Sheltered life beneath elytra: three new species of *Eutarsopolipus* (Acari, Heterostigmatina, Podapolipidae) parasitizing Australian ground beetles

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**Abstract** — In this study, we conducted a summer sampling of carabid beetles in eastern Australia to identify their associated parasitic mites. Here, we describe three new species of the genus *Eutarsopolipus* from under the elytra (forewings) of three native carabid species (Coleoptera: Carabidae): *Eutarsopolipus paryavae* n. sp. (*pterostichi* group) from *Geoscapus laevissimus* Chaudoir; *Eutarsopolipus pulcher* n. sp. (*leyei* group) from *Gnathaphanus pulcher* (Dejean); and *Eutarsopolipus chlaenii* n. sp. (*myzus* group) from *Chlaenius flaviguttatus* Macleay. We further provide an identification key of the world species of *pterostichi* and *leyei* species groups as well as closely related species of the *myzus* group possessing similar characters including short cheliceral styles. The significant diversity of *Eutarsopolipus* recovered here suggests that the current knowledge about Australian podapolipid mites (especially *Eutarsopolipus*) is still in its infancy and deserves further study.

**Key words:** Acari, Biodiversity, Trombidiformes, Carabidae, Symbiosis, Systematics.

**Re´sume´** – Vivre à l’abri sous les élytres : trois nouvelles espèces d’*Eutarsopolipus* (Acari, Heterostigmatina, Podapolipidae) parasitant des carabes australiens. Dans cette étude, nous avons effectué un échantillonnage estival de carabes dans l’est de l’Australie pour identifier leurs acariens parasites associés. Nous décrivons trois nouvelles espèces du genre *Eutarsopolipus* sous les élytres (ailes antérieures) de trois espèces de carabes indigènes (Coleoptera : Carabidae) : *Eutarsopolipus paryavae* n. sp. (groupe *pterostichi*) de *Geoscapus laevissimus* Chaudoir, *Eutarsopolipus pulcher* n. sp. (groupe *leyei*) de *Gnathaphanus pulcher* (Dejean) et *Eutarsopolipus chlaenii* n. sp. (groupe *myzus*) de *Chlaenius flaviguttatus* Macleay. Nous fournissions en outre une clé d’identification des espèces mondiales des groupes d’espèces *pterostichi* et *leyei* ainsi que des espèces étroitement apparentées du groupe *myzus* possédant des caractères similaires, y compris des styles chélicérés courts. La diversité importante des *Eutarsopolipus* collectés ici suggère que les connaissances actuelles sur les acariens podapolipidés australiens (en particulier *Eutarsopolipus*) en sont encore à leurs balbutiements et méritent une étude plus approfondie.

**Introduction**

Beetles are among the most successful animals on the planet, accounting for about 25% of described species [10, 46]. Their success is partly attributed to their modified, sclerotized forewings, known as elytra, that protect their body against physical damage, desiccation, predation and thermal stress, enabling them to occupy a wide range of ecological niches [33, 48]. The subelytral space serves as a suitable microhabitat for a broad range of organisms such as mites, pseudoscorpions and nematodes that occupy this niche temporarily or permanently [6, 36, 37]. Some mitea have evolved to be permanent ectoparasites in the subelytral spaces of beetles, imbibing beetle haemolymph using piercing styles [2, 7]. This parasitic association sometimes occurs in one part of a mite’s life cycle. For example, in Parasitengona (Acariformes: Prostigmata), larvae are parasites of many insects and are sometimes found under the elytra of terrestrial and aquatic beetles, while the nymphs and adults are free-living predators of immature stages of small arthropods [51, 52]. However, some taxa represent evolutionary transitions from phoresy towards parasitism, as in a few canestrinioid mites (Astigmata) in which deutonymphs remain phoretic on the thoracic venter of some carabid beetles, whereas the other stages (feeding stages) are subelytral parasites of the same hosts [15, 49]. Some other groups are real parasites with...
their abbreviated life stages all occurring on the host’s body surface [47]. Such subelytral parasitic associations with beetles have evolved independently in many Astigmata (e.g. most members of Canestrinioidea), Mesostigmata (e.g. several members of Gamasina) and Prostigmata (e.g. several members of Raphignathina and Heterostigmatina) [14, 16, 35, 38].

The cohort Heterostigmatina (Acariformes: Prostigmata) is a large group of morphologically diverse mites, among which numerous species are associated with arthropods [49]. Some species are subelytral symbionts of various beetles with their associations varying from facultative or obligate phoresy to parasitoidism or parasitism [25, 28, 30, 31]. Several species are potential biocontrol agents against pest beetles. For example, the species of the families Pyenotidae and Acarophenaciidae are known as insect ectoparasitoids, with the former mostly attacking juvenile stages of bark beetles and stored-product beetles and the latter egg ectoparasitoids of various beetle families [8, 25, 29, 50].

All members of the family Podapolipidae are specialized obligate external (and rarely internal) parasites of various insects [18], among which at least 20 genera are subelytral ectoparasites of different beetle families, mainly Carabidae, Chrysomelidae, Coccinellidae, and Scarabaeidae [21, 23, 38, 45]. These mites are sexually transmitted, i.e. the motile stages of the mite (larvae or adult females) move from one host individual to another during copulation [17]. Parasitisation with these mites can negatively affect host fitness. For example, in some ladybirds, individuals parasitised with Coccipolipus suffer lower fecundity and egg viability [17] and sometimes reduced longevity [40]. Beyond this, these mites can modify host sexual and behavioural traits to boost their transmission success among individual hosts [1]. For example, in the milk weed leaf beetle, males parasitized by Chrysomelobia tend to more frequently contact other males, and are more successful in mating competition compared to unparasitised males; and this facilitates the mite’s higher transmission rate [1].

Four genera of Podapolipidae are exclusively associated with carabid beetles: Dorsipes (22 species), Eutarsopolipus (99 species), Ovacarus (3 species) and Regenpolipus (5 species) [11, 13, 19, 26, 27, 44]. Apart from Ovacarus, which is an endoparasite of the reproductive tracts of some carabids, the rest are subelytral ectoparasites [11]. Species of Eutarsopolipus are versatile in morphology and are currently grouped into ten species groups [42]. Most of the species are specific to a single host species. However, a few parasitize more than one host species [41] or more rarely more than one genus [26], yet the possibility of them being cryptic species remains untested. More interestingly, in some cases more than one species can parasitize one host species [42] and sometimes they are specialized to different microhabitats such as the elytral cavity, on hindwings or on the dorsal abdomen of their host [39].

Australia is anticipated to harbour rich Eutarsopolipus fauna given its large diversity of carabid beetles [5]. This is inferred from small sampling efforts that have recently been conducted in some regions, and yet that discovered a considerable number of new species [31, 41–44]. Here, we describe three new species of Eutarsopolipus belonging to different species groups (leyei, myzus, pterostichii) from three native Australian carabid beetles, raising the total number of Australian Eutarsopolipus to 30 species. All these species were recovered following a minimal sampling effort at one site, again corroborating the hypothesis that Australia is home to diverse podapolipid fauna awaiting discovery.

Materials and methods

Carabid host beetles were collected at night on the ground, near an outdoor LED solar light lamp in Richmond, New South Wales, in February 2020. The subelytral area of the beetle (preserved in 75–80% ethanol) was subsequently examined for mite infestation. Mite specimens were cleared in a mixture of Neshitt’s fluid and a small amount of glycercine slide mounted in Hoyer’s medium. Mite morphology was studied using a light microscope (Olympus BX51) equipped with phase contrast illumination. Mites from Queensland specimens of the carabid host Gnathaphanus pulcher were removed from dried beetles as described in Seeman [42] and examined using a Nikon 80i microscope equipped with differential interference contrast. All measurements are given in micrometres for holotypes and the range of measurements for five selected paratypes (in parentheses), if available. Distances between setae were measured from the base of one seta to the other; setae with their acetabulum remnant only were categorised as vestigial setae and those with their setae not extending past the acetabulum as microsetae (m). Terminology and setal notation were adapted from Lindquist [32]. The species group assignment follows that of Seeman [42]. Host beetles were all identified with the help of Geoff Monteith.

Abbreviations

| Abbreviation | Description |
|--------------|-------------|
| ap           | apodem      |
| appr         | prosternal apodeme |
| apsej        | sejugal apodeme |
| QM           | Queensland Museum, QLD, Australia |
| ANIC         | Australian National Insect Collection; Canberra, ACT, Australia |
| AC-DE-TMU    | The Acarological Collection, Department of Entomology, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran |

Results

Family Podapolipidae Ewing, 1922
Genus Eutarsopolipus Berlese, 1913

Type species: Tarsopolipus lagenaformis Berlese, 1911, by original designation.

Species group: pterostichii – Key characters of the group based on adult female: stigma and tracheae absent; genua II–III without setae [42].

Eutarsopolipus paryvae Katlav & Hajiqanbar n. sp. (Figs. 1–3)

urn:lsid:zoobank.org:act:36B8618D-FA09-474C-B4C3-2613DD962A5B

Type material: Total material recovered: ♀ (n = 4), ♂ (n = 15), larval ♀ (n = 4), ex. under elytra, on the base of membranous hind wing of one specimen of Geoscaptus
Figure 1. *Eutarsopolipus paryavae* n. sp. (adult female). (a) Body dorsum; (b) body venter; (c) right leg I; (d) ventral view of tarsus I; (e) right leg II; (f) right leg III. All legs in dorsal view.
Figure 2. *Eutarsopolipus paryavae* n. sp. (male). (a) Body dorsum; (b) body venter; (c) right leg I; (d) right leg II; (e) right leg III. All legs in dorsal view.
laevissimus Chaudoir, 1855 (Coleoptera: Carabidae: Scaritinae).

Holotype: adult female (ANIC 52-003953), ex. under elytra, on the base of membranous hind wing of G. laevissimus; Coll. Shams Paryav; 11 Feb 2020. Paratypes: adult female \((n = 3)\), male \((n = 5)\) and larval female \((n = 4)\), same data as holotype.

Figure 3. Eutarsopolipus paryvaev sp. (larval female). (a) Body dorsum; (b) body venter; (c) right leg I; (d) right leg II; (e) right leg III. All legs in dorsal view.
Type locality: Loc. Vines Drive, Hawkesbury Campus, Western Sydney University, Richmond, NSW, 33°36'45.6" S 150°44'40.2" E.

Deposition of type material: The holotype, one adult female, 2 male and 2 larval female paratypes are deposited at ANIC (ANIC 52-003953-58). 1 adult female, 2 males and 1 larval female paratypes are deposited at QM (QMS 117000-04). The remaining paratypes (TMU SP-20200211, 1–3), 10 non-type males and the host beetle specimen are deposited at AC-DE-TMU.

Etymology: The new species is named after the first author’s mother, Shams Paryav, the collector of the host beetle samples, in gratitude of her immense engagement in material collections.

Authorship: Note that the authors of the new taxon are different from the authors of this paper; Article 50.1 and Recommendation 50A of International Code of Zoological Nomenclature [24].

Description

Adult female (Fig. 1) (n = 4)

Gnathosoma (Figs. 1a–1b). Length 68 (72–86), width 58 (60–68); cheliceral styles length 66 (63–68); pharynx length 14 (15–18), pharynx width 13 (13–14); ch 19 (21–26), su 3 (4–5); distance between setae ch–ch 34 (40–42), su–su 17 (19–22).

Idiosoma (Figs. 1a–1b). Length 300 (390–475), width 250 (295–335).

Idiosomal dorsum (Fig. 1a). All dorsal setae needle-like except attenuating setae sc2; procursoral plate (PrS) with setae v1 5 (4–5), v2 vestigial, sc1 8 (7–8), sc2 36 (35–38). Plate C setae c1 8 (9–10), c2 9 (9–11). Plate D setae d 9 (8–9); cupuli ia anterior-lateral setae d. Plate EF setae f 7 (7–8); cupuli im anterior-lateral setae f. Plate H not evident; setae h 12 (9–11).

Distances between setae: v1–v1 30 (31–35), v2–v2 61 (62–69), v1–v2 19 (21–25), sc1–sc1 74 (76–87), v1–sc1 27 (27–31), sc2–sc2 103 (113–125), sc1–sc2 49 (51–56), c1–c1 85 (91–99), c1–c2 49 (58–63), d–d 101 (104–107), f–f 67 (70–74), h1–h1 11 (14–18).

Idiosomal venter (Fig. 1b). All coxal plates smooth; all coxal setae tiny needle-like; ap1–2 well developed; both reaching to appr; coxisternal field I with setae ia 3 (3–4) and coxisternal field II with 2a 4 (3–4); alveoli of setae 1b and 2b not evident; coxisternal field III with setae 3a 7 (7–8) slightly longer than 3b 5 (5–6). Distances between setae: 1a–1a 25 (26–35), 2a–2a 30 (31–45), 3a–3b 21 (23–28).

Legs (Figs. 1c–1e). Setal formula for legs I–III (femur-tarsus): 2-0-5+(+o-7+(+o), 0-0-4-6, 0-0-4-5. Ambulacrum I with well-developed claw, ambulacrum II–III each with a pair of tiny claws. Leg I (Fig. 1c): femur, d microseta, slightly thickened, seta l 2–2 thickened; tibia, q 4–5 clubbed, d 24–26, t 3, t 1–2, v 2–3, v 3–4, seta k absent; tarsus, o 2 tiny, cone-shaped; euphalic setae te 10–12 and tc 11–12 distinctly blunt-ended, setae pf 3–4 and ph 3–4 slightly blunt-ended, pv 2′, pv 2, pv 2, pv 2, seta s 4–5 blunt spur-like, u 1′–2, seta p not evident. Leg II (Fig. 2d): tibia, d 5–7, t 3–5, v 3–4, v 3–2; tarsus, te 4–5, slightly blunt-ended; setae u 5–6 and te 5–6 blunt spur-like, pv 19–20, ph 2′–3′, u 1′–2. Leg III (Fig. 2e): tibia, d 5–6, t 3, v 3, v 3, v 3–3; tarsus, tc 3–4 slightly blunt-ended, setae u 6–7 and te 5–6 blunt spur-like, pv 18–20, ph 3.

Larval female (Fig. 3) (n = 4)

Gnathosoma (Figs. 1a–1b). Length 35–39, width 41–42; cheliceral styles length 30–33; pharynx length 10–12, pharynx width 9–11; ch 21–24, su 3–4; distance between setae ch–ch 35–38, su–su 16–17.

Idiosoma (Figs. 3a–3b). Length 220–235, width 135–175.

Idiosomal dorsum (Fig. 3a). All dorsal setae pointed; PrS with setae v1 3–4, v2 vestigial, sc1 6–7, sc2 65–75. Plate C setae c1 6–9, c2 7–9. Plate D setae d 6–8; cupuli ia anterior-lateral setae d. Plate EF setae f 7–8; cupuli im anterior to setae f. Plate H situated ventrally with setae h1 130–140, h2 29–32. Distances between setae: v1–v1 13–16, v2–v2 39–40, v1–v2 20–23, sc1–sc1 51–53, v1–sc1 26–27, sc2–sc2 53–55, sc1–sc2 40–41, c1–c1 49–53, c1–c2 29–32, d–d 28–29, f–f 28–31.
**Idiosomal venter (Fig. 3b).** All coxal plates smooth; all coxal setae tiny needle-like; ap1 and apsej well developed, both fusing to appr; ap2 not reaching to appr; coxisternal field I with setae 1a 2–3, alveoli 1b not evident; coxisternal field II with 2a 2–3, alveoli 1b not evident; coxisternal field III with setae 3a 5–6 and 3b 5–6 subequal. Distances between setae: 1a–1a 17–22, 2a–2a 24–28, 3a–3b 24–27.

**Legs (Figs. 3c–3e).** Setal formula for legs I–III (femur-tarsus): 2–0–5+(e)–8+(a)=0, 0–0–4, 0–0–4.5. Ambulacrum I with well-developed bifid claw with blunt tips, ambulacrum II–III each with a pair of barely discernible claws. Leg I (Fig. 3c): femur, d microseta, slightly thickened, seta f 2–3 slightly thickened; tibia, φ 5–5 baculiform, d 27–30, setae f 4 and f 2–3 slightly blunt-ended, v 2–3, v 4–5, seta k absent; tarsus, o 2–2 cone-shaped with blunt tip, eupathidial setae tc 10–12 and tc 9 distinctly blunt-ended, pl 3–4, pl 4–5, setae pv 2–2 and pv 2–3 slightly thickened, seta s 5 blunt spur-like, u 2, seta not evident. Leg II (Fig. 2g): tibia, d 10–12, l 4–5, l 4–5, v 4–5, v 3–4; tarsus, tc 5–5, setae u 5–7 and tc 5–7 blunt spur-like, pl 20–23, pv 2–3, u 2. Leg III (Fig. 3e): tibia, d 9–10, l 5–6, v 5, v 2–3; tarsus, tc 4–5, setae u 6–7 and tc 5–6 blunt spur-like, pl 20–23, pv 2–3.

**Differential diagnosis**

Within the pterostichici species group, the new species is most similar to E. fischeri Husband, 1998 and E. teteri Husband & Husband, 2009 in having ambulacra I and II with a pair of claws each and ambulacrum I with one claw and femur I with two setae. However, it differs from both species in having cheliceral styles longer than 60 (vs. shorter than 40 in both species), setae h9 9–12 (absent in E. teteri and microseta in E. fischeri) and seta k on tibia I absent (seta k on tibia I present in both species). The setal counts alone mask further differences. In E. parvaeae and E. fisheri, the setae on I are the tiny setae d and l’, but in E. teteri seta l’ is absent and v’ is present. Another important difference is the absence of a solenidion on tarsus II, which is present in E. teteri and probably present in E. fischeri (present in male and larva, absent or obscured in females). All the important characters among these three species are compared for all life stages in Table 1 and a key to the world species of the pterostichici group of Eutarsopolipus (based on adult females) is presented in Figure 4.

Species group: leyel – Key characters of the group based on adult females: stigmata and tracheae present; ambulacral claws II–III present; genu II–III with setae [42].

**Eutarsopolipus pulcher** Hajiqanbar & Seeman n. sp. (Figs. 5–8)

[URL not provided for the rest of the text]

**Type material.** Total material recovered: adult female (n = 12), male (n = 6), larval female (n = 13), ex. under elytra, on the base of membranous hind wing of specimens of Gnathaphanus pulcher (Dejean, 1829) (Coleoptera: Carabidae: Harpalinae). Four out of ca. 160 examined host specimens found parasitized (4% prevalence). Samples were collected at four independent events on 14 Feb 2020, 26 Feb 2020, 30 Feb 2020 and 3 March 2020. Holotype: adult female (ANIC 52-003959), ex. under elytra, on the base of membranous hind wing of G. pulcher; Coll. Shams Parvay; 14 Feb 2020. Paratypes: adult female (n = 5), male (n = 5), larval female (n = 5), same data as holotype.

**Type locality:** Loc. Vines Drive, Hawkesbury Campus, Western Sydney University, Richmond, NSW, 33°36’45.6” S 150°44’40.2” E.

**Deposition of types:** The holotype, one adult female, 2 male and 2 larval female paratypes are deposited at ANIC (ANIC 52-003959-54). 2 adult female, 2 males and 1 larval female paratypes are deposited at QM (QMS 117005-10). The remaining paratypes (TMU SP-20200214, 1–3) and the host beetle specimen are deposited at AC-DE-TMU.

**Other material examined:** adult female (n = 21), male (n = 4), larval female (n = 3), ex. under elytra, on the base of membranous hind wing of G. pulcher (host registration number T137238), Loc. “Feez Creek” property entrance, QLD, 21°51’40” S 148°14’19” E; Coll. S. Wright & C. Burwell; 9 Mar 2005 (QMS 117011-38). Adult female (n = 1), larval female (n = 2), same data except different beetle (host registration number T137239) (QMS 117039-41).

**Etymology:** The new species name “pulcher” is adopted after the species name of the carabid host beetle G. pulcher meaning “beautiful” in Latin that is associated with the beautiful metallic colouration patterns of elytra in this beetle. Furthermore, this epithet has a proper relevance to the beautiful trifurcate setae u’ on tarsii II–III in adult females of the new mite species.

**Authorship:** Note that the authors of the new taxon are different from the authors of this paper; Article 50.1 and Recommendation 50A of International Code of Zoological Nomenclature [24].

**Description**

**Adult female (Fig. 5) (n = 6)**

**Gnathosoma (Figs. 5a–5b).** Length 45 (42–50), width 40 (34–41); cheliceral styles length 51 (44–48); pharynx length 18 (16–18), pharynx width 14 (13–16); ch 18 (19–25), su 13 (12–14); distance between setae ch–ch 24 (23–26), su–su 14 (14–16).

**Idiosoma (Figs. 5a–5b).** Length 350 (270–415), width 215 (180–290).

**Idiosomal dorsum (Fig. 5a).** All dorsal setae pointed; prodorsal plate (PrS) with setae v1 13 (11–14), v2 vestigial, sc1 11 (9–13), sc2 57 (51–60). Plate C setae c1 6 (4–6), c2 6 (4–6). Plate D setae d 5 (4–5); cupuli iu evident, anterolateral setae d. Plate EF setae f5 4–5; cupuli im evident, anterolateral setae f. Plate H and setae h1 not evident. Distances between setae: v1–v1 46 (46–49), v2–v2 51 (49–59), v1–v2 34 (32–34), sc1–sc1 76 (74–80), v1–sc1 27 (27–29), sc2–sc2 93 (88–99), sc1–sc2 70 (68–71), c1–c1 81 (75–92), c1–c2 54 (49–54), d–d 113 (102–112), f–f 83 (73–93).

**Idiosomal venter (Fig. 5b).** All coxal plates smooth; all coxisternal setae tiny needle-like; ap1–2 and apsej well developed, reaching to appr; coxisternal field I with setae 1a 5 (5–6); alveoli of vestigial setae 1b evident; coxisternal field II with 2a 5 (5–7); alveoli of vestigial setae 2b evident;
Table 1. Comparison of selected characters (range of measurements if available) of *E. paryavae* n. sp. (*Ep*) with two closely related species of the pterostichi species group: *E. fischeri* (*Ef*) and *E. teteri* (*Et*). Dashes (−) denote absence of the character. Characters for which the data are obscured/not available in the original descriptions are given as question marks (?). Letters v and m indicate vestigial and mirosetae, respectively. Abbreviations: L. (length), S. (stylet), Gn. (gnathosoma), Gen. cap. (genital capsule), Ch. (chelicera), Sol. (solenidion), Ta (tarsus), Ti (tibia), Fe (femur).

| Life stage                | Female | Male | Larval female |
|---------------------------|--------|------|---------------|
| Character                 | *Ep*   | *Ef* | *Et*          |
| Gn. L.                    | 68–86  | 45–48| 45            |
| Ch. S. L.                 | 63–68  | 33–34| 38            |
| Setae ch                  | 19–26  | 17–19| 15            |
| Setae su                  | 3–5    | 5–6  | 14            |
| Setae v1                  | 4–5    | 5–6  | 10            |
| Setae s1                  | 7–8    | 6–7  | 9             |
| Setae sc1                 | 35–38  | 32–42| 59            |
| Setae sc2                 | 35–38  | 32–42| 59            |
| Setae c1                  | 8–10   | 3–5  | 5             |
| Setae c2                  | 9–11   | 5–6  | 7             |
| Setae d                   | 8–9    | 3–5  | 7             |
| Setae f                   | 7–8    | 5    | 5             |
| Setae h1                  | 12–16  | m    | –             |
| Gen. cap. L.              | –      | –    | 31–34         |
| Gen. cap. W.              | –      | –    | 25–30         |
| Sol. Ta I ϕ               | 3–4    | 3    | 5             |
| Sol. Ti I ϕ               | 5–7    | 7–10 | 7             |
| Sol. Ta II ϕ              | ?      | 5    | –             |
| Fe I seta v               | –      | 15   | –             |
| Fe I seta h               | m–1    | ~3–4 | –             |
| Ta III seta pl            | 20–24  | 15–17| 15            |

**Figure 4.** Key to the world species of *Eutarsopolipus* in the *pterostichi* group (based on adult females).
Figure 5. *Eutarsopolipus pulcher* n. sp. (adult female). (a) Body dorsum; (b) body venter; (c) right leg I; (d) ventral view of tarsus I; (e) right leg II; (f) right leg III. All legs in dorsal view.
coxisternal field III with setae 3a 4 (4–5) and 3b 6 (5–6). Distances between setae: 1a–1a 31 (29–35), 2a–2a 34 (36–42), 3a–3b 26 (22–27).

Legs (Figs. 5c–5e, 6). Setal formula for legs I–III (femur-tarsus): 3–2–6(+)–8(+)–8(+)–8(+)–0, 0–4–6(+)–0, 0–1–4–6. Ambulacrum I with sickle-shaped claw, ambulacrum II–III each with a pair of well-developed claws. Leg I (Fig. 5c): femur, d microseta, seta ℓ 15 (14–16) pointed and thickened, subequal to v′ 15 (12–15); genu with tiny setae ℓ 2 (2–2) and ℓ 1 (1–2); tibia with φ 8 (7–9) baculiform, d 29 (25–29), ℓ 11 (9–11), ℓ 9 (7–9), v′ 5 (5–6) stiff, v″ 14 (13–16), seta k 8 (8–10); tarsus I, φ 4 (4–5) digitiform, eupathidial setae tc′ 14 (12–15) and tc″ 15 (13–15) distinctly blunt-ended, pℓ 11 (11–13), pℓ″ 15 (13–17), setae pv′ 3 (3–3) and pv″ 2 (2–3) subequal, seta s 6 (6–7) modified and thickened, pℓ 2 (2) slightly thickened. Leg II. (Fig. 5d): genu, ℓ 2 (2); tibia, d 17 (15–17), ℓ 9 (7–9), v′ 14 (12–14), v″ 15 (13–19); tarsus II, φ 4 (3–4) digitiform, tc′ 5 (5–7), setae u′ 8 (7–8) spine-like and trifurcate, tc″ 6 (6–7) blunt spur-like, pℓ″ 13 (12–13), pv″ 2 (2–2), u″ 2 (2). Leg III (Figs. 5e, 6): genu, ℓ 2 (2–2); tibia, d 17 (15–18), ℓ 9 (7–9), v′ 14 (13–14), v″ 17 (15–18); tarsus III, tc′ 5 (5–7), setae u′ 8 (7–8) spine-like and trifurcate (Fig. 6), tc″ 6 (5–6) blunt spur-like (Fig. 5f), pℓ″ 14 (12–14), pv″ 2 (2–2), u″ 14 (12–14).

Male (Fig. 7) (n = 5)

Gnathosoma (Figs. 7a–7b). Length 25–36, width 23–27; cheliceral styles length 17–19; pharynx length 9–10, pharynx width 6–8; ch 8–12; su 9–10; distance between setae ch–ch 17–20, su–su 12–13.

Idiosoma (Figs. 7a–7b). Length 140–160, width 105–115.

Idiosomal dorsum (Fig. 7a). All setae on dorsum microsetae (except sc2); PrS with setae v1 vestigial, setae sc2 34–46 attenuate and pointed. Plate CD with cupuli ia anterior to setae d. Plate EF setae with cupuli im anterolateral setae f. Genital capsule length 23–30, width 28–33, situated posterior to margin of EF, setae h1 barely visible on genital capsule. Distances between setae: v1–v1 18–19, v2–v2 30–33, v1–v2 19–19, sc1–sc1 44–47, v1–sc1 17–18, sc2–sc2 42–45, sc1–sc2 26–28, c1–c1 39–43, c1–c2 25–29, d–d 29–34, f–f 19–21.

Idiosomal venter (Fig. 7b). All coxal plates smooth; all ventral setae on coxal area microsetae; ap–pl 2 well developed, fused with appr, apsez weekly developed, not reaching appr; alveoli of setae 1b on coxisternal field I evident; on coxisternal field II alveoli of setae 2b evident. Distances between setae: 1a–1a 17–19, 2a–2a 22–24, 3a–3b 18–20.

Legs (Figs. 7c–7e). Setal formula for legs I–III (femur-tarsus): 2–2–6(+)–8(+)–8(+)–8(+)–0, 0–1–4–6(+)–0, 0–1–4–6. Ambulacrum I with a small claw, ambulacrum II–III each with a pair of small claws. Leg I (Fig. 7c): femur, setae d and ℓ microsetae; genu, setae ℓ and ℓ microsetae; tibia, φ 6–8 baculiform, d 21–25, ℓ and ℓ microsetae, v′ 1, v″ 12–14, seta k 3–5; tarsus, φ 4–5 digitiform; eupathidial setae tc′ 8–10 and tc″ 10–11 distinctly blunt-ended, setae pℓ″ 8–9 and pℓ″ 10–12, seta pv′ 1–1 stiff and blunt-ended, pv″ 2–2, seta s 4–5 blunt spur-like, pℓ 1–1.

Leg II. (Fig. 7d): genu, ℓ 1; tibia, ℓ 2, d 13–15, v′ 11–14, v″ 11–14; tarsus, φ 4–5 thickened and digitiform, setae tc′ 4–5, slightly blunt-ended, u′ 4–6 spine-like and bifurcate, tc″ 4–5 blunt spur-like, pℓ″ 9–11, pv′ 2, pv″ 2, u″ 1. Leg III (Fig. 7e): genu, ℓ 1; tibia, d 10–13, ℓ 1, v′ 1, v″ 12–14; tarsus, tc′ 5–7 stiff and slightly blunt-ended, setae u′ 5–6 spine-like and bifurcate, tc″ 4–5 blunt spur-like, pℓ″ 9–10, pv′ 1, u″ 1.

Larval female (Fig. 8) (n = 5)

Gnathosoma (Figs. 8a–8b). Length 29–32, width 24–29; cheliceral styles length 28–34; pharynx length 10–13, pharynx width 7–9; ch 20–25; su 10–12; distance between setae ch–ch 15–18, su–su 10–11.

Idiosoma (Figs. 8a–8b). Length 125–145, width 95–110.

Idiosomal dorsum (Fig. 8a). All dorsal setae needle-like except sc2 which is long and attenuate; PrS with setae v1 11–13, v2 vestigial, sc1 10–12, sc2 62–72. Plate C setae c1 7–8, c2 5–7. Plate D setae d 6–7; cupuli ia anterolateral setae d. Plate EF setae f 7–9; cupuli im anterior to setae f. Plate H not evident; setae h1 64–66, h2 m–2. Distances between setae: v1–v1 25–28, v2–v2 35–37, v1–v2 22–25, sc1–sc1 56–60, v1–sc1 23–26, sc2–sc2 44–48, sc1–sc2 30–32, c1–c1 25–28, c1–c2 31–34, d–d 22–25, f–f 25–30.

Idiosomal venter (Fig. 8b). All coxal plates smooth; all coxal setae tiny needle-like; ap–pl 2 well developed, both fusing to appr; apsez not evident; coxisternal field I with setae 1a 5–7; alveoli of setae 1b on coxisternal field I evident; coxisternal field II with 2a 4–6; alveoli of setae 2b evident; coxisternal field III with setae 3a 5–6 and 3b 5 subequal. Distances between setae: 1a–1a 17–21, 2a–2a 16–22, 3a–3b 17–19.

Legs (Figs. 8c–8e). Setal formula for legs I–III (femur-tarsus): 3–2–6(+)–8(+)–8(+)–8(+)–0, 0–1–4–5(+)–0, 0–1–4–5. Ambulacrum I
Figure 7. *Eutarsopolipus pulcher* n. sp. (male). (a) Body dorsum; (b) body venter; (c) right leg I; (d) right leg II; (e) right leg III. All legs in dorsal view.
with a small bilid claw, ambulacrum II–III each with a pair of small claws. Leg I (Fig. 8c): femur, $d$ microseta, seta $l'$ 2 slightly thickened, $v''$ 10–11; genu, $l'$ 2, $l''$ 1–1; tibia, $\varphi$ 7–8 baculiform and bent, $d$ 28–30, setae $l'$ 8–9 and $l''$ 9–12, $v'$ 4–5, $v''$ 10–12, seta $k$ 3–4; tarsus, $\omega$ 4–5 digitiform, eupathidial setae $tc'$ 8–9 and $tc''$ 9–10 distinctly blunt-ended, $pl'$ 9–10,

Figure 8. Eutarsopolipus pulcher n. sp. (larval female). (a) Body dorsum; (b) body venter; (c) right leg I; (d) right leg II; (e) right leg III. All legs in dorsal view.
Deposition of material: The holotype, one adult female and 2 larval female paratypes are deposited at ANIC (ANIC 52-003965-68). 1 adult female and 2 larval female paratypes are deposited at QM (QMS 117009-10, 117042). The remaining paratypes (TMU SP-202000224, 1–3), 11 non-type larval females and the host beetle specimen are deposited at AC-DE-TMU.

Etymology: The species epithet “chlaenii” refers to the generic name of the carabid host beetle *Chlaenius flaviguttatus*.

Authorship: Note that the authors of the new taxon are different from the authors of this paper; Article 50.1 and Recommendation 50A of International Code of Zoological Nomenclature [24].

### Adult female (Fig. 10) (n = 4)

*Gnathosoma* (Figs. 10a–10b). Length 45 (43–45), width 42 (40–42); cheliceral styles length 28 (29–30); pharynx length 12 (12–13); pharynx width 12 (12–13); ch 15 (15–16), pointed; su 6 (5–6), needle-like; distance between setae *ch–ch* 27 (27–29), *su–su* 17 (16–17).

*Idiosoma* (Figs. 10a–10b). Length 230 (225–240), width 185 (165–185).

*Idiosomal dorsum* (Fig. 10a). Respiratory system (stigmata and tracheae) present, stigmata stalked; all dorsal setae pointed; prodorsal plate (PrS) with setae *v1* 6 (5–6), *v2* 5–6, *v3* 5–6, *v4* 5–6; Plate C setae *c1* 7 (6–7), *c2* 5 (6–6). Plate D setae *d1* 5 (5–6); cupuli *ia* evident, anterolateral setae *d* setae *Pr* 7 (6–7). Cupuli im evident, anterolateral setae *f*. Plate H not evident, setae *h* 7 (7–8). Distances between setae: *v1–v1* 35 (34–37), *v2–v2* 42 (41–44), *v1–v2* 13 (13–14), *c1–c1* 61 (57–60), *v1–c1* 18 (18–19), *c2–c2* 62 (58–61), *c1–c2* 39 (38–40), *c1–c1* 61 (57–64), *c1–c2* 48 (42–46), *d–d* 59 (57–58), *f–f* 37 (33–36).

*Idiosomal venter* (Fig. 10b). All coxal plates smooth; all coxal setae pointed; ap–1 and appr well developed, ap2 reaching to appr; apsej absent; coxisternal field I with setae *la* 3 (2–2); alveoli of vestigal setae *lb* not evident; coxisternal field II with 2 *a* 2 (2–2); alveoli of vestigial setae *h* evident; coxisternal field III with subequal setae *ca* 7 (7–8) and *cb* 7 (8–8). Distances between setae: *la–la* 19 (20–22), *la–la* 27 (25–26), 3a–3b 19 (24–26).

Legs (Figs. 10c–10e). Setal formula for legs I–III (femur-tarsus): 2-0-6+(+)+0–8+(+), 0-0-4-6+(+), 0-0-4-6. Ambulacrum I with a well-developed sickle-shaped claw, ambulacrum II–III each with a pair of well-developed claws. Leg I (Fig. 10f): femur, *d* 3 (2–2), slightly thickened, seta *l* 16 (15–16) thick and blunt-ended; tibia with *f3* 5–5, *v* 45, length 32 (29–31), length 4 (4–5), length 5 (3–3), length 9 (8–9), seta *k* 5 (5–6); tarsus I, *o* 3 (3–4) digitiform, eupathidial setae *tv* 9 (9–8) and *tv* 10 (9–10) distinctly blunt-ended, *pf* 9 (8–9), setae *tv* 2 (2–3), *tv* 3 (2–2) and *pv* 2 (2–2) subequal, seta *t* 5 (5–5) spine-like, with a blunt tip, *p* 1 (1–2). Leg II (Fig. 10d): tibia, *d* 7 (8–8), *l* 7 (6–7), *v* 11 (10–11), *v* 6 (6–6); tarsus, *o* 4 (3–4) digitiform, *tv* 7 (7–6), setae *tv* 6 (6–6) and *tv* 5 (5–6) spine-like, *pl* 17 (17–18), *pv* 3 (3–3), *tv* 2 (2–2), Leg III (Fig. 10e); tibia, setae *d* 7 (7–8), *l* 6 (6–7), *v* 11 (10–12), *v* 6 (6–6); tarsus, *tc* 10 (10–10), setae *tv* 6 (6–7) and *tv* 5 (5–6) spine-like, *pl* 16 (15–16), *pv* 3 (3–3), *tv* 2 (2–2).

**Eutarsopolis chlaenii** Katlav & Hajiqanbar n. sp. (Figs. 10–11)

urn:lsid:zoobank.org:act:25276820-D40C-4F2F-AAA2-E68575A38719

Type material: *Total material recovered*: ♀ (n = 4), larval ♀ (n = 16), ex. under elytra, on the base of membranous hind wing of specimens of *Chlaenius flaviguttatus* Macleay, 1825 (Coleoptera: Carabidae: Harpalinae: Chlaenini) (Fig. 13). Three out of four collected host specimens found parasitised. Beetle specimens were collected at three independent events on 24 Feb 2020, 26 Feb 2020, and 28 Feb 2020. Holotype: adult female (ANIC 52-003965), ex. under elytra, on the base of membranous hind wing of *C. flaviguttatus*; Coll. Shams Paryav; 24 Feb 2020. Paratypes: adult female (n = 3), larval female (n = 5), same data as holotype (24 Feb 2020, 26 Feb 2020, and 28 Feb 2020). Location: Loc. Vines Drive, Hawkesbury Campus, Western Sydney University, Richmond, NSW, 33°36′45.6″ S 150°44′40.2″ E.

**Eutarsopolis** ^ E48575A38719

p^f^ 12–14, setae *pv*^f^ 1–1 and *pv*^f^ 2–2, *su* 3–5 blunt spur-like, *p*^f^ 2. *Leg II.* (Fig. 8d): genu, *l* 2; tibia, *d* 13–18, *l* 10–11, *v* 10–13, *v* 13–15; *tv* 3–4, *tv* 5 and *tv* 4–5 blunt spur-like, *pv*^f^ 9–11, *pv*^f^ 2, *u*^f^ not evident. *Leg III* (Fig. 8e): genu, *l* 2; tibia, *d* 14–15, *l* 8–12, *v* 7–11, *v* 11–12; *tv* 6–7, setae *u*^f^ 5–6 and *tv*^f^ 5–6 blunt spur-like, *pf* 10–11, *pv*^f^ 2, *u*^f^ not evident.

Differential diagnosis

This new species is unique in *Eutarsopolis* by having trifurcate setae *d* on tarsi II–III. However, among species with simple claws on legs I (unlike *E. bicinctus* Seeman, 2021 and *E. janus* Seeman, 2021 with bifurcate claws on legs I), it is most similar to *E. leytei* Husband & Raros, 1989 with femur I seta *f* short, not reaching genual base in adult females; but it is readily distinguishable from this species by longer setae *v1* 11–14 (m–5 in *E. leytei*) and shorter cheliceral styles being at most 51 in *E. pulcher* n. sp. vs. 68 in *E. leytei*.

The new species further differs from *E. dasycthe* with setae *v1* longer than *ch* and setae *c1, c2, d* and *f* shorter than 8 in adult females (vs. setae *v1* shorter than *ch* and setae *c1, c2, d* and *f* longer than 15 in adult females of *E. dasycthe*). The male of *E. pulcher* n. sp. resembles that of *E. orpheus* with all ventral and dorsal setae (except *sc2*) being microsetae, but it differs from *E. orpheus* with setae *v1* longer than 8 (*ch* microsetae in male of *E. orpheus*). The larval female of *E. pulcher* n. sp. is similar to *E. orpheus* with *h1* shorter than 70 and *h2* shorter than 2, but it is readily distinguishable from *E. pulcher* n. sp. by shorter setae *sc1*, *sc2*, *c1*, *c2*, *d*, 3a and 3b (Table 2). All the important characters among the species of *leytei* group are compared for all life stages (excluding *E. leytei* with unknown male) in Table 2 and keys to the world species (based on adult females) are presented in Figure 9.

Species group: *myzus* – Key characters of the group based on adult females: stigmata and tracheae present; ambulacral claws II–III present; genu I–III without setae; femur I with two setae [42].
Table 2. Comparison of selected characters (range of measurements if available) of all the described species of the *leytei* species group in the genus *Eutarsopolipus* (male is unknown for *E. leYTEI*); species abbreviated as *E. pulcher* n. sp. (*Ep*), *E. leYTEI* (*El*), *E. dasychi* (*Ed*), *E. orpheus* (*Eo*), *E. biuncatus* (*Eb*), and *E. junus* (*Ej*).

| Life stage | Female | Male | Larval female |
|------------|--------|------|---------------|
|            | *Ep*   | *El* | *Ed* | *Eo* | *Eb* | *Ej* | *Ep* | *El* | *Ed* | *Eo* | *Eb* | *Ej* |
| Gn. L.     | 42–50  | 78   | 47–50 | 50–57 | 44–46 | 52–57 | 25–36 | 30–33 | 30–32 | 28–31 | 28–37 | 29–32 | 56   | 37–40 | 32–38 | 30–34 | 31–34 |
| Ch. S. L.  | 44–51  | 68   | 47–48 | 23–28 | 35–38 | 45–51 | 17–19 | 23–26 | 15   | 17–18 | 25–28 | 28–34 | 54   | 35–40 | 21–27 | 25–27 | 36–42 |
| Setae eh   | 18–25  | 20   | 27–30 | 10–18 | 14–22 | 25–35 | 8–12  | 12–15 | m    | 1–2  | 3–4  | 20–25 | 20   | 30–36 | 31–35 | 19–23 | 26–33 |
| Setae su   | 12–14  | 3    | 22   | 11–15 | 8–12  | 15–20 | 9–10  | 9–10 | 6–7  | 4–6  | 8–9  | 10–12 | 3    | 15–18 | 6–7   | 8–10  | 12–15 |
| Setae v1   | 11–14  | 5    | 36–45 | 17–26 | 8–10  | 19–24 | m     | 5–10 | m    | m–2 | 4–9  | 11–13 | m    | 42–50 | 26–32 | 12–14 | 15–18 |
| Setae sc1  | 9–13   | 11   | 25   | 17–29 | 7–9   | 9–11  | m     | 5–13 | m    | m   | m–2 | 10–12 | 10   | 25–28 | 28–33 | 5–6   | 8–10  |
| Setae sc2  | 51–60  | 62   | 58–70 | 47–59 | 15–20 | 36–40 | 34–46 | 60–70 | 38–40 | 2–3  | 27–34 | 62–72 | 78   | 94–101 | 90–95 | 51–52 | 70–80 |
| Setae c1   | 4–6    | 12   | 18–19 | 8–10  | 5–7   | 8–9   | m     | 10   | m    | m   | 2–3 | 7–8   | 10   | 18–22 | 14–18 | 5–6   | 7–10  |
| Setae c2   | 4–6    | 9    | 17–21 | 9–18  | 4–6   | 8–10  | m     | 5–7   | m   | m   | 2   | 5–7   | 9    | 17–21 | 10–15 | 3–4   | 7–10  |
| Setae d    | 4–5    | 12   | 18–21 | 11–18 | 4–5   | 9–10  | m     | 8–10  | m   | m   | m–2 | 6–7   | 9    | 20–23 | 15–17 | 4–5   | 7–9   |
| Setae f    | 5      | 8    | 22   | 10–11 | 4–5   | 7–9   | m     | 3–4   | m   | m   | m–2 | 7–9   | 8    | 16–18 | 8–12  | 4–5   | 6–8   |
| Setae h1   | –      | –    | –    | –     | –     | –     | –     | –    | m   | m   | m   | 64–67 | 148  | 65–90 | 55–64 | 65–70 | 100   |
| Setae h2   | –      | –    | –    | –     | –     | –     | –     | –    | m   | m   | m   | m–2 | 1–2   | 67   | 12  | 3–4   | 4–6   |
| Setae 1a   | 5–6    | –4   | 5–6  | 4–5   | 5–6   | 6–7   | m     | 2–5   | m   | 2–3 | 4–5 | 5–7   | 2    | 8–10  | 6–8   | 2–3   | 4–5   |
| Setae 2a   | 5–7    | –4   | 5    | 3–4   | 4–5   | 6–7   | m     | 3–4   | m   | 2–3 | 4–5 | 4–6   | 2    | 7–10  | 8–9   | 3–4   | 4–5   |
| Setae 3a   | 4–5    | 8    | 9    | 2–3   | 5–6   | 6–9   | m     | –2   | m   | 3   | 5–6 | 5–6   | 4    | 10–13 | 9–11  | 4–5   | 7–8   |
| Setae 3b   | 5–6    | 4    | 7    | 3     | 4–5   | 6–7   | m     | –4   | m   | 2–3 | 5–6 | 5    | 2    | 10–12 | 9–10  | 3–4   | 5–6   |
| Sol. Ta I  | 4–5    | –2   | 4–5  | 5–6   | 3–4   | 4–5   | 4–5   | 5–7   | 3   | 3–4 | 4–5 | 4–5   | 4–5   | 4–5   | 3–4   | 4–5   |
| Sol. Ti I  | 7–9    | 7    | 10   | 7–8   | 6–7   | 6–8   | 6–8   | 5–6   | 5–6 | 4–5 | 6–7 | 7–8   | 7    | 7–9   | 8–9   | 6–7   | 7–8   |
Adult females of *leytei* group

- Claws on legs single
- Femur I seta ′very short, not reaching to genual base
- Setae sc1 15–21

*E. bluncatus Seeman, 2021*

- Claws on legs bifurcate
- Femur I seta ′long, extending past genual base
- Setae sc2 36–40

*E. janus Seeman, 2021*

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**Male (Unknown)**

**Larval female (Fig. 11) (n = 5)**

*Gnathosoma* (Figures 11a–11b). Length 39–46, width 38–40; idioskeletal styles length 29–32; pharynx length 13–15, pharynx width 10–11; ch 17–19 pointed; su 3–4 needle-like; distance between setae ch–ch 22–26, su–su 12–14.

*Idiosoma* (Figs. 11a–11b). Length 165–195, width 125–145.

*Idiosomal dorsum* (Fig. 11a). All dorsal setae needle-like except sc1 attenuate; PrS with setae v1 6–7, v2 vestigial, sc1 6–7, sc2 95–98. Plate C setae c1 5–6, c2 5–6. Plate D setae d 6–7; cupuli ia anterolateral setae d. Plate EF setae f 7–8; cupuli im anterolateral setae f. Plate H situated ventrally with setae h1 97–101 and h2 22–24. Distances between setae: v1–v1 24–26, v2–v2 44–47, v1–v2 12–14, sc1–sc1 59–62, v1–sc1 20–22, sc2–sc2 57–58, sc1–sc2 40–42, c1–c1 83–86, c1–c2 21–23, d–d 34–36, f–f 28–29.

*Idiosomal venter* (Fig. 11b). All coxal plates smooth; all coxal setae tiny and pointed; ap1–2 and apsej evident; coxisternal fields I–II each divided from its pair, with setae 1a 1–1; alveoli of setae 1b not evident; coxisternal field II with 2a 2–3; alveoli of setae 2b not evident; coxisternal field III widened, with setae 3a 7–9 and 3b 7–8 subequal. Distances between setae: 1a–1a 22–34, 2a–2a 28–30, 3a–3b 21–22.

*Legs* (Figs. 11c–11e). Setal formula for legs I–III (femur-tarsus): 2–0–6(+φ)–7(+φ), 0–0–4–6(+φ), 0–0–4–6. Ambulacrum I with a small bilid claw, ambulacrum II–III each with a pair of tiny claws. *Leg I* (Fig. 11c): femur, d microseta, seta f 4–5 stiff; tibia, φ 3–4 baculiform, d 17–21, seta f 4–5 slightly thickened, ′f 2–3, ′v 3–4, seta ′v 4–5 slightly thickened and blunt-ended, seta k 2–3; tarsus, φ 3–4 digitiform, eupathidial setae tc 7–8 and tc′ 7–8 subequal, distinctly blunt-ended, pl′ 6–6, setae pv′ 1–2, pv′′ 2–3, seta s 4–5 blunt spur-like, pv′ 1–1; u″ not visible. *Leg II* (Fig. 11d): tibia, d 4–5, ′f 6–7, ′v 6–7, ′v 4–6; tarsus, φ 2–3 digitiform, tc 5–7, setae u′ 4–5 and tc″ 5–6 blunt spur-like, pl″ 10–12, pv″ 2–2, u″ 2–2. *Leg III* (Fig. 11e): tibia, d 5–6, ′f 6–7, ′v 6–8, ′v 3–5; tarsus, tc′ 6–7, setae u′ 5–6 and tc″ 6–7 blunt spur-like, pl″ 10–13, pv″ 3–4, u″ 1–1.

**Differential diagnosis**

The new species belongs to a subgroup of the *myzus* species group that shares a combination of the following characters in adult females: ambulacrum I claw well-developed, idiosoma without lateral bulges or posteriorly without wrinkled lobes, shield C not divided, femur I seta almost developed (not microseta), and coxisternal styles less than 35 μm long [13]. This assemblage includes *E. chlaenii* n. sp. and four other species: *E. steveni* Khustov, 2010, *E. anichtchenkoi* Hajian & Mortazavi, 2012, *E. gombrooni* Hajian & Mortazavi, 2019, and *E. oconnori* Hajian & Mortazavi, 2019. Among these species, *E. chlaenii* n. sp. is more similar to *E. anichtchenkoi* and *E. oconnori* by having setae h and f subequal. However, it is readily distinguishable from *E. anichtchenkoi* by having developed setae v1, sc1, 1a and 2a (adult female with microsetae v1, sc1, 1a and 2a in *E. anichtchenkoi*), sc2 almost five times longer than h1 (adult female with sc2 at least nine times longer than h1 in *E. anichtchenkoi*) and tarsus III with six setae (tarsus III with seven setae in *E. anichtchenkoi*). *Eutarsopolipus chlaenii* n. sp. also differs from *E. oconnori* by having shorter distances c1–c1, d–d, f–f in the adult female (64, 59, 37 vs. 101, 113, 86, respectively, in *E. oconnori*) and longer setae su and h1 and coxisternal styles in larval females (101, 4, 32, vs. 61, m, 26, respectively, in *E. oconnori*).
Figure 10. *Eutarsopolipus chlaenii* n. sp. (adult female). (a) Body dorsum; (b) body venter; (c) right leg I; (d) ventral view of tarsus I; (e) right leg II; (f) right leg III. All legs in dorsal view.
in *E. oconnori*). All the important characters among these five species of the *myzus* species group are compared for all life stages (excluding *E. chlaenii* n. sp. with unknown male) in Table 3. Among adult females of the *myzus* species group with a strong claw on ambulacrum I, lateral bulges or posterior wrinkled lobes and entire shield C, six species have short che-liceral stylets (less than 35 μm long). The key to this subgroup is presented in Figure 12.
Table 3. Comparison of selected characters (range of measurements if available) of five closely related species of the myzus species group in *Eutarsophilus* (male is unknown for *E. chaenii* n. sp.): *E. chaenii* n. sp. (*Ec*), *E. steveni* (*Es*), *E. anichchenkoi* (*Ea*), *E. gombrooni* (*Eg*), and *E. oconnori* (*Eo*).

| Life stage | Female | Male | Larval female |
|------------|--------|------|---------------|
| Character  | *Ec*   | *Es* | *Ea* | *Eg* | *Eo* | *Ec* | *Es* | *Ea* | *Eg* | *Eo* | *Ec* | *Es* | *Ea* | *Eg* | *Eo* |
| Gn. L.     | 43~45  | 31~34 | 47~50 | 43~50 | 50   | 21~22 | 26~29 | 24~26 | 25   | 39~46 | 22~24 | 30~35 | 23   | 26~36 |
| Ch. S. L.  | 28~30  | 28~31 | 30~35 | 29~32 | 34   | 14~15 | 12~13 | 13~16 | 13   | 29~32 | 19~20 | 17~19 | 18   | 16~26 |
| Setae *ch* | 15~16  | 17~19 | 12~13 | 14~16 | 14   | 6~7   | 8~10  | 4     | 5    | 17~19 | 15~17 | 12~13 | 14   | 11~14 |
| Setae *su* | 5~6    | 6~7   | 4~6   | 5~7   | 5    | 3~4   | 2~3   | 2     | m    | 3~4   | 7~8   | 2     | m    | 7    | m    |
| Setae *v1* | 5~6    | 5~6   | m     | 6~7   | 8    | 3~4   | m     | 3~4   | m    | 6~7   | 3~4   | 6~7   | 5    | 5~7   |
| Setae *c1* | 5~6    | 5~6   | m     | 8     | 8    | 3~4   | m     | 3~4   | m    | 6~7   | 3~4   | 5~6   | m    | 5~7   |
| Setae *c2* | 38~42  | 26~28 | 37~45 | 18~21 | 45   | 35~37 | 39~45 | 26~31 | 17   | 95~98 | 41~47 | 78~79 | 43   | 85~93 |
| Setae *f*  | 6~7    | 6~8   | 4~5   | 5~9   | 9    | 4~5   | m     | m~3   | m    | 5~6   | 4~5   | 7~9   | 5    | 6~7   |
| Setae *c1* | 5~6    | 6~7   | 4~5   | 5~8   | 9    | 4~5   | m     | 4~5   | m    | 5~6   | 4~5   | 6~4   | 4    | 6~7   |
| Setae *d*  | 5~6    | 6~7   | 4~5   | 5~7   | 8    | 4~5   | m     | m~4   | m    | 6~7   | 4~5   | 9     | 3    | 7     |
| Setae *f*  | 6~7    | 7~8   | 4~5   | 5~7   | 8    | 4~4   | m     | m~3   | m    | 7~8   | 6~7   | 9     | 6    | 5~8   |
| Setae *h1* | 7~8    | 24~26 | 3~4   | 13~16 | 9    | –     | –     | –     | –    | –     | 97~101 | 70~75 | 140~172 | 89 | 57~61 |
| Setae *h2* | –      | –     | –     | –     | –    | –     | –     | –     | –    | –     | 22~24 | 24~27 | 20~21 | 20 | 12~20 |
| Setae *l1* | 2~3    | 2~3   | m     | 2~3   | m    | v     | m     | m     | m    | 1     | 2     | m     | m     | m    |
| Setae *l2* | 2      | 3~4   | m     | 3~4   | m    | 2     | m     | 1~2   | m    | 2~3   | 3     | m     | 2    | m     |
| Setae *3a* | 7~8    | –     | 4~5   | 5~7   | 8~9  | 9     | 3~4   | m     | 3~4   | 7~9   | 10    | 3     | 10   | 5~9   |
| Setae *3b* | 7~8    | 8~9   | 4~5   | 5~8   | 11   | 4     | m~4   | m~5   | m~5  | 7~8   | 6~4   | 9     | 6    | 8~6   |
| Gen. cap. L. | –     | –     | –     | –     | –    | –     | –     | –     | –    | –     | 21~22 | 26~29 | 31~34 | 18 | –     |
| Gen. cap. W. | –     | –     | –     | –     | –    | –     | –     | –     | –    | –     | 21~22 | 25~28 | 34~35 | 24 | –     |
| Sol. Ta I o | 3~4   | –     | –     | –     | –    | 3~4   | 3     | 3~4   | 6    | 3~4   | 3~4   | 2~3   | 2~3   | 2     |
| Sol. Ti o | 5    | 4~5   | 5     | 4~5   | 4~5  | 4~5   | 3~5   | 8     | 3~4   | 4~5   | 4     | 4~5   | 4~5   | 4~5   |
| Sol. Ta I o | 3~4   | 3~4   | 2     | 3     | 3~4  | 3~4   | 2     | 3~4   | 6    | 2~3   | 3~4   | 3     | 3~4   |
| Fe I seta d | 2~3   | m     | m~1   | m     | m    | m~1   | m~1   | m~1   | m    | m~1   | m~1   | m~1   | m~1   | m~1   |
| Fe I seta l’ | 15~16 | ~14   | 12~13 | 11~13 | 13   | m~1   | ~1~1 | 4     | 4~5   | m~1   | ~1~1 | 4~5   | m~1   | 4~5   |
| Ti I seta d | 28~31 | ~20   | ~22   | 17~26 | 18   | ~17~22 | 15~16 | 28    | 17~21 | ~18   | ~18   | ~20   | ~20   | ~19   |

**Figure 12.** Key to closely related species of myzus group (based on adult females) possessing similar characters including short cheliceral styles (<35 μm long).
Eutarsopolipus the other Australian genual I as in (2 setae) and sometimes reduction-absence of ambulacral claws and absence of genual I some apomorphies [reduction of femoral I setation (2 setae) (well-developed tracheal system and ambulacral claws) and group, possessing a combination of plesiomorphies notion that Australia exhibits diverse than three weeks. This may substantiate the previously held following a minimal sampling effort preformed across fewer able species diversity was detected in a single location diate position. It is surprising that in our study such consider-

Among all Eutarsopolipus, leytei is apparently the most primitive group that represents the putative plesiomorphies of a well-developed tracheal system as well as retention of genual I–III setae (2-1-1) and all femoral I setae (3 setae). Conversely, the pterostichi group with a missing tracheal system and genual I–III setae (0-0-0), reduction of femoral I setation (2 setae) and sometimes reduction/absence of ambulacral claws [as in E. echinatus, 43] may be relatively more derivative than the other Australian Eutarsopolipus [31, 43]. However, the myzus group, possessing a combination of plesiomorphies (well-developed tracheal system and ambulacral claws) and some apomorphies [reduction of femoral I setation (2 setae) and absence of genual I–III setae (0-0-0)], may hold an interme-
diate position. It is surprising that in our study such consider-
able species diversity was detected in a single location following a minimal sampling effort preformed across fewer than three weeks. This may substantiate the previously held notion that Australia exhibits diverse Eutarsopolipus fauna with a wide gradient of morphological variations [42]. Despite a few sporadic studies on Australian Eutarsopolipus, six out of the ten known species groups that exist across the world (including ochoai, megachell and secundus) have so far been recorded from Australia ([31, 42, 44], present study). However, the rich diversity of Australian carabid beetles may posite the idea that the current knowledge about their associated Eutarsopolipus mites is still in its infancy; therefore, more extensive faunistic studies in different regions could potentially lead to the discov-
ery of enormous diversity in Eutarsopolipus.

With the description of E. chlaenii, this study reports the myzus group for the first time in Australia, thereby extending its distribution to Oceania, and beyond the previously recorded Holarctic, Afrotopical and Oriental realms [12, 22]. About half of the species of this group (13/25) are parasites of carabids of the genus Chlaenius Bonelli [12, 22]. Furthermore, the finding of E. pulcher n. sp. from G. pulcher is the second record of the leytei group from a native carabid of the genus Gnathaphanus Macleay, 1825 (tribe Harpalini). Recently, a study in the same

Discussion

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netically diverged from the carabid tribe Harpalini. This kind of counterintuitive host range is even more profound among the myzus and pterostichi groups, both of which are associated with carabids of the two distantly related subfamilies, Harpalinae and Scartininae [26, 42], suggesting that several episodes of host switching may have contributed to the evolution of their host associations.

Carabid beetles are generalist predators that feed on a variety of small invertebrates including important agricultural pests and thus serve as important biocontrol agents [34]. However, their ecological interactions are often hard to predict [9]. It is unknown how the parasitic role of Eutarsopolipus mites can shape the ecology and evolution of carabids, yet incorporation of such information may contribute to models predicting interaction networks of carabids for future biocontrol programs.

Conflict of interest

The authors declare that they do not have any conflict of interest.

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