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SHORT COMMUNICATION

First reported observation of phoresy of pseudoscorpions on an endemic New Zealand mammal, the lesser short-tailed bat, *Mystacina tuberculata*

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The pseudoscorpion *Apatochernes vastus* Beier, 1976 (Chernetidae) is recorded for the first time on the pelage of the endemic New Zealand lesser short-tailed bat, *Mystacina tuberculata*. Despite previous descriptions of numerous species of pseudoscorpions throughout New Zealand, the distribution, abundance and life history strategies of pseudoscorpions is poorly known.

Keywords: *Apatochernes*; *Mystacina*; New Zealand; phoresy; pseudoscorpion; short-tailed bat

Introduction

Pseudoscorpions are small (2–8 mm) arachnids with four pairs of legs and a pair of large pedipalps. They are widespread throughout the world with more than 3500 species currently recognised (Harvey 2013a). Pseudoscorpions occupy a range of habitats including small crevices in rocky areas, under bark, in leaf litter and in caves, frequently on bat guano. A number of species are obligate commensals, spending their entire life cycle in association with their host animal, either in the fur or in the nests of mammals or by attaching themselves to various body parts of flying insects as well as spiders (Harvey 2013b).

Pseudoscorpions have previously been recorded in the pelage (fur) of bats in Australia and Central Africa (Harvey & Parnaby 1993). They have also been recorded from accumulations of bat guano in cave systems across Eurasia (Christophoryová et al. 2013) and additionally from guano piles below *Mystacina tuberculata* roost trees in New Zealand (Beier 1976). However, the presence of pseudoscorpions on the pelage of bats in New

Zealand has not previously been documented. Here we record the presence of pseudoscorpions in the pelage of the New Zealand lesser short-tailed bat, *M. tuberculata* from Pureora Forest Park in the North Island of New Zealand.

Methods

Pureora Forest Park is in the North Island of New Zealand (38°30'S, 175°33'E) and is approximately 78,000 ha (King et al. 1996). The park, managed by the New Zealand Department of Conservation (DOC), contains remnant native podocarp forest dominated by rimu (*Dacrydium cupressinum*), mataī (*Prumnopitys taxifolia*), miro (*Prumnopitys ferruginea*) and tawa (*Beilschmiedia tawa*) and other forest species such as tōtara (*Podocarpus totara*), tāwheowheo (*Quintinia serrata*) and kāmahī (*Weinmannia racemosa*). Tōtara is an important species in the forest in providing maternal roosts for *M. tuberculata*. The forest floor also contains the threatened parasitic flowering plant *Dactyloctenium aegyptium*, considered an important food source for

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M. tuberculata when in flower. The park is a significant conservation area, supporting a number of remnant populations of native fauna including a large colony of short-tailed bats (Lloyd 2001).

Mystacina tuberculata were trapped using harp traps (Faunatech Austbat, Bairnsdale, Australia) suspended across the entrances of known maternity roost trees at Pureora Forest Park between October 2013 and April 2014 as part of a study investigating the effects of a diphacinone bait operation for rodent control on the survival and individual fitness of *M. tuberculata* (G Dennis, unpubl. data). While bats were being processed, pseudoscorpions were observed attached to the fur of some individual bats. Two specimens were collected opportunistically and preserved in 95% ethanol. Identifications were made at the Western Australian Museum and the two specimens have been lodged at the Western Australian Museum, Perth (registration number T135430) and Te Papa, Wellington (registration number AF.000963), respectively.

Results

Two pseudoscorpion specimens were collected from the ventral and dorsal fur of *M. tuberculata* on 3 and 8 February 2014, respectively. Both specimens were adult male *Apatochernes vastus* Beier, 1976 (Chernetidae) (Fig. 1). The specimens matched the original description of *A. vastus* quite well. Salient measurements (length and width in mm) and observations include: body length: 3.30–3.33; pedipalps: femur 1.02–1.10/0.46–0.51 (= 2.16–2.22 ×); patella 1.06–1.07/0.52–0.53 (= 2.00–2.06 ×); chela (with pedicel) 1.76–1.86/0.62–0.64 (= 2.83–2.91 ×); chela (without pedicel) 1.59–1.68; hand (without pedicel) 0.78–0.81 (= 1.26 ×); movable finger 0.95–0.98. Carapace 1.18–1.20/1.00–1.01 (= 1.17–1.20 ×). Eye spots barely visible. Tergite XI and sternite XI not divided.

Discussion

The presence and abundance of pseudoscorpions in New Zealand, particularly in association with host fauna species, is not extensively documented despite 79 species being recorded from a number



Figure 1 An adult male *Apatochernes vastus* Beier, 1976 (Chernetidae) collected from the pelage of *Mystacina tuberculata* at Pureora Forest Park, New Zealand.

of localities throughout New Zealand (Harvey 2013b).

Elsewhere in New Zealand, pseudoscorpions have been recorded as part of surveys in black beech forests in the Maitai Valley near Nelson through bark sampling (Morales et al. 1988). Pseudoscorpions from the Neobisiidae family have been found to be associated with beech logs in a study of litter-dwelling invertebrates in Maruia State Forest in the South Island (Evans et al. 2003). In Otago's Rock and Pillar Range, a single undescribed *Apatochernes* species (Chernetidae) was recorded from a pitfall trap and on a shrub (Derraik et al. 2001).

The genus *Apatochernes* contains 16 described species in New Zealand and an additional species, *A. posticus*, from Norfolk Island (Beier 1976; Harvey 2013b). The genus is widespread throughout New Zealand including species from offshore islands in the south (*A. antarcticus* from Campbell Island, *A. chathamensis* from the Chatham Islands and *A. posticus* from Norfolk Island) and north (*A. cruciatus* from Green Island, *A. gallinaceus* from the Hen and Chicken Islands group and *A. turbotti* from the Three Kings Island group). Species from the North Island include *A. solitarius* from Waikato, *A. obrieni* from the Bay of Plenty and *A. wisei* from Northland. Species of *Apatochernes* from the South Island include *A. proximus* from Otago, *A. nestoris* from the west coast,

*A. cheliferoide*s and *A. curtulus* from Southland, *A. kuscheli* and *A. maoricus* from Canterbury, and *A. insolitus* from Tasman. *Apatochernes vastus* was first recorded in 1976 at Kauri Sanctuary, Omahuta Forest, Northland (Beier 1976) in bat guano and from a kauri tree hollow, which potentially could have been used as a bat roost.

Observations of pseudoscorpions associated with *M. tuberculata* at Pureora also included additional individuals on the pelage of bats trapped between October 2013 and April 2014, and a single individual recorded on video footage captured outside a bat lekking roost during a study investigating lekking behaviour in this species (C Toth, pers. comm. 2014). Given the difficulty in correctly identifying pseudoscorpions in the field, it cannot be confidently determined that all individuals observed were *A. vastus*, or what the sex or life stage of these pseudoscorpions was. Interestingly, pseudoscorpions have not been observed on the pelage or in association with the other forest-dwelling endemic bat, the New Zealand wattled bat *Chalinolobus tuberculatus* (commonly referred to as the New Zealand long-tailed bat), which roosts in the same forest fragment.

Despite numerous records of pseudoscorpions throughout New Zealand, information on the distribution, abundance, sex ratios, life stages and life history strategies for this group remains poor. This is the first description of *A. vastus* from the pelage of bats in New Zealand. In general, most mammal commensals usually belong to *Megachernes*, which is in the same family as *Apatochernes* in the Chernetidae. However, these genera are not considered to be closely related and are included in different subfamilies (Harvey et al. 2012). There appear to be no adaptive physical features in either genus that would predispose them to associating with mammals. Also, *A. vastus* is the only species of the genus that has been recorded on mammals, whereas all other species occupy litter and other similar habitats.

Beier (1976) also recorded *A. vastus* as ‘very common in old, hollow kauri (*Agathis australis*)’, suggesting that the relationship with the bat is not an obligate one. It is of particular interest that the act of phoresy between pseudoscorpions and

micro-bats has been recorded in New Zealand, as it has elsewhere in the world, despite New Zealand’s geographic isolation of the last 80 million years. For it to occur on the only extant land mammal highlights a truly unique relationship between both species. Whether a similar interaction may have occurred between pseudoscorpions and the now extinct greater short-tailed bat, *Mystacina robusta*, will never be known. This discovery highlights the how the protection of one species has implications for protecting lesser-known species with hitherto unidentified associations.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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