (Table 1), and the instances of infestation of the endangered pale-headed snake (*Hoplocephalus bitorquatus*) in a pastoral area near Pilliga in New South Wales (Fitzgerald *et al.*, 2010) indicates that these mites are present in the wild in other parts of southeastern and southern Australia, leading us to the conclusion the species has become naturalised.

Ophionyssus natricis can readily be accidentally introduced into new localities along with their hosts. The larvae of *Op. natricis* are fairly sedentary, while the protonymph, deutonymph and adult (male and female) life stages are more active (Camin, 1953). Only the protonymph and adult life stages are parasitic and, as they are photophobic, tend to attach under scales of the host (Camin, 1953; Wozniak and DeNardo, 2000). They can be easily overlooked, particularly if they are un-engorged. Case in point, the first record of *Op. natricis* in New Zealand was from dead juvenile eastern blue-tongued lizards that were obtained from Melbourne Zoo by Wellington Zoo in New Zealand (Heath, 1986). It is therefore imperative that wildlife rescuers in areas where this mite is present should take this into consideration when reptiles are relocated, and ideally, such reptiles should be treated for possible mite infestation prior to release.

Interestingly, our observations in the mid-north of South Australia were from a xeric environment, which indicates that the distribution of *Op. natricis* can extend beyond high rainfall parts of Australia. *Ophionyssus natricis* is generally considered sensitive to desiccation and eggs and larvae suffer high mortality in conditions with a relative humidity lower than 75% (Camin, 1953; Wozniak and DeNardo, 2000). The distribution in drier areas is of concern regarding the potential for spread of this invasive species.

Our findings also highlight the importance of continued monitoring of *Op. natricis* in the wild. During the 2017 field season it was noted that what appeared to be snake mites were quite common on sleepy lizards at the study site surrounding the Bunday Lutheran Church ruins



Figure 3 One of the four engorged females of *Ophionyssus natricis* that were collected from a sleepy lizard (*Tiliqua rugosa*) on 17 August 2019 at the study site surrounding the Bunday Lutheran Church ruins in the Mid North of South Australia (photographed by Gerrut Norval).

(Sih 2017, *personal observation*). The study site typically experiences rainfall of less than 300 mm during late winter to early summer (August to December) (Kerr and Bull, 2004) and the only record of *Op. natricis* at the study site in 2019 was in mid-August when the study site was experiencing a severe drought, which lasted throughout the time the study was conducted. It is therefore possible that no other instances of mite infestation were found at the study site because the mite population in this area may have been drastically reduced or may even have died out due to desiccation stress. It is therefore recommended that follow up investigations be done during non-drought periods to verify the status and distribution of this snake mite population.

Herein we describe instances of *Op. natricis* parasitising skinks from South Australia and summarised the known hosts and distribution records of this mite in Australia. Our observation from the mid-north of South Australia is a new distribution record for *Op. natricis* in Australia and appears to be the first confirmed instance of these mite infesting a sleepy lizard in the wild. Additional surveys are needed to confirm the extent of the distribution of this mite in Australia, and we encourage the submittal of mite specimens for species verification and the reporting of the host species and localities where *Op. natricis* are found in Australia.

Disclosures

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Table 1 Records of the snake mite (*Ophionyssus natricis*) from Australia, with notes on the record date, locality and the host (* explicitly stated that the specimens came from hosts in captivity; ** uncatalogued specimens; [†] the specimens are from the wild). ANIC – Australian National Insect Collection; QM – Queensland Museum; SAMA – South Australian Museum.

Host	Locality	Date	Reference
Lizards			
<i>Amphibolurus muricatus</i> *	South Australia Museum, Adelaide, SA	Aug. 1973	SAMA**
<i>Carlia longipes</i> , listed as <i>Leiopisma fusca</i> *	Arnhem Land, NT	1948	SAMA**
<i>Chlamydosaurus kingii</i> *	Taronga Zoo, Sydney, NSW	3 Dec. 1999	ANIC 1133/1
<i>Lacerta viridis</i> *	Royal Melbourne Zoo, VIC	Sep. 1982	QM 93971 – 93980; Domrow (1985)
<i>Tiliqua rugosa</i> *	Adelaide University, SA	2 Aug. 1979	SAMA**
<i>Tiliqua rugosa</i> *	Lone Pine Koala Sanctuary, Brisbane, QLD	13 Oct. 1995	QM**; Walter and Shaw (2002)
<i>Tiliqua rugosa</i> *	Warrawong Wildlife Sanctuary, Mylor, SA	23 May 2007	SAMA**
<i>Tiliqua scincoides</i>	St. Albans, VIC	1 Jul. 1971	QM 93993
<i>Tiliqua scincoides</i>	Campbellfield, Melbourne, VIC		Hoser and Valentic (1996)
<i>Tiliqua scincoides</i>	Melbourne, VIC	Jul. 1999 – Apr. 2000	Watharow and Reid (2002)
<i>Tiliqua scincoides</i>	Capel Sound, Mornington Peninsula, VIC	1995	Hoser and Valentic (1996)
<i>Tiliqua scincoides</i>	Werribee, Skeleton Coast, VIC	15 May. 1999	QM**
<i>Tiliqua scincoides</i>	Campbellfield, Ivanhoe, Rockbank, Sydenham, Templestowe and Werribee, VIC	Jul. – Sep. 1999	Walter and Shaw (2002)
<i>Tiliqua scincoides</i> *	Largs North, SA	2 Aug. 1978	SAMA**
<i>Tiliqua scincoides</i>	Melbourne, VIC	1990 – 1993	Turner (2010)
Unspecified lizards *	Adelaide College of Advanced Education, SA	30 Apr. 1980	SAMA**
Unspecified lizards and snakes	Adelaide, SA	12 Jul. 1964	QM 93960 - 93970
Snakes			
<i>Acanthophis antarcticus</i> *	Adelaide, SA	12 Aug. 1971	Domrow (1985)
<i>Acanthophis antarcticus</i> *	Bundaberg, QLD	Jun. 1989	QM 93986 - 93990
<i>Antaresia children</i> , listed as <i>Liasis childreni</i>	Townsville, QLD	24 Jul. 1966	QM 93957 - 93959
<i>Antaresia children</i> , listed as <i>Liasis childreni</i>	Townsville, QLD	Dec. 1982	QM 93991
<i>Antaresia children</i> , listed as <i>Liasis children</i> *	Royal Melbourne Zoo, VIC		QM 93992
<i>Aspidites ramsayi</i> *	South Australia Museum, Adelaide, SA	Dec. 1980	SAMA**
<i>Hoplocephalus bitorquatus</i> [†]	Namoi River, NSW	Nov. 2001 – Mar. 2002	Fitzgerald <i>et al.</i> (2010)
<i>Hoplocephalus stephensii</i> *	Brisbane, QLD		ANIC**
<i>Liasis fuscus</i> *	Lone Pine Koala Sanctuary, Brisbane, QLD	13 Oct. 1995	QM**
<i>Morelia viridis</i> *	Royal Melbourne Zoo, VIC	21 Jun. 1971	QM**
<i>Morelia viridis</i> *	Mareeba, Far North, QLD	3 Jan. 1999	QM**
<i>Morelia spilota metcalfei</i> *	Warrawong Wildlife Sanctuary, Mylor, SA	23 May 2007	SAMA**
<i>Morelia spilota variegata</i>	Malanda, QLD	27 Oct. 1952	SAMA J16096
<i>Morelia spilota variegata</i> *	Royal Melbourne Zoo, VIC	Jun. 1983	QM 93997
<i>Notechis scutatus</i>	Campbellfield, Melbourne, VIC	1996	Hoser and Valentic (1996)
<i>Pseudechis porphyriacus</i> *	Brisbane, QLD	1982	Domrow (1985)
<i>Pseudonaja textilis</i> , listed as <i>Demansia textilis</i>	Sydney, NSW	Dec. 1952	SAMA J16086 - J16092
<i>Python molurus bivittatus</i> *		26 Dec. 1956	SAMA J16098 – J16110
<i>Tropidechis carinatus</i>	North Coast, NSW		QM 93981 - 93985
Unspecified snake *	Westmead, NSW	1 Sep. 2006	ANIC**
Unspecified snake *	Warrnambool, VIC	Oct. 1974	QM 93996
Unspecified snake *	Adelaide		SAMA J16093 - J16094
Unspecified snake	Cairns, QLD	Oct. 1952	SAMA J16095
Unspecified snake skin *	Queensland Institute of Medical Research, QLD	Jun. 1967	QM 939954- 93995
Environment			
Moss [†]	Mt. Remarkable, Melrose, SA	2 Sep. 1960	SAMA J16083 - J16085

are those of the authors and are not to be construed as official or representing the views of the institutions they are affiliated to.

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References

- Amanatfard E., Youssefi M.R., Barimani A. 2014. Human dermatitis caused by *Ophionyssus natricis*, a snake mite. Iranian Journal of Parasitology, 9: 594-596. <http://ijpa.tums.ac.ir/index.php/ijpa/article/view/360>
- Beck W. 1996. Tierische Milben als Epizoonoseerreger und ihre Bedeutung in der Dermatologie. Der Hautarzt, 47: 744-748. doi:10.1007/s001050050501
- Camin J.H. 1953. Observations on the life history and sensory behavior of the snake mite *Ophionyssus natricis* (Gervais) (Acarina: Macronyssidae). Chicago Academy of Sciences Special Publication, 10: 1-75. doi:10.1086/400476
- Domrow R. 1985. Species of *Ophionyssus* Mégnin from Australian lizards and snakes (Acari: Dermanyssidae). Australian Journal of Entomology, 24: 149-153. doi:10.1111/j.1440-6055.1985.tb00213.x
- Domrow R. 1988. Acari Mesostigmata parasitic on Australian vertebrates: an annotated checklist, keys and bibliography. Invertebrate Taxonomy, 1: 817-948. doi:10.1071/IT9870817
- Fitzgerald M., Brian L., Shine R. 2010. Ecology and conservation of the pale-headed snake (*Hoplocephalus bitorquatus*, Elapidae). Australian Zoologist, 35: 283-290. doi:10.7882/AZ.2010.017
- Frank W. 1981. Ectoparasites. In: Cooper J.E., Jackson O.F., (Eds). Diseases of the Reptilia. London, UK: Academic Press Inc. (London) Ltd. p. 359-383.
- Gervais P. 1844. Histoire Naturelle des Insectes. Aptères. Paris, France: Roret.
- Goldberg S.R., Bursey C.R. 1991. Duration of attachment by mites and ticks on the iguanid lizards *Sceloporus graciosus* and *Uta stansburiana*. Journal of Wildlife Diseases, 27: 719-722. doi:10.7589/0090-3558-27.4.719
- Heath A.C.G. 1986. First occurrence of the reptile mite, *Ophionyssus natricis* (Acari: Dermanyssidae) in New Zealand. New Zealand Veterinary Journal, 34: 78. doi:10.1080/00480169.1986.35304
- Hoser R., Valentic R. 1996. Notes on a field trip to the Lower Mornington Peninsula with comments on the wider significance of some observations. Monitor, 8: 24-34.
- Kerr G.D., Bull C.M. 2004. Field observations of extended locomotor activity at sub-optimal body temperatures in a diurnal heliothermic lizard (*Tiliqua rugosa*). Journal of Zoology, London, 264: 179-188. doi:10.1017/S0952836904005734
- Lane T.J., Mader D.R. 1996. Parasitology. In: Mader D.R., (Ed). Reptile Medicine and Surgery. Philadelphia, U.S.A.: W.B. Saunders Company. p. 185-203.
- Miranda R.J., Cleghorn J.E., Bermudez S.E., Perotti M.A. 2017. Occurrence of the mite *Ophionyssus natricis* (Acari: Macronyssidae) on captive snakes from Panama. Acarologia, 57: 365-368. doi:10.1051/acarologia/20164161
- Schultz H. 1975. Human infestation by *Ophionyssus natricis* snake mite. British Journal of Dermatology, 93: 695-697. doi:10.1111/j.1365-2133.1975.tb05120.x
- Sih A., Spiegel O., Godfrey S., Leu S., Bull C.M. 2018. Integrating social networks, animal personalities, movement ecology and parasites: a framework with examples from a lizard. Animal Behaviour, 136: 195-205. doi:10.1016/j.anbehav.2017.09.008
- Šlapeta J., Modrý D., Johnson R. 2018. Reptile parasitology in health and disease. In: Doneley B., Monks D., Johnson R., Carmel B., (Eds). Reptile Medicine and Surgery in Clinical Practice. West Sussex, UK: John Wiley & Sons Ltd. p. 425-439. doi:10.1002/9781118977705.ch31
- Turner G.S. 2010. Natural history notes on the eastern blue-tongued skink *Tiliqua scincoides scincoides* from the basalt plains around Melbourne. The Victorian Naturalist, 127: 70-78. <https://search.informit.com.au/documentSummary;dn=282048267549394;res=IELHSS;subject=Arts>
- Walter D.E., Shaw M. 2002. First record of the mite *Hirstiella diolii* Baker (Prostigmata: Pterygosomatidae) from Australia, with a review of mites found on Australian lizards. Australian Journal of Entomology, 41: 30-34. doi:10.1046/j.1440-6055.2002.00272.x
- Watharow S., Reid A. 2002. The introduced snake mite *Ophionyssus natricis* on wild populations of eastern blue tongue lizards (*Tiliqua scincoides*). Herpetofauna, 32: 26-29.
- Wildlife Health Australia. Snake mite (*Ophionyssus natricis*) [Internet]. Wildlife Health Australia; [cited]. Available from: <https://wildlifehealthaustralia.com.au/FactSheets.aspx>
- Womersley H. 1956. On some new Acarina - Mesostigmata from Australia, New Zealand and New Guinea. Journal of the Linnean Society of London, Zoology, 42: 505-599. doi:10.1111/j.1096-3642.1956.tb02218.x
- Wozniak E.J., DeNardo D.F. 2000. The biology, clinical significance and control of the common snake mite, *Ophionyssus natricis*, in captive reptiles. Journal of Herpetological Medicine and Surgery, 10: 4-10. doi:10.5818/1529-9651-10.3.4
- Yunker C.E. 1956. Studies on the snake mite, *Ophionyssus natricis*, in nature. Science, 124: 979-980. doi:10.1126/science.124.3229.979