

Three new species of *Dolichogenidea* Viereck (Hymenoptera, Braconidae, Microgastrinae) from Australia with exceptionally long ovipositors

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Abstract

The subfamily Microgastrinae contains an extraordinarily rich diversity of parasitoid wasps which parasitise larval lepidopterans. The Australian fauna has generally been poorly studied, particularly for the very speciose genera. One such genus is *Dolichogenidea* Viereck, which in Australia is known from only six described species. Here we describe three new species of *Dolichogenidea* from Australia, which are distinguished by possessing extremely long ovipositors compared with the typical form for the genus. These are *D. finchi* Fagan-Jeffries & Austin, **sp. n.**, *D. mediocaudata* Fagan-Jeffries & Austin, **sp. n.**, and *D. xenomorph* Fagan-Jeffries & Austin, **sp. n.** In describing these new species we also discuss relationships within the genus, and the diversity and biology of the Australian fauna.

Keywords

Microgastrinae, *Dolichogenidea*, parasitoid, ovipositor

Introduction

The subfamily Microgastrinae are agriculturally and environmentally important as endoparasitoid wasps of larval lepidopterans. There are currently over 2700 species described worldwide (Yu et al. 2016), with estimates from cytochrome c oxidase subunit I (*COI*) DNA barcoding suggesting this could be as little as 6% of the true global diversity (Whitfield et al. 2018, Rodriguez et al. 2013). The subfamily comprises 81 genera (Fernandez-Triana and Boudreault in review), several of which are very large, including *Dolichogenidea* Viereck, with over 180 described species (Yu et al. 2016). This genus was initially described as a subgenus of *Apanteles* Foerster (Viereck 1911) for the placement of his new species *D. banksi* because of its elongated genae. Subsequently, it was treated as one or more species-groups of *Apanteles* sensu lato (Wilkinson 1928, Nixon 1965), but was then raised to genus level by Mason (1981) in his reclassification of the large and polyphyletic *Apanteles* sensu lato, which previously contained the majority of described microgastrine species. Mason's (1981) concept of *Dolichogenidea* included three of Nixon's (1965) species-groups; the *ultor*-group, the *laevigata*-group, and the *longipalpis*-group. Whilst Mason (1981) proposed several characters to distinguish *Dolichogenidea* from *Apanteles* sensu stricto, including *Dolichogenidea* having 'punctures of the mesonotum typically distinctly separated and never breaking into aciculations posterolaterally', many species have strongly reduced cuticular sculpturing, making the punctation characters unusable for placement in the correct genus. Analysis of thousands of specimens by Fernández-Triana et al. (2014) suggests that "the only reliable character is the number and density of setae fringing on the median portion of the vannal lobe" of the hind wing. *Dolichogenidea* has a convex to almost straight vannal lobe, which is uniformly fringed by setae, while in *Apanteles* sensu stricto the vannal lobe is strongly concave to almost straight and is lacking setae at the midlength. This lack of setae may be partial (i.e. there may be some small and sparse setae on the lobe) or total (i.e. no setae at all). The two genera are also generally resolved as separate monophyletic clades using molecular data and thus are distinguishable in DNA barcoding studies (Fagan-Jeffries et al. in press, Smith et al. 2013).

The Australasian members of *Dolichogenidea* were reviewed by Austin and Dangerfield (1992) and currently the genus contains six species from Australia: *D. biroi* (Szépligeti, 1905), *D. eucalypti* (Austin and Allen, 1989), *D. hyposidrae* (Wilkinson, 1928), *D. lip-sis* (Nixon, 1967), *D. miris* (Nixon, 1967), and *D. tasmanica* (Cameron, 1912). Long-term sorting of microgastrines in Australian collections and a recent large barcoding study (Fagan-Jeffries et al. in press) have revealed several remarkable specimens belonging to three species of *Dolichogenidea* that possess extremely long ovipositors. We here describe these species as a contribution to on-going studies on Australian members of the genus.

Materials and methods

Terms for general morphology follow Fernández-Triana et al. (2014) who combined traditional microgastrine morphological terms, such as those used by Mason (1981), with the standards introduced in the Hymenoptera Anatomy Ontology (HAO) pro-

ject (Yoder et al. 2010). Terms for sculpturing follow Eady (1968). The following acronyms and abbreviations are used throughout the paper: T1, T2, T3 for the first, second and third mediotergites, respectively; S1–3 for the first, second and third sternites; ACT, Australian Capital Territory; NSW, New South Wales; Qld, Queensland; Vic, Victoria; WA, Western Australia. The following abbreviations are used for collections: **ANIC**, Australian National Insect Collection, Canberra; **WAM**, Western Australian Museum, Perth. We define colour as either pale (white, cream or pale yellow), orange, or dark (brown or black).

Taxonomy

Dolichogenidea Viereck

Dolichogenidea Viereck, 191 1: 173 (as a subgenus of *Apanteles* Foerster s.l.). Type species, by original designation, *Apanteles (Dolichogenidea) banksi* Viereck. Generic status by Mason 1981: 34. See Shenefelt (1972) for bibliographic history and Mason (1981) for discussion of relationships.

Diagnosis. Fore wing areolet (second submarginal cell) absent (i.e. vein r-m absent); hind wing vannal lobe convex to almost straight and uniformly fringed by setae; propodeum often with a complete areola, sometimes areola reduced with at least posterior diverging carinae present, rarely with these carinae completely absent; metasoma with T2 variable in shape, but usually rectangular or subrectangular; hypopygium membranous mid-ventrally and expandable (sometimes folded inwards and hidden by laterotergites in dead specimens); ovipositor protruding from posterior metasoma, usually as long as or longer than length of metatibia.

Remarks. In resurrecting *Dolichogenidea*, Mason (1981) allocated three of Nixon's (1965) species-groups to the genus: the *ultor*-, *laevigatus*-, and *longipalpis*-groups. The *longipalpis*-group was erected by Nixon for a single European species, *D. longipalpis* (Reinhard, 1880), which has unusually long mouthpart palps. The *ultor*-group was defined by Nixon (1965) for those species with a complete or partially complete propodeal areola, and the *laevigatus*-group for species with the areola represented only by two basal diverging carinae, or the propodeum virtually completely devoid of carinae. However, there are numerous species that represent intermediates between these conditions, and Mason (1981) was instrumental in recognising that there were likely to be independent pathways for reduction and eventual loss of the areola (Whitfield et al. 2018). Hence, it is very likely that neither the presence of a propodeal areola or its loss define monophyletic groups. This said, the three species described here most closely resemble the condition found in classic '*laevigatus*-group species', having a smooth and shiny propodeum, a transverse T2 (rather than triangular) and an ovipositor much longer than the metatibia.

Identification of the species described here. *Dolichogenidea* is highly speciose and there are large numbers of undescribed species in Australia. Austin and Dangerfield (1992) estimated that fauna to be 50–70 species. However, it may be much larger

than this given that a recent DNA barcoding study of Australian microgastrines recognised 236 species from 525 individuals, 42 of which belonged to *Dolichogenidea* (Fagan-Jeffries et al. in press). Given this considerable number of additional species in *Dolichogenidea*, it is pointless to present a key to the described fauna; rather we provide the characters that distinguish the three species treated here from the six described species, as follows: the absence of a conspicuous white blotch on the gena separates the three species from *D. lipsis*, *D. biroi*, and *D. tasmanica*; *D. hyposidrae* and *D. eucalypti* both have ovipositors significantly shorter than the metatibia and a clearly defined propodeal areola, whilst the species described here all have ovipositors significantly longer than the metatibia and a propodeal areola only indicated at most by short posterior diverging carinae; *D. miris* is separated by the presence of a partially defined areola with lateral costula, and a shorter T2 with strong rugose sculpturing, differing from the smooth or almost smooth T2 of the three new species here. In addition, the lengths of the ovipositor and sheaths of all undescribed *Dolichogenidea* we have seen in Australian collections do not exceed approximately $1.5 \times$ that of the metatibia, compared with $1.8\text{--}4.2 \times$ for the three new species.

The newly described species appear to be quite rare, although two are widespread (Fig. 1). After considerable collecting effort and searching of both pinned and ethanol museum material from all major Australian collections, only 14 specimens have been located.

***Dolichogenidea finchi* Fagan-Jeffries & Austin, sp. n.**

<http://zoobank.org/CDDDB476E-FE7F-4404-AE6D-5764C44ACE9F>

Figure 2

Material examined. Holotype ♀: AUSTRALIA, WA, Kariijini NP, Kariijini Dr, 22.5716°S, 118.3072°E; 19-25/iv/2003, C Lambkin & T Weir, malaise in open *Eucalyptus* grassland, 814 m (WAM: E94085). Paratypes: ♀ WA, Kariijini NP, Weano Gorge Rd, 22°21'19"S, 118°15'00"E; 25/iv/2003 - 15/v/2003, C Lambkin & T Weir, malaise in grassy dry creek *Eucalyptus-Acacia* scrub, 695 m (WAM: E94086); ♀ NSW, Wilcannia, 23/xi/1949, E.F. Riek (ANIC: #32 130282); ♀ QLD, Binna Burra, Lamington National Park, 29/v/1966, Z. Liepa, at light (ANIC: #32 130284); ♀ QLD, Brisbane, vi/1904, RCL Perkins (NHM: #NHMUK010880682); ♀ QLD, 3.5 km SW by S of Mt Baird, 15.10°S, 145.07°E; 3-5/v/1981, I.D. Nauman, ex ethanol, collected at light (ANIC: #32 130286); ♀ Vic, 18 km NW by N Omeo, 28/ii/1980, J.C. Cardale, ex alcohol (ANIC: #32 130283); ♀ WA, Millstream, 26/x/1970, J.C. Cardale (ANIC: #32 130285); ♀ WA, 21 km E by N Yellowdine, 10/x/1981, I.D. Naumann, J.C. Cardale, ex ethanol, on *Eucalyptus* flowers (WAM: E94087); ♀ WA, 1 km NNW of Eucla Pass, 31.40°S 128.52°E, 20/v/1984, E.S. Nielson, E.D. Edwards (WAM: E94088).

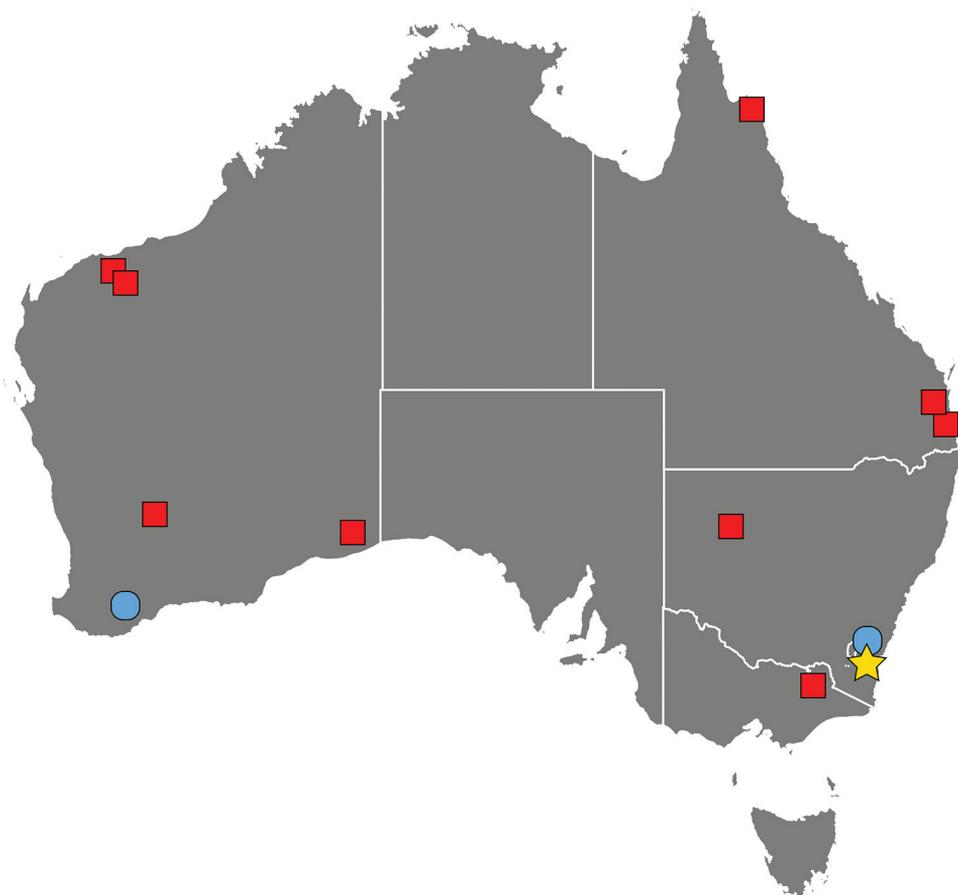


Figure 1. Known distributions of *D. xenomorph* (blue circles) *D. finchi* (red squares) and *D. mediocaudata* (yellow star).

Diagnosis. *Dolichogenidea finchi* can be separated from *D. mediocaudata* by having a longer ovipositor, smoother T1, and more consistent pale orange colouration of the legs; and from *D. xenomorph* by absence of a strong sculpturing pattern on the propodeum (Fig. 2d) and lighter colouration of the lateral metasoma (Fig. 2b).

Description. (Female). Colour. Head and body dark; tergites dark, T3 sometimes orange on lateral thirds (Fig. 2a); S1-3 paler than posterior sternites; antenna dark; coxae (pro-, meso-, metacoxa): dark, dark, dark; femora (pro-, meso-, metafemur): pale/orange, pale/orange, pale/orange; tibiae (pro-, meso-, metatibia): pale/orange, pale/orange, pale/orange anteriorly and subtly darker at basitarsus boundary; tegula and humeral complex pale; pterostigma dark, often with subtle to distinct pale patch at proximal end; fore wing veins pale proximally transitioning to dark distal to pterostigma.

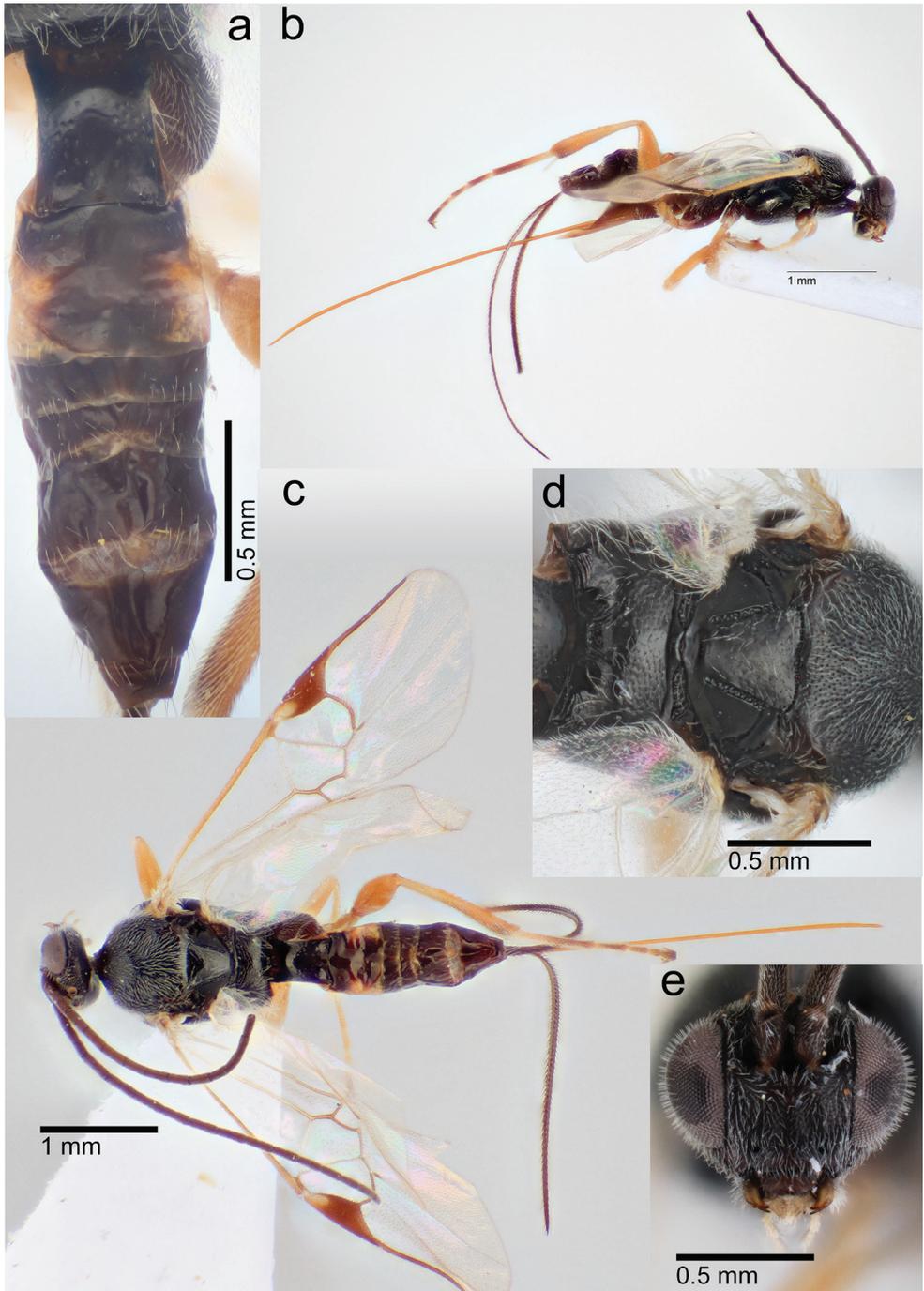


Figure 2. *Dolichogenidea finchi* (holotype): **a** metasoma **b** lateral habitus **c** dorsal habitus **d** mesosoma **e** head.

Head. Antennae slightly shorter than body length; body length (head to apex of metasoma): 3.4–4.4 mm; ocular–ocellar line/posterior ocellus diameter: 1.4–1.9; interocellar distance/posterior ocellus diameter: 1.3–2.3.

Mesosoma. Anteromesoscutum densely and evenly punctate; mesoscutellar disc mostly smooth and shining with sparse punctures mostly associated with setae, lateral faces of the mesoscutellum normally smooth and shining to lunules but sometimes with a distinct line of pits or with subtle area of sculpturing posterior to lunules; number of pits in scutoscuteellar sulcus: varies from 12 to 22; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.7–0.8. Propodeum with sparse punctures associated with setae, areola only indicated by smoother area in centre of propodeum and short carinae diverging from centre posterior margin of propodeum.

Fore wing length 3.2–4 mm; length of veins r/2RS 1.5–2.2; length of veins 2RS/2M 1.0–1.7; length of veins 2M/(RS+M)b 0.5–0.8; pterostigma length/width 2.6–3.1.

Legs. Metatibia inner spur length/metabasitarsus length 0.2–0.4.

Metasoma. T1 length/width at posterior margin 1.2–1.8; T1 shape broad, rectangular, almost parallel-sided; T1 mostly smooth with sparse punctures associated with short setae on lateral sides of posterior half; T2 width at posterior margin/length 2.1–3.1; T2 sculpture smooth and shiny, few shallow punctures associated with setae; T2/T3 boundary indistinct and sinuate. T3 smooth and shiny, at least twice as long as T2; hypopygium large with lateral creases, ovipositor sheath length/metatibial length 2.9–3.9.

Male. Unknown.

COI Genbank accession numbers. MH138733 (Holotype) MH138940 (Paratype WAM: E94086)

Remarks. It is possible that if more specimens become available and are amenable to DNA sequencing, *D. finchi*, as described here, will turn out to be a species complex of several closely related species. There is variation in several morphological characters such as subtle differences in the length and shape of the metanotum, the colour of T3, and length of the ovipositor in relation to the metatibia. However, with so few specimens and a lack of molecular data we feel it is more practical at this stage to treat them as one variable species. Further, the *COI* sequences of the two specimens, sequenced as part of a parallel study (Fagan-Jeffries et al. in press), are 2.5% divergent, which is above the 2% divergence of the *COI* barcoding region threshold considered to delimit species of microgastrines in 95% of cases (Smith et al. 2013).

Etymology. This species is named for the late grandfather of one of us (EFJ), Alexander Finch, who was a sheep pastoralist near the town of Wilcannia, the locality for one of the paratypes.

Distribution. This species occurs widely across the continent (Fig. 1) and is recorded from WA, Qld, Vic and NSW.

Host. Whilst the host for this species has not been recorded, two specimens were collected in association with *Eucalyptus*. As *D. xenomorph* is the parasitoid of a larva feeding on *Eucalyptus*, it is a strong possibility that *D. finchi* also parasitises a *Eucalyptus*-associated lepidopteran.

***Dolichogenidea mediocaudata* Fagan-Jeffries & Austin, sp. n.**

<http://zoobank.org/8AD0F877-7CBD-4B6C-82EE-C77F58B6EE4E>

Figure 3

Material examined. Holotype ♀: AUSTRALIA, NSW, 8 miles ESE of Nimmitable 3600ft, emerged 03/xii/1969, I.F.B. Common & J. Cusbert, L19. Larva tying leaves on fallen dead branch of *Eucalyptus pauciflora* (ANIC: #32 130288).

Diagnosis. This species can be separated from *D. finchi* and *D. xenomorph* by having a shorter ovipositor (Fig. 3a) and deeper sculpturing on both the propodeum and T1 (Fig. 3e), and presence of distinct dark colouration on the distal half of the metatibia.

Description. (Female). Colour. Head and body dark other than S1-3 which are distinctly paler than posterior sternites; antenna dark; coxae (pro-, meso-, metacoxa): dark, dark, dark; femora (pro-, meso-, metafemur): pale, dark, dark; tibiae (pro-, meso-, metatibia): pale, pale, pale anteriorly, posterior half distinctly darker; tegula and humeral complex pale; pterostigma dark; fore wing veins pale proximally transitioning to dark distally.

Head. Antennae slightly shorter than body length; body length (head to apex of metasoma): 3 mm; ocular–ocellar line/posterior ocellus diameter: 2.2; intercellular distance/posterior ocellus diameter: 1.9.

Mesosoma. Anteromesoscutum densely and evenly punctate, no punctures at posterior margin; mesoscutellar disc mostly smooth and shining with sparse punctures mostly associated with setae, lateral faces of the mesoscutellum smooth and shining but with a distinct line of pits posterior to lunules; number of pits in scutoscuteellar sulcus: varies from 12–13; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.7. Propodeum with deep non-uniform punctures, posterior half with rugose sculpturing, areola only indicated by a central depression and short carinae diverging from centre posterior margin of propodeum.

Fore wing length 2.7 mm; length of veins r/2RS 1.3; length of veins 2RS/2M 1.8; length of veins 2M/(RS+M)b 0.6; pterostigma length/width 2.8.

Legs. Metatibia inner spur length/metabasitarsus length 0.4.

Metasoma. T1 length/width at posterior margin 1.6; T1 shape broad, rectangular, almost parallel-sided; T1 with rugose sculpturing and sparse punctures over most of length; T2 width at posterior margin/length 2.0; T2 sculpture smooth and shiny, few shallow punctures associated with setae; T2/T3 boundary indistinct and sinuate. T3 smooth and shiny, at least twice as long as T2; hypopygium large with lateral creases, ovipositor sheath length/metatibial length 1.8.

Male. Unknown.

Etymology. This species is named for the length of the ovipositor, which appears to be intermediate between most *Dolichogenidea* and the extremely long ovipositors of *D. xenomorph* and *D. finchi*.

Distribution. This species is only known from the holotype collected near Nimmitable in south-eastern NSW.

Host. This specimen was reared from a lepidopteran larva tying leaves together on a dead branch of *Eucalyptus pauciflora*.

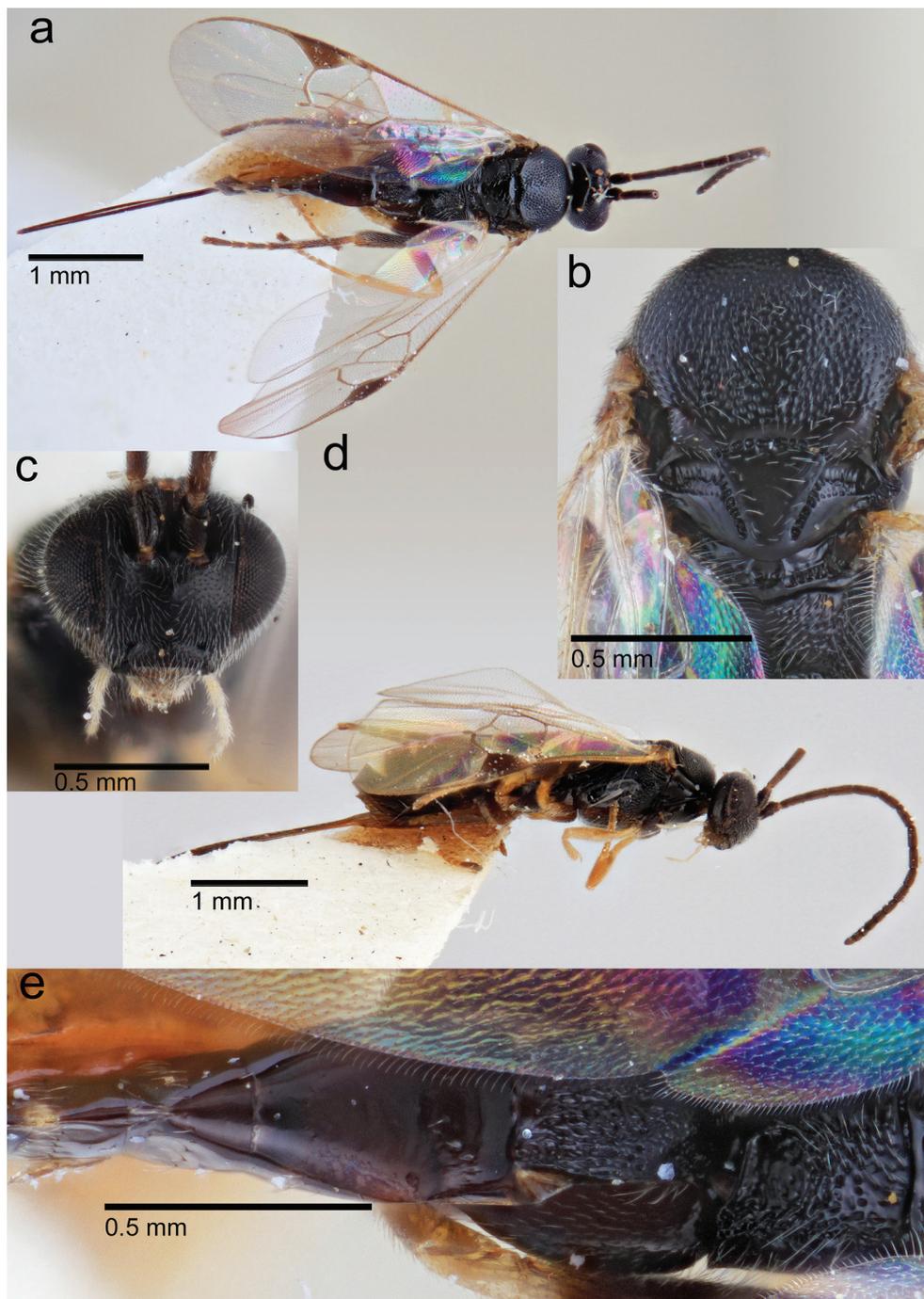


Figure 3. *Dolichogenidea mediocaudata* (holotype): **a** dorsal habitus **b** anteromesoscutum, mesoscutellum and metanotum **c** head **d** lateral habitus **e** propodeum and tergites.

***Dolichogenidea xenomorph* Fagan-Jeffries & Austin, sp. n.**

<http://zoobank.org/F7E2A57E-8F65-45F3-9752-C3165DD513DC>

Figure 4

Material examined. Holotype ♀: AUSTRALIA, NSW, 2.7 km NE of Queanbeyan, emerged 28/x/1979, I.F.B. Common, ex *Ocystola euanthes* Meyr (ANIC: #32 130289). Paratype ♀: same data as holotype (ANIC: #32 130290). Other material ♀: AUSTRALIA, WA, Stirling National Park, 22/ix/1965, E. Britton, U. Baker (ANIC: #32 130287).

Diagnosis. *Dolichogenidea xenomorph* can be separated from *D. mediocaudata* by having a longer ovipositor, smoother T1, and lighter, more consistent colouration of the femora and tibiae. The species is very similar to *D. finchi*, but can be separated by the stronger sculpturing pattern on the propodeum (Fig. 4d) and darker colouration of the lateral metasoma (Fig. 4b).

Description. (Female). Colour. Head and body dark, including tergites and sternites; antenna dark; coxae (pro-, meso-, metacoxa): dark, dark, dark; femora (pro-, meso-, metafemur): orange, orange, dark to orange; tibiae (pro-, meso-, metatibia): orange, orange, orange; tegula and humeral complex orange; pterostigma dark; fore wing veins pale proximally transitioning to dark distally.

Head. Antennae slightly longer than body length; body length (head to apex of metasoma): 4 mm; ocular–ocellar line/posterior ocellus diameter: 1.8–2.1; interocellar distance/posterior ocellus diameter: 1.7–2.5.

Mesosoma. Anteromesoscutum densely and evenly punctate; mesoscutellar disc mostly smooth and shining with sparse punctures mostly associated with setae, lateral faces of mesoscutellum with anterior shallow sculpturing posterior to lunules (Fig. 4c); number of pits in scutoscutellar sulcus: 16; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.7–0.8. Propodeum with sparse punctures associated with setae, areola only indicated by smoother area in centre of propodeum and short carinae diverging from centre posterior margin of propodeum. Propodeum with rugose sculpturing in posterior half.

Fore wing length 4.3–4.4 mm; length of veins r/2RS 1.3–1.9; length of veins 2RS/2M 1.1–1.2; length of veins 2M/(RS+M)b 0.8–1; pterostigma length/width 2.6–3.

Legs. Metatibia inner spur length/metabasitarsus length 0.3–0.4.

Metasoma. T1 length/width at posterior margin 1.1–1.4; T1 shape broad, rectangular, almost parallel-sided; T1 mostly smooth with sparse punctures associated with short setae on lateral sides of posterior half; T2 width at posterior margin/length 4; T2 sculpture smooth and shiny, few shallow punctures associated with setae; T2/T3 boundary indistinct and sinuate. T3 smooth and shiny, at least twice as long as T2; hypopygium large with lateral creases, ovipositor sheath length/metatibial length 3.7–4.2.

Male. Unknown.

Remarks. The specimen from WA is here assigned to this species, but excluded from the type series due to its disjunct distribution which is also outside the known

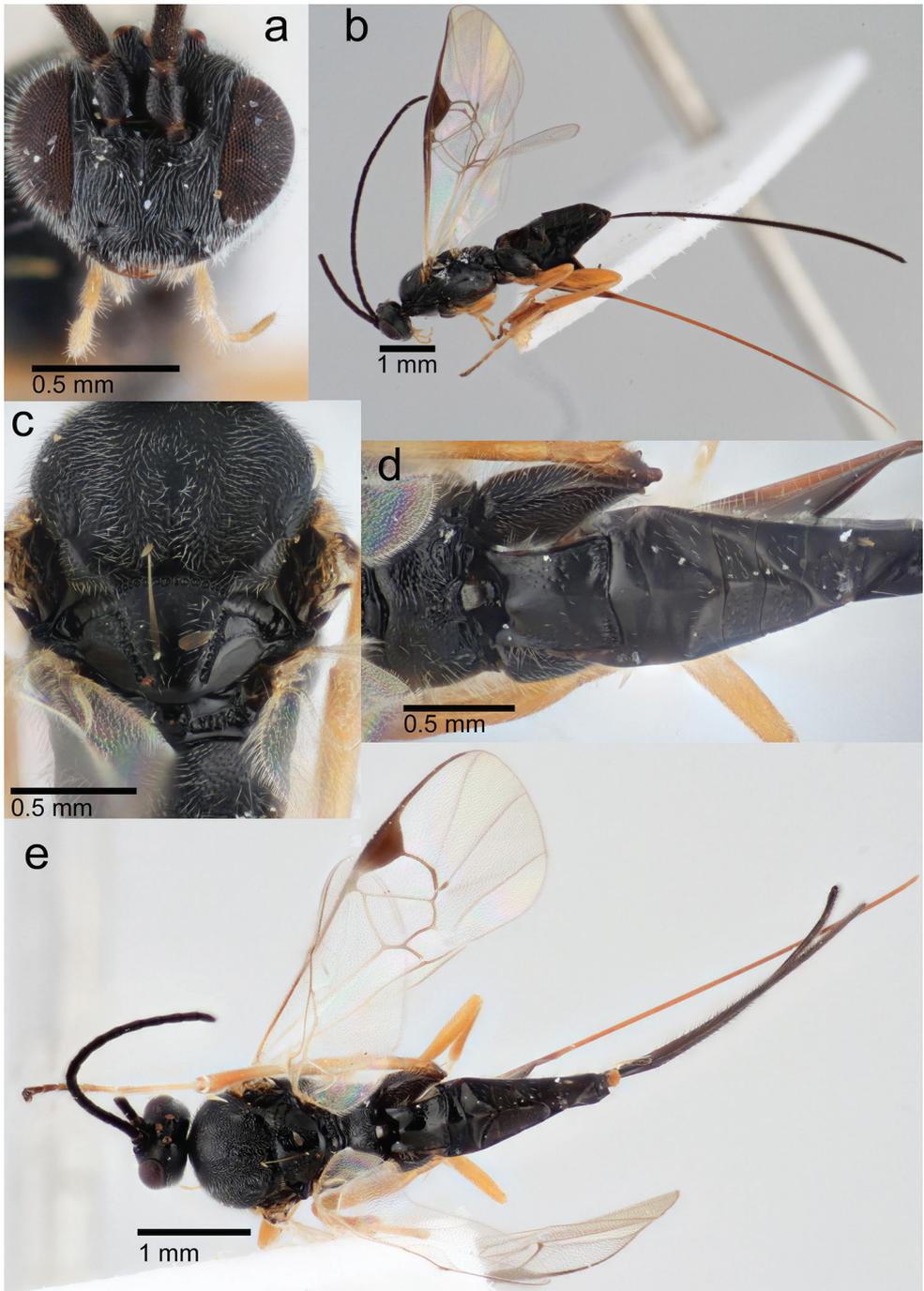


Figure 4. *Dolichogenidea xenomorph*: **a** head (paratype) **b** lateral habitus (paratype) **c** anteromesoscutum, mesoscutellum and metanotum (holotype) **d** propodeum and tergites (holotype) **e** dorsal habitus (holotype).

range of the host species. However, other species of the host genus are known from WA, but we take a more conservative approach until further specimens and host data become available.

Etymology. This species is named for the fictional creature from the movie franchise ‘Alien’, which reportedly was inspired by the lifecycle of parasitic wasps. The name of the fictional creature comes from the Greek ‘xeno’ (strange) and ‘morphe’ (form) which is also appropriate, considering the remarkably long ovipositor of this species compared to other members of the genus. The species name is a noun in apposition.

Distribution. Recorded from NSW and south-western WA.

Host. Reared from *Antipterna euanthes* (Meyrick, 1885) (Oecophoridae), a species in which the larvae fold over the tip of a *Eucalyptus* leaf and continue developing even after the leaf is shed from the tree (Common 1994). This lepidopteran species is recorded from ACT, NSW and Vic, however the genus extends into eastern Qld, Tasmania, and south-western WA (Common 1994). The holotype and paratype of *D. xenomorph* have the same locality and host information. Whether they emerged singularly from two host larvae collected on the same date, or were gregarious in the one host is unknown.

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