

New Zealand Pneumolaelaps Berlese (Acari: Laelapidae): description of a new species, key to species and notes on biology

Authors: Fan, Qing-Hai, Zhang, Zhi-Qiang, Brown, Robert, France, Santha, and Bennett, Shaun

Source: Systematic and Applied Acarology, 21(1) : 119-138

Published By: Systematic and Applied Acarology Society

URL: <https://doi.org/10.11158/saa.21.1.8>

The BioOne Digital Library (<https://bioone.org/>) provides worldwide distribution for more than 580 journals and eBooks from BioOne's community of over 150 nonprofit societies, research institutions, and university presses in the biological, ecological, and environmental sciences. The BioOne Digital Library encompasses the flagship aggregation BioOne Complete (<https://bioone.org/subscribe>), the BioOne Complete Archive (<https://bioone.org/archive>), and the BioOne eBooks program offerings ESA eBook Collection (<https://bioone.org/esa-ebooks>) and CSIRO Publishing BioSelect Collection (<https://bioone.org/csiro-ebooks>).

Your use of this PDF, the BioOne Digital Library, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Digital Library content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne is an innovative nonprofit that sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

New Zealand *Pneumolaelaps* Berlese (Acari: Laelapidae): description of a new species, key to species and notes on biology

QING-HAI FAN¹, ZHI-QIANG ZHANG², ROBERT BROWN³, SANTHA FRANCE¹ & SHAUN BENNETT¹

¹ Plant Health & Environment Laboratory, Ministry for Primary Industries, 231 Morrin Road, Auckland, New Zealand.

E-mail: Qinghai.Fan@mpi.govt.nz

² Landcare Research, Private Bag 92170, Auckland, New Zealand & School of Biological Sciences, The University of Auckland, Auckland, New Zealand. E-mail: zhangz@landcareresearch.co.nz

³ Landcare Research, PO Box 69040, Lincoln 7640, New Zealand.

Abstract

Mites of the genus *Pneumolaelaps* Berlese are often found in association with bumble bees (Hymenoptera: Apidae). Approximately sixty species of the genus have been described worldwide but only two of them have been recorded in New Zealand, viz. *Pneumolaelaps bombicolens* (Canestrini, 1885) and *P. breviseta* (Evans & Till, 1966). A new species, *Pneumolaelaps niutirani*, collected from hives of honeybee *Apis mellifera* (Apidae) and nests of the German wasp *Vespula germanica* (Vespidae) brings the number of species in New Zealand to three. We herein review *P. bombicolens* and *P. breviseta*, describe the new species, *Pneumolaelaps niutirani*, with notes on its biology, and provide a key to the species known in New Zealand. This is the first report of *Pneumolaelaps* in association with a vespid wasp.

Key words: Mesostigmata, *Apis mellifera*, *Bombus* spp., *Vespula germanica*

Introduction

The genus *Pneumolaelaps* Berlese, 1920 has had a history of unsettled classification for many years until the last two decades. The name *Pneumolaelaps* was originally proposed for a subgenus of the genus *Hypoaspis* by Berlese (1920), who designated *Iphis bombicolens* Canestrini, 1885 as its type species. This classification of *Pneumolaelaps* as a subgenus of *Hypoaspis* was followed for over five decades (e.g. Bregetova 1977). However, some authors considered it a separate genus (Willmann 1953; Hunter 1966). It is now classified in the subfamily Melittiphidinae of the family Laelapidae along with other genera that contain species closely associated with Hymenoptera (Casanueva 1993; Lindquist *et al.* 2009).

Mites of the genus *Pneumolaelaps* are common inhabitants of nests of bumblebees (Apidae) (Costa 1966; Hunter 1966; Hunter & Husband 1973; Macfarlane 2005; OConnor & Klimov 2012), honeybees (Apidae) (OConnor & Klimov 2012), the solitary bee *Megachile torrida* (Megachilidae) (Elsen 1973), and wasps (Vespidae) (present study). There are about 60 species described in the genus. Two species were previously recorded from New Zealand, *Pneumolaelaps bombicolens* (Canestrini, 1885) and *P. breviseta* (Evans & Till, 1966) (Macfarlane 2005). The main purpose of this paper is to describe a new species with notes on its biology and provide additional information on the two other species in New Zealand. We also give a key to species found in New Zealand to facilitate identification of these mites.

Material and methods

Taxonomy

Specimens were illustrated using a drawing tube attached to a Nikon interference-phase contrast microscope, and then re-examined, measured and imaged with a Zeiss interference-phase contrast microscope. Images were edited with Helicon Focus and Photoshop CS4. Lengths of legs were measured from the bases of trochanters to the tips of tarsal claws. All measurements are given in micrometers (μm). The chaetotaxy of the idiosoma and legs follows Evans & Till (1965) and Lindquist & Evans (1965).

Acronyms. BMNH: British Museum (Natural History), now The Natural History Museum (NHM), London, UK; NZAC: New Zealand Arthropod Collection; PANZ: Plant Health & Environment Laboratory, Auckland, New Zealand.

Observations on mite-host association

Two *Vespa germanica* (Fab.) colonies were obtained in April 2012 by excavating wild nests found in Lincoln, Canterbury, South Island, New Zealand. For each nest, adult specimens were separated by caste and held for up to 3–4 weeks in 3 L polycarbonate storage containers (H: 12 cm, L: 23, W: 15 cm) (Sistema, New Zealand) modified with a 5 x 12 cm ventilation hole on the short sides covered with stainless steel mesh (2-mm mesh). Remaining comb from nest excavations containing gyne and male pupae was kept with several workers to aid the adult emergence. As new gynes and males emerged, they were separated into new holding containers. The wasps were allowed to feed *ad libitum* from 20 mL of 30% sucrose water solution until they were used for experiments. Live and freshly-dead individuals were inspected under a dissecting microscope (Leica, Germany, model# M80) and mite numbers and location on the wasps were recorded. Living wasps were anesthetized with CO₂ before inspection. Thirty-five gynes, 17 workers, and 22 males were inspected.

Results

Pneumolaelaps Berlese, 1920

Type species: *Iphis bombicolens* Canestrini, 1885; by original designation.

Pneumolaelaps bombicolens (Canestrini, 1885)

(Figures 1, 9–14)

Iphis bombicolens Canestrini, 1885: 96.

Diagnosis. FEMALE: dorsal idiosomal shield (Fig. 1A) reticulate throughout, most cells as wide as long; bearing 42–46 pairs of setae, all smooth and tapered; setae *j2–j3*, *z2–z4*, *s1–s4* and *r2–r5* approximately twice as long as *j1* and other setae. Presternal and sternal shields (Figs 1B, 9A) clearly separate; presternal shield with 3 transverse cells at each side; posterior margin of sternal shield obviously concave. Epigynal shield (Fig. 1B, 11A) medially reticulated with 6–8 large cells posterior to *st5*, margins of cells straight or curved but not sinuous; without a pair of longitudinal internal sclerites between *st4*. Peritrematal shield (Fig. 10A) broadly enlarged around stigmatic opening, where about as wide as length of poststigmatal plate; poststigmatal plate broadly triangular. Anal

shield (Fig. 12A) approximately 1.5× as long as wide. Deutosternal groove (Fig. 1B, 14A) with 6 rows of 1–4 denticles per row. Setation on segments of legs same as that in *P. niutirani* sp. nov.

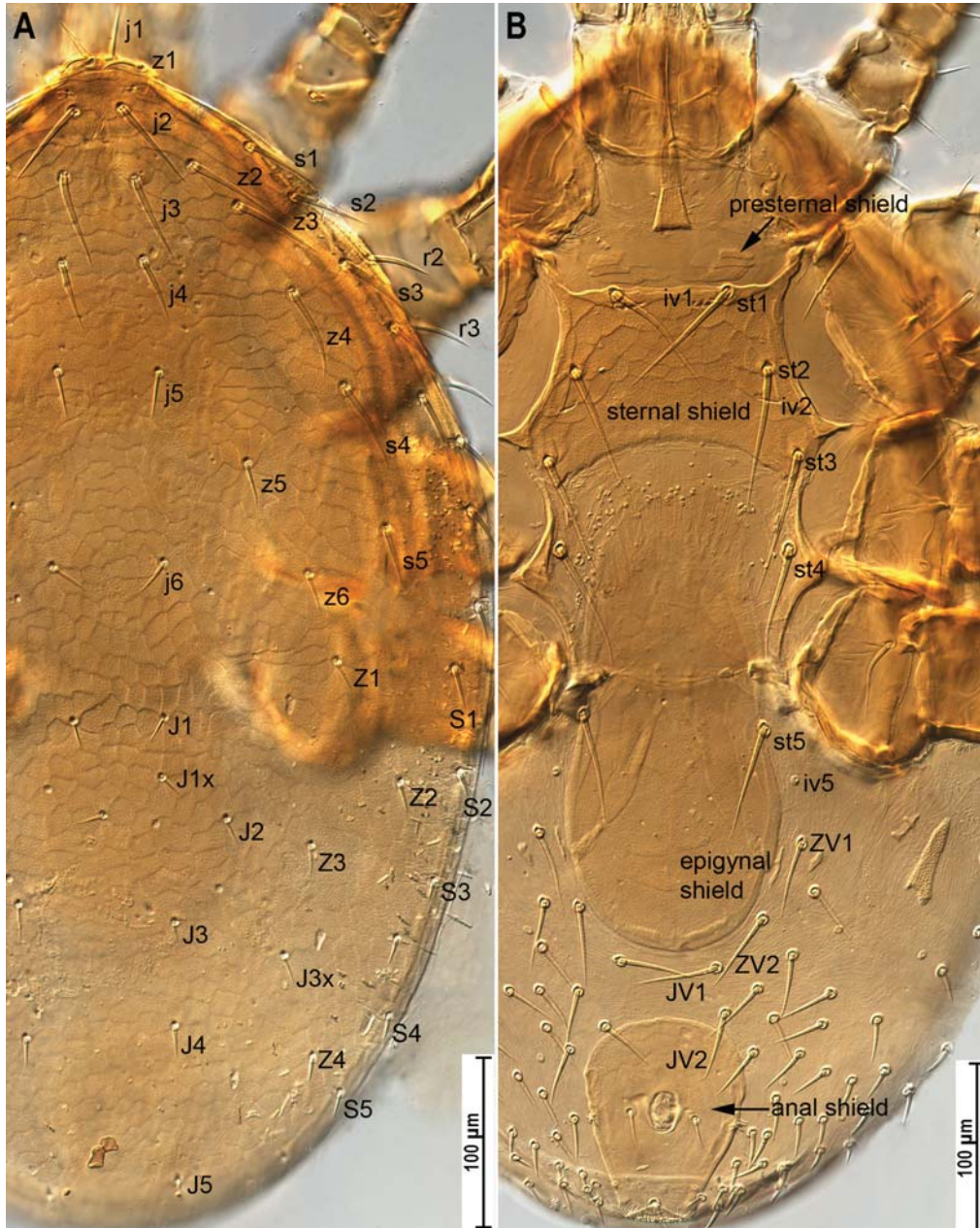


FIGURE 1. *Pneumolaelaps bombicolens* (Canestrini, 1884). Adult female (differential interference contrast microscope images). A, dorsum; B, venter.

Specimen examined. Britain: Essex: Grays, 1 female labelled *Pneumolaelaps bombicolens* Can., ex *Bombus terrestris*, 13.viii.1986 (NHM 1965:12:29:42).

New Zealand: Auckland (AK): 1 female, honey bee (*Apis mellifera*), 16.ix.2002, by A. Yearsley (PANZ, 03/2002/2545); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005, by A. Wei (PANZ, 03/2005/1806); Birkenhead, 1 female, ex sticky board in honeybee

(*A. mellifera*) hive, 1.vi.2005, A. Wei (PANZ, 03/2005/1749); Drury, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005, by A. Wei (PANZ, 03/2005/1805); Howick, 5 females, ex sticky board in honeybee (*A. mellifera*) hive, 1.vi.2005, by A. Wei (PANZ, 03/2005/1739); Lynfield, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005, by G. Matthews and A. Wei (PANZ, 03/2005/1829); Swanson, 2 females, ex sticky board in honeybee (*A. mellifera*) hive, 2005, by A. Wei (03/2005/1752); Waikowhai, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005, by A. Wei (PANZ, 03/2005/1828); Waitakere, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 16.vi.2005, by A. Wei (PANZ 03/2005/1847); Whenuapai, 3 females on two slides, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005, by J. Green and A. Wei (PANZ, 03/2005/1830). **Bay of Plenty (BP):** Bethlehem Road, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 2.v.2011, by H. Fergusson (PANZ, T11_02119). **Marlborough (MB):** Picton, 2 females, swarm trap, 27.xi.2002, by G. Carr (PANZ, 03/2002/3243). **Mid Canterbury (MC):** Avonhead: Russley Road, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 8.v.2011, by H. Fergusson (PANZ, T11_02250); Winfield: Beetham Road, 1 female, honey bee, 20.iv.2011, by S. Connell (PANZ, T11_01996). **Northland (ND):** Te Wahapu Road, 1 female, honey bee, 1.iv.2012, by S. Fitzgerald (PANZ, T12_01502). **Nelson (NN):** 1 female, ex *Bombus* sp. nest, 11.xi.1949, by L. Garr (NZAC). **North Island (NO):** 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005, by A. Wei (PANZ, 03/2005/1819); 1 female, honey bee, 23.vi.2004, by M. Titulaer (PANZ, 03/2004/2346); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 8.ix.2005, by A. Wei (PANZ, 03/2005/2421). **Otago Lakes (OL):** Queenstown: Avalon Crescent, 1 female, honey bee, 3.v.2012, by S. Fitzgerald (PANZ, T12_01611). **South Canterbury (SC):** 1 female, honey bee, 29.iv.2008, by A. Wei (PANZ, 03/2008/671). **Taranaki (TK):** Omata, 2 females, ex sticky board in honeybee (*A. mellifera*) hive, 23.iv.2007, by A. Wei (PANZ, 03/2007/1065). **Waikato (WO):** Hamilton, 1 female, honey bee, 2.iv.2007, by A. Wei (PANZ, 03/2007/840); Waikato, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 30.viii.2013, by D. Kanchiraopally (PANZ, T13_02786). **Wanganui (WI):** Palmerston North, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005, by A. Wei (PANZ, 03/2005/1810); Wanganui, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 1.vi.2005, by A. Wei (PANZ, 03/2005/1732). **Wellington (WN):** Lower Hutt, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 16.vi.2005, by A. Wei (PANZ, 03/2005/1858); Upper Hutt, 5 females, ex *Bombus terrestris*, 10.i.2011, by S. George (PANZ, T11_00126); Wellington, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, D. Kanchiraopally (PANZ, T13_02420).

Host: *Apis mellifera*, *Bombus hortorum* (?), *Bombus ruderatus* (?), *Bombus terrestris*.

Distribution: Britain (Evans & Till 1966), China (Ye & Ma 1996; Ren & Guo 2008; Bai & Ma 2013), former Czechoslovakia (Haragsim *et al.* 1978), Italy (Canestrini 1885; Berlese 1920); New Zealand (Macfarlane 2005; Donovan 2007; present study), Poland (Rozej *et al.* 2012), Switzerland (Schwarz *et al.* 1996), USA (El-Banhawy & Nasr 1984), former USSR (Gilyarov & Bregetova 1977).

Biology: Donovan (2007) found *P. bombicolens* (as *Pneumonyssus bombicolens*) from queens of two bumble bee species, *Bombus terrestris* and *B. hortorum*, and noted that one queen, one worker and two males of *B. hortorum* each carried one large mite, probably *P. bombicolens*. Large mites, most likely *P. bombicolens*, were found with collapsed eggs of bumble bee in the laboratory (Donovan 2007).

Remarks. It should be noted that bumble bee queens of at least three species were imported from England to New Zealand during 1883–1885 (Macfarlane & Griffin 1990). An adult female *P. bombicolens* collected from Nelson on 11 November 1949 indicates this species has been in New Zealand for at least sixty-six years.

Pneumolaelaps breviseta (Evans & Till, 1966)
(Figures 2, 9–14)

Hypoaspis breviseta Evans & Till, 1966: 193

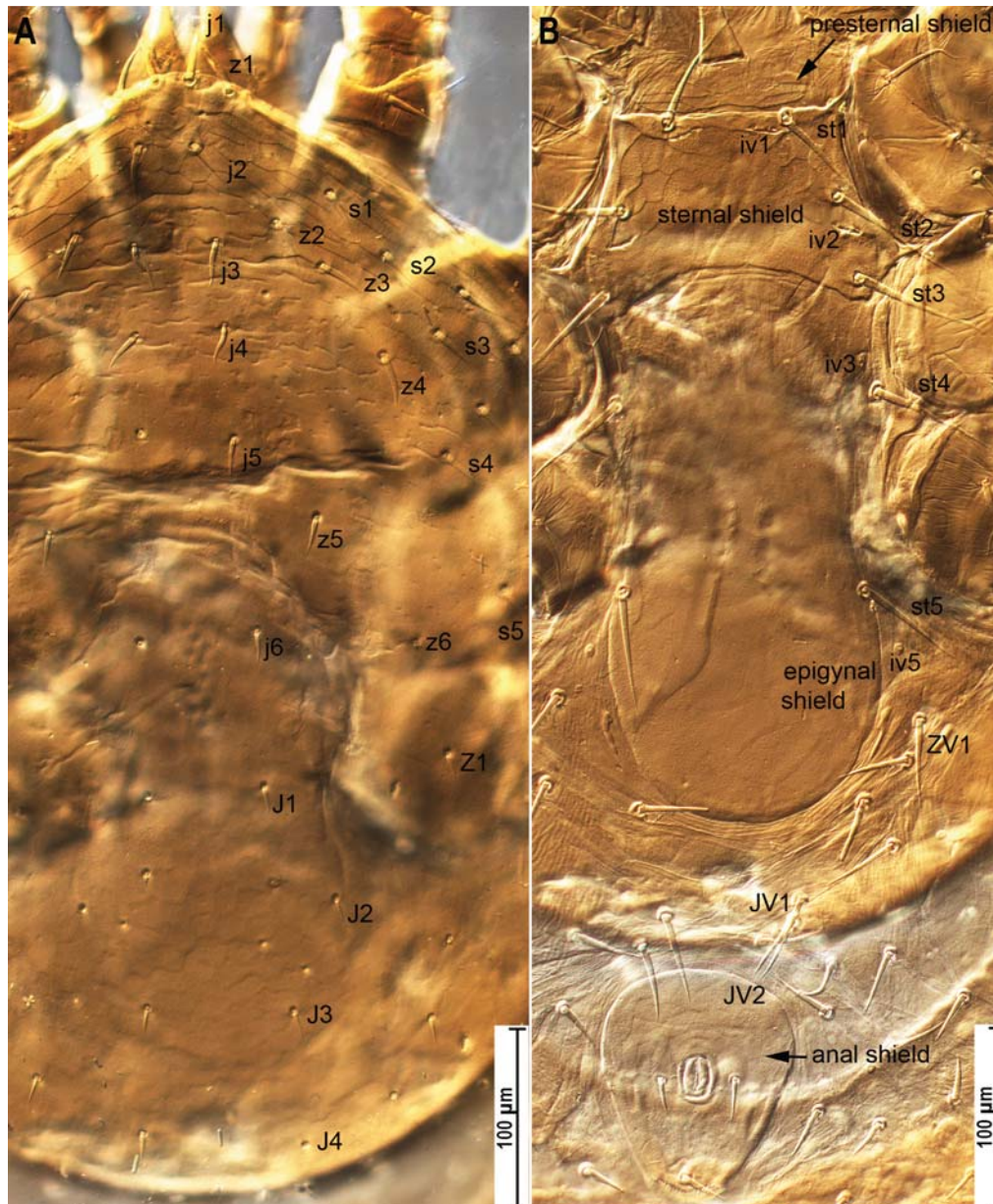


FIGURE 2. *Pneumolaelaps breviseta* (Evans & Till, 1966). Adult female (differential interference contrast microscope images). A, dorsum; B, venter.

Diagnosis. FEMALE: dorsal idiosomal shield (Fig. 2A) marginally reticulate, ornamentation in medial area very faint, most cells as wide as long; bearing 42–46 pairs of setae (*px1–3* present), *j2–j3*, *z2–z4*, *s1–s4* and *r2–r5* about as long as *j1* and slightly longer than other setae. Presternal and sternal shields (Figs 2B, 9B) clearly separate; presternal shield with 3 faint transverse cells at each

side; posterior margin of sternal shield obviously concave. Epigynal shield (Fig. 2B, 11B) with 6–8 faint cells posterior to *st5*, margins of cells straight or curved but not sinuous; internal sclerites between *st4* about the size of *iv2*. Peritrematal shield (Fig. 10B) broadly enlarged around stigmatic opening, where about as wide as length of poststigmatal plate; poststigmatal plate broadly triangular. Anal shield (Fig. 2B, 12B) 1.2×–1.5× as long as wide. Deutosternal groove (Fig. 14B) with 6 rows of 1–4 denticles per row. Setation on segments of legs same as that in *P. niutirani* sp. nov.

Specimen examined. Mid Canterbury (MC): Christchurch, 3 females, 1 male, ex nest of *Bombus terrestris*, 12.xii.1975, by R.P. Macfarlane (NZAC); Christchurch, 3 females, ex nest of *Bombus hortorum*, 10.ii.1976, by R.P. Macfarlane (NZAC); Christchurch, 2 males, ex nest of *Bombus hortorum*, v.1987, by R.P. Macfarlane (NZAC); Christchurch, 3 females, ex nest of *Bombus* sp., 24.vi.1987, by R.P. Macfarlane (NZAC); Christchurch, 2 females, ex nest of *Bombus terrestris*, 3.vii.1987, by R.P. Macfarlane (NZAC); French Farm Bay, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 9.v.2014, by H. Aliakbarpour (PANZ T14_01842). **Nelson (NN):** 3 females, ex *Bombus* sp. nest, 11.xi.1949, by L. Garr (NZAC). **Wanganui (WI):** Palmerston North: Massey University, 1 female, ex lucerne (*Medicago sativa*), iii.1977, by N. Henderson (NZAC).

Host: *Apis mellifera*, *Bombus muscorum*, *B. terrestris*, *B. hortorum*.

Distribution: Britain (Evans & Till 1966), New Zealand (Macfarlane 2005; present study).

Remarks. Three adult females of this species were collected from Nelson on 11 November 1949. This indicates that this species has been in New Zealand for at least sixty-six years.

Pneumolaelaps niutirani Fan & Zhang, sp. nov.

(Figures 3–14)

Diagnosis. FEMALE: dorsal idiosomal shield (Figs 3A, 5A) strongly reticulate throughout, most cells wider than long; setae *j2–3*, *z2–z4*, *s1–4* and *r2–5* as long as or slightly longer and stouter than *j1* and others. Presternal and sternal shields (Figs 4A, 5B, 9D) fused; posterior margin of sternal shield slightly convex. Epigynal shield (Figs 4A, 5B, 11D) medially reticulated with 6–8 large cells posterior to *st5*, margins of cells sinuous; a pair of longitudinal internal sclerites (Figs 4A, 5B) present between *st4*. Peritrematal shield (Figs 4A, 10D) broadly enlarged around stigmatic opening, where about twice width of poststigmatal plate; poststigmatal plate narrow and faint. Peritreme running anteriorly to posterior margin of coxa I. Anal shield (Figs 4A, 5B, 12D) about as long as wide. Deutosternal groove (Figs 4C, 14D) with 6 transverse rows of denticles, each row bearing 1–4 teeth.

Description. FEMALE: Dorsal idiosomal shield (Figs 3A, 5A) oval, 505 (487–518) long and 328 (315–338) wide; reticulate throughout, most cells wider than long, no more than 4 cells between *j6–j6* or *J1–J1*; idiosomal shield usually bearing 37 pairs of setae including 22 pairs of podonotals (*j1–6*, *z1–6*, *s1–6* and *r2–5*) and 15 pairs of opisthonotals (*J1–5*, *Z1–5* and *S1–5*); a single or a pair of setae (*Jx1*) may be present (9% chance) between *J1* and *J2*, and/or a single or a pair of setae (*Jx4*) may be present (22% chance) behind or around *J4* in some individuals, rarely with *Jx3* and/or *Zx3*; all setae smooth and not reaching bases of setae in next row. Measurements (n=5): lengths: *j1* 18 (17–20), *j2* 26 (22–28), *j3* 23 (20–25), *j4* 18 (17–22), *j5* 17 (16–22), *j6* 17 (16–21); *z1* 15 (14–19), *z2* 23 (20–25), *z3* 24 (22–25), *z4* 22 (20–24), *z5* 18 (17–21), *z6* 20 (18–23); *s1* 22 (18–24), *s2* 25 (20–27), *s3* 24 (23–27), *s4* 22 (21–24), *s5* 22 (20–24), *s6* 23 (21–25); *r2* 21 (20–24), *r3* 24 (22–26), *r4* 25 (23–28), *r5* 22 (20–24); *J1* 17 (16–20), *J2* 17 (16–20), *J3* 16 (14–19), *J4* 15 (14–17), *Jx4* 15 (13–18), *J5* 19 (18–22); *Z1* 19 (17–22), *Z2* 20 (18–23), *Z3* 16 (14–19), *Z4* 18 (15–19), *Z5* 19 (16–22); *S1* 22 (17–23), *S2* 20 (18–22), *S3* 14 (13–18), *S4* 15 (13–18), *S5* 17 (15–20); distances: *j1–j1* 20 (18–23), *j2–j2* 22 (19–24), *j3–j3* 49 (44–51), *j4–j4* 53 (45–55), *j5–j5* 48 (45–51), *j6–j6* 63 (54–68); *z5–z5* 130 (120–

133); *J1–J1* 59 (55–62), *J2–J2* 125 (122–131), *J3–J3* 63 (53–66), *J4–J4* 67 (61–70), *J5–J5* 47 (43–50). Dorsal shield with 15 pairs of discernible pore-like structures.

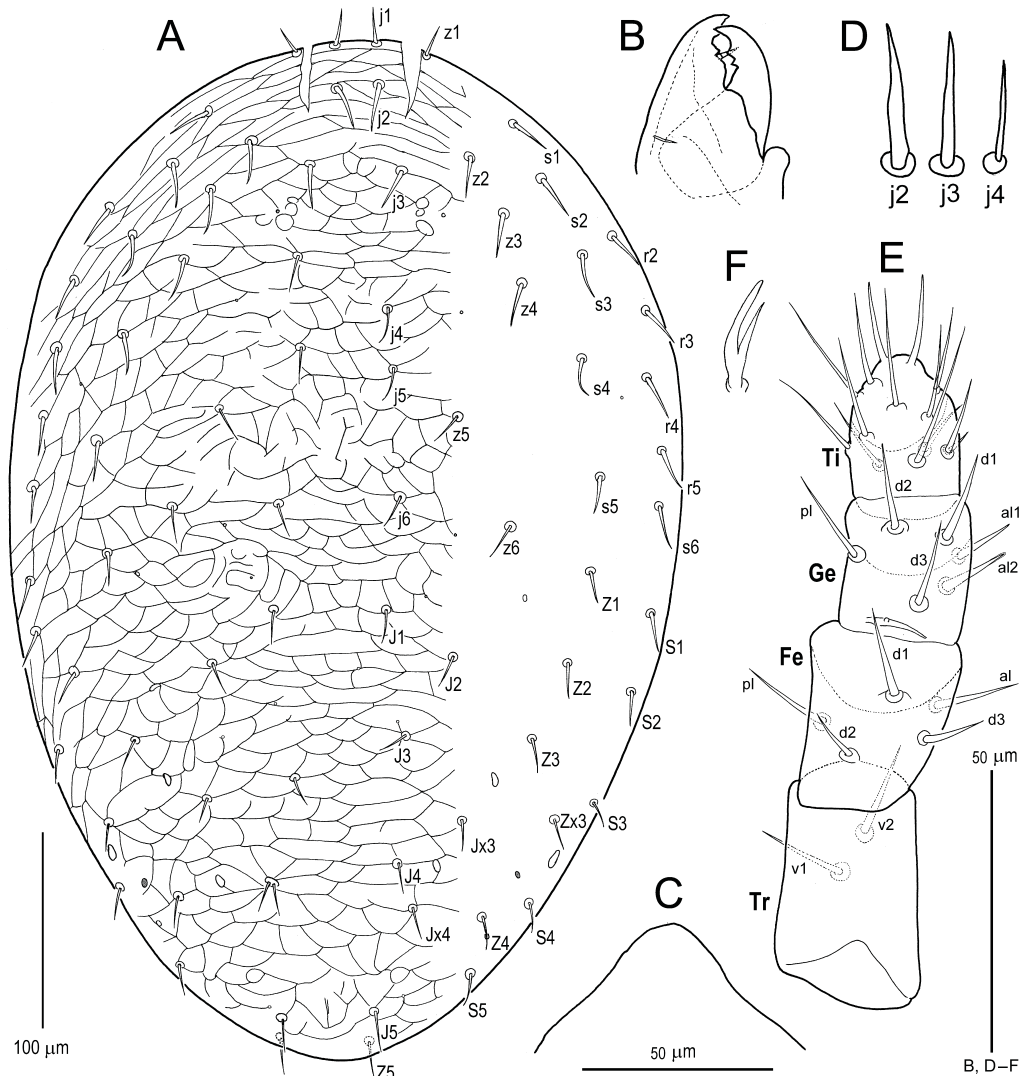


FIGURE 3. *Pneumolaelaps niutirani* Fan & Zhang, **sp. nov.** Adult female (line drawings). A, dorsum; B, chelicera; C, epistome; D, prodorsal setae; E, palp; F, palpal apotele.

Ventral idiosoma (Figs 4A, 5B). Tritosternum with plumose laciniae; tritosternal base (Fig. 4A) trapezoid-shaped, anterior base 12 (9–13), posterior base 22 (19–23), altitude 17 (15–19); laciniae (69–77) each with 8–11 pectinates. Sternal and presternal shields (Figs 4A, 5B, 9D) fused together; presternal area reticulated with transversally elongate cells; sternal shield with posterior margin medially convex, its anterior and lateral areas reticulated, postero-median region forming a triangular smooth area; reticulated cells elongate and compressed in anterior area; shield bearing 3 pairs of long setae *st1–3* and 2 pairs of lyrifissures (*iv1–2*). Measurements (n=5): lengths: *st1* 51 (50–55), *st2* 58 (55–60), *st3* 58 (55–62); distances: *st1–st1* 58 (55–60), *st1–st2* 35 (33–39), *st2–st2* 92 (88–94), *st2–st3* 46 (44–48), *st3–st3* 119 (117–123); lyrifissures *iv1* posteromedial to *st1*, *iv2* posterolateral to *st2*. Setae *st4* and lyrifissure *iv3* on soft cuticle; endopodal plate medial of coxae III–IV separate from

sternal shield. Epigynal shield (Figs 4A, 5B, 11D) 223 (219–228) long and 94 (90–96) wide at level of *st5*, with hyaline anterior margin broadly rounded and posterior margin arched, reticulate throughout, with 6–8 large cells posterior to *st5*; margins of cells sinuous; bearing a pair of setae *st5* on margins, and flanked by a pair of lyrifissures *iv5* on soft cuticle posterolateral to *st5*; a pair of longitudinal internal sclerites (Figs 4A, 5B), 21 (18–22) long, 6 (5–7) wide, present between *st4*. Measurements (n=5): lengths: *st4* 42 (42–50), *st5* 49 (44–52). Spermathecal apparatus with tubulus annulatus widened near ramus sacculus (Fig. 4B), ramus sacculus slightly sclerotized. External metapodal platelets elongate, 37 (35–40) long and 13 (10–15) wide; inner metapodal platelets very small, 13 (12–14) long and 4 (3–5) wide; paragenital platelet tiny, beside seta *ZV1*. Peritrematal shield (Figs 4A, 10D) broadly enlarged, 29 (28–32) wide at level of stigmatic opening, about twice the width of peritreme; peritreme broad and free from exopodal platelets and dorsal shield, running

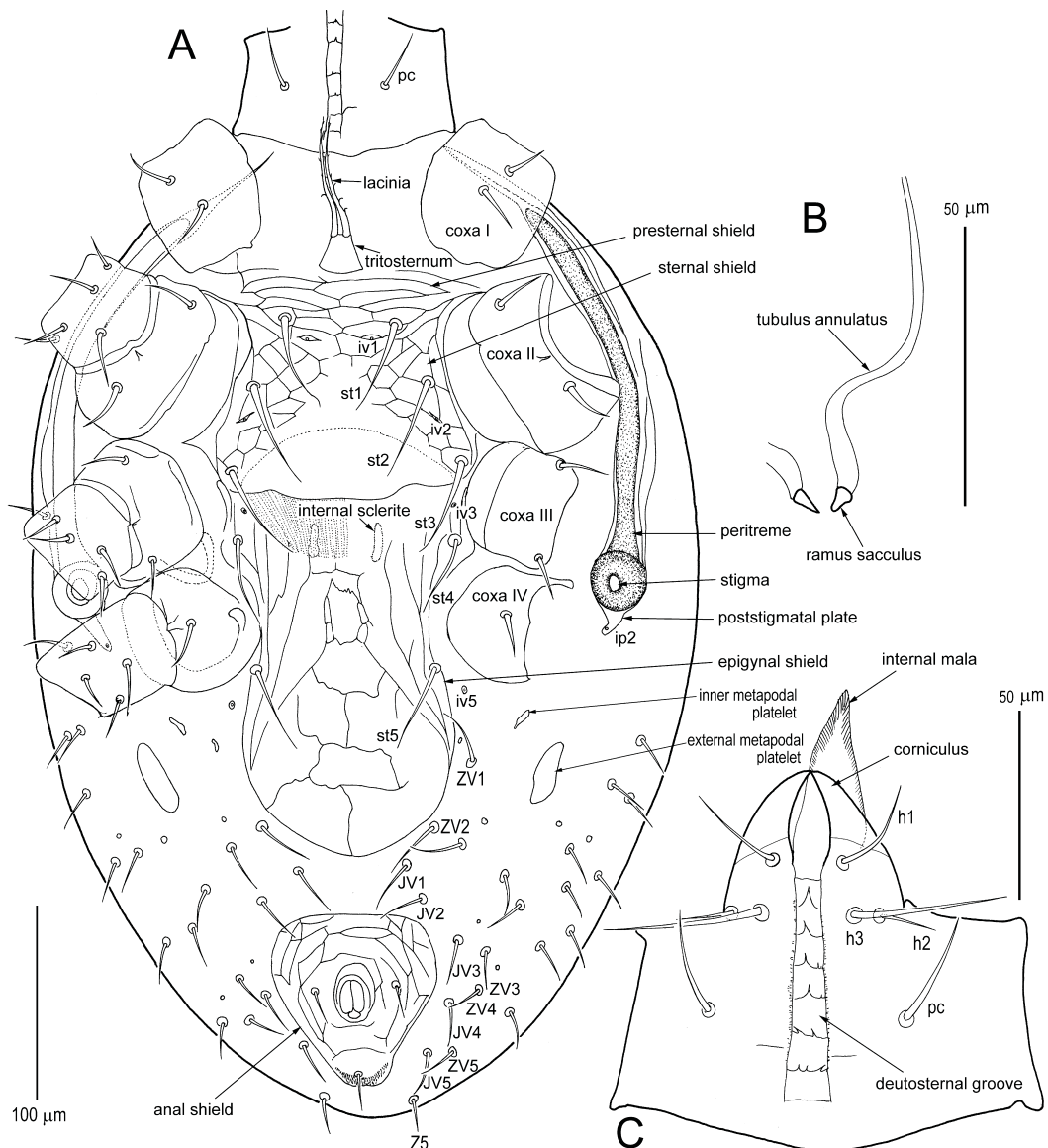


FIGURE 4. *Pneumolaelaps niutirani* Fan & Zhang, **sp. nov.** Adult female (line drawings). A, venter; B, tubulus annulatus and ramus sacculus; C, subcapitulum.

anteriorly to posterior margin of coxa I; poststigmatal plate reduced, 20 (19–22) long), shorter than width of peritrematal plate around stigmatic opening, bearing a pore. Anal shield (Figs 4A, 5B, 12D) inversely subtriangular, about as long as wide, length 83 (82–93) and width 85 (80–92); reticulated throughout; post-anal seta (21 (19–22)) as long as para-anal setae (22 (21–24)); cribrum with a transverse band of dense spicules. Soft cuticle with simple ventral setae, subequal in length. Setal lengths: *JV1* 34 (31–35), *JV2* 30 (29–33), *JV3* 27 (26–28), *ZV1* 33 (30–33), *ZV2* 27 (26–29), *ZV5* 17 (15–19).

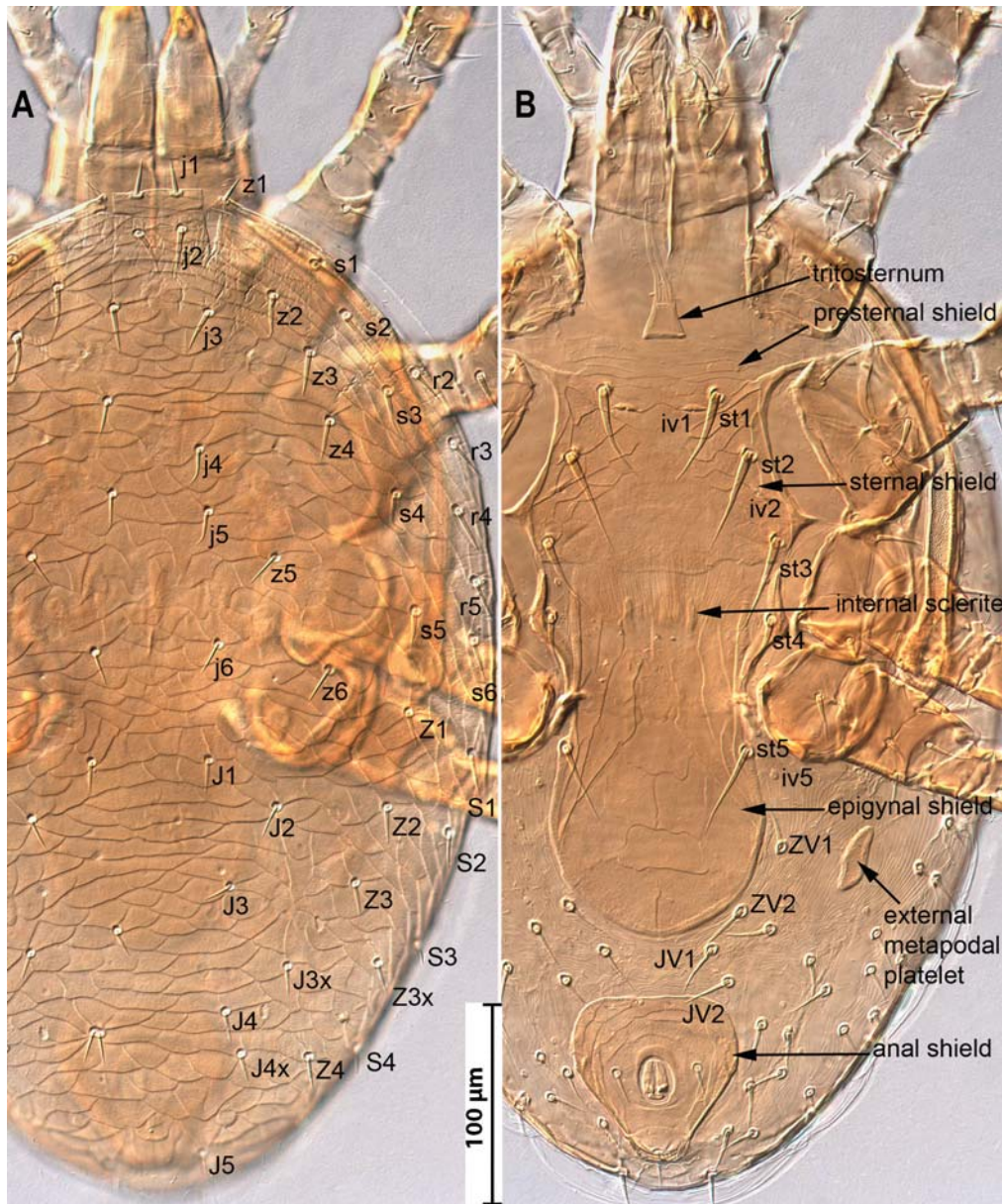


FIGURE 5. *Pneumolaelaps niutirani* Fan & Zhang, **sp. nov.** Adult female (differential interference contrast microscope images). A, dorsum; B, venter.

Gnathosoma. Epistome (Figs 3C, 13D) subtriangular with anterior margin smooth and nearly rounded. Deutosternal groove (Figs 4C, 14D) with 6 transverse rows of denticles, preceded anteriorly and followed posteriorly by a smooth ridge devoid of teeth; typically first row bearing a large denticle, rows 2–5 each with 1–3 denticles; 6th row with 4 small denticles; corniculi horn-like, convergent; internal malae projecting medially, fringed laterally, labrum extending beyond tip of corniculi; hypostomal setae simple, inner posterior setae $h3 >$ palpcoxal setae $pc >$ anterior setae $h1 >$ outer posterior setae $h2$; lengths: $h1$ 26 (24–27), $h2$ 16 (14–16), $h3$ 43 (40–45), pc 33 (31–34); distances: $h1-h1$ 19 (18–21), $h3-h3$ 27 (25–28), $pc-pc$ 53 (50–55). Cheliceral fixed digit (Fig. 3B) bearing 2 medial teeth, followed by setiform pilus dentilis, then two large blunt teeth; dorsal seta nearly twice as long as pilus dentilis, posteriad of dorsal lyrifissure; movable digit with 2 medial teeth. Palpal setae (Fig. 3E) simple, $al1$ and $al2$ of genu slightly thickened, $al2$ with hyaline sheath; setation of palp segments from trochanter to tarsus: 2–5–6–12+2 solenidia–6+9 solenidia; palp tarsal claw 2-tined (Fig. 3F), with ventral tine (8–9 long) tapered and dorsal tine finger-shaped (12–14 long).

Legs (Figs 6A, 6B, 7A, 7B). Each pretarsus bearing a pair of claws with large membranous pulvillae. Legs I with tarsus (excluding pretarsus) 1.5× as long as tibia, about 2× for legs II–IV. Coxae without prominent serrations or spur-like processes on distal margins. Tarsus I without prominently elongated setae apically. Tarsi II–IV with apical setal processes $ad-1$, $pd-1$ long, as long as pretarsi (to the base of claws). All setae simple. Setation on segments of legs (I–IV): coxae 2–2–2–1; trochanters 6 (1 1/3 1)—5 (1 0/3 1)—5 (1 0/3 1)—5 (1 0/3 1); femora 13 (2 2/2 3/2 2)—11 (2 2/1 3/2 1)—6 (1 2/1 1/0 1)—6 (1 2/1 1/0 1); genua 13 (2 3/2 3/1 2)—11 (2 3/1 2/1 2)—9 (2 2/1 2/1 1)—10 (2 2/1 3/1 1); tibiae 13 (2 3/2 3/1 2)—10 (2 2/1 2/1 2)—8 (2 1/1 2/1 1)—10 (2 1/1 3/1 2); tarsi 30+ setae and 9+ solenidia—18—18—18.

Male and immature stages. Unknown.

Specimen examined. Holotype female and a paratype female, Waikato, ex sticky board in honeybee (*Apis mellifera*) hive, 2007 (PANZ, 03/2007/1521). Paratypes: **Auckland (AK):** Bucklands Beach, 2 females, ex sticky board in honeybee (*A. mellifera*) hive, 7.vii.2005 (PANZ, 03/2005/1741); Auckland: Waitakere, 3 females, ex sticky board in honeybee (*A. mellifera*) hive, 16.vi.2005 (PANZ, 03/2005/1847); Auckland: Whenuapai, a female, ex sticky board in honeybee (*A. mellifera*) hive, 14.vi.2005 (PANZ, 03/2005/1830); Auckland, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 24.vi.2014, by J. Paul (PANZ, T14_02425); Auckland, 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 23.vi.2014, by H. Aliakbarpour (PANZ, T14_02430). **Bay of Plenty (BP):** 1 female, ex honeybee (*A. mellifera*) hive, 26.iii.2008 (PANZ, 03/2008/398); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 11.ix.2014, by L. Li (PANZ, T14_02075). **Gisborne (GB):** 1 female, ex honeybee (*A. mellifera*) hive, 31.vii.2013, by D. Kanchiraopally (PANZ, T13_02654). **Marlborough (MB):** 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 16.vi.2014, by J. Paul (PANZ, T14_02305). **Mid Canterbury (MC):** Rangiora, 1 female, ex honeybee (*A. mellifera*) hive, 27.iv.2012, by D. Kanchiraopally (PANZ, T12_01901); Lincoln, 3 females, ex *Vespula germanica*, 3.v.2012, by R.L. Brown (NZAC, 12-950 Z); Lincoln, 3 females, ex *Vespula germanica*, 3.v.2012, by R.L. Brown (PANZ, T12_02097); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 6.v.2014, by H. Aliakbarpour (PANZ, T14_01755); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 29.v.2014, by S. Agate (PANZ, T14_02256); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 6.vi.2014, by J. Paul (PANZ, T14_02263); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 6.vi.2014, by J. Paul (PANZ, T14_02265); 3 females, ex sticky board in honeybee (*A. mellifera*) hive, 10.vi.2014, by H. Aliakbarpour (PANZ, T14_02273). **Nelson (NN):** 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 29.v.2014, by L. Li (PANZ, T14_02255); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 6.vi.2014, by S. Agate (PANZ, T14_02287); 3 females, ex sticky board in honeybee (*A. mellifera*) hive,

10.vi.2014, by J. Paul (PANZ, T14_02288). **North Island (NO):** Cambridge, a female, ex honeybee (*A. mellifera*) hive, 18.viii.2003 (PANZ, 03/2003/1370); 1 female, ex honeybee (*A. mellifera*), 6.v.2005 (PANZ, 03/2005/1450); 1 female, ex honeybee (*A. mellifera*) hive, 14.vi.2005 (PANZ, 03/2005/1829); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 9.xii.2005 (PANZ, 03/2005/2017); 1 female, ex honeybee (*A. mellifera*) hive, 7.vi.2006 (PANZ, 03/2006/1107); 1 female, ex honeybee (*A. mellifera*) hive, 7.vi.2006 (PANZ, 03/2006/1110). **Otago Lakes (OL):** 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 23.v.2014, by L. Li (PANZ, T14_02075). **South Is. (SO):** a female, ex honeybee (*A. mellifera*) hive, 30.iv.2004 (PANZ, 03/2004/1596). **Taranaki (TK):** Omata, 2 females, ex honeybee (*A. mellifera*) hive, 20.iv.2007 (PANZ, 03/2007/1065).

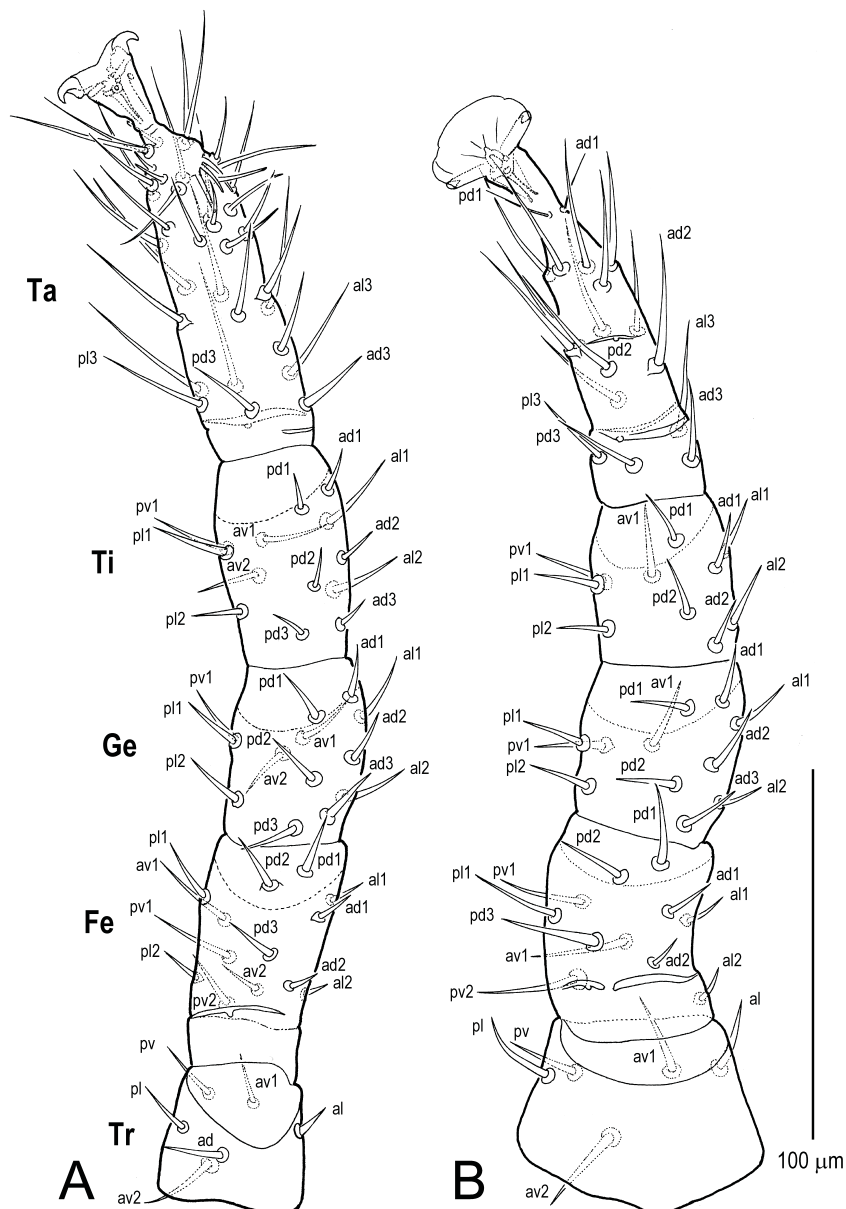


FIGURE 6. *Pneumolaelaps niutirani* Fan & Zhang, **sp. nov.** Adult female (line drawings). A, leg I (trochanter-tibia); B, leg II (trochanter-tibia).

Wanganui (WI): 1 female, ex honeybee (*A. mellifera*) hive, 28.v.2007 (PANZ, 03/2007/1478); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 16.vi.2014, by J. Paul (PANZ, T14_02328); 4 females, ex sticky board in honeybee (*A. mellifera*) hive, 12.vi.2014, by H. Aliakbarpour (PANZ, T14_02334); 4 females, ex sticky board in honeybee (*A. mellifera*) hive, 9.vi.2014, by H. Aliakbarpour (PANZ, T14_02335); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 11.vi.2014, by S. Agate (PANZ, T14_02236); 1 female, ex sticky board in honeybee (*A. mellifera*) hive, 11.vi.2014, by S. Agate (PANZ, T14_02344); 2 females, ex sticky board in honeybee (*A. mellifera*) hive, 17.vi.2014, by H. Aliakbarpour (PANZ, T14_02345); 3 females, ex sticky board in honeybee (*A. mellifera*) hive, 16.vi.2014, by J. Paul (PANZ, T14_02349); Palmerston North, 1 female, sticky board, 14.vi.2005, by A. Wei (PANZ, 03/2005/1810).

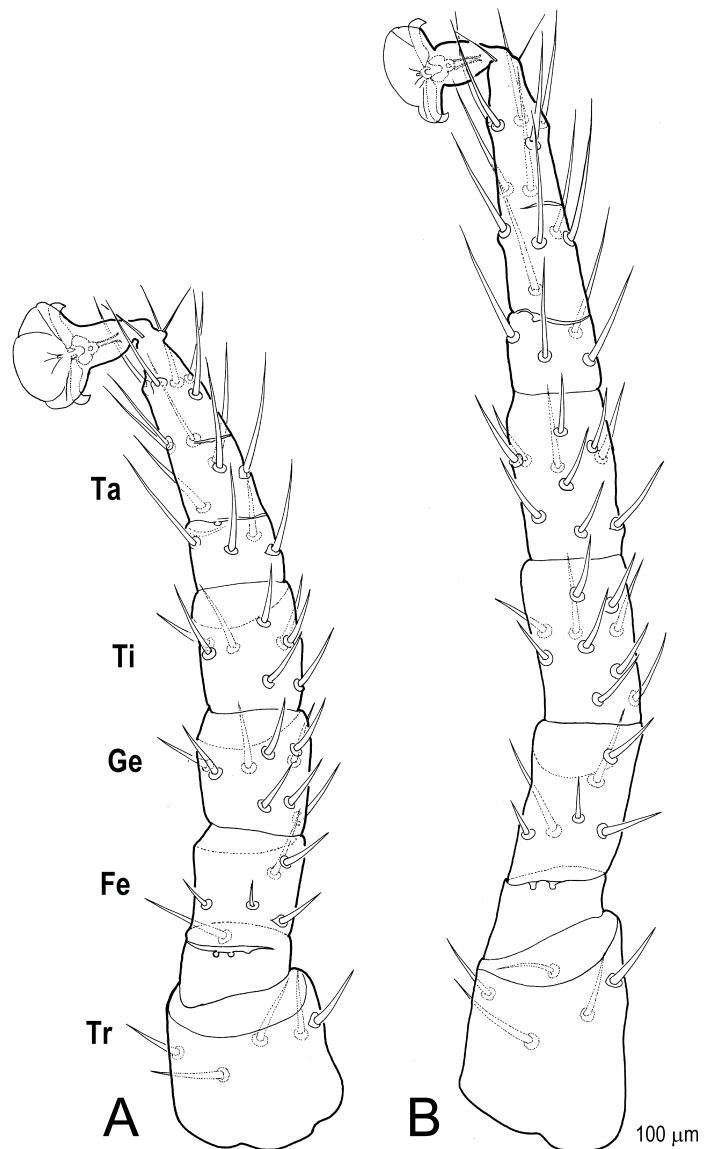


FIGURE 7. *Pneumolaelaps niutirani* Fan & Zhang, **sp. nov.** Adult female (line drawings). A, leg III (trochanter-tibia); B, leg IV (trochanter-tibia).

Holotype and a paratype will be deposited in NZAC. All other paratypes are deposited in PANZ and NZAC.

Etymology. The specific name, *niutirani*, is derived from the Maori “*Niu Tīrani*”, meaning “New Zealand”, referring the locality from where the species were found. It is used here as a noun in apposition.

Other specimen examined for comparison: Britain: Cumberland: Gosforth, holotype female of *Pneumolaelaps minutissima*, ex *Bombus terrestris* queen, 3.v.1960, by D.C. Lee (NHM 1965:12:29:5).

Remarks. The new species is most similar to *P. minutissima* (absent from New Zealand) in the general appearance of the dorsal idiosomal shield. It can be easily distinguished from the latter and two New Zealand species, viz. *P. bombicolens* and *P. breviseta* by the characters listed in Table 1.

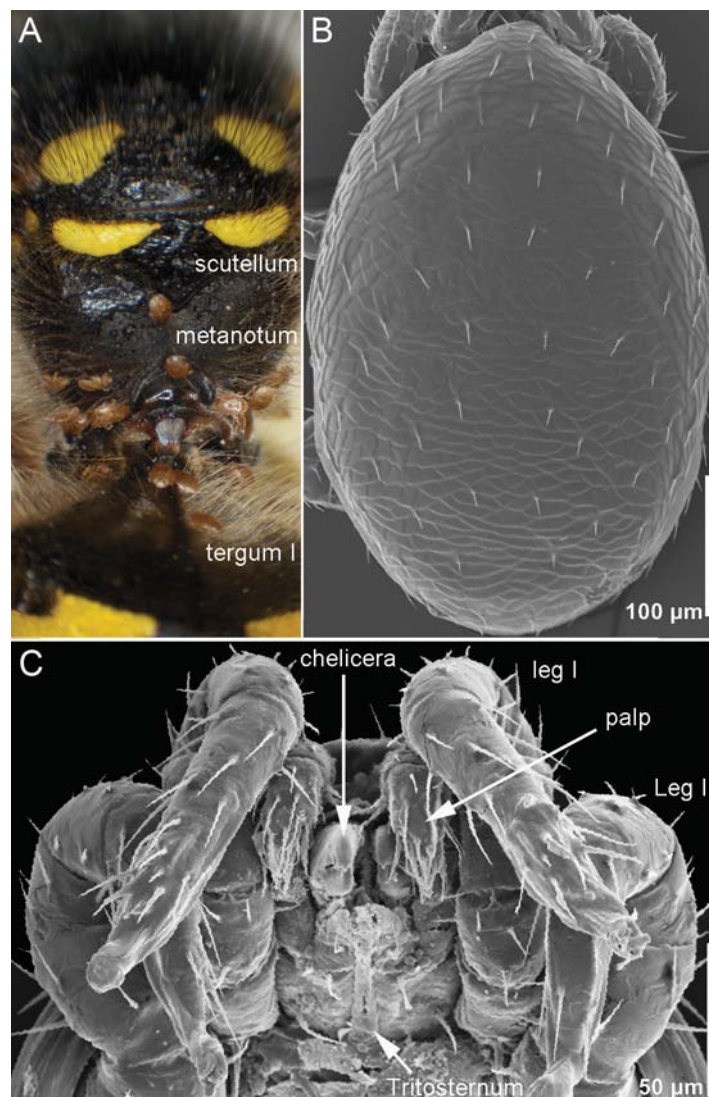


FIGURE 8. *Pneumolaelaps niutirani* Fan & Zhang, **sp. nov.** A, habitus; B, adult female dorsum (scanning electron microscope, SEM); C, ventral propodosoma (SEM).

TABLE 1. Distinguishing characters of *Pneumolaelaps bombicolens* (*Pbo*), *P. breviseta* (*Pbr*), *P. minutissima* (*Pm*) and *P. niutirani* **sp. nov.** (*Pn*).

| | Cells of reticulation of dorsal shield | <i>j2, j3, z2-z4, s1-s4</i> and <i>r2-r5</i> | Presternal and sternal shields (Fig. 9) | Posterior margin of sternal shield (Fig. 9) | Poststigmatal plate (Fig. 10) | Margins of cells on epigynal shield behind <i>s5</i> (Fig.11) | Internal sclerites between <i>st4</i> (Fig. 11) | Anal shield (Fig. 12) | Deutosternal groove (Fig. 14) |
|------------|--|--|---|---|---------------------------------|---|---|--------------------------------|-------------------------------|
| <i>Pbo</i> | Small, mostly as long as wide | ≈ 2× <i>j1</i> | Separate | Strongly concave | Prominent, broadly triangular | Curved and plain | Absent | Distinctively longer than wide | 6 rows of 2–4 denticles |
| <i>Pbr</i> | Small, mostly as long as wide | ≈ as long as <i>j1</i> | Separate | Strongly concave | Prominent, broadly triangular | Curved and plain | Absent | Distinctively longer than wide | 6 rows of 2–5 denticles |
| <i>Pm</i> | Large, mostly wider than long | ≈ as long as <i>j1</i> | Separate | Protruding | Prominent, elongated triangular | Serrated | Absent | Nearly as long as wide | 6 rows of 9–12 denticles |
| <i>Pn</i> | Large, mostly wider than long | ≈ as long as <i>j1</i> | fused | Medially convex | Reduced, narrow and obscure | Sinuuous | Present | Nearly as long as wide | 6 rows of 2–4 denticles |

Biology. *Pneumolaelaps niutirani* sp. nov. is commonly found in association with the honeybee *Apis mellifera* and the German wasp *Vespula germanica*. In the sample collected from Canterbury in 2013, there was a high variation in the number of mites found among the individual adult wasps. Sixteen of the 35 gynes examined (46%) were found to have at least one mite on their body. Four of the male wasps (18%), had at least one mite on them at the time of inspection. There were no mites found on the 17 workers examined. The majority of the mites were found on the thorax and abdomen of *V. germanica*, and with few occurring on the head (Table 2).

TABLE 2. Summary of counts and locations of *Pneumolaelaps niutirani* sp. nov. found on *Vespula germanica* reproductive castes.

| Wasp caste | Location on body | | | |
|--------------------|------------------|-------------|-------------|--------------|
| | Head | Thorax | Abdomen | Combined |
| Gyne (n=16) | | | | |
| Mean ± SEM | 0.063 ± 0.063 | 9.88 ± 2.32 | 2.38 ± 0.73 | 12.31 ± 2.89 |
| Total | 1 | 158 | 38 | 197 |
| Male (n=4) | | | | |
| Mean ± SEM | 0.25 ± 0.25 | 1.75 ± 0.48 | 0.75 ± 0.75 | 2.75 ± 1.44 |
| Total | 1 | 7 | 3 | 11 |

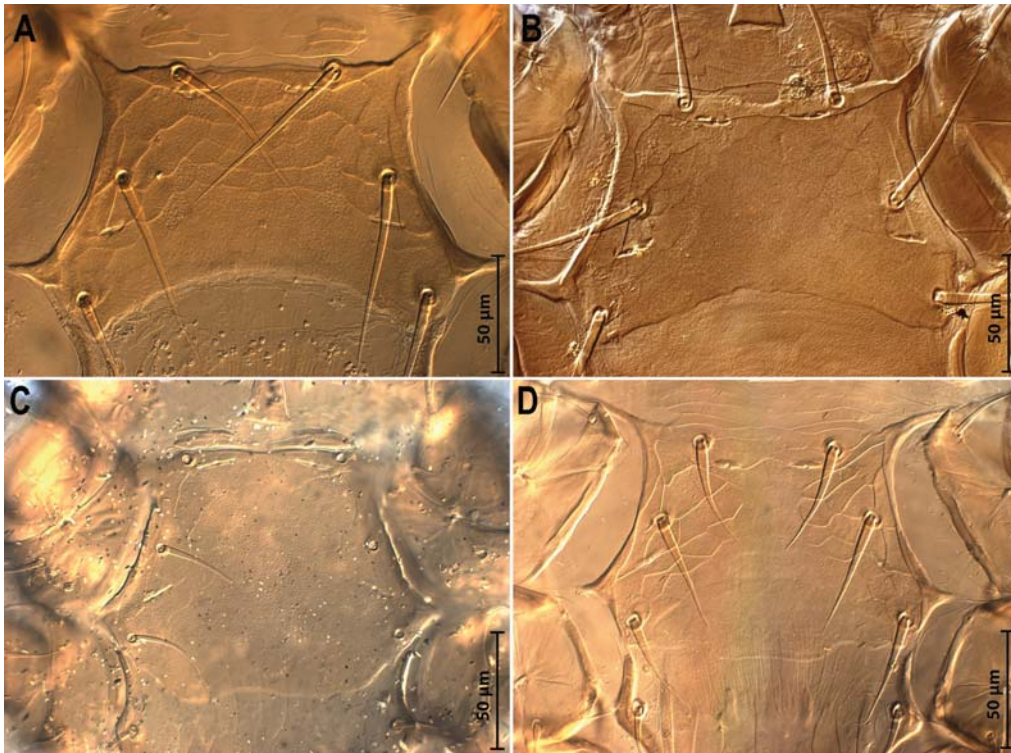


FIGURE 9. Sternal shield (differential interference contrast microscope images). A, *P. bombicolens*; B, *P. breviseta*; C, *P. minutissima*; D, *P. niutirani*.

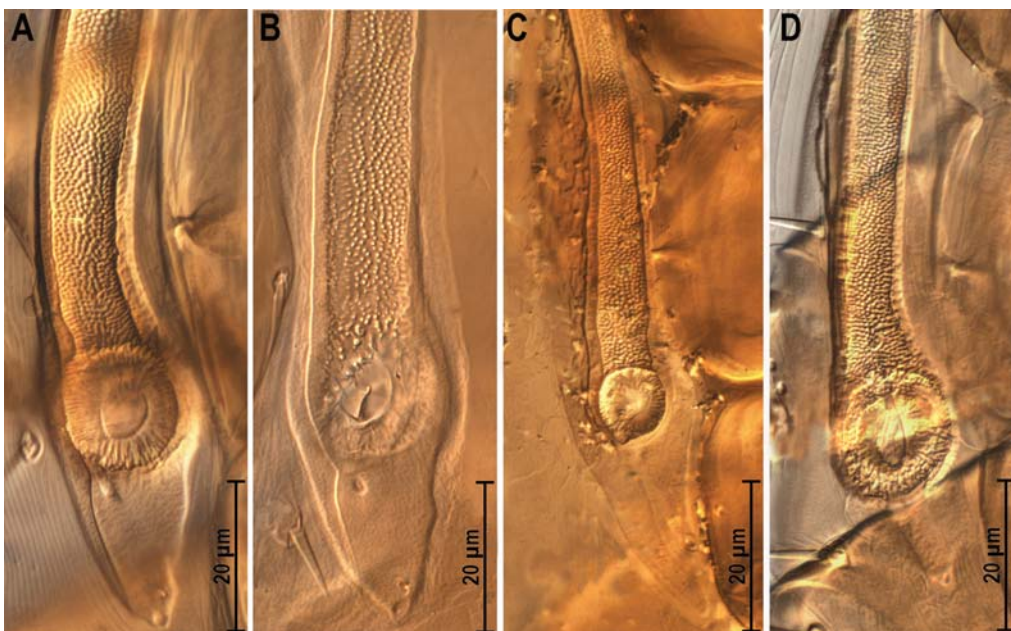


FIGURE 10. Peritreme (differential interference contrast microscope images). A, *P. bombicolens*; B, *P. breviseta*; C, *P. minutissima*; D, *P. niutirani*.

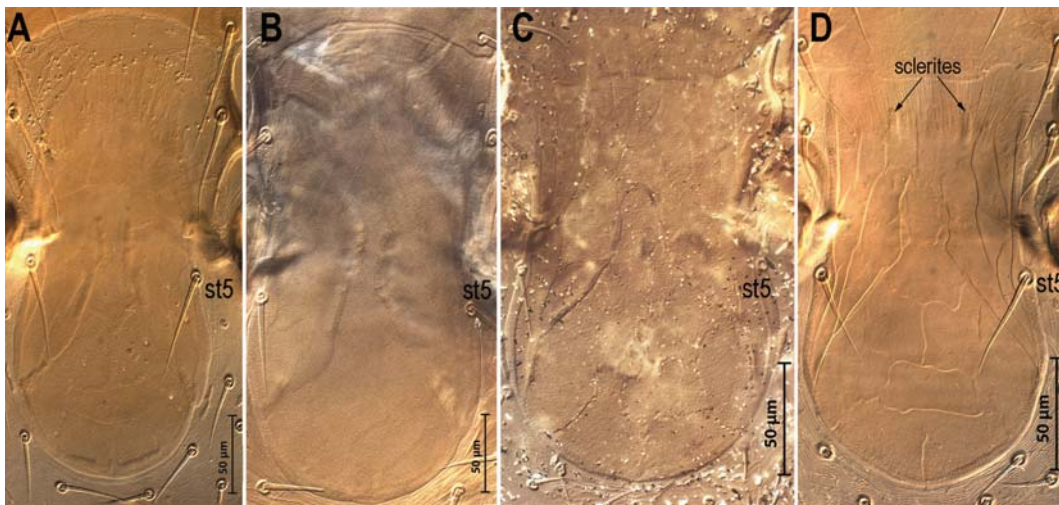


FIGURE 11. Epigynal shield (differential interference contrast microscope images). A, *P. bombicolens*; B, *P. breviseta*; C, *P. minutissima*; D, *P. niutirani*.

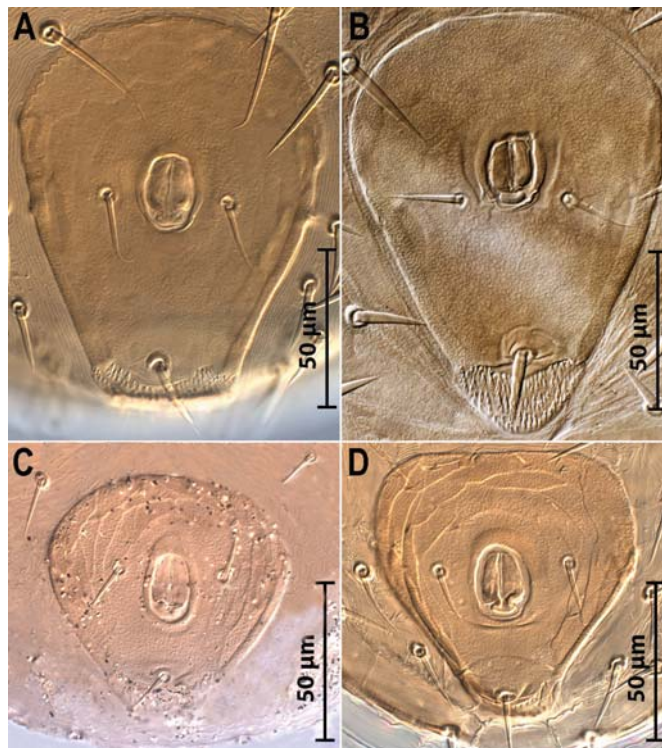


FIGURE 12. Anal shield (differential interference contrast microscope images). A, *P. bombicolens*; B, *P. breviseta*; C, *P. minutissima*; D, *P. niutirani*.

Key to females of *Pneumolaelaps* known in New Zealand

1. Presternal and sternal shields separate; posterior margin of sternal shield concave; margins of cells on epigynal shield behind *st5* straight or curved but not sinuous; cells of reticulation on dorsal shield about as wide as long 2

- Presternal and sternal shields fused; posterior margin of sternal shield medially convex; margins of cells on epigynal shield behind *st5* sinuous; cells of reticulation on dorsal shield mostly wider than long
 *P. niutirani* Fan & Zhang, **sp. nov.**
- 2. Podonotal setae *j2-3*, *z2-z4*, *s1-s4* and *r2-s5* about as long as *j1* and slightly longer than other setae; ornamentation in region of dorsal hexagon (*j5-z5-j6*) faint *P. breviseta* Evans & Till, 1966
- Podonotal setae *j2-3*, *z2-z4*, *s1-s4* and *r2-s5* about twice as long as *j1* and 2-4× as long as other setae; ornamentation in region of dorsal hexagon (*j5-z5-j6*) clearly distinguishable.
 *P. bombicolens* (Canestrini, 1885)

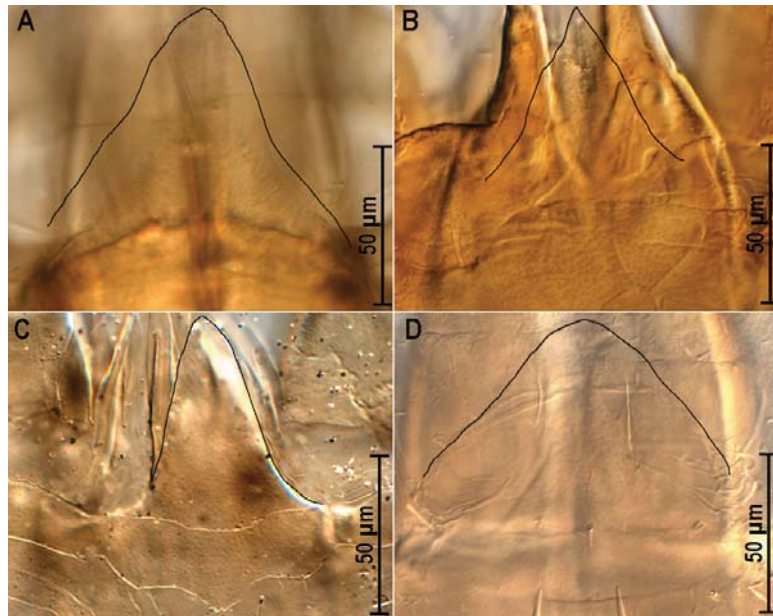


FIGURE 13. Epistome (differential interference contrast microscope images). A, *P. bombicolens*; B, *P. breviseta*; C, *P. minutissima*; D, *P. niutirani*.

Discussion

Previous papers on the feeding behaviour of *Pneumolaelaps* provide scant information. Members of the genus mainly have been considered to be nectar and pollen feeders (Hunter & Husband 1973; Royce & Krantz 1989). *Pneumolaelaps longanalis* Hunter & Husband 1973, an associate of bumblebees, was known to feed on nectar and surface compounds of pollen (Royce & Krantz 1989). It is also known to feed on liquids from wounds of bumblebees, viz. the haemolymph of an accidentally decapitated bumblebee and the exposed air sac of a bumblebee (Hunter & Husband 1973). *Pneumolaelaps hyatti* (Evans & Till, 1966) was observed to feed on an acarid mite *Kuzinia laevis* (Dujardin, 1849) (Acaridae) (Costa 1966; Macfarlane 2005). The feeding habits of *P. niutirani* sp. nov. are unknown at the present. In this study, we reported the first case of *Pneumolaelaps-Vespula* association, but the nature of association remains to be studied. Many laelapid mites are very well preadapted to parasitism (Radovsky 1985). If *P. niutirani* sp. nov. were a true parasite of its host, then its offspring would be also found in the large number of samples from the hosts accumulated over the years. Despite the large number of specimens collected from bees, bumblebees and wasps over many years, only adult females of *P. niutirani* sp. nov. were found on adult bees and wasps. Thus adult females of this species likely mate with males and produce offspring off their hosts. In other mites associated with bees that commonly feed on pollen and nectar, similar observations have been made, e.g. mites of the family Ameroseiidae usually disperse via hosts as adult female mites

(Evans 1963). Kar *et al.* (2015) also collected only females of *Neocyphoelaps novaehollandiae* Evans, 1963 (Ameroseiidae) from its insect hosts, but males and offspring were collected from flowers of plants where they feed on pollen and reproduce.

To understand the feeding habits of *P. niutirani* sp. nov., it will be useful to conduct direct observations on the feeding behaviour of the mite or obtain evidence of feeding via gut analysis (DNA). It will also be very useful to collect mites from soil and litter associated with the nests of wasps for the presence of mites.

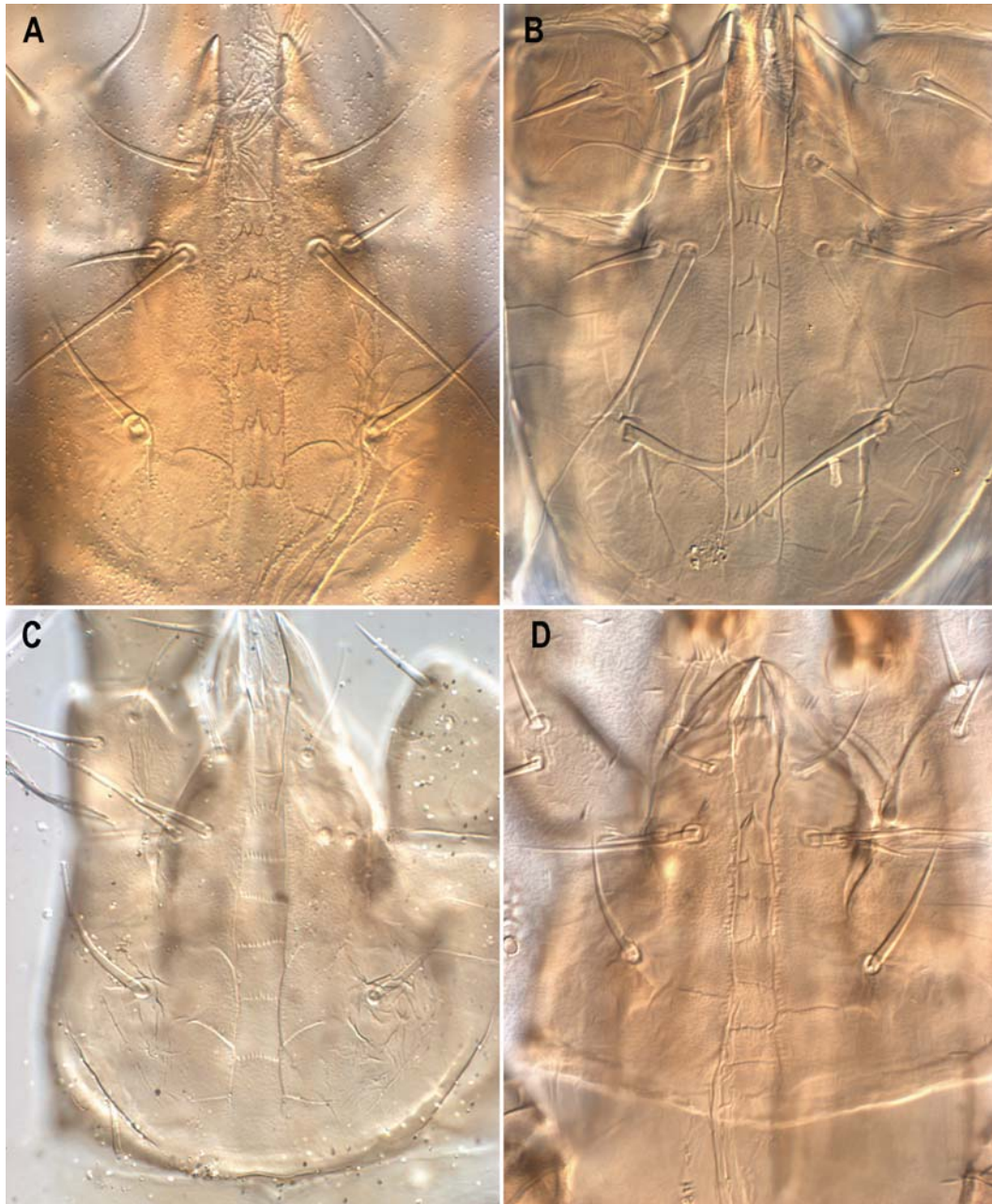


FIGURE 14. Deusternal groove (differential interference contrast microscope images). A, *P. bombicolens*; B, *P. breviseta*; C, *P. minutissima*; D, *P. niutirani*.

Acknowledgements

We are deeply indebted to Dr Anne Baker (Natural History Museum, UK) for the loans of the type specimens, to Maurice O'Donnell & Dr Sherly George, Plant Health & Environment Laboratory (PHEL), Ministry for Primary Industries (MPI), New Zealand for organizing the specimens collected in the National Apiculture Surveillance Programme for our study. We thank Dr Sherly George and Alan Flynn (PHEL, MPI), Graham Burnip (Surveillance & Investigation, MPI), Omid Joharchi (Islamic Azad University, Iran) and two anonymous reviewers for their insightful comments and suggestions. Zhi-Qiang Zhang was supported by Core funding for Crown Research Institutes from the Ministry of Business, Innovation and Employment's Science and Innovation Group.

References

- Bai, X.-L. & Ma, L.-M. (2013) Investigations on mesostigmatic mites from Ningxia and neighboring provinces (Acari) (2). *Bulletin of Disease Control and Prevention*, 28(2), 13–16.
- Berlese, A. (1920) Centuria quinta di Acari nuovi. *Redia*, 14, 143–195.
- Bregetova, N.G. (1977) [Family Laelaptidae]. In: Gilarov, M.S. & Bregetova, N.G. (Eds.) [*Opredelitel' obyayshchikh v pochve kleshchey Mesostigmata = Identification key to soil-inhabiting mites Mesostigmata*], Leningrad: Nauka, pp. 483–554.
- Canestrini, G. (1885) *Prospetto dell'Acarofauna Italiana, Volume I, Famiglie: Oribatini, Gamasini, Hoplopini, Trombidini, Rhyncholophini*. Proserpini, Padova. 163 pp. + Plates I–IX.
- Casanueva, M.E. (1993) Phylogenetic studies of the free-living and arthropod associated Laelapidae (Acari: Mesostigmata). *Gayana Zoologia*, 57, 21–46.
- Costa, M. (1966) The biology and development of *Hypoaspis (Pneumolaelaps) hyatti* (Acari: MesoStigmata). *Journal of Zoology*, 148(2), 191–200.
<http://dx.doi.org/10.1111/j.1469-7998.1966.tb02947.x>
- Donovan, B.J. (2007) Apoidea (Insecta: Hymenoptera). *Fauna of New Zealand*, 57, 1–295.
- El-Banhawy, E.M. & Nasr, A.K. (1984) Incidence of mites in bee hives in the state of New York with descriptions of two new species. *Bulletin of the Zoological Society of Egypt*, (34), 76–82.
- Elsen, P. (1973) *Pneumolaelaps machadoi* sepc. nov. et autres acariciens mésostigmatiques phorétiques d'Hyménoptères Apidae (Insecta) d'Angola. *Publicações Culturais da Companhia de Diamantes de Angola*, 87, 181–186.
- Evans, G.O. (1963) The genus *Neocypholaelaps* Vitzthum (Acari: Mesostigmata). *Annals and Magazine of Natural History*, ser. 13, 6(64), 209–230.
<http://dx.doi.org/10.1080/00222936308651345>
- Evans, G.O. & Till, W.M. (1965) Studies on the British Dermanyssidae (Acari: Mesostigmata) Part I. External morphology. *Bulletin of the British Museum (Natural History) Zoology*, 13(8), 247–394.
- Evans, G.O. & Till, W.M. (1966) Studies on the British Dermanyssidae (Acari: Mesostigmata) Part II Classification. *Bulletin of the British Museum (Natural History) Zoology*, 14, 8–370.
- Haragsim, O., Samšňák, K. & Vobrázková, E. (1978) The mites inhabiting the bee-hives in ĀSR. *Zeitschrift für Angewandte Entomologie*, 87 (1–4), 52–67.
<http://dx.doi.org/10.1111/j.1439-0418.1978.tb02425.x>
- Hunter, P.E. (1966) The genus *Pneumolaelaps* with description of three new species (Acarina: Laelaptidae). *Journal of the Kansas Entomological Society*, 39, 357–369.
<http://dx.doi.org/10.1080/00779962.2015.1043043>
- Hunter, P.E. & Husband, R.W. (1973) *Pneumolaelaps* (Acarina: Laelapidae) mites from North America and Greenland. *The Florida Entomologist*, 56, 77–91.
<http://dx.doi.org/10.2307/3493231>
- Kar, F., Lin, S. & Zhang, Z.-Q. (2015) *Neocypholaelaps novaehollandiae* Evans (Acari: Ameroseiidae) rediscovered: experiments on its life history and behaviour. *New Zealand Entomologist*, 38(2), 126–133.
<http://doi.org/10.1080/00779962.2015.1043043>
- Lindquist, E.E. & Evans, G.O. (1965) Taxonomic concepts in the Ascidae, with a modified setal nomenclature of the Gamasina (Acarina: Mesostigmata). *Memoirs of the Entomological Society of Canada*, 47, 1–64.

- <http://dx.doi.org/10.4039/entm9747fv>
- Lindquist, E.E., Krantz, G.W. & Walter, D.E. (2009) Order Mesostigmata. *In*: Krantz, G.W. & Walter, D.E. (Eds.), *A Manual of Acarology*, Third Edition. Texas Tech University Press, Lubbock, pp. 124–232.
- Macfarlane, R.P. (2005) Mites associated with bumble bees (*Bombus*: Apidae) in New Zealand. *Records of the Canterbury Museum*, 19, 29–34.
- Macfarlane, R.P. & Griffin, R.P. (1990) New Zealand distribution and seasonal incidence of the nematode *Sphaerularia bombi* Dufour a parasite of bumble bees in New Zealand. *New Zealand Journal of Zoology*, 17, 191–199.
- Radovsky, F.J. (1985) Evolution of mammalian mesostigmatid mites. *In*: Kim, K.C. (Ed.), *Coevolution of Parasitic Arthropods and Mammals*. New York: Wiley-Interscience, pp. 441–568.
- Ren, T.-G. & Guo, X.-G. (2008) Preliminary study on Laelapidae fauna in China (Acari: Gamasida [sic]: Laelapidae). *Chinese Journal of Vector Biology and Control*, 4, 326–332.
- Royce, L.A. & Krantz, G.W. (1989) Observations on pollen processing by *Pneumolaelaps longanalis* (Acari, Laelapidae), a mite associate of bumblebees. *Experimental and Applied Acarology*, 7, 161–165.
<http://dx.doi.org/10.1007/BF01270436>
- Rozej, E., Witalinski, W., Szentgyorgyi, H., Wantuch, M., Moron, D. & Woyciechowski, M. (2012) Mite species inhabiting commercial bumblebee (*Bombus terrestris*) nests in Polish greenhouses. *Experimental and Applied Acarology*, 56(3), 271–282.
<http://dx.doi.org/10.1007/s10493-012-9510-8>
- Schwarz, H. H. Huck, K. & Schmid-Hempel, P. (1996) Prevalence and host preferences of mesostigmatic mites (Acari: Anactinochaeta) phoretic on Swiss bumble bees (Hymenoptera: Apidae). *Journal of the Kansas Entomological Society*, 69(4, supplement), 35–42.
- Willmann, C. (1953) Neue Milben aus den östlichen Alpen. *Sitzungsberichte der Österreichischen Akademie der Wissenschaften/Mathematisch-Naturwissenschaftliche Klasse, Abteilung I*, 162, 449–519.
- Ye, R.-Y. & Ma, L.-M. (1996) Two new species and a new record of the family Laelapidae from China (Acari: Mesostigmata). *Acta Zootaxonomica Sinica*, 21(3), 296–299.

Submitted: 16 Sept. 2015; accepted by Hans Klompen: 9 Dec. 2015; published: 15 Jan. 2016