

This article was downloaded by: [The University of British Columbia]

On: 16 November 2012, At: 11:12

Publisher: Taylor & Francis

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Journal of Natural History

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/tnah20>

A new species of the pseudoscorpion genus *Megachernes* (Pseudoscorpiones: Chernetidae) associated with a threatened Sri Lankan rainforest rodent, with a review of host associations of *Megachernes*

Mark S. Harvey^{a b c d}, Pamoda B. Ratnaweera^{e f}, Preethi V. Udagama^e & Mayuri R. Wijesinghe^e

^a Department of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool, DC, WA 6986, Australia

^b Division of Invertebrate Zoology, American Museum of Natural History, 79th Street @ Central Park West, New York, NY, 10024-5192, USA

^c Department of Entomology, California Academy of Sciences, Golden Gate Park, San Francisco, CA, 94103-3009, USA

^d School of Animal Biology, University of Western Australia, Crawley, WA, 6009, Australia

^e Department of Zoology, University of Colombo, Cumaratunga Munidasa Mawatha, Colombo 03, Sri Lanka

^f Science and Technology Degree Programme, Uva Wellasa University, Badulla, Sri Lanka

Version of record first published: 15 Nov 2012.

To cite this article: Mark S. Harvey, Pamoda B. Ratnaweera, Preethi V. Udagama & Mayuri R. Wijesinghe (2012): A new species of the pseudoscorpion genus *Megachernes* (Pseudoscorpiones: Chernetidae) associated with a threatened Sri Lankan rainforest rodent, with a review of host associations of *Megachernes*, *Journal of Natural History*, 46:41-42, 2519-2535

To link to this article: <http://dx.doi.org/10.1080/00222933.2012.707251>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.tandfonline.com/page/terms-and-conditions>

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

A new species of the pseudoscorpion genus *Megachernes* (Pseudoscorpiones: Chernetidae) associated with a threatened Sri Lankan rainforest rodent, with a review of host associations of *Megachernes*

Mark S. Harvey^{a,b,c,d,*}, Pamoda B. Ratnaweera^{e,f}, Preethi V. Udagama^e and Mayuri R. Wijesinghe^e

^aDepartment of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool DC, WA 6986, Australia; ^bDivision of Invertebrate Zoology, American Museum of Natural History, 79th Street @ Central Park West, New York, NY 10024-5192, USA; ^cDepartment of Entomology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94103-3009 USA; ^dSchool of Animal Biology, University of Western Australia, Crawley, WA 6009, Australia; ^eDepartment of Zoology, University of Colombo, Cumaratunga Munidasa Mawatha, Colombo 03, Sri Lanka; ^fScience and Technology Degree Programme, Uva Wellassa University, Badulla, Sri Lanka

(Received 14 March 2012; final version received 25 June 2012; printed 28 October 2012)

Most species of the Old World pseudoscorpion genus *Megachernes* are associated with mammals, either within their nests or in their pelage, whereas others are found in cave systems, usually in bat guano. The first Sri Lankan species of the genus, *Megachernes kanneliyensis*, is described from the fur of an endemic, threatened Sri Lankan mouse, *Mus mayori pococki* from the Kanneliya rainforest. The species is compared with other species of the genus. Host associations of all named and several unnamed species of *Megachernes* are reviewed, with two main habitat types, those found in mammal nests and in their pelage, and those found in bat guano. Based on similarities with *Megachernes*, *Chiridiochernes* is transferred to Lamprochernetinae as the spermathecae are T-shaped, the sole diagnostic feature of the subfamily.

Keywords: threatened species; *Mus mayori pococki*; rainforest; morphology; taxonomy

Introduction

Mayor's Mouse, *Mus mayori* (Thomas, 1915), is endemic to the rainforests of Sri Lanka, with *Mus mayori mayori* found in the montane zone and *Mus mayori pococki* Ellerman, 1947 found in the lowlands (Phillips 1980). It is listed as Vulnerable by the IUCN because of deforestation of its native habitat (Goonatilake et al. 2008). *Mus mayori pococki* is a medium-sized murid with a snout–vent length of approximately 90 mm (Phillips 1980; Ratnaweera et al. 2010). Previous studies on parasites occurring on *Mus mayori* found the laelapid mite *Laelaps atypicus* Turk, 1950 (Laelapidae) and the flea *Stivalius phoberus* Jordan and Rothschild, 1922 (Stivaliidae) (Turk 1950; Phillips 1980; Cruz 1984). Recent studies on populations of *Mus mayori pococki* from four rainforest reserves in Sri Lanka recorded several ectoparasitic or commensal

*Corresponding author. Email: mark.harvey@museum.wa.gov.au

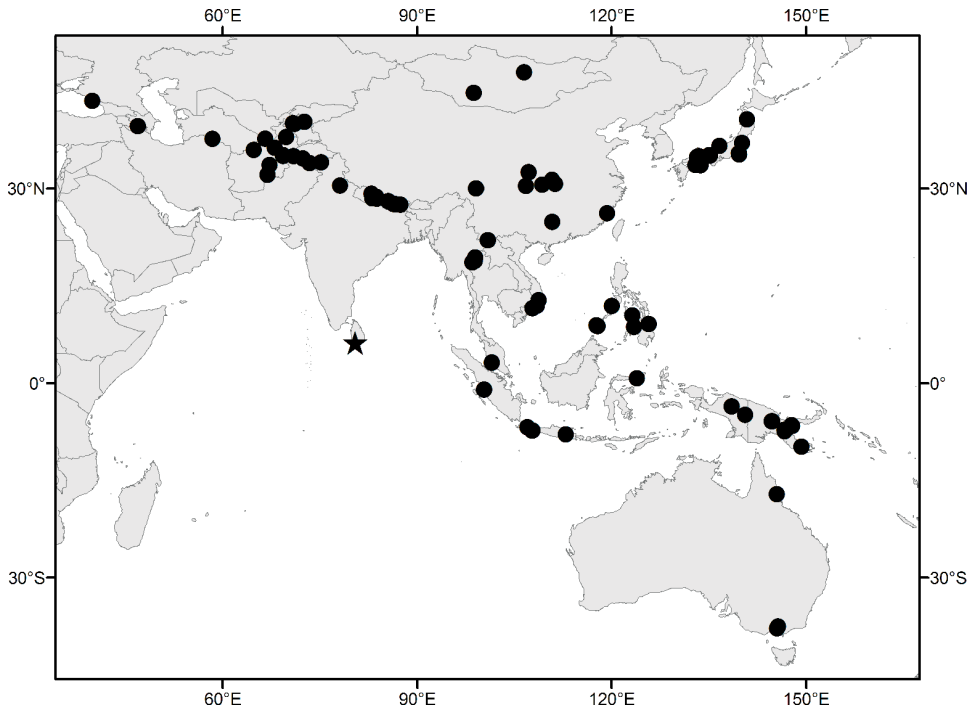


Figure 1. Map showing distribution of *Megachernes kanneliyensis* (★) and all other *Megachernes* species (●).

arthropods including mites of the genus *Echinolaelaps* Ewing, 1929 (Laelapidae), the louse *Polyplax serrata* (Burmeister, 1839) (Hoplopleuridae), a species of the tick genus *Ixodes* Latreille, 1795 (Ixodidae), and a pseudoscorpion of the genus *Megachernes* Beier, 1932 (Ratnaweera et al. 2010). The pseudoscorpion is now named and described in this paper.

Species of *Megachernes* occur widely throughout the eastern portion of the Old World, with the 22 named species ranging from the Black Sea in the west to Japan in the northeast and as far south as eastern Australia (Harvey 2011) (Figure 1). Members of the genus are unusual among pseudoscorpions in that many appear to be obligate commensals with mammals, occurring in their nests and living phoretically in their pelage (e.g. Beier 1948; Martens 1975; Durden 1991), or occurring in caves (e.g. Morikawa 1960). Despite records of *Megachernes* from other regions of Asia, and only two records from India, both of *Megachernes himalayensis* (Ellingsen, 1914) from the northern states of Uttarakhand (Ellingsen 1914) and Jammu and Kashmir (Beier 1978) there had been no records from Sri Lanka. The discovery of specimens of *Megachernes* in the fur of a Sri Lankan rodent allows us to record the genus from Sri Lanka for the first time.

Materials and methods

The material examined here is lodged in the collections of the Western Australian Museum, Perth (WAM). Terminology and mensuration mostly follow Chamberlin (1931), with the exception of the nomenclature of the pedipalps and legs and with

some minor modifications to the terminology of the trichobothria (Harvey 1992) and chelicera (Judson 2007). The terminology for the mammalian hosts follows Wilson and Reeder (2005).

The terms antaxial and paraxial have been recently proposed to describe the lateral faces of pseudoscorpion appendages (Judson 2007) to replace the inadequate and ambiguous terms anterior and posterior. This change is welcome but we here use the terms prolateral and retrolateral as used in describing spider appendages (e.g. Forster 1967; Dondale and Redner 1978). When the appendage is (imaginarily) stretched at 90° to the longitudinal axis of the body, the anterior-facing surface is the prolateral face and the posterior-facing surface is the retrolateral face.

The specimens were collected and stored in 75% ethanol. They were studied using a Leica DM2500 compound microscope and Leica MZ16A and M205C stereo microscopes. The line drawings were prepared with the aid of a drawing tube attached to the Leica DM2500 microscope, and the digital images were taken with a Leica DFC 500 camera attached to the Leica MZ16A and M205C stereo microscopes. Measurements were taken at the highest possible magnification using an ocular graticule. The material was studied using temporary slide mounts prepared by the dissection of the pedipalps, one chelicera, leg I and leg IV from the body, immersion of the larger portions in concentrated lactic acid at room temperature for several days, and mounting them on microscope slides using 10-mm coverslips supported by small sections of nylon fishing line. After study the specimens were washed in distilled water and returned to 75% ethanol with the dissected portions placed in 12 × 3-mm glass genitalia microvials (BioQuip Products, Inc., Compton, CA, USA).

Family **CHERNETIDAE** Menge
Subfamily **LAMPROCHERNETINAE** Beier

Remarks

Harvey (1995) discussed the composition of the Lamprochernetinae, which was restricted to those chernetids with T-shaped spermathecae. Although the genera *Allochernes* Beier, 1932, *Lamprochernes* Tömösváry, 1882, *Lasiochernes* Beier, 1932, *Megachernes*, *Nudochernes* Beier, 1935, *Pselaphochernes* Beier, 1932 and *Wyochernes* Hoff, 1949 were included by Harvey (1995), it now appears that *Wyochernes* does not have T-shaped spermathecae (Muchmore 1996) and is better placed in the Chernetinae, despite the lack of a precise subfamilial definition (Harvey 1995).

The differences between *Megachernes* and *Lasiochernes* are slight and rest on the presence of a rounded protuberance on the posterolateral corner of coxa IV of *Megachernes*, which is absent in *Lasiochernes*. Beier (1932) claimed that the relative position of the tactile seta on legs III and IV differed between the genera, near the middle of the segment in *Megachernes* and more distally placed in *Lasiochernes*, but subsequent descriptions of other species of *Lasiochernes* suggest that a medial position typical of *Megachernes* species also occurs (Beier 1949, 1961, 1963), casting doubt on the utility of this feature. Other consistent differences may occur in the female genitalia, but too few species of either genus have been examined so far to establish whether this feature is reliable. The spermathecal arms of *Lasiochernes siculus* Beier, 1961, the only species described to date, are short (Callaini 1986), whereas those of *Megachernes* are extremely elongated and T-shaped as described for *Megachernes pavlovskyi* Redikorzev, 1949 (Vachon 1938, fig. 56k), *Megachernes ochotonae* Krumpál

and Keifer, 1982 (Krumpál and Kiefer 1982, fig. 7) and *Megachernes tuberosus* Mahnert, 2009 (Mahnert 2009, fig. 25).

The southeast Asian chernetid genus *Chiridiochernes* Muchmore, 1972 is also associated with rodents and has posterolaterally enlarged fourth coxae characteristic of *Megachernes*. *Chiridiochernes* differs in numerous ways from *Megachernes* including the lack of a tactile seta on tarsi III and IV, the lack of trichobothrium *st*, a prominent rounded process on the proximal region of the prolateral face of the male pedipalpal femur, flattened pedipalpal segments and the junction between the femur and patella of legs I and II more like cheiridioids than cheliferoids (Muchmore 1972). The sole named species of the genus, *Chiridiochernes platypalpus* Muchmore, 1972 from Sulawesi, is only known from a single adult male (Muchmore 1972). Dr M. Judson (Muséum National d'Histoire Naturelle, Paris) kindly informed us (in litt., 16 March 2012) that females of an undescribed species of *Chiridiochernes* have T-shaped spermathecae and therefore conform to current diagnoses of Lamprochernetinae, to which it is here transferred.

Megachernes Beier

Megachernes Beier 1932: 128; Beier 1933: 518; Beier 1948: 476; Morikawa 1960: 144; Harvey 1991: 599; Harvey 2011, without pagination.

Type species

Chernes grandis Beier, 1930, by original designation.

Diagnosis

Megachernes differs from other chernetid genera by the following combination of character states: posterolateral corner of coxa IV enlarged and rounded (Figures 3, 4B); cheliceral rallum with three blades (Figure 4F); tarsus III and IV with long tactile seta situated in middle of segment (Figure 4G); and female spermathecae very long and T-shaped.

Megachernes kanneliyensis sp. nov.

(Figures 2–4)

Material examined

Holotype. Male, Kanneliya rainforest, Southern Province, Sri Lanka, 6°09' to 6°18' N, 80°19' to 80°27' E, 9 November 2006, from dorsal fur of *Mus mayori pococki* Ellerman, P.B. Ratnaweera (WAM T121678).

Paratypes. One female (with attached brood-sac) (WAM T121679), two protonymphs (WAM T121680), collected with holotype.

Etymology

This species is named after the type locality, Kanneliya rainforest.

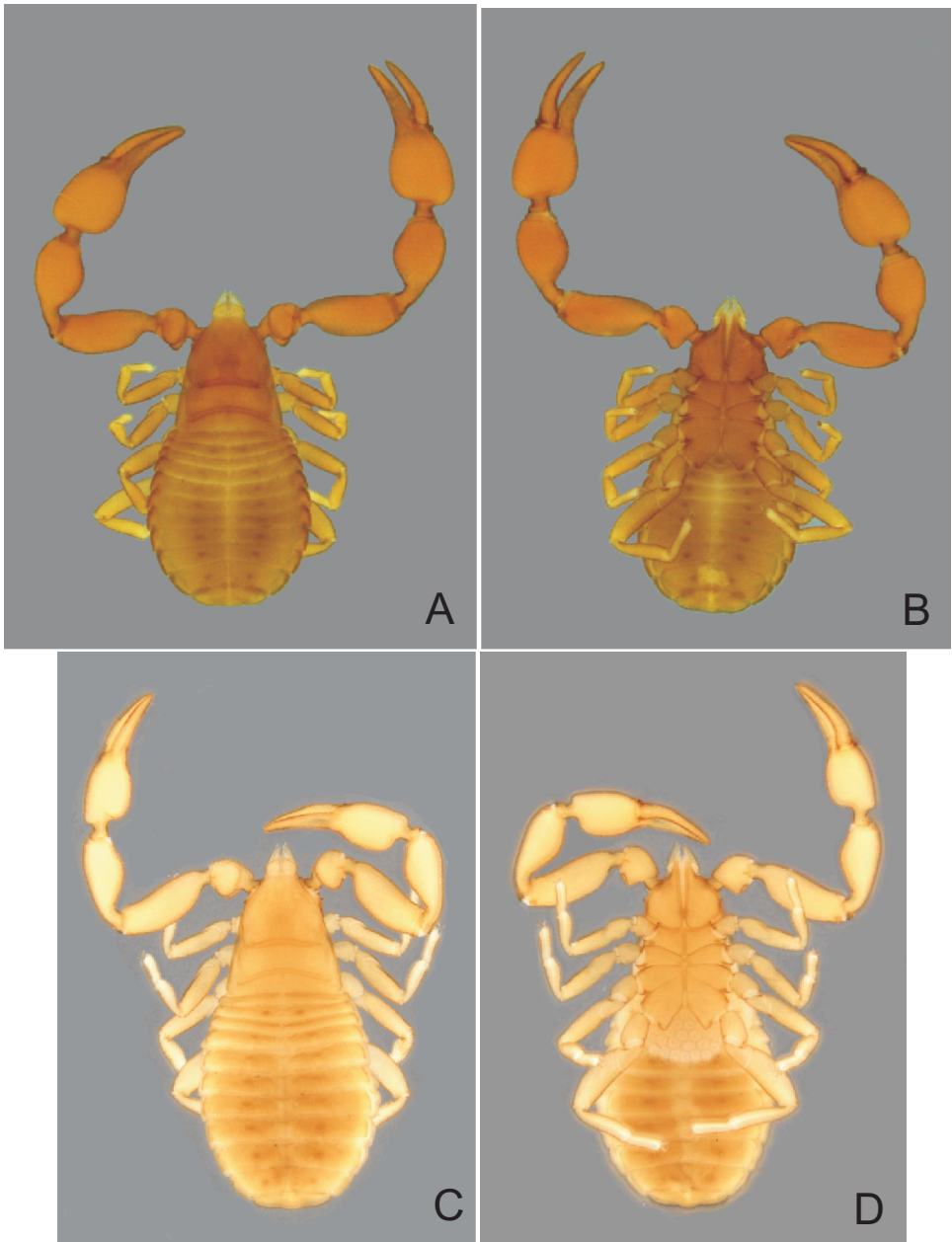


Figure 2. *Megachernes kanneliyensis* sp. nov. (A) Holotype male, dorsal; (B) holotype male, ventral; (C) paratype female, dorsal; (D) paratype female, ventral.

Diagnosis

Megachernes kanneliyensis is the only species of the genus in which males have been described with long setae on the pedipalpal patella and chela, particularly on the pro-lateral surfaces, but short setae on the femur (Figure 4C). Males of *Megachernes* with



Figure 3. *Megachernes kanneliyensis* sp. nov., paratype female, ventral showing detail of coxae and brood-sac.

long setae on the patella usually also have long setae on the femur as reported for *M. afghanicus* Beier, 1959, *M. barbatus* Beier, 1951, *M. glandulosus* Mahnert, 2009, *M. limatus* Hoff and Parrack, *M. loebli* Schawaller, 1991, *M. monstrosus* Beier, 1966, *M. trautneri* Schawaller, 1994 and *M. tuberosus* Mahnert, 2009 (Beier 1951, 1959, 1966, 1967; Hoff and Parrack 1958; Schawaller 1991, 1994; Mahnert 2009). Other species for which males have been described have short setae as in the majority of females. These include *M. grandis* (Beier, 1930), *M. mongolicus* (Redikorzev, 1934), *M. soriciola* Beier, 1974, *M. titanius* Beier, 1951 and *M. vietnamensis* Beier, 1967 (Beier 1930, 1951, 1967, 1974; Redikorzev 1934). Of the species for which males have not been fully described or illustrated, *M. kanneliyensis* is substantially larger than *M. crinitus* Beier 1948, *M. himalayensis* (Ellingsen 1914), *M. ochotonae* Krumpál and Kiefer 1982, *M. papuanus* Beier 1948, *M. pavlovskiyi* Redikorzev 1949, *M. penicillatus* Beier 1948 and *M. queenslandicus* Beier 1948, which have a female pedipalpal femur length less than 1.30 mm (Beier 1932, 1948; Redikorzev 1949; Krumpál and Kiefer 1982; Dashdamirov 2005), compared with 1.44 mm for *M. kanneliyensis*. Of those species of a comparable size, *M. kanneliyensis* differs as follows: the pedipalpal segments are less slender than in *M. philippinus* Beier, 1966 (Beier 1966); and the prolateral face of the chelal hand is only slightly curved in *M. kanneliyensis*, but is noticeably curved in *M. ryugadensis* Morikawa, 1954 (Morikawa 1954).

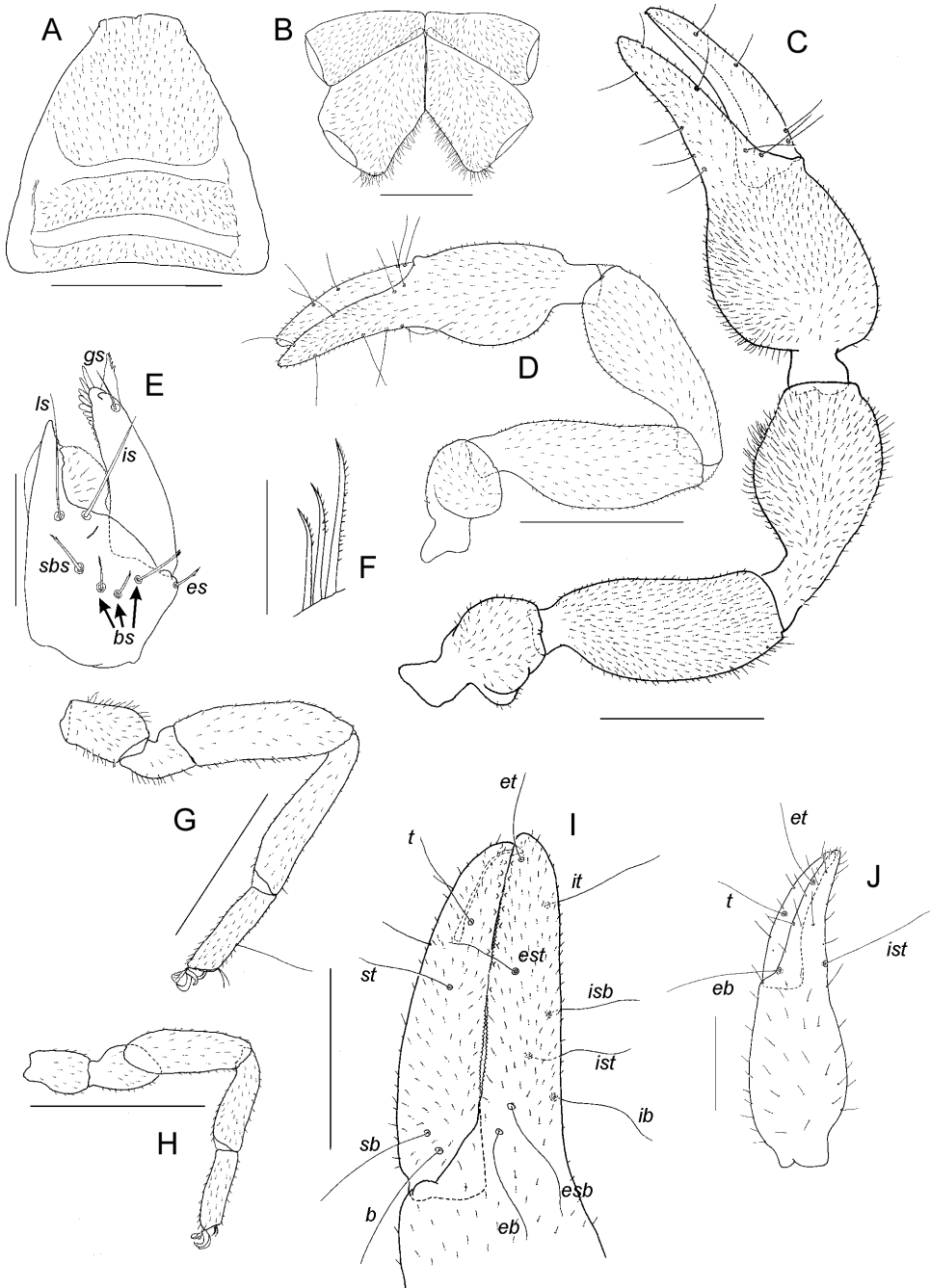


Figure 4. *Megachernes kanneliyensis* sp. nov., paratype female, unless stated otherwise. (A) Carapace, dorsal; (B) coxae III and IV, ventral; (C) right pedipalp, male holotype, dorsal; (D) right pedipalp, dorsal; (E) right chelicera, dorsal; (F) right rallum; (G) left leg IV, lateral; (H) left leg I, lateral; (I) left chela, lateral; (J) left chela, protonymph, dorsal. Scale bars = 1.0 mm (A, C, D, G, H), 0.5 mm (B, I), 0.2 mm (E, J), 0.1 mm (F).

Description – Adults

Pedipalps, cephalothorax, abdomen and legs uniformly pale yellow (Figures 2, 3). Vestitural setae generally short and inconspicuous, lightly dentate; most sternal setae acicular. Pleural membrane longitudinally wrinkled striate for entire length, without setae.

Pedipalps. Robust (Figures 2A–D, 4C,D), with trochanter 1.45 (♂), 1.55 (♀), femur 2.48 (♂), 2.62 (♀), patella 2.14 (♂), 2.56 (♀), chela (with pedicel) 2.78 (♂), 3.41 (♀), chela (without pedicel) 2.54 (♂), 3.08 (♀), hand (without pedicel) 1.26 (♂), 1.44 (♀) times longer than wide; movable finger 1.12 (♂), 1.14 (♀) times length of hand. All pedipalpal surfaces finely granulate. Fixed finger with *c.*60 (♂), *c.*64 (♀) marginal teeth, movable finger with *c.*64 (♂), *c.*70 (♀) marginal teeth; accessory teeth present in distal half of fingers, fixed finger with six (♂), eight (♀) retrolateral and 12 (♂), seven (♀) prolateral teeth; movable finger with six (♂), seven (♀) retrolateral and 10 (♂), 6 (♀) prolateral teeth; fingers not gaping when closed; chelal gland pores not observable. Pedipalpal setae: male with setae on trochanter and femur small and inconspicuous, on patella and chela long and slightly curved, especially on prolateral margin (Figure 4C); female with all setae small and inconspicuous (Figure 4D). Fixed finger with eight trichobothria, movable chelal finger with four trichobothria (Figure 4C,D,I); *eb* closer to *esb* than to *est*; *est* closer to *et* than to *esb*; *ib* and *ist* inserted basally; *isb* closer to *ist* than to *ib*; *sb* closer to *b* than to *st*; *st* closer to *t* than to *sb*. Venom apparatus only present in movable finger with nodus ramosus terminating between *t* and *st* (Figure 4I).

Chelicerae. Hand with seven (♂, ♀) setae, including the usual five setae and two additional *bs* setae, all except *ls* and *is* dentate; movable finger with one acuminate seta (Figure 4E). Galea long and stout with seven (♂), nine (♀) prominent distal rami (Figure 4E). Rallum (Figure 4F) composed of three blades; each dentate along anterior margin. Serrula exterior with 26 (♂), 20 (♀) lamellae. Lamina exterior present.

Cephalothorax. Carapace (Figures 2A,C, 4A) 1.09 (♂), 0.99 (♀) times longer than wide, broadest posteriorly; unicolorous; eyes and eye-spots completely absent; setae small and inconspicuous, with numerous setae, including about six (♂), five (♀) setae near anterior margin, and *c.*59 (♂), *c.*62 (♀) setae on posterior disk; posterior half with two deeply incised transverse furrows, anterior furrow crosses the carapace at *c.*0.56 (♂), *c.*0.57 (♀) of carapace length, posterior furrow crosses at *c.*0.80 (♂), *c.*0.84 (♀) of carapace length; completely granulate with exception of transverse furrows. Manducatory process with one long distal and several other sub-distal setae, and with short, curved sub-oral seta; remainder of maxilla with numerous setae. Coxae (Figures 2B,D, 3, 4B) with numerous small setae over entire ventral surface, with longer setae on posterior margin of coxae IV; posterior corners of coxae IV rounded and slightly protruding but not particularly enlarged.

Abdomen. Tergites I–X and sternites V–X divided (Figure 2). Tergal chaetotaxy, ♂: 44: 49: 53: 66: 68: 64: 63: 65: 48: 39: 17: 2; ♀: 62: 60: 72: 76: 74: 72: 70: 68: 54: 52: 24: 2; setae usually restricted to posterior and lateral tergal margins. Sternal chaetotaxy, ♂: 70: (4)

61 (4): (2) 32 (2): 58: 66: 62: 60: 53: 45: 14: 2; ♀: 40: (2) 14 (2): (4) 42 (4): 66: 72: 82: 76: 72: 48: 14: 2.

Genital region. Male not studied in detail; female genitalia with anterior genital operculum with setae arranged in inverted-U, some long most short; spermathecae not observable. Brood-sac with *c.*24 embryos (Figure 3).

Legs. Legs I and II with a strongly oblique junction between femur and patella (Figure 4H). Leg IV (Figure 4G) with femur + patella 3.82 (♂), 3.72 (♀) times longer than broad. Tibiae of legs III and IV without tactile setae. Tarsi of legs III and IV with long tactile seta (Figure 4G), TS = 0.59 (♂), 0.54 (♀). Tarsi with slightly raised slit sensillum. Sub-terminal tarsal setae arcuate, not dentate. Tarsal claws simple; arolium shorter than claws.

Dimensions (mm). Male holotype: body length 4.2. Pedipalps: trochanter 0.94/0.65, femur 1.54/0.62, patella 1.56/0.73, chela (with pedicel) 2.47/0.89, chela (without pedicel) 2.26, hand length (without pedicel) 1.12, movable finger length 1.25. Chelicera 0.51/0.27, movable finger length 0.36. Carapace 1.72/1.58. Leg I: femur 0.48/0.30, patella 0.82/0.29, tibia 0.68/0.20, tarsus 0.53/0.16. Leg IV: femur + patella 1.45/0.38, tibia 1.16/0.23, tarsus 0.70/0.19.

Female paratype. Body length 4.2. Pedipalps: trochanter 0.79/0.51, femur 1.44/0.55, patella 1.36/0.53, chela (with pedicel) 2.08/0.61, chela (without pedicel) 1.88, hand length (without pedicel) 0.88, movable finger length 1.00. Chelicera 0.39/0.23, movable finger length 0.30. Carapace 1.52/1.54. Leg I: femur 0.42/0.27, patella 0.75/0.25, tibia 0.61/0.19, tarsus 0.48/0.14. Leg IV: femur + patella 1.34/0.36, tibia 1.04/0.22, tarsus 0.65/0.16.

Description – protonymph

Uniformly very pale yellow, nearly white. Vestitural setae generally short and inconspicuous, lightly dentate. Pleural membrane longitudinally striate for entire length, without setae.

Pedipalps. Robust, with trochanter 1.60, femur 2.44, patella 2.12, chela (with pedicel) 3.35, chela (without pedicel) 3.10, hand (without pedicel) 1.65 times longer than wide; movable finger 0.97 times the hand (with pedicel). All surfaces of pedipalps finely granulate with exception of fingers. Fixed finger with three trichobothria, movable chelal finger with one trichobothrium (Figure 4J); *eb* and *ist* situated basally; *et* situated subdistally; *t* medially. Venom apparatus only present in movable finger with nodus ramosus terminating slightly distal to *t*.

Chelicerae. With four setae on hand; movable finger without seta. Galea long and stout with seven prominent distal rami. Rallum composed of three blades.

Cephalothorax. Carapace: 0.91 times longer than wide, broadest posteriorly; eyes and eye-spots completely absent; setae small and inconspicuous, with five setae on anterior

margin, and six setae on posterior margin; shallow median furrow present, posterior furrow absent.

Abdomen. Tergites I–X and sternites II–X divided. Tergal chaetotaxy: 6: 6: 6: 6: 6: 6: 6: 6: 6: 6: T2T: 2. Sternal chaetotaxy: 0: (0) 2 (0): (1) 4 (1): 7: 6: 6: 6: 6: 6: 4: 2.

Legs. Tarsi of legs III and IV with long tactile seta, situated medially.

Dimensions (mm). Body length 1.56. Pedipalps: trochanter 0.24/0.15, femur 0.39/0.16, patella 0.36/0.17, chela (with pedicel) 0.67/0.20, chela (without pedicel) 0.62, hand length (without pedicel) 0.33, movable finger length 0.32. Carapace 0.56/0.61.

Remarks

Megachernes kanneliyensis is the first species of *Megachernes* recorded from Sri Lanka and the first pseudoscorpion recorded from the pelage of a Sri Lankan mammal. The occurrence of adult and nymphal specimens of *M. kanneliyensis* in the fur of *Mus mayori pococki* strongly suggests that the pseudoscorpions are either breeding in the pelage or in their nests and are being transported phoretically by the mouse. Species of *Megachernes* do not appear to be restricted to individual host species (Table 1).

Host associations of *Megachernes*

Species of *Megachernes* are closely associated with other animals, either in the nests or fur of small mammals, nests of birds and bumblebees, or in bat guano within caves (Tables 1, 2). The following species have been collected most frequently or exclusively in the nests or pelage of small mammals: *M. barbatus*, *M. crinitus*, *M. grandis*, *M. himalayensis*, *M. kanneliyensis*, *M. limatus*, *M. monstrosus*, *M. ochotonae*, *M. penicillatus*, *M. philippinus*, *M. queenslandicus*, *M. soricicola*, *M. titanius*, *M. trautneri* and *M. vietnamensis*, as well as three undescribed species from Papua New Guinea and Australia (Table 1). This assemblage may also include *M. loebli*, specimens of which were sifted from leaf litter at the foot of a wall (Schawaller 1991), a habitat that Schawaller (1991) suggested is frequently occupied by murids and that a close association with a small mammal was likely.

Three other species, *M. afghanicus*, *M. pavlovskyi* and *M. ryugadensis*, have been collected from guano in caves (Table 1). Although the origin of the guano is rarely stated, deposits of bat faeces are the likely source in all cases. Two of these species have also been recorded from other habitats. *Megachernes pavlovskyi* has been taken from within a barn, under stones, in pigeon guano, forest litter, plant roots and rodent nests, and the subspecies *M. ryugadensis myophilus* differs from the other two subspecies (*M. ryugadensis ryugadensis* and *M. ryugadensis naikaiensis*) by its close association with other animals, having been collected on small mammals (*Rattus norvegicus* and *Mogera wogura*) and from nests of bumblebees. Of the remaining three species (Table 1), *M. glandulosus* and *M. tuberosus* have been collected in caves without any mention of whether they were taken in guano (Mahnert 2009), and *M. mongolicus* lacks any habitat data (Redikorzev 1934).

Table 1. Habitat data and hosts recorded for species of *Megachernes*

Taxon	Country	Host and habitat	References
<i>M. afghanicus</i> Beier, 1959	Afghanistan	from guano in cave	(Beier 1959, 1960)
<i>M. barbatus</i> Beier, 1951	Vietnam	from <i>Niviventer tenaster</i> (given as <i>Rattus niviventer champa</i>), <i>Maxomys surifer</i> (given as <i>R. rajah koratis</i>) and <i>R. sladeni</i> <i>sladeni</i>	(Beier 1967)
<i>M. crinitus</i> Beier, 1948	Vietnam	taken from fur of various species of rats	(Judson 1997)
<i>M. glandulosus</i> Mahnert, 2009	Indonesia	on <i>Maxomys bartelsii</i> (given as <i>Rattus bartelsi</i>); from <i>Hylomys</i> <i>suillus</i> ; from <i>Rattus lepturus</i>	(Beier 1948)
<i>M. grandis</i> (Beier, 1930)	China Philippines	in cave from <i>Apomys insignis</i> , <i>A. sp.</i> , <i>Bullimus bagobus</i> (given as <i>Apomys</i> <i>bagobus</i> and <i>Rattus bagobus</i>), <i>Cyanopterus brachyotis</i> , <i>Maxomys</i> <i>panglima</i> (given as <i>Rattus palawanensis</i>) and <i>Rattus sp.</i>	(Mahnert 2009) (Beier 1966)
<i>M. himalayensis</i> (Ellingsen, 1914)	Indonesia Malaysia China	from <i>Maxomys muschenbroekii</i> and <i>Niviventer fulvescens</i> (given as <i>Rattus bukit treubi</i>) from <i>Maxomys rajah</i> (given as <i>Rattus rajah</i>) from <i>Niviventer confucianus</i> (given as <i>Echimys confucianus</i>)	(Beier 1948; Durden 1986) (Beier 1964) (Beier 1948) (as <i>M. sinensis</i> Beier, 1932)
	India	from conifer leaf litter	(Beier 1978; Schawaller 1988)
	Nepal	from <i>Apodemus gurkha</i> , <i>Apodemus sylvaticus</i> , <i>Mus musculus</i> , <i>Niviventer fulvescens</i> (given as <i>Rattus fulvescens</i>) and <i>Rattus</i> <i>pyctoris</i> (given as <i>Rattus rattoides</i>)	(Beier 1974; Martens 1975; Schawaller 1983)
<i>M. kanneliyensis</i> sp. nov.	Sri Lanka	from pelage of <i>Mus mayori pococki</i>	this study
<i>M. limatus</i> Hoff and Parrack, 1958	Papua New Guinea	from <i>Melomys</i> sp., <i>Pogonomys</i> sp., <i>Rattus niobe</i> , <i>Rattus nitidus</i> (given as <i>Rattus ruber trimitius</i> ⁶), and from rat	(Hoff and Parrack 1958; Beier 1965; Durden 1991)
<i>M. limatus crassus</i> Beier, 1965	Indonesia	from unidentified rodents [given as <i>Rattus</i> sp. by Beier (1965)] and from <i>Paramelomys</i> cf. <i>platyops</i> [given as <i>Pseudocheirus</i> sp. by Beier (1965)]	(Beier 1965; Tenorio and Muchmore 1982)

(Continued)

Table 1. (Continued)

Taxon	Country	Host and habitat	References
<i>M. loebli</i> Schawaller, 1991	Nepal	from forest litter	(Schawaller 1991)
<i>M. mongolicus</i> (Redikorzev, 1934)	Mongolia	habitat not stated	(Redikorzev 1934)
<i>M. monstrosus</i> Beier, 1966	Philippines	from nest of <i>Maxomys panglima</i> (given as <i>Rattus palawanensis</i> by Beier (1966))	(Beier 1966)
<i>M. ochotona</i> Krumpál and Kiefer, 1982	Mongolia	under stones in hole of <i>Ochotona dauurica</i> ; in nest of <i>Passer</i> sp.	(Krumpál and Kiefer 1982)
<i>M. papuanus</i> Beier, 1948	Papua New Guinea	from <i>Paramelomys levipes</i> (given as <i>Melomys levipes</i>), <i>Melomys</i> sp., <i>Mus</i> sp., <i>Rattus niobe</i> , from unidentified rats and Rainbow Lory (<i>Trichoglossus haematodus</i>)	(Beier 1948, 1965; Hoff and Parrack 1958; Durden 1991; Judson 1997)
<i>M. pavlovskiyi</i> Redikorzev, 1949	Afghanistan Azerbaijan	from guano in cave in cave; in bat guano (<i>Rhinolophus mehelyi</i> , <i>Myotis blythi</i> , <i>Miniopterus scheibersii</i>)	(Beier 1959) (Krumpál 1986; as <i>M. caucasicus</i> Krumpál 1986; Schawaller and Dashdamirov 1988) (Schawaller 1986) (Dashdamirov 2005)
	Kyrgyzstan Pakistan	in bat guano; and in pigeon guano roots of <i>Aesculus</i> and nest of rodent; and under stones at the edge of a stream	
	Russia	<i>Taxus</i> – <i>Buxus</i> woods with <i>Fagus</i>	(Schawaller and Dashdamirov 1988)
	Turkmenistan Turkmenistan	in cracks of a livestock barn in guano	(Redikorzev 1949) (Dashdamirov and Schawaller 1995)
<i>M. penicillatus</i> Beier, 1948	Australia	from <i>Phascogale</i> sp.	(Beier 1948; Judson 1997)
<i>M. philippinus</i> Beier, 1966	Philippines	from <i>Rattus</i> sp.	(Beier 1966; Tenorio and Muchmore 1982)

(Continued)

Table 1. (Continued)

<i>M. queenslandicus</i> Beier, 1948	Australia	from <i>Rattus fuscipes assimilis</i> , <i>R. fuscipes</i> and grey scrub rat	(Beier 1948; Judson 1997)
<i>M. ryugadensis</i> Morikawa, 1954	Japan	in bat guano in caves	(Morikawa 1954, 1960)
<i>M. ryugadensis myophilus</i> Morikawa, 1960	Japan	from nest of <i>Bombus diversus</i> and <i>B. ardens</i> ; on <i>Mogera wogura</i> ; on <i>Rattus norvegicus</i>	(Morikawa 1960)
<i>M. ryugadensis naikaiensis</i> Morikawa, 1957	Japan	from bat guano in caves	(Morikawa 1957, 1960)
<i>M. soricicola</i> Beier, 1974	Nepal	from <i>Soriculus nigrescens</i>	(Beier 1974; Martens 1975)
<i>M. titanius</i> Beier, 1951	Vietnam	from <i>Niviventer tenaster</i> (given as <i>Rattus niviventer champa</i>), <i>Maxomys surifer</i> (given as <i>R. rajah korattis</i>), <i>R. sladeni sladeni</i> ; and "from the fur of various species of rats"	(Beier 1967; Judson 1997)
<i>M. trautneri</i> Schawaller, 1994	Thailand	from small mammal nest	(Schawaller 1994)
<i>M. tuberosus</i> Mahnert, 2009	China	in cave	(Mahnert 2009)
<i>M. vietnamensis</i> Beier, 1967	Vietnam	from <i>Niviventer fubescens</i> and <i>Rattus andamanensis</i> (originally reported as <i>Rattus niviventer</i> and <i>R. sladeni sladeni</i>)	(Beier 1967; Tenorio and Muchmore 1982)
<i>M. sp. indet.</i>	Papua New Guinea	from nests of <i>Micromurexia habbema</i> (given as <i>Antechinus habbema</i>) and <i>Phascomurexia naso</i> (given as <i>Antechinus naso</i>)	(Woolley 1989)
<i>M. sp. nov.</i> (Papua New Guinea)	Papua New Guinea	from <i>Rattus nitobe</i> , <i>Melomys sp.</i> and <i>Murexechinus melanurus</i> (given as <i>Antechinus wilhelmina</i>)	(Durden 1991)
<i>M. sp. nov.</i> (Australia)	Australia	from <i>Vespadelus regulus</i> (given as <i>Eptesicus regulus</i>) and <i>Falsistrellus tasmaniensis</i>	(Harvey and Parnaby 1993)
<i>M. sp. nov.</i> (Australia)	Australia	from nest box of Leadbeater's Possum (<i>Gymnobelideus leadbeateri</i>)	(Harvey and Parnaby 1993)

*The host name "*Rattus ruber trimitius*" recorded by Beier (1965) appears to be a lapsus. *Rattus ruber* is now a synonym of *R. nitidus* (Wilson and Reeder, 2005) and "trimitius" may refer to the trichozoan blood parasite *Trimitus*.

Table 2. Host animals recorded for *Megachernes* species, excluding associations with mammal guano (see Table 1).**Phylum Chordata**

Class Mammalia

Order Dasyuromorpha

Micromurexia habbema (Tate and Archbold, 1941)*Murexechinus melanurus* (Thomas, 1899)*Phascomurexia naso* (Jentink, 1911)*Phascogale* sp.

Order Diprotodontia

Gymnobelideus leadbeateri McCoy, 1867

Order Soricomorpha

Mogera wogura (Temminck, 1842)*Soriculus nigrescens* (Gray, 1842)

Order Erinaceomorpha

Hylomys suillus Müller, 1840

Order Lagomorpha

Ochotona dauurica (Pallas, 1776)

Order Rodentia

Apodemus gurkha Thomas, 1924*Apodemus sylvaticus* (Linnaeus, 1758)*Apomys insignis* Mearns, 1905*Apomys* sp.*Bullimus bagobus* Mearns, 1905*Maxomys bartelsii* (Jentink, 1910)*Maxomys musschenbroekii* (Jentink, 1878)*Maxomys panglima* (Robinson, 1921)*Maxomys rajah* (Thomas, 1894)*Maxomys surifer* (Miller, 1900)*Melomys* sp.*Mus mayori pococki* Ellerman, 1947*Mus musculus* Linnaeus, 1758*Mus* sp.*Niviventer confucianus* (Milne-Edwards, 1871)*Niviventer fulvescens* (Gray, 1847)*Niviventer lepturus* (Jentink, 1879)*Niviventer tenaster* Thomas, 1916*Paramelomys levipes* (Thomas, 1897)*Paramelomys* cf. *platyops* (Thomas, 1906)*Pogonomys* sp.*Rattus andamanensis* (Blyth, 1860)*Rattus fuscipes* (Waterhouse, 1839)*Rattus fuscipes assimilis* Gould, 1858*Rattus niobe* (Thomas, 1906)*Rattus nitidus* (Hodgson, 1845)*Rattus norvegicus* (Berkenhout, 1769)*Rattus pyctoris* (Hodgson, 1845)*Rattus* sp.

(Continued)

Table 2. (Continued).

Order Chiroptera
<i>Cyanopterus brachyotis</i> (Müller, 1838)
<i>Vespadelus regulus</i> (Thomas, 1906)
<i>Falsistrellus tasmaniensis</i> (Gould, 1858)
Class Aves
Order Psittaciformes
<i>Trichoglossus haematododus</i> (Linnaeus, 1771)
Order Passeriformes
<i>Passer</i> sp.
Phylum Arthropoda
Class Hexapoda
Order Hymenoptera
<i>Bombus ardens</i> Smith, 1879
<i>Bombus diversus</i> Smith, 1869

Acknowledgements

We gratefully acknowledge the assistance of the National Science Foundation, Sri Lanka (grant number: RG/ 2004/ B2) and the University of Colombo for funding this project; the Forest Department and the Department of Wildlife Conservation, Sri Lanka, for granting permission to carry out studies on small mammals in the forest reserves of Sri Lanka; Mr P.M. Weerawarna for field assistance and his support which extended throughout the study; Dr M. Burger (Western Australian Museum) who kindly provided some of the digital images; Dr M. Judson (Muséum National d'Histoire Naturelle, Paris) for providing information on *Chiridiochernes*; and Dr Judson and three anonymous reviewers for the comments on the manuscript.

References

- Beier M. 1930. Die Pseudoskorpione der Sammlung Roewer. Zool Anz. 91:284–300.
- Beier M. 1932. Pseudoscorpionidea II. Subord. C. Cheliferinea. Tierreich 58:i–xxi, 1–294.
- Beier M. 1933. Revision der Chernetidae (Pseudoscorp.). Zoologische Jahrbücher, Abteilung für Systematik, Ökol Geogr Tiere. 64:509–548.
- Beier M. 1948. Phoresie und Phagophilie bei Pseudoscorpionen. Öst Zool Z. 1:441–497.
- Beier M. 1949. Türkiye Psevdoscorpion'ları hakkında. Türkische Pseudoscorpione. Rev Faculté Sci Univ Istanbul (B). 14:1–20.
- Beier M. 1951. Die Pseudoscorpione Indochinas. Mém Mus Natl Hist Nat Paris nlle sér. 1:47–123.
- Beier M. 1959. Zur Kenntnis der Pseudoscorpioniden-Fauna Afghanistans. Zool Jahrb Abt Syst Ökol Geogr Tiere. 87:257–282.
- Beier M. 1960. Pseudoscorpionidea. Contribution à l'étude de la faune d'Afghanistan. 27. Förhandl Kungl Fysiogr Sällskap Lund. 30:41–45.
- Beier M. 1961. Ueber Pseudoscorpione aus sizilianischen Höhlen. Boll Accad Gioen Sci Nat Catan. (4) 6:89–96.
- Beier M. 1963. Pseudoskorpione aus Anatolien. Annal Naturhist Mus Wien. 66:267–277.
- Beier M. 1964. Some further nidicolous Chelonethi (Pseudoscorpionidea) from Malaya. Pacific Insects. 6:312–313.
- Beier M. 1965. Die Pseudoscorpioniden Neu-Guineas und der benachbarten Inseln. Pacific Insects. 7:749–796.
- Beier M. 1966. Über Pseudoscorpione von den Philippinen. Pacific Insects. 8:340–348.

- Beier M. 1967. Pseudoscorpione vom kontinentalen Südost-Asien. *Pacific Insects*. 9:341–369.
- Beier M. 1974. Pseudoscorpione aus Nepal. *Senckenberg Biol.* 55:261–280.
- Beier M. 1978. Pseudoskorpione aus Kashmir und Ladakh (Arachnida). *Senckenberg Biol.* 58:415–417.
- Callaini G. 1986. Appunti su alcune specie italiane della famiglia Chernetidae Menge (Arachnida, Pseudoscorpionida). *Notulae Chernetologicae XV. Boll Mus Civic Stor Nat Verona*. 11:379–401.
- Chamberlin JC. 1931. The arachnid order Chelonethida. *Stanford Univ Publ Biol Sci.* 7(1):1–284.
- Cruz H. 1984. Parasites of endemic and relict vertebrates: a biogeographical review. In: *Ecology and biogeography in Sri Lanka*. The Hague (the Netherlands): Dr. W. Junk Publishers. p. 321–351.
- Dashdamirov S. 2005. Pseudoscorpions from the mountains of northern Pakistan (Arachnida: Pseudoscorpiones). *Arthropoda Selecta*. 13:225–261.
- Dashdamirov S, Schawaller W. 1995. Pseudoscorpions from Middle Asia, Part 4 (Arachnida: Pseudoscorpiones). *Stuttg Beitr Naturk (A)*. 522:1–24.
- Dondale CD, Redner JH. 1978. The crab spiders of Canada and Alaska: Araneae: Philodromidae and Thomisidae. Ottawa: Biosystematics Research Institute.
- Durden LA. 1986. Ectoparasites and other arthropod associates of tropical rain forest mammals in Sulawesi Utara, Indonesia. *Natl Geogr Res.* 2:320–331.
- Durden LA. 1991. Pseudoscorpions associated with mammals in Papua New Guinea. *Biotropica*. 23:204–206.
- Ellingsen E. 1914. On the pseudoscorpions of the Indian Museum, Calcutta. *Records Ind Mus.* 10:1–14.
- Forster RR. 1967. The spiders of New Zealand. Part I. *Otago Mus Bull.* 1:1–124.
- Goonatilake dA, W.I.L.D.P.T.S., Nameer PO, Molur S. 2008. *Mus mayori* [Internet]. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. [cited 2011 Jan 15]. Available from: <http://www.iucnredlist.org>.
- Harvey MS. 1991. Catalogue of the Pseudoscorpionida. Manchester (UK): Manchester University Press.
- Harvey MS. 1992. The phylogeny and classification of the Pseudoscorpionida (Chelicerata: Arachnida). *Invert Taxon.* 6:1373–1435.
- Harvey MS. 1995. *Barbaraella* gen. nov. and *Cacoxylus* Beier (Pseudoscorpionida: Chernetidae), two remarkable sexually dimorphic pseudoscorpions from Australasia. *Records West Aust Mus Suppl.* 52:199–208.
- Harvey MS. 2011. Pseudoscorpions of the World, version 2.0. Western Australian Museum, Perth. [cited 2011 Dec 14]. Available from: <http://www.museum.wa.gov.au/catalogues/pseudoscorpions/>.
- Harvey MS, Parnaby HE. 1993. Records of pseudoscorpions associated with bats. *Aust Mamm.* 16:39–40.
- Hoff CC, Parrack D. 1958. Results of the Archbold Expeditions. No. 77. Two species of *Megachernes* (Pseudoscorpionida, Chernetidae). *Am Mus Novit.* 1881:1–9.
- Judson MLI. 1997. Catalogue of the pseudoscorpion types (Arachnida: Chelonethi) in the Natural History Museum, London. *Occas Papers Syst Entomol.* 11:1–54.
- Judson MLI. 2007. A new and endangered species of the pseudoscorpion genus *Lagynochthonius* from a cave in Vietnam, with notes on chelal morphology and the composition of the Tyrannochthoniini (Arachnida, Chelonethi, Chthoniidae). *Zootaxa* 1627:53–68.
- Krumpál M. 1986. Pseudoscorpione (Arachnida) aus Höhlen der UdSSR. Über Pseudoscorpioniden-Fauna der UdSSR V. *Biológia* 41:163–172.
- Krumpál M, Kiefer M. 1982. Pseudoskorpione aus der Mongolei (Arachnida, Pseudoskorpiones). *Ergebnisse der gemeinsamen Mongolisch-Slowakischen biologischen expedition.* *Annot Zool Bot.* 146:1–27.

- Mahnert V. 2009. New species of pseudoscorpions (Arachnida, Pseudoscorpiones: Chthoniidae, Chernetidae) from caves in China. *Rev Suisse Zool.* 116:185–201.
- Martens J. 1975. Phoretische Pseudoskorpione auf Kleinsäugetern des Nepal-Himalaya. *Zool Anz.* 194:84–90.
- Morikawa K. 1954. On some pseudoscorpions in Japanese lime-grottoes. *Mem Ehime Univ.* (2B) 2:79–87.
- Morikawa K. 1957. Cave pseudoscorpions of Japan (II). *Mem Ehime Univ.* (2B) 2:357–365.
- Morikawa K. 1960. Systematic studies of Japanese pseudoscorpions. *Mem Ehime Univ.* (2B) 4:85–172.
- Muchmore WB. 1972. A remarkable pseudoscorpion from the hair of a rat (Pseudoscorpionida, Chernetidae). *Proc Biol Soc Wash.* 85:427–432.
- Muchmore WB. 1996. On the occurrence of *Wyochernes* in Asia (Pseudoscorpionida: Chernetidae). *Bull Br Arachnol Soc.* 10:215–217.
- Phillips WWA. 1980. *Manual of mammals of Sri Lanka – Part II.* Colombo: Wildlife and Nature Protection Society of Sri Lanka, Aitken Spence & Co., Ltd.
- Ratnaweera PB, Wijesinghe MR, Udagama-Randeniya PV. 2010. Parasitic associations of a threatened Sri Lankan rainforest rodent, *Mus mayori poccocki* (Rodentia: Muridae). *J Threatened Taxa.* 2:901–907.
- Redikorzev V. 1934. Neue paläarktische Pseudoskorpione. *Zool Jahrb Abt Syst Ökol Geogr Tiere.* 65:423–440.
- Redikorzev V. 1949. [Pseudoscorpionidea of Central Asia]. *Trav Inst Zool Acad Sci URSS.* 8:638–668.
- Schawaller W. 1983. Neue Pseudoskorpion-Funde aus dem Nepal-Himalaya (Arachnida: Pseudoscorpionidea). *Senckenberg Biol.* 63:105–111.
- Schawaller W. 1986. Pseudoskorpione aus der Sowjetunion, Teil 2 (Arachnida: Pseudoscorpiones). *Stuttg Beitr Naturk (A).* 396:1–15.
- Schawaller W. 1988. Neue Pseudoskorpion-Funde aus dem Kashmir-Himalaya (Arachnida: Pseudoscorpionida). *Ann Naturhist Mus Wien.* 90:157–162.
- Schawaller W. 1991. Neue Pseudoskorpion-Funde aus dem Nepal-Himalaya, III (Arachnida: Pseudoscorpiones). *Rev Suisse Zool.* 98:769–789.
- Schawaller W. 1994. Pseudoskorpione aus Thailand (Arachnida: Pseudoscorpiones). *Rev Suisse Zool.* 101:725–759.
- Schawaller W, Dashdamirov S. 1988. Pseudoskorpione aus dem Kaukasus, Teil 2 (Arachnida). *Stuttg Beitr Naturk (A).* 415:1–51.
- Tenorio JM, Muchmore WB. 1982. Catalog of entomological types in the Bishop Museum. Pseudoscorpionida. *Pacific Insects.* 24:377–385.
- Turk FA. 1950. Studies on Acari VI. Parasitic mites from mammalian hosts obtained from Ceylon. *Parasitology.* 40:63–76.
- Vachon M. 1938. Recherches anatomiques et biologiques sur la reproduction et le développement des Pseudoscorpions. *Ann Sci Nat Zool.* (11) 1:1–207.
- Wilson DE, Reeder DM, Eds. 2005. *Mammal species of the world. A taxonomic and geographic reference.* Baltimore (MD): Johns Hopkins University Press.
- Woolley PA. 1989. Nest location by spool-and-line tracking of dasyurid marsupials in New Guinea. *J Zool Lond.* 218:689–700.