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New species of Australian microgastrine parasitoid wasps (Hymenoptera: Braconidae: Microgastrinae) documented through the 'Bush Blitz' surveys of national reserves

ERINN P. FAGAN-JEFFRIES[1,3], STEVEN J.B. COOPER[1,2] & ANDREW D. AUSTIN[1]

[1]*Australian Centre for Evolutionary Biology and Biodiversity, School of Biological Sciences, University of Adelaide, South Australia 5005, Australia*

[2]*Evolutionary Biology Unit, South Australian Museum, North Terrace, Adelaide, South Australia 5000, Australia*

[3]*Corresponding author. E-mail: erinn.fagan-jeffries@adelaide.edu.au*

Abstract

The braconid subfamily Microgastrinae are ecologically important parasitoids of larval lepidopterans, but are poorly studied in many regions of the world. In this study, we focus on describing new species of microgastrine wasps, in part from specimens collected on six different 'Bush Blitz' surveys of regional reserves in South Australia and Tasmania. Ten species of Microgastrinae are described as new and DNA barcodes of the genes *COI* and *wingless* are provided: three species in the genus *Choeras* Mason: *C. bushblitz* Fagan-Jeffries & Austin **sp. nov.**, *C. parvoculus* Fagan-Jeffries & Austin **sp. nov.**, and *C. zygon* Fagan-Jeffries & Austin **sp. nov.**; six species in the genus *Dolichogenidea* Viereck: *D. bonbonensis* Fagan-Jeffries & Austin **sp. nov.**, *D. brabyi* Fagan-Jeffries & Austin **sp. nov.**, *D. forrestae* Fagan-Jeffries & Austin **sp. nov.**, *D. garytaylori* Fagan-Jeffries & Austin **sp. nov.**, *D. kelleri* Fagan-Jeffries & Austin **sp. nov.**, and *D. lobesiae* Fagan-Jeffries & Austin **sp. nov.**; and one species from the genus *Sathon* Mason: *S. oreo* Fagan-Jeffries & Austin **sp. nov.** These new species represent just a small fraction of the potential of 'Bush Blitz' surveys in regional Australia, which provide DNA-quality material allowing an integrative taxonomic approach and offer a window into the biodiversity of some of the least studied areas of the continent.

Key words: *Dolichogenidea, Choeras, Sathon, biodiversity, inventory, bushblitz*

Introduction

Species discovery and documentation is the foundation of all environmental biology and directly underpins studies in fields as disparate as ecology, conservation, biological control, and biosecurity. In Australia, there is an estimated 205,000 species of insects (Yeates *et al.* 2003), a figure that is likely to be a substantial underestimate, but only 69,000 are formally described (ABRS 2017). Major collections contain a huge number of undescribed species but large areas of the continent have, to date, been poorly surveyed and many species are yet to be discovered. To improve this situation, a large nature discovery program was initiated in 2010 to document the biodiversity of the national reserve system. The 'Bush Blitz' program, coordinated by the Federal Government's Australian Biological Resources Study, is a multi-institutional partnership that aims to bring together taxonomists, traditional land owners, property owners and park rangers to intensely survey the flora and fauna of reserves across the continent and describe the new species discovered during the process (ABRS 2018).

One insect assemblage virtually absent in outputs from the 'Bush Blitz' program are the parasitoid Hymenoptera (but see Kittel & Austin 2016). An important component of this assemblage is the Microgastrinae, a subfamily of wasps that are endoparasitoids of lepidopteran larvae (Whitfield *et al.* 2018), which are often collected by a range of methods including Malaise traps and sweep netting. Whilst new species of microgastrines can be discovered simply by sorting material in museum collections, surveys such as 'Bush Blitz' have been instrumental in collecting fresh specimens from remote locations that are viable for DNA sequencing. DNA data allow for faster, directed taxonomy, enabling species delimitation and descriptions that combine both molecular

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and morphological evidence into a comprehensive approach. An integrative species discovery approach is particularly important for megadiverse, yet morphologically conservative groups such as the Microgastrinae.

Microgastrine wasps are an extraordinarily diverse group of insects with over 2,700 species described worldwide (Yu *et al.* 2016) and a true fauna estimated to be as high as 40,000 species (Rodriguez *et al.* 2013). For Australia, approximately 120 species have been described in 22 genera (Austin & Dangerfield 1992, 1993; Saeed *et al.* 1999; Fernández-Triana *et al.* 2014a; Fagan-Jeffries & Austin 2018; Fagan-Jeffries *et al.* 2018a; Fernández-Triana & Boudreault 2018). However, estimates based on DNA barcoding suggest that this number of species may represent only about 10% of the true size of the Australian fauna (Fagan-Jeffries *et al.* 2018b). Microgastrines play important roles in regulating caterpillar populations, both in native ecosystems and in agricultural systems against both native and introduced lepidopteran pests (Whitfield *et al.* 2018). With the incredible size of the undescribed fauna, and the cosmopolitan nature of many of the larger genera, complete generic revisions are untenable at the present time. The lack of clarity surrounding the limits of large genera and the relationships among them further hampers thorough taxonomic work on the subfamily, but there have been several major revisions of regional faunas in recent years, particularly in Costa Rica (Fernández-Triana *et al.* 2014b; c) and Canada (Fernández-Triana 2010, 2018).

In this study we describe 10 new species of microgastrine wasps, eight of which are based on material collected during Bush Blitz surveys. We describe three species in the genus *Choeras* Mason, six species in the genus *Dolichogenidea* Viereck and one species in the genus *Sathon* Mason. All species have been DNA barcoded for the cytochrome oxidase I (*COI*) gene and some also for the nuclear gene wingless (*WG*) (Fagan-Jeffries *et al.* 2018b), to provide an integrative approach to species delimitation using a general lineage concept (de Queiroz 1998). Descriptions of these particular species have been prioritised because of available host records, unique morphological characteristics, or to show the diversity of new species collected and identified on 'Bush Blitz' surveys, and thus the importance of these surveys in gathering new, DNA-grade material from remote locations.

Materials and methods

Terms for general morphology follow Fernández-Triana *et al.* (2014c) who combined traditional microgastrine morphological terms, such as those used by Mason (1981), with the standards introduced in the Hymenoptera Anatomy Ontology (HAO) project (Yoder *et al.* 2010). Measurements are given as ranges when differences were observed between paratypes or when multiple measurements of the same specimen produced different results to account for imprecision (see Fernández-Triana *et al.* (2014c) for measurement terminology and appendix 1 in the same paper for discussion on characters prone to variable results when measuring). Measurements or ratios indicated with an asterisk in the descriptions could only be taken accurately on the holotype due to wing placement in the paratypes, thus, there is likely more variation in those indicated measurements than listed.

Terms for sculpture 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, S2, S3 for the first, second and third sternites; ACT, Australian Capital Territory; NSW, New South Wales; Qld, Queensland; SA, South Australia; Tas, Tasmania; Vic, Victoria; WA, Western Australia. The following collection acronyms are used: ANIC, Australian National Insect Collection, Canberra; NHMUK, Natural History Museum, London; MV, Museum Victoria, Melbourne; QM, Queensland Museum, Brisbane; SAMA, South Australian Museum, Adelaide; TMAG, Tasmanian Museum and Art Gallery, Hobart. We define colour as either pale (white, cream or pale yellow), orange, light brown or dark (dark brown or black).

Nearly all specimens included in this study have had legs removed for DNA extraction, and thus nearly all type specimens are missing 1–3 legs. DNA extraction and sequencing methods follow Fagan-Jeffries *et al.* (2018b). A Bayesian tree of the specimens sequenced in Fagan-Jeffries *et al.* (2018b) and 44 additional specimens sequenced for *COI* using the Sanger methods outlined in the previously mentioned study was constructed using the program MrBayes (Ronquist *et al.* 2012). The genes *COI* and *WG* were concatenated and partitioned, and both genes were modelled with a GTR+I+G model of evolution. The tree was run for 15,000,000 generations and convergence was established using the program Tracer (Rambaut *et al.* 2018) ensuring ESS values were >200.

As the previously mentioned DNA barcoding study has shown that there are many more additional undescribed species of *Choeras*, *Sathon* and *Dolichogenidea* in Australia to those treated here (Fagan-Jeffries *et al.* 2018b), we feel that it is premature to update the key to Australasian *Choeras* in Fagan-Jeffries and Austin (2018) or provide keys to Australian *Dolichogenidea* and *Sathon*, and instead provide clear comparative diagnoses for the following new species. To facilitate clear diagnostic differences for the new species, all holotypes from the Australasian region, including the South-West Pacific, have been examined, with the exception of *Dolichogenidea upoluensis* (Fullaway 1941) and *D. agonoxenae* (Fullaway 1941), where the original descriptions were used, and *D. stantoni* (Ashmead 1904), where the original descriptions and a series of specimens (NHMUK) identified by G. E. J. Nixon were examined. A summary of the diagnostic characters for the Australasian *Dolichogenidea* species is provided (Table 1).

Taxonomy

Choeras Mason, 1981

Choeras Mason, 1981: 76; Austin & Dangerfield 1992: 18; van Achterberg 2002 (treated as a subgenus of *Apanteles* Foerster); Song *et al.* 2014: 502 (treated as a subgenus of *Apanteles*); Ghafouri Moghaddam *et al.* 2018: 457. See Shenefelt (1973) for earlier bibliographic history of species, and Fagan-Jeffries and Austin (2018) for a review and comments on the Australasian fauna.

Type species: *Apanteles* (*Pseudapanteles*) *consimilis* Viereck 1911, by original designation.

Diagnosis. Fore wing areolet absent, small or large; propodeum either with median longitudinal carina or carina absent, but never with any indication of an areola, surface smooth to coarsely rugose; T1 usually parallel-sided or narrowing posteriorly; T2 either transverse rectangular, subtriangular, broadly pentagonal or almost linear; hypopygium medio-longitudinally folded with several striae (as in *Apanteles*), degree of striations variable to the point where hypopygium has only faint lateral creases; ovipositor sheaths from about half as long as metatibia to longer.

Remarks. *Choeras* is a cosmopolitan genus, with nearly 60 species described worldwide (Yu *et al.* 2016; Fagan-Jeffries & Austin 2018; Ghafouri Moghaddam *et al.* 2018). There are currently nine species described from Australasia: *C. calacte* (Nixon 1965), *C. ceto* (Nixon 1965), *C. dissors* (Nixon 1965), *C. epaphus* (Nixon 1965), *C. helespas* Walker (1996), *C. koalascatocola* Fagan-Jeffries & Austin (2017), *C. morialta* Fagan-Jeffries & Austin (2017), *C. papua* (Wilkinson 1936), and *C. tegularis* (Szepligeti 1905). The genus is likely to be paraphyletic (Williams 1988; Austin & Dangerfield 1992), with the Australian fauna forming two main clades in a recent molecular study (Fagan-Jeffries *et al.* 2018b); one clade including species possessing a small, slit-like fore wing areolet, and a second clade of species with a large fore wing areolet that includes species appearing to be morphologically intermediate between *Choeras* and *Sathon* (Fig. 1). It is clear that the genus needs to be revised, however, a world-wide sampling effort and inclusion of several morphologically-related genera such as *Sathon* and *Lathrapanteles* Williams would be required for a detailed treatment that does not cause further confusion to generic boundaries in the Microgastrinae. As such, we here place species from both of the Australian molecular clades (with fore wing areolet both large and small) into *Choeras*, but present detailed descriptions, images and molecular data, so that they can be more easily assessed in future studies. For the Australian fauna, we provisionally separate *Choeras* and *Sathon* based on form of the hypopygium (*sensu* Austin & Dangerfield 1992), with the species that we place in *Choeras* possessing a hypopygium with at least some flexibility, medial folds, or striation, whilst the species we place in *Sathon* has a completely inflexible hypopygium. The distribution of two of the new species of *Choeras* are restricted to a single collection locality in Tasmania, whilst the third species has a broad distribution across south-western Australia (Fig. 2).

We here formally recognise the corrected species name *Choeras ceto* (Nixon), which was mistakenly changed to *Choeras cetus* by Austin and Dangerfield (1992).

Choeras bushblitz Fagan-Jeffries & Austin sp. nov.

(Fig. 3)

urn:lsid:zoobank.org:act:4AEF09D9-5DEC-4F7F-AB75-7BB36F7C3A5A

Material examined (including Genbank numbers of DNA barcodes). Holotype: Tasmania: ♀ Southwest National Park Bush Blitz, SSS1, -43.199° 146.78481°, 01–09/ii/2016, K. Moore, pitfall trap (TMAG: F59023; Genbank *COI*: MH138610 *WG*: MH139104). **Paratypes: Tasmania:** ♀ Southwest National Park Bush Blitz,

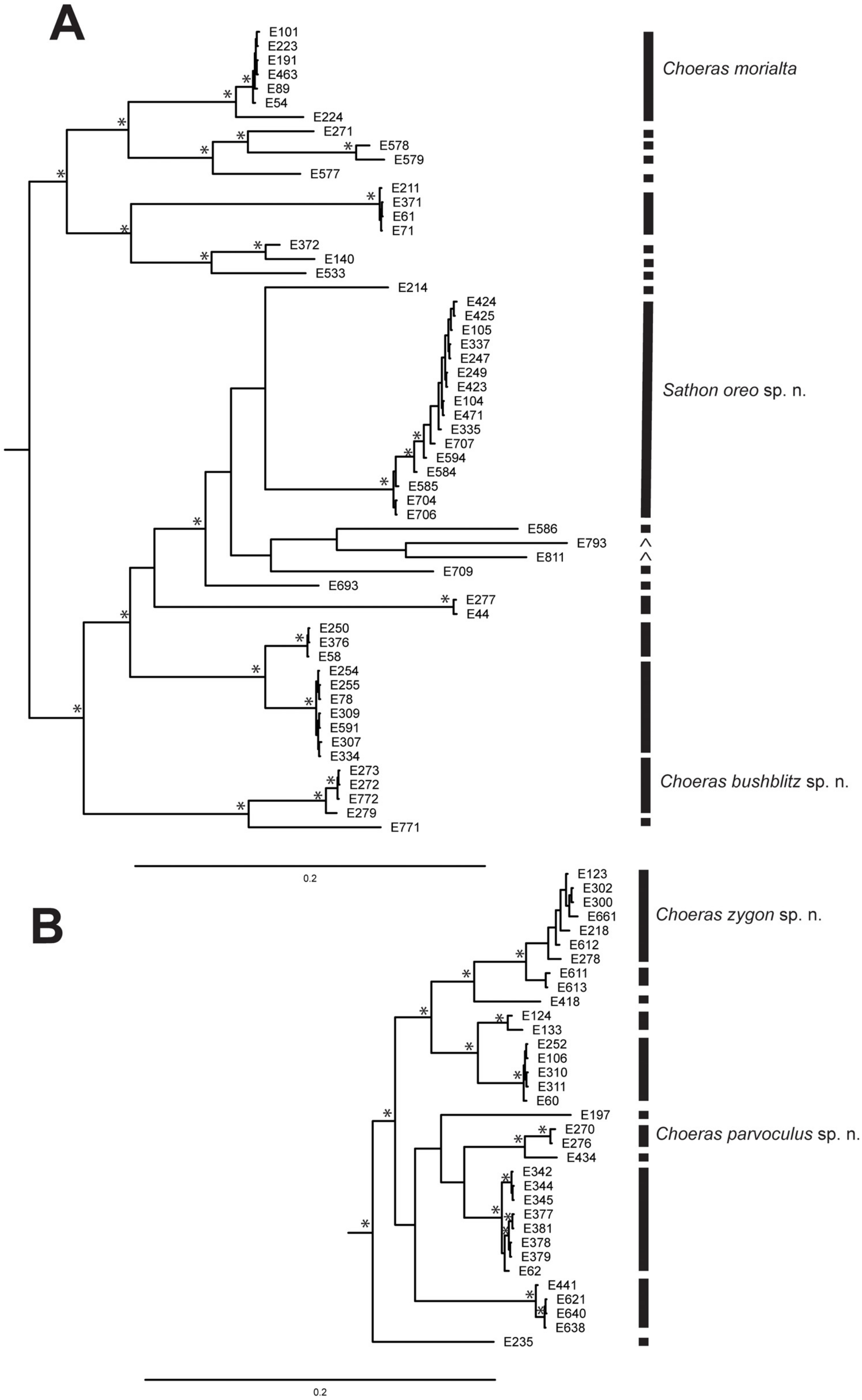

FIGURE 1. A) The clade of specimens morphologically identified as either *Choeras* or *Sathon* (i.e. possessing either a solid hypopygium or a flexible hypopygium, respectively) with a large fore wing areolet, and B) the clade of *Choeras* specimens with a small fore wing areolet. Clades are isolated from a larger concatenated *COI* and *WG* Bayesian tree of Microgastrinae. * indicates nodes with ≥ 95% posterior probability support. The consensus species delimitation hypothesis as determined in Fagan-Jeffries *et al.* (2018b) is indicated with bars to the right of the tree. ^ indicates the specimen was newly sequenced since Fagan-Jeffries *et al.* (2018b). These clades (A and B) are not closely related in the larger phylogeny, but there is limited support in the connecting nodes. Refer to Fagan-Jeffries *et al.* (2018b, figure 4b) for a simplified version of the complete phylogeny depicting the relationships among genera, including between these two *Choeras* clades.

SSS1, -43.199° 146.78481°, 01–09/ii/2016, K. Moore, Malaise trap (TMAG: F59022; Genbank *COI*: MH138609). ♀ Southwest National Park Bush Blitz, SSS1, -43.199° 146.78481°, 01–09/ii/2016, K. Moore, yellow pan traps (TMAG: F59029; Genbank *COI*: MH138613; stored in ethanol). ♂ Southwest National Park Bush Blitz, SSS1, -43.199° 146.78481°, 01–09/ii/2016, K. Moore, pitfall trap (TMAG: F94025; Genbank *COI*: MK073919).

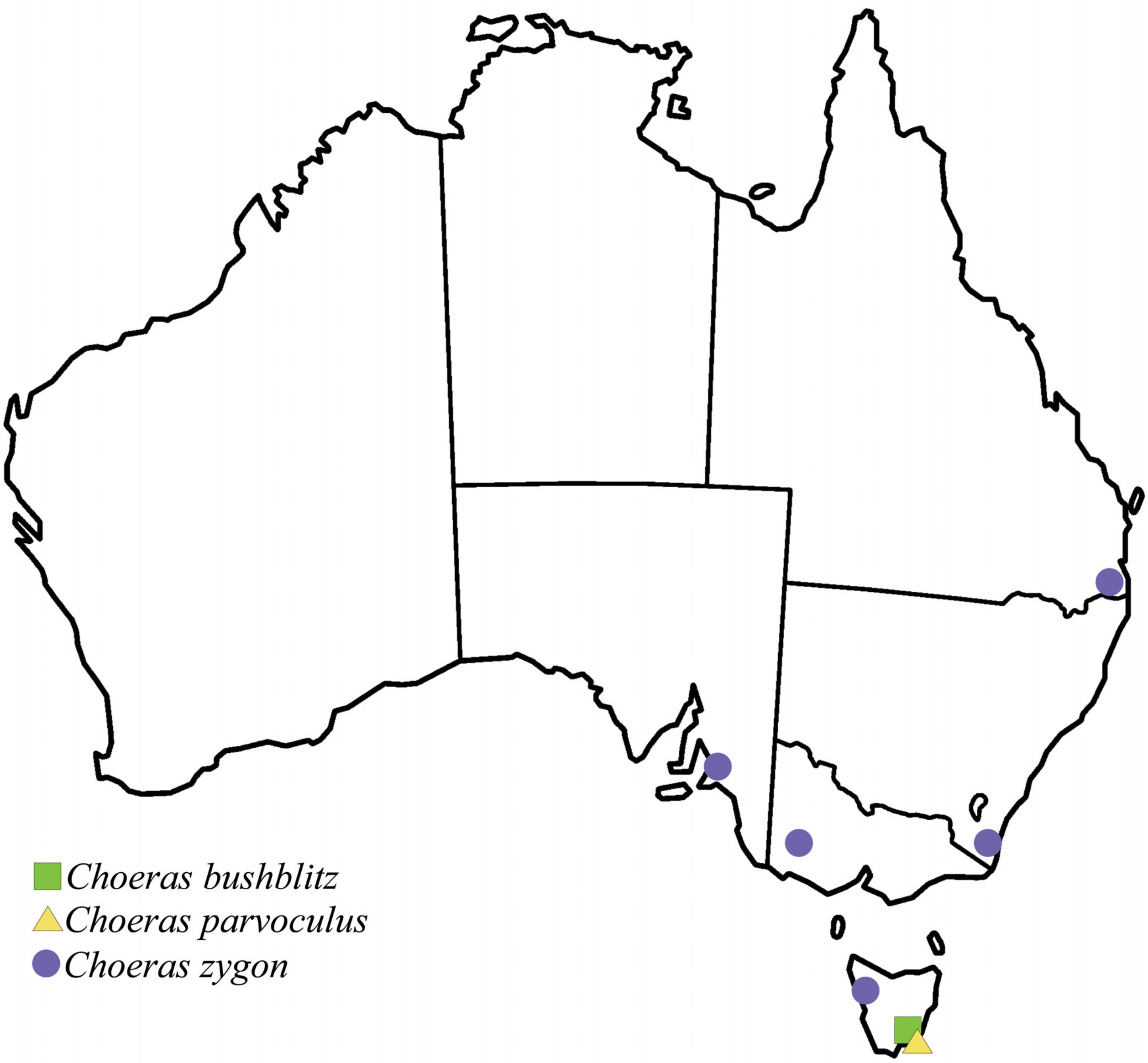

FIGURE 2. Known distribution of the three new *Choeras* species described in this study.

Diagnosis. This species can be separated from the other Australian species of *Choeras* with large fore wing areolets by the following combination of characters: presence of a medial longitudinal carina on the propodeum (as opposed to *C. tegularis* and *C. ceto* which do not possess a medial longitudinal carina), T1 narrowing posteriorly (as opposed to *C. epaphus* and *C. koalascatocola*, which have T1 parallel sided or broadening posteriorly) and by the distinctive colouration of the anteromesoscutum and the strong rugose carinae of the propodeum, which differs from the colouration and sculpturing of all described Australian species.

Description. FEMALE. *Colour*: head dark, antenna light brown with scape and pedicel paler, anteromesoscutum dark with light brown to orange area in centre covering approximately half dorsal width, scutellum and mesoscutum light brown to orange, propodeum light brown or orange at centre with darker outer edges, tergites dark, T1 with pale posterior section at boundary to T2, non-sclerotised area around T1 pale, non-sclerotised area around T2 light brown, sternites and hypopygium dark; coxae (pro-, meso-, metacoxa) pale, pale, pale; femora (pro-, meso-, metafemur) pale, pale, pale with darker blotch posteriorly; tibiae (pro-, meso-, metatibia) pale, pale, pale transitioning to light brown posteriorly; tegula and humeral complex pale; pterostigma dark; fore wing veins dark. *Head*: antenna similar length to body length; body length (head to apex of metasoma) 2.5–3.0 mm; ocular–ocellar line/posterior ocellus diameter 2.5–2.8; interocellar distance/posterior ocellus diameter 1.5–1.6. *Mesosoma*: anteromesoscutum mostly smooth, with shallow punctures associated with setae, more visible in anterior and lateral thirds; mesoscutellar disc completely smooth; number of pits in scutoscutellar sulcus 10; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.3–0.4. *Wings*: fore wing length 2.7 mm; length of veins r/2RS 0.6–0.8; length of veins 2RS/2M 0.8–0.9; length of veins 2M/(RS+M)b 1.7–2.0; pterostigma length/width 2.8–3.0; fore wing areolet large, enclosed. *Legs*: Metatibia inner spur length/ metabasitarsus length 0.4. *Propodeum:* percurrent median longitudinal carina and strong rugose sculpturing, carinae often appearing to form pentagonal areola bisected by longitudinal carina. *Metasoma*: T1 length/width at posterior margin 3; T1 shape clearly narrowing posteriorly with rugulose sculpturing on lateral edges, smoother in centre; T2 width at posterior margin/length 3.6; T2 trapezoid shaped, broadening posteriorly, sculpture smooth and shiny; T3 sculpture smooth and shiny; hypopygium large with some lateral creases and membranous area along ventral margin; ovipositor sheath length/metatibial length 1.1–1.2.

MALE. Very similar to female, however the antenna is longer than body length.

Etymology. This species is named for the Bush Blitz expeditions on which it was collected. These expeditions are a significant contribution to documenting Australia's biodiversity. The species name is a noun in apposition.

Distribution. This species has currently only been collected from the south-west of Tasmania.

Remarks. The molecular data for *C. bushblitz* places it in the clade of Australian species that possess a large fore wing areolet, along with taxa that morphologically can be identified as *Choeras* and *Sathon* (i.e. a clade of species with both membranous and solid hypopygia) (Fig. 1). This species clearly has a membranous area on the hypopygium, and we therefore place it in *Choeras*. It represents the first member of *Choeras,* at least in the Australian fauna, Australian fauna, to possess a propodeum where the rugose surface give the false impression of an areola bisected by a longitudinal carina. There is no information about possible host species. The *COI* divergence within this species is slightly higher than the commonly used 2% delimitation threshold (2.3%) and there are no species with available sequence data within 10% divergence. The Barcode of Life Database (BOLD) Barcode Index Number Registries (BINs) for *C. bushblitz* are: BOLD:ADL3153 and BOLD:ADL5128.

Choeras parvoculus **Fagan-Jeffries & Austin sp. nov.**

(Fig. 4)
urn:lsid:zoobank.org:act:3BCE8A24-220C-44A9-BC81-26E5017C4674

Material examined (including Genbank numbers of DNA barcodes). Holotype: Tasmania: ♀ Southwest National Park Bush Blitz, SSS2, -43.1413° 146.76241°, 03–09/ii/2016, K. Moore, Malaise trap (TMAG: F59020; Genbank *COI*: MH138608 *WG*: MH139103). **Paratype: Tasmania:** ♀ Southwest National Park Bush Blitz, SSS2, -43.1413° 146.76241°, 03–09/ii/2016, K. Moore, Malaise trap (TMAG: F59026; Genbank *COI*: MH138611 *WG*: MH139105).

Diagnosis. Differs from *C. bushblitz*, C. *tegularis*, *C. ceto*, *C. epaphus*, *C. koalascatocola*, *C. helespas* and *C. morialta* by the presence of a small areolet in the fore wing; previously mentioned species all have a large fore wing areolet. Differs from *C. dissors* by having less slender antennae, the fore wing vein r curved rather than sharply angled, and the mesoscutellar disc not densely covered with setae. Differs from *C. calacte* by having smaller eyes (ocular–ocellar line/posterior ocellus diameter 2.7–3.0 compared to 2.0–2.2 in *C. calacte*) and shorter flagellomeres (*C. calacte* has flagellomere 14 1.3 x as long as wide, whilst in *C. parvoculus* flagellomere 14 is as long as wide. Differs from *C. zygon* by smaller eyes and an almost parallel-sided T1 compared to T1 of *C. zygon*, which narrows posteriorly.

Description. FEMALE. *Colour*: all dark other than pale non-sclerotised area of T1–2, antenna dark; coxae (pro-, meso-, metacoxa) dark, dark, dark; femora (pro-, meso-, metafemur) dark lightening at distal end, dark lightening at distal end, dark; (pro-, meso-, metatibia) dark, dark with white band at proximal end, proximal third white distal two thirds dark; tegula and humeral complex light brown; pterostigma dark; fore wing veins dark, paler at proximal end of wings. *Head*: antenna approximately equal to body length; body length (head to apex of metasoma) 1.9–2.0 mm; ocular–ocellar line/posterior ocellus diameter 2.7–3.0; interocellar distance/posterior ocellus diameter 2.0–2.5. *Mesosoma*: anteromesoscutum smooth other than small punctures associated with setae; mesoscutellar disc completely smooth and shining; number of pits in scutoscutellar sulcus 10–12; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.3–0.4. *Wings*: fore wing length 2.0–

2.1 mm; fore wing areolet small, enclosed; length of veins r/2RS 1.8–2; length of veins 2RS/2M 0.6–0.7; length of veins 2M/(RS+M)b 1.3–1.4; pterostigma length/width 2.2–2.4. *Legs*: metatibia inner spur length/metabasitarsus length 0.9–1.0. *Propodeum:* multiple short carinae diverging from posterior centre, medial longitudinal carina in posterior half, rugose appearance in the posterior centre margin, otherwise smooth and shining. *Metasoma*: T1 length/width at posterior margin 1.4–1.8; T1 shape broad, rectangular, almost parallel-sided; T1 sculpture smooth in anterior half, posterior half with shallow striations; T2 width at posterior margin/length 4.1–4.4; T2 sculpture smooth and shiny with a few scattered punctures; T3 sculpture smooth and shiny; hypopygium large with membranous area ventrally; ovipositor sheaths length/metatibial length 0.9–1.1.

MALE. Unknown.

Etymology. The species epithet *parvoculus* combines the Latin 'parvus' meaning little, and 'oculus' meaning eyes, referring to the smaller eyes of this species compared to the morphologically similar *Choeras calacte*. It is a noun in apposition.

Distribution. This species has currently only been collected from Southwest National Park, Tasmania.

Remarks. In this species we also tentatively place the following specimens, which have been sequenced for the *COI* barcoding region by the Biodiversity Institute of Ontario, and are stored in the Centre for Biodiversity Genomics, and are publically available on BOLD in the BIN BOLD:ADD0336. These specimens are all collected from Tasmania, and whilst they were not available to be compared to the type series, the *COI* sequences fall within the 2% divergence threshold that generally discriminates species in the Microgastrinae. BOLD numbers: GMATR1295-16, GMATT3228-16, GMATT3510-16, GMATT3519-16, GMATT3806-16, GMATV2548-16, GMATS2612-16, GMATV2575-16, GMATU3015-16. The nearest neighbour to this group with available sequence information are specimens from Canberra, Australia, at 2.1% *COI* divergence, which based on images available on BOLD, appear to be a distinct species with a larger fore wing areolet and T1 narrowing more strongly posteriorly. The *WG* sequences for the type specimens of *C. parvoculus* are identical. No information about the host is known. The BOLD BIN for *C. parvoculus* is BOLD:ADD0336.

Choeras zygon Fagan-Jeffries & Austin sp. nov.

(Figs 5–6)

urn:lsid:zoobank.org:act:246CA6AB-857D-47E3-9986-E616D861A21E

Material examined (including Genbank numbers of DNA barcodes). Holotype: Queensland: ♀ Lamington NP -28.21° 153.139°, 15–25/i/2007, C. Lambkin, N. Starick, 474m, IBISCA Plot # IQ-500-C, rainforest Malaise trap (QM: T208374; Genbank *COI*: MH138822 *WG*: MH139278). **Paratypes: New South Wales:** ♀ East Boyd State Forest, Goanna Rd, 37°12'05"S 149°46'30"E, 06/xii/2004–12/i/2005, C. Lambkin & N. Starick, Malaise across disused snig-track in forest 56 km SE Bombala, 219 m (ANIC: 32 130201; Genbank *COI*: MH138605). **Queensland:** ♀ Lamington NP, -28.262 153.17, 11–21/iii/2008, C. Lambkin & N. Starick, 1140m, IBISCA Plot # IQ-1100-D, rainforest Malaise trap (QM: T208375; Genbank *COI*: MH138872). **South Australia:** ♀ Cox Scrub Conservation Park, 35°19'52"S 138°44'51"E, 25/i/2016–13/ii/2016, A. Austin, Malaise trap (WINC; Genbank *COI*: MH138601 *WG*: MH139098). **Tasmania:** ♀ Pieman River State Reserve Bush Blitz: E of Corinna campground, SSS2, -41.6556 145.0819, 27/i/2015, S. Grove, Malaise trap (TMAG: F59027; Genbank *COI*: MH138612 *WG*: MH139106). **Victoria:** ♀ Vic, Grampians National Park Bioscan, 37°19'51"S 142°11'36" E, 26–28/xi/2012, B. Patullo, P. Lillywhite, Malaise trap, Ming Ming Swamp GB442 (MV: HYM-61350; Genbank *COI*: MH138614). ♀ Vic, Grampians National Park Bioscan, 37°19'53"S 142°11'17" E, 26–28/xi/2012, B. Patullo, P. Lillywhite, Malaise trap, Ming Swamp GB442 (MV: HYM-61351; Genbank *COI*: MH138615 *WG*: MH139107; stored in ethanol).

Diagnosis. *Choeras zygon* can be separated from the other Australasian species of *Choeras* with a small fore wing areolet by having T2 narrowing posteriorly (as opposed to the almost parallel sided T1 of *C. calacte* and *C. parvoculus*) and differs from *C. papua* by a lack of pale orange colouration over the entire body.

Description. FEMALE. *Colour*: body dark, ranging from 'black' in Tas, SA and Vic specimens to 'reddish-brown' in specimens from Qld and NSW, pale non-sclerotised areas of T1-2, sternites, and hypopygium; antenna dark, sometimes with paler scape and pedicle; coxae (pro-, meso-, metacoxa) pale, pale, dark fading to pale in distal half; femora (pro-, meso-, metafemur) dark, dark, dark, although colour much paler in Qld and NSW specimens; tibiae (pro-, meso-, metatibia) dark with pale area in proximal third, colour much paler in Qld and NSW specimens; tegula and humeral complex pale in Qld and NSW specimens, dark in others; pterostigma dark; fore wing veins dark. *Head*: antenna approximately equal to body length; body length (head to apex of metasoma) 2.3–2.9 mm; ocular–ocellar line/posterior ocellus diameter 2.0–2.6; interocellar distance/posterior ocellus diameter 1.5–2.0. *Mesosoma*: anteromesoscutum smooth with shallow punctures associated with setae; mesoscutellar disc completely smooth with sparse setae; number of pits in scutoscutellar sulcus 8–10, maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.3–0.6. *Wings*: fore wing length 2.2–2.6 mm; length of veins r/2RS 1.5–2.0; vein r slightly curved; length of veins 2RS/2M 0.7–0.9; length of veins 2M/(RS+M)b 0.9–1.4; pterostigma length/width 2.5–2.8; fore wing areolet small and closed. *Legs*: metatibia inner spur length/metabasitarsus length 0.3–0.4. *Propodeum:* often with short carinae or rugosity radiating from centre of posterior boundary, sometimes with a medial longitudinal carina in posterior half, or a complete medial longitudinal carina, posterior lateral corners of propodeum rugose, sometimes area either side of medial longitudinal carina rugose, remainder of propodeum smooth. *Metasoma*: T1 length/width at posterior margin 2.1–2.7; T1 narrowing slightly posteriorly, anterior half often with rugosity on lateral edges, often smooth in centre, posterior half shallowly punctate with surrounding rugosity, sometimes with smooth semi-circle at border with T2; T2 width at posterior margin/length 2.6–4.0; T2 sculpture mostly smooth, sometimes with longitudinal striations right at border with T1, sometimes with very shallow pits near border with T3; hypopygium large with membranous area mid-ventrally; ovipositor sheaths length/metatibial length 1.1–1.2.

MALE. Unknown.

Etymology. The name 'zygon' references the shape-shifting race of aliens on the BBC television show *Doctor Who*. The shape-shifting nature of this fictional race mirrors the large morphological variability within *C. zygon*, which appears to 'shape shift' (i.e. variation in colour and sculpture) between different populations whilst retaining extremely small molecular divergences. The Zygon in *Doctor Who* also consume their 'host', a trait particularly relevant to endoparasitoid wasps. The species name is a noun in apposition.

Distribution. This species is widespread and currently known from South Australia, southern Qld, New South Wales, Victoria and Tasmania.

Remarks. This species shows variation in characters often used to separate species of Microgastrinae, namely the sculpturing of the propodeum and T1, and also shows geographical variation in colour. However, there is less than 1.4% divergence among the *COI* sequences of these specimens, well below the threshold often used to delimit species in this subfamily. As such, we describe this species as one with substantial morphological variation associated with different populations, which nonetheless has distinct characters that separate it from other described species of *Choeras* from Australasia. However, the variation in the propodeal and T1 sculpture will need to be taken into account when more species are described, particularly those which are shown from molecular analyses to be closely related. Specimens from South Australia, Victoria and Queensland shared a *WG* haplotype, however the *WG* sequence of the specimen from Tasmania is 4 bp (of a total 443 bp sequence length) different. The nearest neighbour with available *COI* DNA barcodes is an unidentified species of *Choeras* from Queensland, at a distance of 2.9%. The BOLD BIN for *C. zygon* is BOLD:ADL3152.

Dolichogenidea **Viereck**

Dolichogenidea Viereck 1911: 173 (as a subgenus of *Apanteles* Foerster s.1.); generic status by Mason 1981: 34. Austin and Dangerfield 1992: 27. See Shenefelt (1972) for earlier bibliographic history, Mason (1981) for discussion of relationships, and Fagan-Jeffries and Austin (2018a) for comments on the Australian fauna.

Type species, by original designation, *Apanteles* (*Dolichogenidea*) *banksi* Viereck.

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, often as long as or longer than length of metatibia, but also commonly shorter than the metatibia.

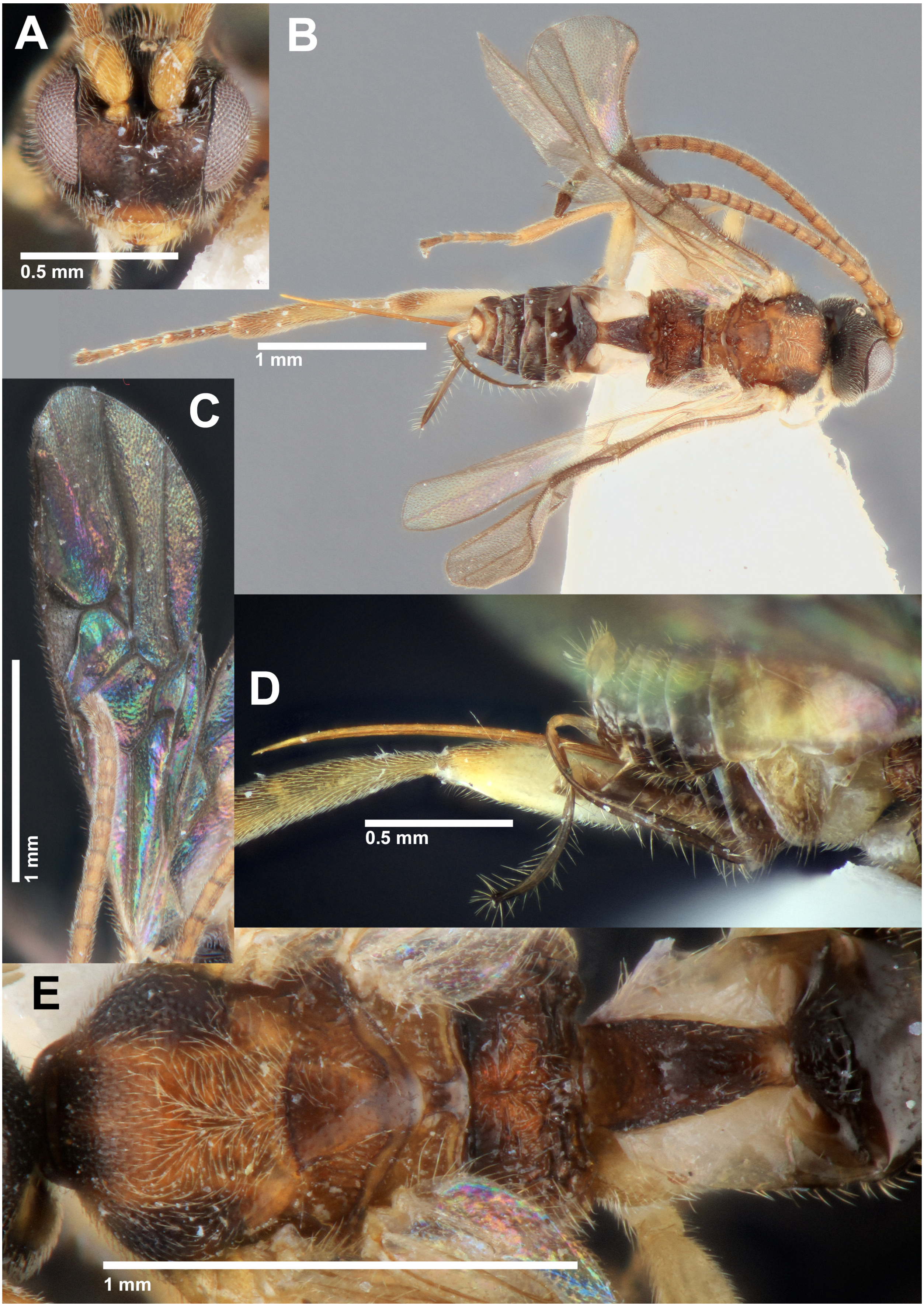

FIGURE 3. *Choeras bushblitz* holotype A. anterior view of head; B. dorsal habitus; C. fore wing; D. lateral view of metasoma; E. dorsal mesosoma and T1–2.

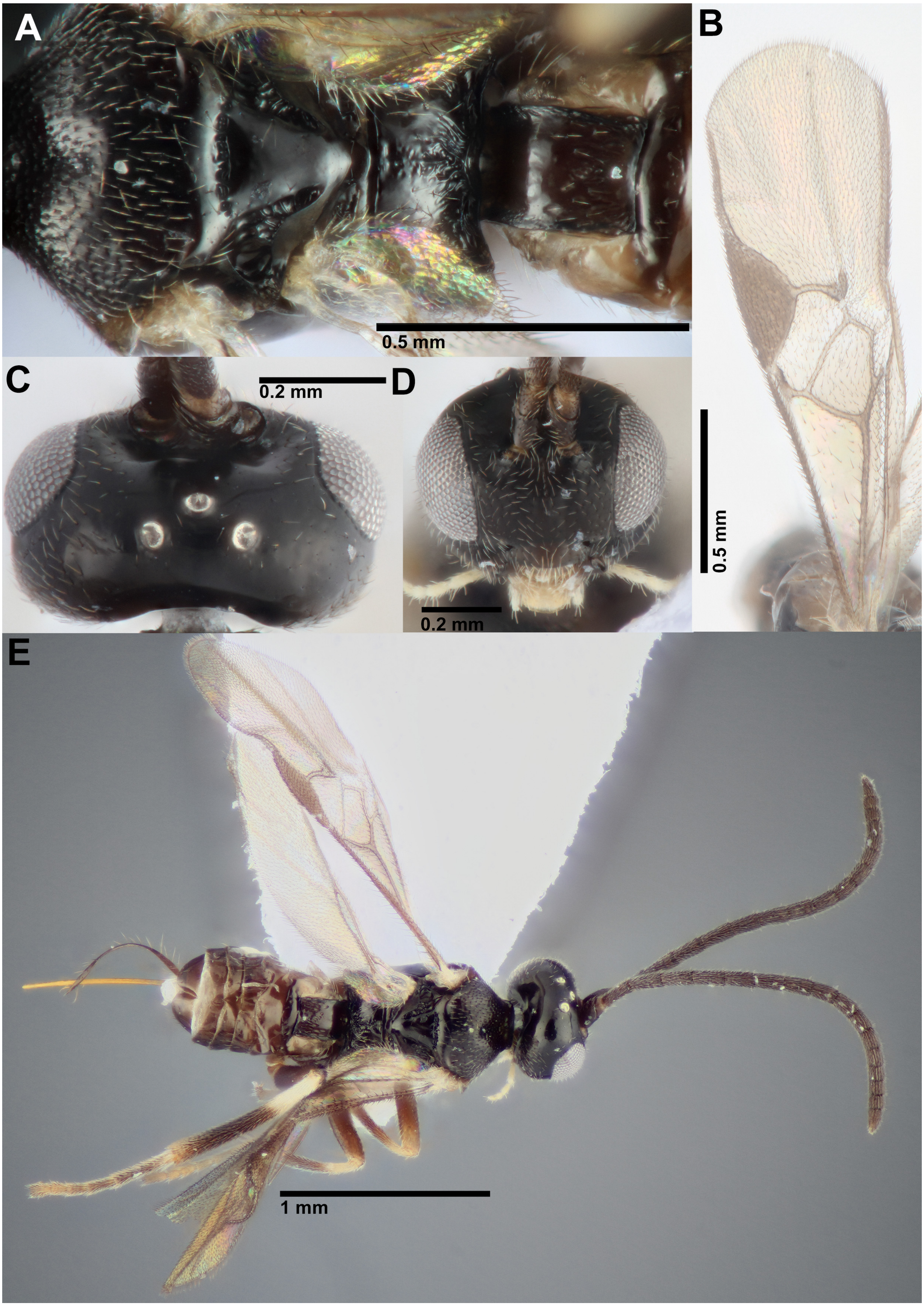

FIGURE 4. *Choeras parvoculus* holotype: A. mesosoma and partial metasoma; B. fore wing; C. dorsal view of the head; D. anterior view of the head; E. dorsal habitus.

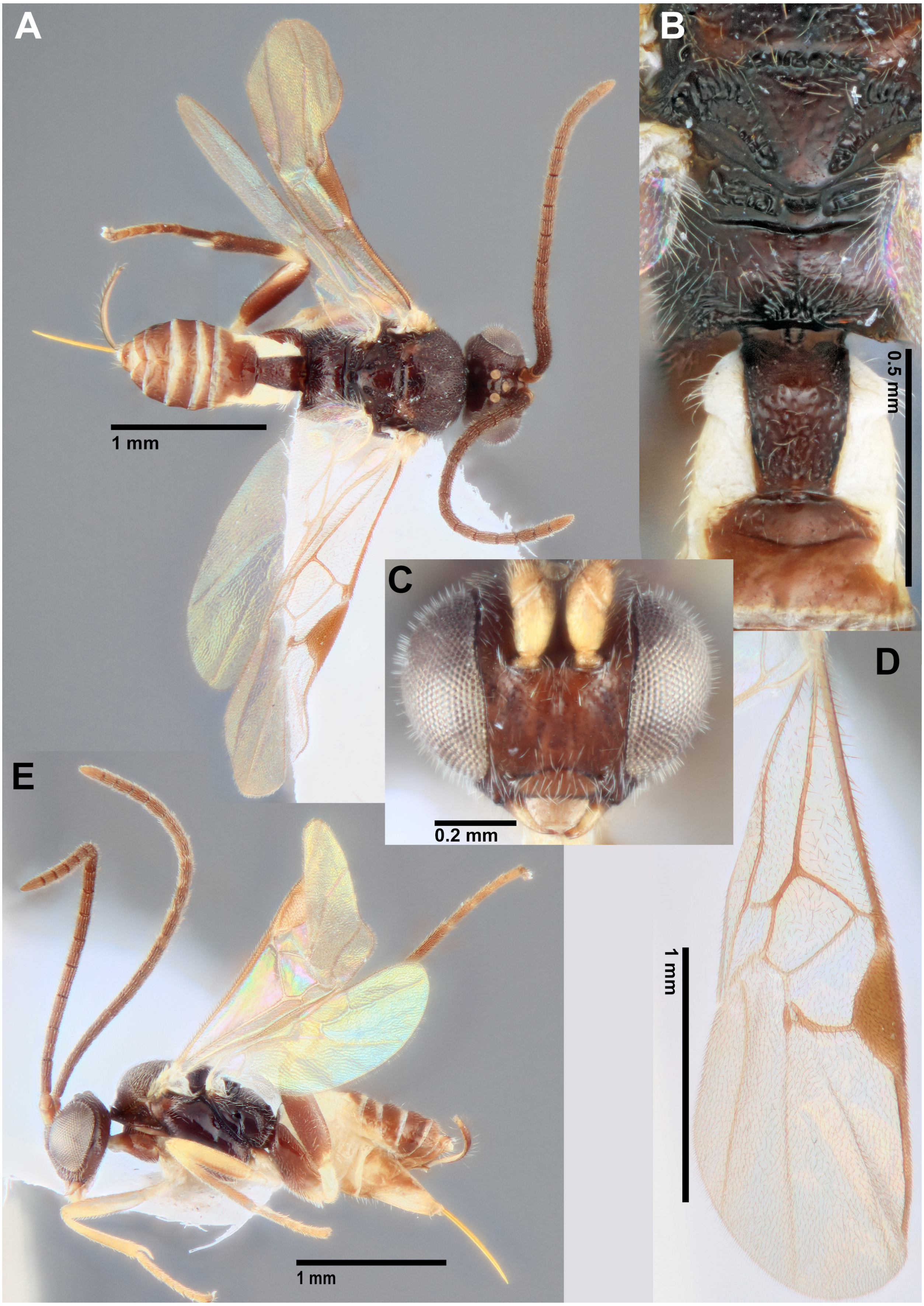

FIGURE 5. *Choeras zygon* holotype. A. dorsal habitus; B. mesosoma and T1–2; C. anterior head; D. fore wing; E. lateral habitus.

Remarks. *Dolichogenidea* is a cosmopolitan genus with approximately 200 described species (Yu *et al.* 2016; Fagan-Jeffries *et al.* 2018a; Liu *et al.* 2018). There are currently nine species described from Australia: *D. biroi* (Szepligeti 1905), *D. eucalypti* Austin and Allen 1989, *D. finchi* Fagan-Jeffries and Austin 2018, *D. hyposidrae* (Wilkinson 1928), *D. lipsis* (Nixon 1967), *D. mediocaudata* Fagan-Jeffries and Austin 2018, *D. miris* (Nixon 1967), *D. tasmanica* (Cameron 1912), and *D. xenomorph* Fagan-Jeffries and Austin 2018. There are an additional 17 species recorded from the Australasian region, mostly from Papua New Guinea and Fiji. The genus is generally monophyletic in molecular studies, and is clearly distinct from the morphologically similar genus *Apanteles* Foerster (Smith *et al.* 2013; Fagan-Jeffries *et al.* 2018b). Most of the species described in this study have restricted known distributions (Fig. 7), however, this is likely to relate to inadequate sampling rather than representing true distributions. The six species described here are just a fraction of the diversity suggested by molecular data (Fig. 8).

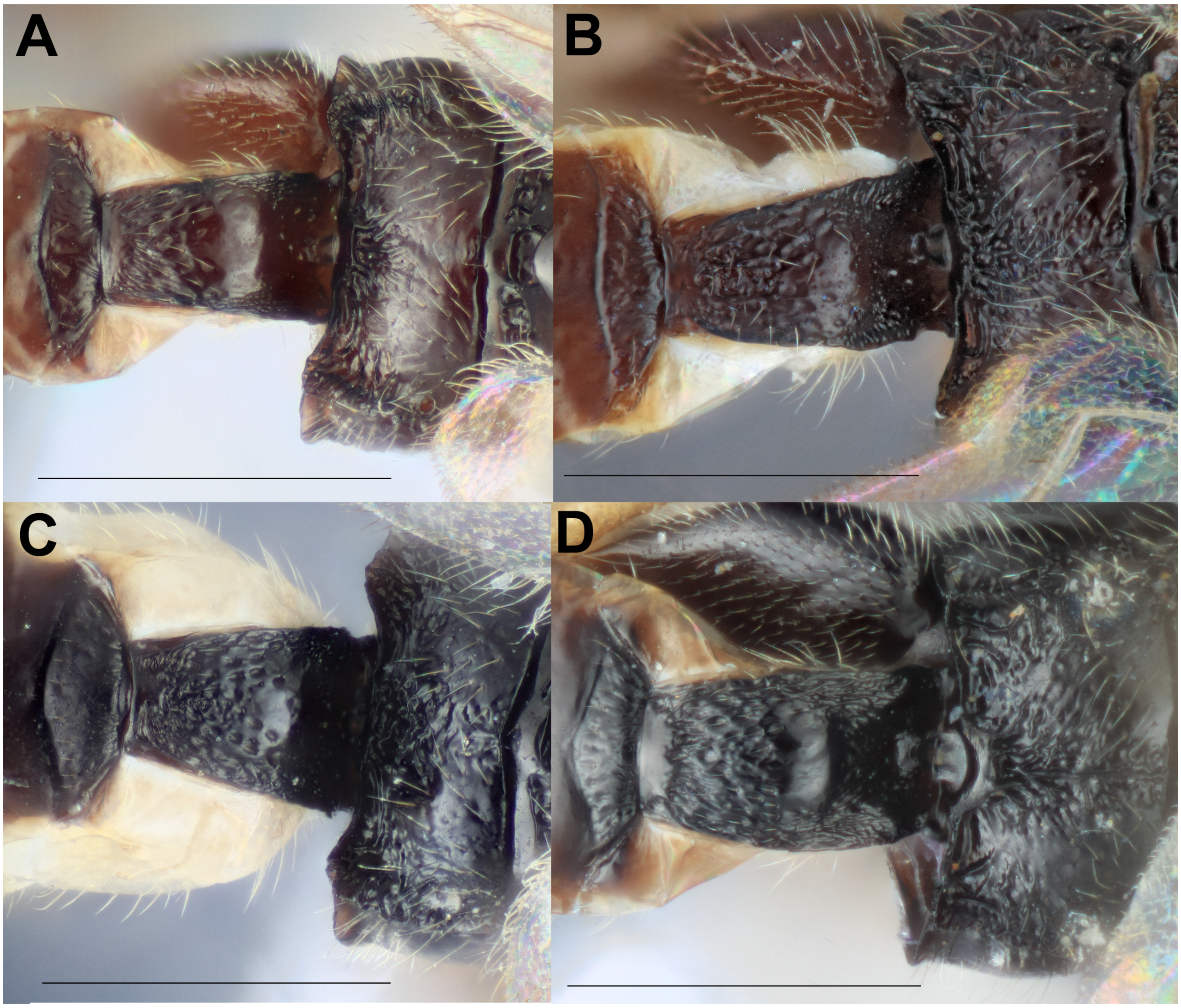

FIGURE 6. *Choeras zygon* range of propodeal and T1 sculpturing. A. specimen from NSW, propodeum with radiating short carinae and no clear longitudinal medial carina with much reduced rugosity in medial area; B. paratype from Qld, indistinct medial carina, rugosity around centre longitudinal area; C. specimen from Tas, as in B; D. specimen from Vic, strong medial longitudinal carina, rugosity surrounding medial area, T1 with smooth area at border with T2. Scale bars = 0.5 mm.

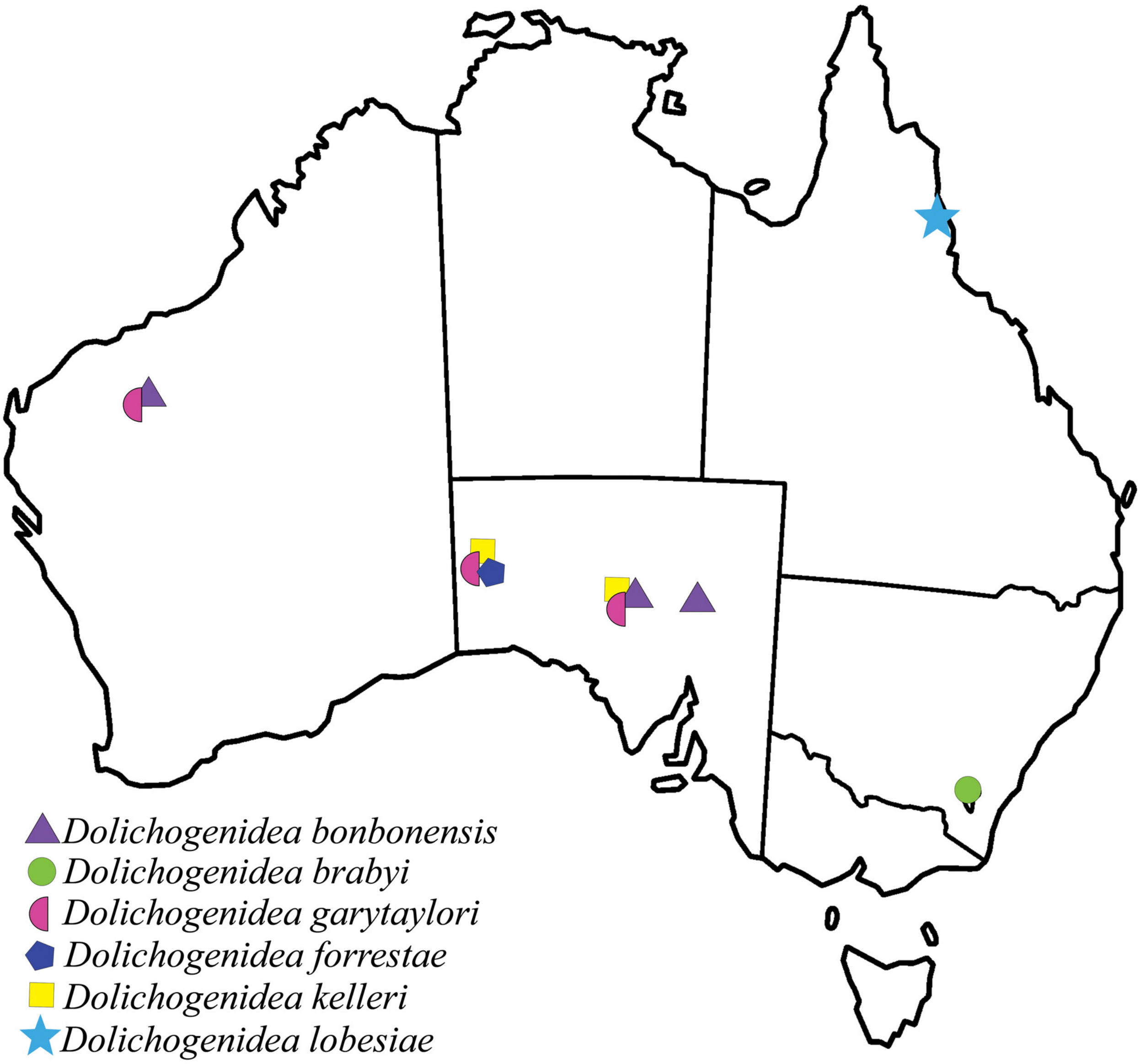

FIGURE 7. Known distributions of the six *Dolichogenidea* species described in this study.

Dolichogenidea bonbonensis **Fagan-Jeffries & Austin sp. nov.**
(Fig. 9)
urn:lsid:zoobank.org:act:49AC03B5-FCB0-4DE2-88F3-209F60EA0322

Material examined (including Genbank numbers of DNA barcodes). Holotype: South Australia: ♀ Bon Bon Stn, 30°18'50"S 135°32'50"E, 28/x/2010, R. Kittel, Bush Blitz Svy RK129 on *Acacia victoriae* sweep netting (SAMA: 32-036126; Genbank *COI*: MH138727 *WG*: MH139204). **Paratypes: South Australia:** ♀ Witchelina Stn, 30°01'07"S 137°54'04"E, 23/x/2010, R. Kittel, Bush Blitz Svy RK091 sweeping *Acacia victoriae* (SAMA: 32-036127; Genbank *COI*: MH138708 *WG*: MH139188). **Western Australia:** ♀ Kariijini NP, Weano Gorge Rd, 22°21'19"S 118°15'00"E, 25/iv/2003–15/v/2003, C. Lambkin & T. Weir, Malaise grassy dry creek *Eucalyptus* & *Acacia* scrub, 695 m (ANIC: 32 130220; Genbank *COI*: MH138946 *WG*: MH139367).

Diagnosis. *Dolichogenidea bonbonensis* can be separated from *D. biroi*, *D. ilione* (Nixon 1967), *D. lipsis* and *D. tasmanica* by the absence of a white gena blotch. *Dolichogenidea bonbonensis* has ovipositor sheaths slightly shorter than the metatibia (ovipositor sheaths length/metatibial length 0.7–0.9) whilst *D. acratos* (Nixon 1967), *D. brabyi*, *D. eucalypti, D. expulsa* (Turner 1918), *D. garytaylori, D. hyposidrae* and *D. orelia* (Nixon 1967) all have ovipositors much shorter, half the length of the metatibia or less, whilst *D. carposinae* (Wilkinson 1938)*, D. coequata* (Nixon 1967)*, D. cyamon* (Nixon 1967)*, D. finchi, D. hyblaeae* (Wilkinson 1928)*, D. ilione, D. inquisitor* (Wilkinson 1928), *D. iulis* (Nixon 1967)*, D. labaris* (Nixon 1967)*, D. lobesiae*, *D. mediocaudata, D. miris*, *D. platyedrae* (Wilkinson 1928)*, D. stantoni,* and *D. xenomorph* all have ovipositor sheaths longer than the metatibia. *Dolichogenidea kelleri* has slightly longer ovipositor sheaths than *D. bonbonensis* (equal to metatibia) and a less well-defined areola. *Dolichogenidea gentilis* (Nixon 1967) has a similar ovipositor sheath length/metatibia ratio to *D. bonbonensis,* but *D. gentilis* has the propodeal areola poorly defined, whilst *D. bonbonensis* has a clearly defined areola. *Dolichogenidea heterusiae* (Wilkinson 1928) has ovipositor sheaths approximately equal to the metatibia, but can also be separated from *D. bonbonensis* by having a more rugulose propodeum (*D. bonbonensis* has a mostly smooth propodeum). *Dolichogenidea heterusiae* can also be separated by the prominent carinae on the lateral margins of T1, which are not present in *D. bonbonensis*. *Dolichogenidea upoluensis* (described from a single male) and *D. agonoxenae* are described as having a rugose propodeum, whilst *D. bonbonensis* has a mostly smooth propodeum (Table 1).

Description. FEMALE. *Colour*: all dark, antenna dark; coxae (pro-, meso-, metacoxa) dark, dark, dark; femora (pro-, meso-, metafemur) pale/light brown, dark, dark; tibiae (pro-, meso-, metatibia) light brown, dark, dark; tegula and humeral complex dark; pterostigma dark; fore wing veins dark. *Head*: antenna slightly shorter than body length; body length (head to apex of metasoma) 1.9–2.1 mm; ocular–ocellar line/posterior ocellus diameter 1.6–1.8; interocellar distance/posterior ocellus diameter 2.6–2.8. *Mesosoma*: anteromesoscutum evenly and densely punctate; mesoscutellar disc with a few fine punctures associated with setae; number of pits in scutoscutellar sulcus 13–15; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.5. *Wings*: fore wing length 2.1–2.3 mm; length of veins r/2RS 1.1–1.6; length of veins 2RS/2M 1.0–1.3; length of veins 2M/(RS+M)b 1.2–1.3; pterostigma length/width 2.5–2.8. *Legs*: metatibia inner spur length/metabasitarsus length 0.5. *Propodeum:* clearly defined areola, open at anterior end, lateral carinae present and reasonably straight, otherwise mostly smooth with some reticulate rugose sculpturing at anterior centre. *Metasoma*: T1 length/width at posterior margin 1.1–1.2; T1 shape broad, rectangular, almost parallel-sided; T1 sculpture rugose with irregularly shaped punctures, longitudinal strigosity or rugosity in posterior half; T2 width at posterior margin/length 3.8–4.3; T2 sculpture almost smooth, some sparse punctures associated with setae; T3 sculpture smooth and shiny; hypopygium with central membranous area mid-ventrally; ovipositor sheaths length/ metatibial length 0.7–0.9.

MALE. Unknown.

Etymology. The species name *bonbonensis* is from the collecting locality of the holotype, Bon Station, South Australia. It is a Latin second declension adjective.

Distribution. This species has been collected from central South Australia and northern WA.

Remarks. The specimen from WA shows slight variation in colour of the metasoma, and in the curvature of the carinae at the base of the propodeal areola. However, there is less than 0.5% difference in the *COI* sequences of this specimen and those from South Australia, and all specimens share a *WG* haplotype. As such, we include the WA specimen in the type series despite the small morphological differences. The BOLD BIN for *D. bonbonensis* is BOLD:ADL4681.

Dolichogenidea brabyi Fagan-Jeffries & Austin sp. nov.

(Fig. 10)

urn:lsid:zoobank.org:act:D5196CB0-2A43-420F-A23E-4155DA29906C

Material examined (including Genbank numbers of DNA barcodes). Holotype: Australian Capital Territory: ♀ Black Mountain, emerged 6/iii/2017, M.F. Braby, reared from larva of *Pollanisus apicalis* (Lep: Zyg) (ANIC: 32 130291; Genbank *COI*: MH138906). **Paratypes:** 2♂, same data as holotype (ANIC: 32 130292, 32 130293).

Diagnosis. *Dolichogenidea brabyi* can be separated from *D. biroi*, *D. ilione, D. lipsis,* and *D. tasmanica* by the absence of a white gena blotch. It can be separated from *D. bonbonensis*, *D. carposinae, D. coequata, D. cyamon, D. finchi, D. gentilis, D. heterusiae, D. hyblaeae, D. ilione, D. inquisitor, D. iulis, D. kelleri*, *D. labaris, D. lobesiae*, *D. mediocaudata, D. miris*, *D. platyedrae, D. stantoni,* and *D. xenomorph*, by having ovipositor sheaths shorter, approximately 0.4 x the length of the metatibia, whilst the species listed above all have ovipositors all at least 0.7 x as long as the metatibia and generally much longer. *Dolichogenidea brabyi* has a similar ovipositor sheath length to *D. acratos*, *D. expulsa* and *D. orelia,* but can be distinguished from *D. acratos* by the slightly broadening T1 (*D. acratos* has T1 parallel-sided), from *D. expulsa* by a smoother anterior half of T2 and different T1 sculpturing (*D. expulsa* has densely rugulose T2) and from *D. orelia* by a smoother propodeum (*D. orelia* has the propodeal surface coarsely rugose). Of the species described here, *D. brabyi* is most similar to *D. eucalypti* (particularly in the form of the propodeum), but has a different host and T2 sculptured (smooth in *D. eucalypti*) with distinctive anterior curved corners. *Dolichogenidea brabyi* also closely resembles *D. garytaylori* and *D. hyposidrae*, but the distinctive T2 sculpturing and shape clearly differentiates *D. brabyi* from these two species. The punctate sculpturing on the anteromesoscutum also differs among *D. brabyi* and *D. garytaylori* and *D. hyposidrae*; they are sparser and more irregular in *D. hyposidrae* than *D. brabyi*, and finer and shallower in *D. garytaylori* than *D. brabyi*. Both *D. agonoxenae* and *D. upoluensis* are described as possessing a rugose propodeum whilst *D. brabyi* has a mostly smooth propodeum (Table 1).

Description. FEMALE. *Colour:* all dark but with slightly lighter non-sclerotised area around T1–2, antenna dark; coxae (pro-, meso-, metacoxa) dark, dark, dark; femora (pro-, meso-, metafemur) dark to pale at posterior end, dark to paler at posterior end, dark; tibiae (pro-, meso-, metatibia) pale though darkening towards posterior end, pale though darkening towards posterior end, dark with lighter area at anterior third; tegula and humeral complex dark; pterostigma dark; fore wing veins pale proximally, dark distal to pterostigma. *Head*: antenna slightly longer than body length; body length (head to apex of metasoma) 2.1 mm; ocular–ocellar line/posterior ocellus diameter 2.0; interocellar distance/posterior ocellus diameter 2.2. *Mesosoma*: anteromesoscutum punctate with punctures irregularly spaced and sized, mesoscutellar disc smooth with scattered tiny shallow punctures associated with setae; number of pits in scutoscutellar sulcus 6; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.4. *Wings*: fore wing length 2.5 mm; length of veins r/2RS 1.5; length of veins 2RS/2M 1.3; length of veins 2M/(RS+M)b 0.8; pterostigma length/width 3.1. *Legs*: metatibia inner spur length/ metabasitarsus length 0.5. *Propodeum:* areola clearly defined in posterior half and most of anterior half, but open at anterior end, lateral carinae clear and mostly straight, anterior half of propodeum with shallow punctate sculpturing which is more pronounced in anterior centre where areola is open, posterior half of propodeum and centre of areola mostly smooth. *Metasoma*: T1 length/width at posterior margin 1.2; T1 shape broad, slightly broadening posteriorly; T1 sculpture reticulate rugose with occasional irregularly shaped punctures; T2 width at posterior margin/length 3.5; T2 with indistinct shallow sculpture and visibly not smooth, line of ridges/pits at border with T3; T3 sculpture smooth and shiny; hypopygium with central membranous area mid-ventrally; ovipositor sheaths length/metatibial length 0.4.

MALE. As female but with 8 pits in scutoscutellar sulcus, slight variations in measurements.

Etymology. This species is named for the collector and prominent lepidopterist Dr Michael Braby, who has generously provided EPF-J with many reared specimens throughout her PhD. The authors would like to note that many host records for small parasitoids such as microgastrines exist because of the diligence of lepidopterists in keeping and preserving parasitoid specimens that often appear ‘undesirably’ when they are attempting to rear adult butterflies and moths, and we would like to extend thanks to those who preserve them in collections. The species name is an invariable genitive.

Distribution. This species is known from the Australian Capital Territory, however the host is widely distributed in the eastern states, including in Tasmania, South Australia, and southern Queensland, thus it is highly possible that *D. brabyi* also occurs in these regions.

Remarks. This species is gregarious and has been reared from *Pollanisus apicalis* Walker (1854) (Lepidoptera: Zygaenidae), a small metallic green day-flying moth. The caterpillars are known to feed on the plant *Hibbertia obtusifolia*.

***Dolichogenidea forrestae* Fagan-Jeffries & Austin sp. nov.**
(Fig. 11)
urn:lsid:zoobank.org:act:3FDC2335-3A17-4169-AAC0-D23E6386031C

Material examined (including Genbank numbers of DNA barcodes). Holotype: South Australia: ♀ Great Victoria Desert between Oak Valley and 64km NW, 29°00'24.23"S, 130°15'37.37"E to 29°24'57.70"S, 130°43'51.83"E, 3/ix/2015, J.A. Forrest, R. Leijs, vehicle net, *Euc*. woodland (SAMA: 32-036145; Genbank *COI*:

MK073917). **Other material: South Australia:** ♂ Great Victoria Desert, Cook Road, 28.9684°S, 130.0772°E to 29.0449°S, 129.9475°E, 29/viii/2015, J.A. Forrest, R. Leijs, vehicle net (SAMA: 32-036146; Genbank *COI*: MK073916).

Diagnosis. *Dolichogenidea forrestae* can be separated from *D. biroi*, *D. ilione, D. lipsis,* and *D. tasmanica* by the absence of a white gena blotch. *Dolichogenidea bonbonensis*, *D. carposinae, D. coequata, D. cyamon, D. finchi, D. gentilis, D. heterusiae, D. hyblaeae, D. ilione, D. inquisitor, D. iulis, D. kelleri*, *D. labaris, D. lobesiae*, *D. mediocaudata, D. miris*, *D. platyedrae, D. stantoni,* and *D. xenomorph* all have ovipositor sheaths at least 0.7 x as long as the metatibia, generally much longer, whilst *D. forrestae* has ovipositor sheaths only 0.6 x the length of the metatibia. *Dolichogenidea bonbonensis,* which has ovipositor 0.7 x the metatibia, is also differentiated by a more clearly differentiated areola. *Dolichogenidea brabyi, D. eucalypti, D. garytaylori,* and *D. hyposidrae* all have the propodeal areola at least partially defined, whilst *D. forrestae* only has several fine diverging carinae at the posterior centre of the propodeum. *Dolichogenidea orelia* has a complete areola and shorter ovipositor sheaths compared to *D. forrestae*. *Dolichogenidea acratos* has a similar ovipositor sheath to metatibia ratio (0.5) to *D. forrestae* (0.6) but has a strongly carinate, complete propodeal areola easily separated from the indistinct areola of *D. forrestae. Dolichogenidea agonoxenae* is described as having a strongly formed propodeal areola and costulae which distinguishes the species from the indistinct areola of *D. forrestae*. *Dolichogenidea expulsa* can be differentiated from *D. forrestae* by a complete areola, T1 broadening posteriorly (*D. forrestae* has T1 with parallel margins) and T2 densely rugose (*D. forrestae* has T2 almost smooth). *Dolichogenidea upoluensis* is described as having an indistinct areola and costulae with very weak carinae, implying that the costulae carinae are still able to be distinguished, which separates this species from *D. forrestae* which has a propodeum with no trace of lateral carinae (Table 1).

Description. FEMLAE. *Colour*: all dark, antenna dark; coxae (pro-, meso-, metacoxa) dark, dark, dark; femora (pro-, meso-, metafemur) dark, dark to paler at posterior end, dark; tibiae (pro-, meso-, metatibia) dark, dark with lighter area anteriorly, dark with lighter area anteriorly; tegula and humeral complex pale; pterostigma dark; fore wing veins mostly dark, M+CU1, 1-M and 1-SR+M pale. *Head*: antenna approximately equal to body length; body length (head to apex of metasoma) 2.5 mm; ocular–ocellar line/posterior ocellus diameter 1.6; interocellar distance/posterior ocellus diameter 2.3. *Mesosoma*: anteromesoscutum punctate, punctures mostly evenly sized and spaced, but generally smaller and more distinct over notauli; mesoscutellar disc with numerous tiny shallow scattered punctures associated with setae; number of pits in scutoscutellar sulcus 21–22; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.5–0.6. *Wings*: fore wing length 2.5 mm; length of veins r/2RS 1.5; length of veins 2RS/2M 1.3; length of veins 2M/(RS+M)b 2.0; pterostigma length/width 2.6. *Legs*: metatibia inner spur length/metabasitarsus length 0.6. *Propodeum:* generally smooth, scattered shallow punctures, areola only indicated by slight depression and area of rugosity in posterior centre of propodeum and multiple short diverging carinae posteriorly. *Metasoma*: T1 length/width at posterior margin 1.2; T1 shape broad, rectangular, almost parallel-sided, T1 sculpture punctate; T2 width at posterior margin/length 3.5; T2 sculpture almost smooth; T3 sculpture smooth and shiny; hypopygium with central membranous area mid-ventrally; ovipositor sheaths length/metatibial length 0.6.

Etymology. This species is named for Jan Forrest (OAM) who collected the specimens, and who once supervised a young high school student (author EPF-J) volunteering in the South Australian Museum entomology collection and exposed her to the world of professional insect collections for the first time. The species name is an invariable genitive.

Distribution. So far only collected from the Great Victoria Desert, in western SA.

Remarks. We include in the examined material a male specimen from the same location that resembles the female in the form of the propodeum, but with T1 narrower and longer (T1 length/width at posterior margin ratio larger) and much smoother, and T2 more triangular. The differences in the tergites between the male and female specimens were quite pronounced and larger than what we would generally consider species-level variation. However, the sequenced *COI* barcode has a divergence of only 5 SNPs (0.08% divergent), well within the normal genetic threshold of a microgastrine species. As such, we include it here, but with the substantial morphological variation we question the validity of the DNA barcode, and do not include this specimen in the type series. The BOLD BIN for *D. forrestae* is BOLD:ADO7795.

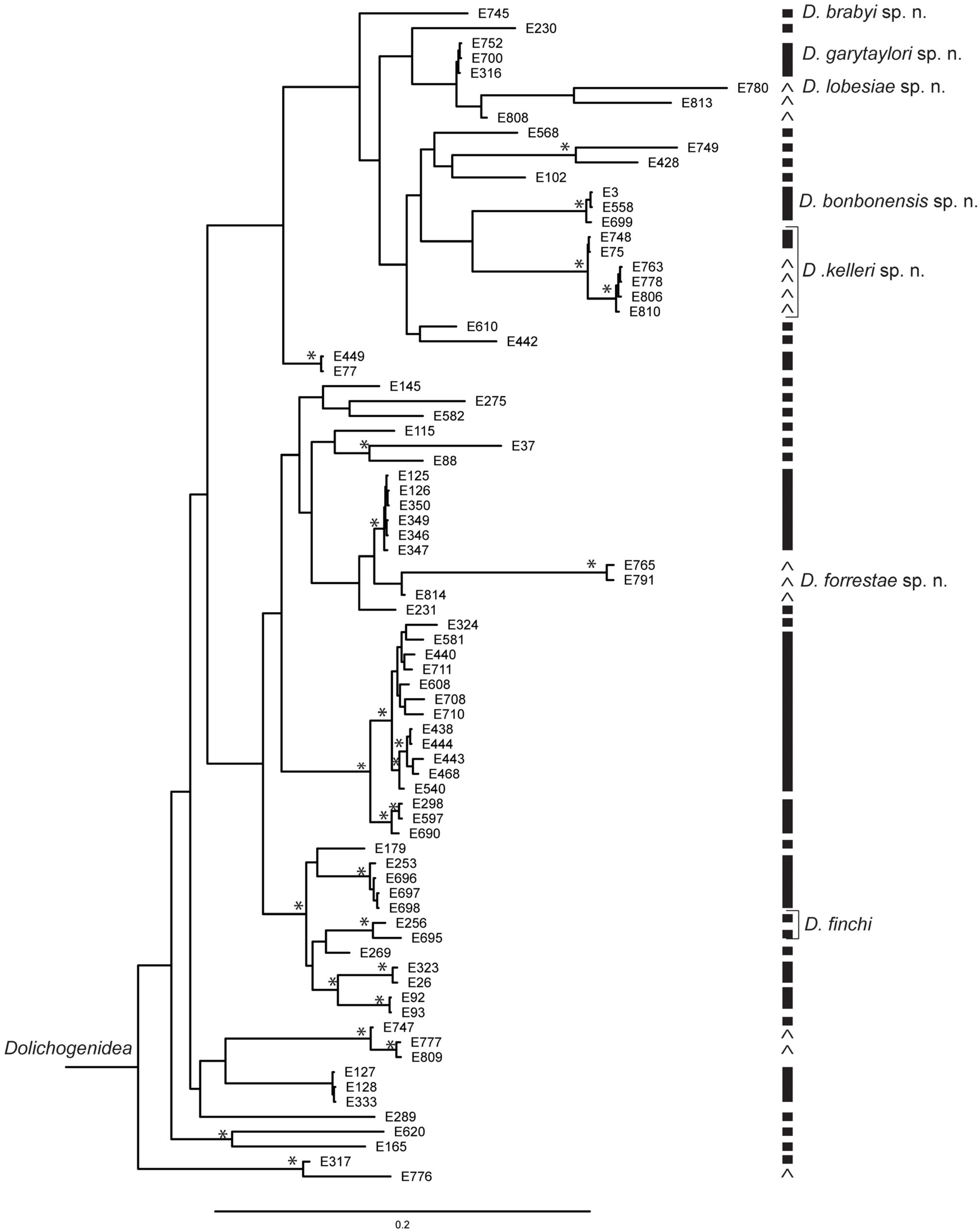

FIGURE 8. The *Dolichogenidea* clade isolated from a larger concatenated *COI* and *WG* Bayesian tree of Microgastrinae. * indicates nodes with ≥ 95% posterior probability support. The consensus species delimitation hypothesis as determined in Fagan-Jeffries *et al.* (2018b) is indicated with bars to the right of the tree. ^ indicates the specimen was newly sequenced since Fagan-Jeffries *et al.* (2018b).

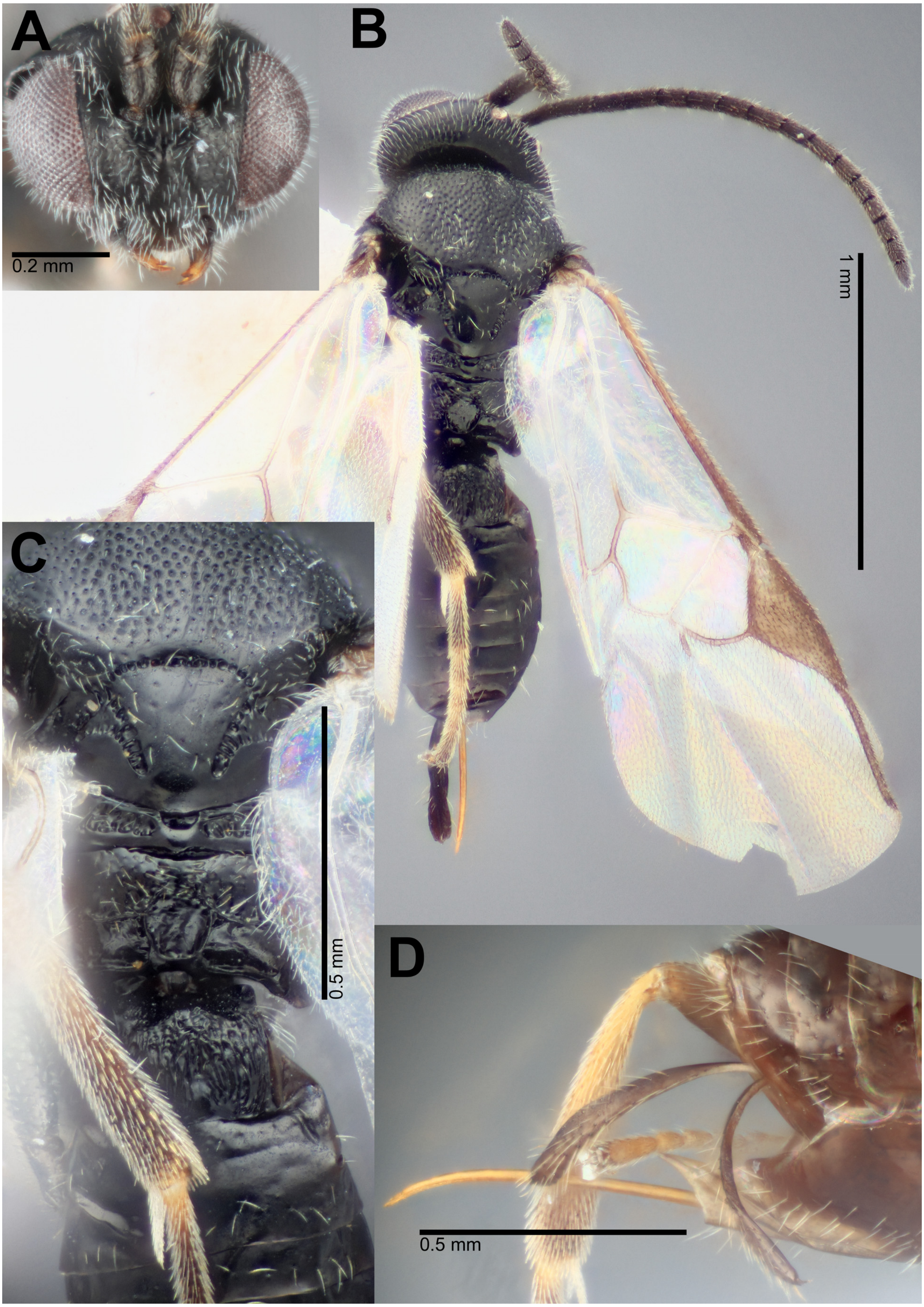

FIGURE 9. *Dolichogenidea bonbonensis* A. holotype, anterior head; B. holotype, dorsal habitus; C. holotype, meso- and metasoma (in part); D. paratype, hypopygium and ovipositor sheaths.

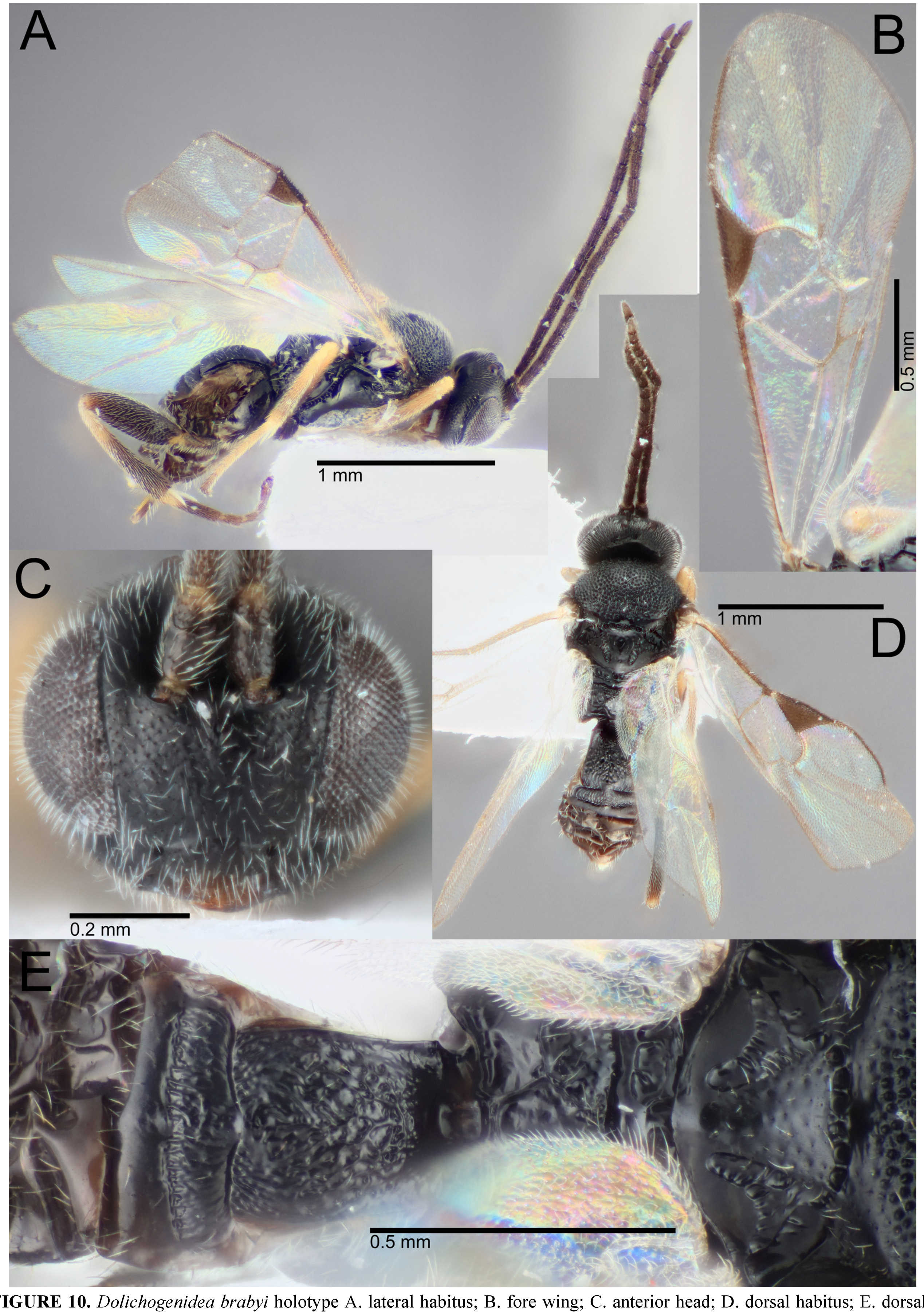

FIGURE 10. *Dolichogenidea brabyi* holotype A. lateral habitus; B. fore wing; C. anterior head; D. dorsal habitus; E. dorsal mesoscutellum, propodeum and T1–3.

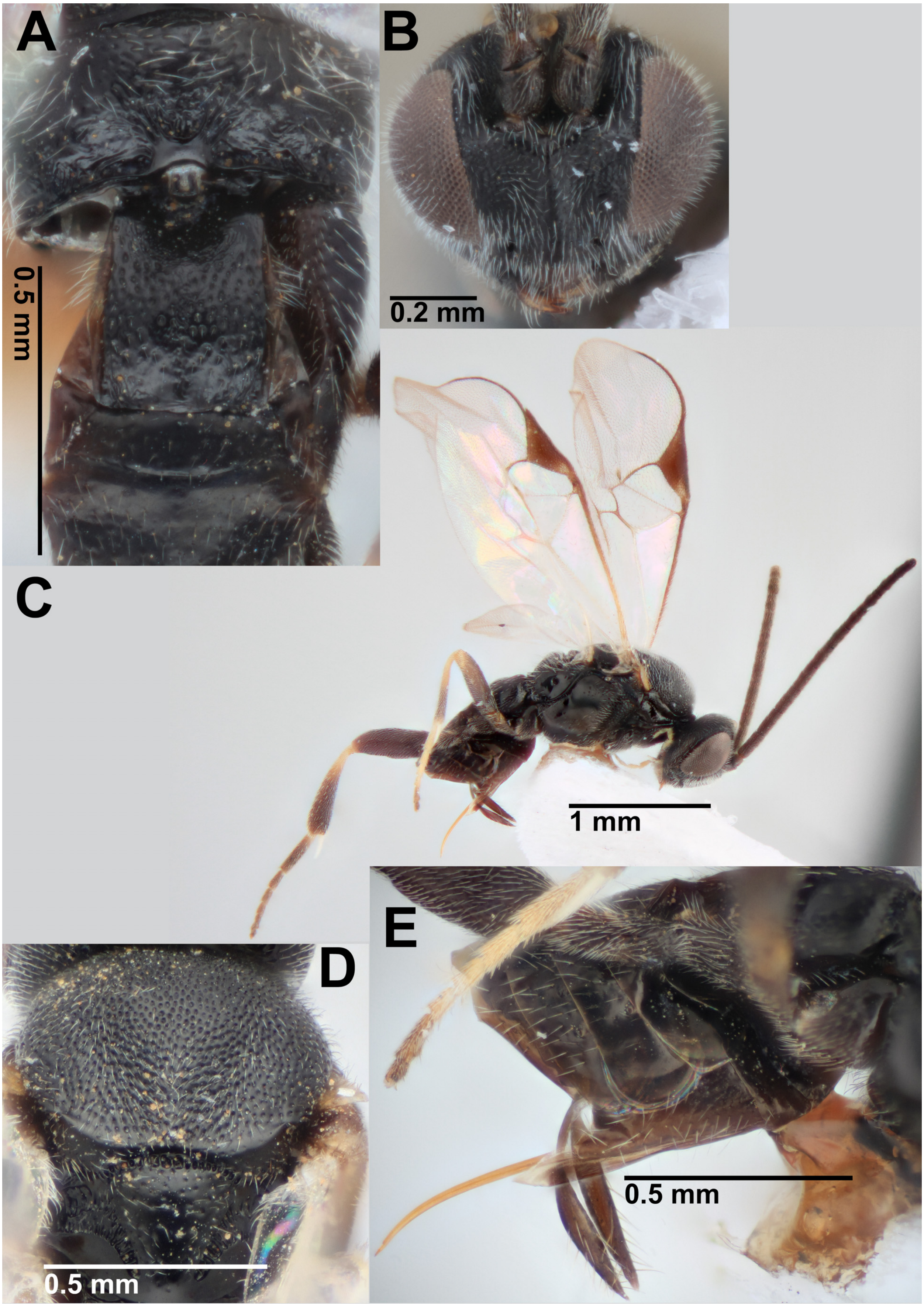

FIGURE 11. *Dolichogenidea forrestae*: holotype. A. propodeum, T1–2; B. anterior head; C. lateral habitus; D. anteromesoscutum, mesoscutellar disk; E. hypopygium and ovipositor sheaths.

Dolichogenidea garytaylori **Fagan-Jeffries & Austin sp. nov.**
(Fig. 12)
urn:lsid:zoobank.org:act:B1F65F8E-E6A6-4699-9BF7-357242E340CA

Material examined (including Genbank numbers of DNA barcodes). Holotype: South Australia: ♀ Great Victoria Desert Bush Blitz, -28.9258159° 129.5377178°, 22/ix/2017, B. Parslow (SAMA: 32-035467; Genbank *COI*: MH138913 *WG*: MH139348). **Paratypes: South Australia:** ♀ Bon Bon Stn, 30°18.828'S 135°32.848'E, 28/x/2010, G.S. Taylor, swept *Acacia victoriae*, 2010 069 (B30) Bush Blitz svy (SAMA: 32-036128; Genbank *COI*: MH138726 *WG*: MH139203). ♂ Great Victoria Desert Bush Blitz, vehicle net Rodinia Road SSS2 to airstrip, -28.8161 129.5358 to -29.11530 129.54124, 18/ix/2017, R. Leijs (SAMA: 32-036129; Genbank *COI*: MK073918). **Western Australia:** ♀ Kariijini NP, Weano Gorge Rd, 22°21'19"S 118°15'00"E, 25/iv/2003–15/v/2003, C. Lambkin & T. Weir, Malaise grassy dry creek *Eucalyptus* & *Acacia* scrub, 695 m (ANIC: 32 130221; Genbank *COI*: MH138949 *WG*: MH139370).

Diagnosis. *Dolichogenidea garytaylori* closely resembles *D. hyposidrae*, but the latter has a smooth propodeum other than the carinae of the areola and lateral carinae, and the areola is also only open at the anterior end, whereas *D. garytaylori* has the propodeal areola poorly defined in the whole anterior half. The fore wing r vein is also less continuously curved with 2RS (more differentiated) in *D. garytaylori* compared to *D. hyposidrae*. *Dolichogenidea garytaylori* also closely resembles *D. brabyi*, but *D. brabyi* has a distinctive T2 shape (curved at anterior corners) and sculpturing (strongly sculptured in posterior half). *Dolichogenidea eucalypti* has a more defined anterior areola and a smoother propodeum, particularly within the areola, than *D. garytaylori*. *Dolichogenidea garytaylori* can be separated from *D. biroi*, *D. lipsis, D. ilione,* and *D. tasmanica* by the absence of a white gena blotch. *Dolichogenidea bonbonensis*, *D. carposinae, D. coequata, D. cyamon, D. finchi, D. gentilis, D. heterusiae, D. hyblaeae D. ilione, D. inquisitor, D. iulis, D. kelleri*, *D. labaris, D. lobesiae*, *D. mediocaudata, D. miris*, *D. platyedrae, D. stantoni,* and *D. xenomorph* all have ovipositors at least 0.7 x as long as the metatibia, generally much longer, whilst *D. brabyi* has an ovipositor only 0.4 x the length of the metatibia. *Dolichogenidea expulsa* can be differentiated by a smoother propodeum and more coarsely sculptured T2 than *D. garytaylori*. *Dolichogenidea orelia* can be separated by having rugulose and strigate sculpturing on T2, as opposed to the very shallow sculpturing of *D. garytaylori*. *Dolichogenidea acratos* has slightly longer ovipositor sheaths than *D. garytaylori* (ovipositor sheath to metatibia ratio 0.5), and also has T1 parallel-sided, without the slightly broadening area posteriorly of *D. garytaylori*. *Dolichogenidea agonexenae* and *D. upoluensis* are described as having a rugose propodeum, which differentiates these species from *D. garytaylori*, which has a mostly smooth propodeum other than the centre of the areola and directly anterior to the areola, which is strongly sculptured (Table 1).

Description. FEMALE. *Colour*: all dark, antenna dark; coxae (pro-, meso-, metacoxa) dark, dark, dark; femora (pro-, meso-, metafemur) pale, dark to paler at posterior end, dark; tibiae (pro-, meso-, metatibia) dark, dark, dark with lighter area anteriorly; tegula and humeral complex dark; pterostigma dark; fore wing veins pale proximally, dark distal to pterostigma. *Head*: antenna approximately equal to body length; body length (head to apex of metasoma) 2.4–2.7 mm; ocular–ocellar line/posterior ocellus diameter 1.6–1.8; interocellar distance/posterior ocellus diameter 2.1–2.2. *Mesosoma*: anteromesoscutum punctate, punctures not regularly sized and spaced over whole of anteromesocutum; mesoscutellar disc with several shallow punctures down lateral edges associated with setae; number of pits in scutoscutellar sulcus 10–12; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.4*. *Wings*: fore wing length 2.5–2.8 mm; length of veins r/2RS 1.4–1.7; length of veins 2RS/2M 1.3–1.6; length of veins 2M/(RS+M)b 0.8–0.9; pterostigma length/width 2.8–3.5. *Legs*: metatibia inner spur length/metabasitarsus length 0.4–0.5. *Propodeum:* areola clearly defined in posterior half and lateral carinae clear and mostly straight, anterior part of areola and centre area with less well defined carinae but with irregular reticulate rugose and punctate sculpturing, rest of propodeum mostly smooth. *Metasoma*: T1 length/width at posterior margin 1.3*; T1 shape broad, rectangular, almost parallel–sided, very slightly broadening posteriorly; T1 sculpture irregularly reticulate rugose and punctate, sometimes with smoother area at posterior border with T2; T2 width at posterior margin/length 3.2*; T2 sculpture almost smooth, some very shallow sculpturing in anterior half and scattered shallow punctures associated with setae; T3 sculpture smooth and shiny; hypopygium with central membranous area mid-ventrally; ovipositor sheaths length/metatibial length 0.2–0.4.

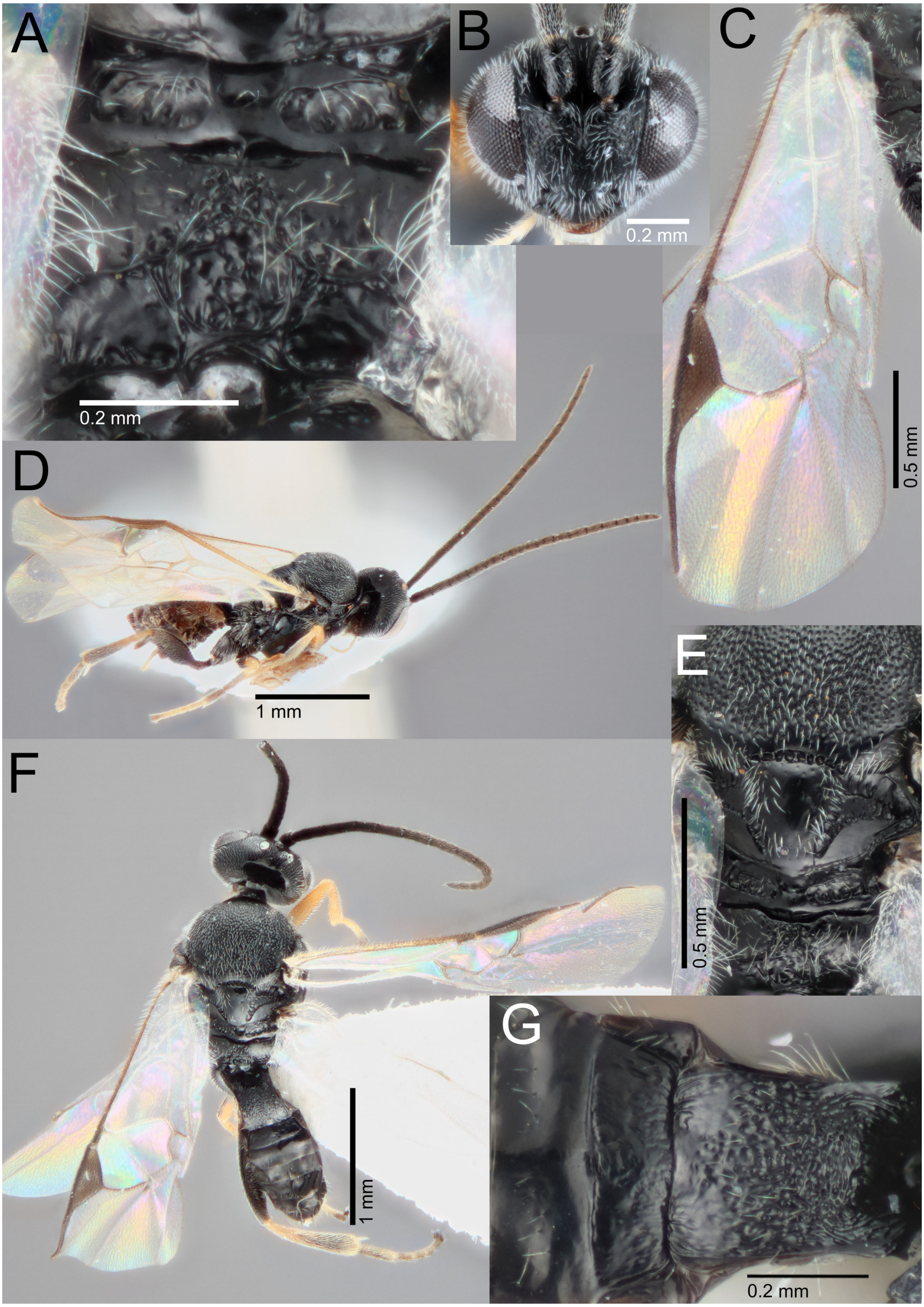

FIGURE 12. *Dolichogenidea garytaylori* holotype (A–C, E–G) paratype (D). A. propodeum; B. anterior head; C. fore wing; D. lateral habitus; E. mesosoma (part); F. dorsal habitus; G. T1–3.

MALE. As female, but with the antenna longer than body length, propodeum smoother in centre of areola, anterior carinae of areola much more defined than in female, but with anterior end of areola still open with reticulate rugose sculpturing.

Etymology. This species is named for Dr Gary Taylor, who collected a paratype of this species plus many other microgastrine specimens on Bush Blitz expeditions, and who has provided author EPF-J with many hours of valuable advice both at the microscope and in the field. The species name is an invariable genitive.

Distribution. Currently only collected from central and western SA and northern WA.

Remarks. There is no *COI* or *WG* variation in the specimens of this species listed and sequenced here, and the *COI* sequences are approximately 5% divergent from the nearest relative in this study, and 4% divergent from the closest sequence on Genbank. The BOLD BIN for *D. garytaylori* is BOLD:ADL4226.

Dolichogenidea kelleri Fagan-Jeffries & Austin sp. nov.

(Fig. 13)

urn:lsid:zoobank.org:act:9E4C3CF1-EF91-423B-B8EA-2690BE5BB069

Material examined (including Genbank numbers of DNA barcodes). Holotype: South Australia: ♀ Bon Bon Stn, 30°37'34"S 135°24'11"E, 25–28/x/2010, S. Mantel, F.C., R. Kittel, G. Taylor, Bush Blitz Svy Malaise 9 amongst *Senna artemisioides*, *Acacia tetragonophila*, *A. aneura*, & *A. victoriae* (SAMA: 32-036130; Genbank *COI*: MH138911 *WG*: MH139346). **Paratypes: South Australia:** ♂ Great Victoria Desert, Cook Road, -28.9684°S 130.0772°E to -29.0449°S 129.9475°E, 29/viii/2015, J.A. Forrest, R. Leijs, vehicle net (SAMA: 32-036131; Genbank *COI*: MK073915). ♀ Great Victoria Desert Bush Blitz, 29°6'49"S 129°32'29"E, 23/ix/2017, E. Fagan-Jeffries, sweeping general vegetation, 250 m (SAMA: 32-035459; Genbank *COI*: MH138909 *WG*: MH139344). 2♂ Great Victoria Desert, 29.453611°S 129.534722°E, 24/ix/2017, E. Fagan-Jeffries, sweeping *Senna artemisioides* (one in ethanol) (SAMA: 32-036132 pinned, SAMA: 32-036133 in ethanol; Genbank *COI*: MK073913, MK073912, respectively). ♂ Great Victoria Desert, 29.176111°S 129.949722°E, 26/ix/2017, E. Fagan-Jeffries, sweeping *Dodonaea* sp. (SAMA: 32-036134; Genbank *COI*: MK073914).

Diagnosis. *Dolichogenidea kelleri* can be separated from *D. bonbonensis* by having a longer ovipositor (ovipositor sheaths equal in length to metatibia rather than shorter than metatibia), a narrower T1, and a less clearly defined propodeal areola. *Dolichogenidea kelleri* can be separated from *D. biroi*, *D. lipsis, D. ilione* and *D. tasmanica* by the absence of a white gena blotch. *Dolichogenidea acratos, D. brabyi*, *D. hyposidrae*, *D. eucalypti*, *D. expulsa*, *D. garytaylori* and *D. orelia* all have ovipositor sheaths shorter than *D. kelleri*, less than half the length of the metatibia. *Dolichogenidea carposinae, D. coequata, D. cyamon, D. finchi, D. ilione, D. iulis, D. labaris, D. lobesiae*, *D. mediocaudata, D. miris*, *D. platyedrae, D. stantoni,* and *D. xenomorph* all have ovipositor sheaths longer than the metatibia, and clearly longer than that of *D. kelleri*. *Dolichogenidea hyblaeae* has ovipositor slightly longer than the metatibia, and a completely smooth propodeum with only a slight depression indicating the areola, whilst *D. kelleri* has the areola clearly defined in the posterior half. *Dolichogenidea inquisitor* also has ovipositor sheaths only slightly longer than the metatibia (ovipositor sheaths measured as 1.25 x metatibia on holotype, description states 1.5 x) but can be separated by having a complete propodeal areola which is strongly carinate anteriorly, as opposed to the more indistinct anterior half of the areola in *D. kelleri*. *Dolichogenidea gentilis* and *D. heterusiae* both have strong carinae along the lateral margins of T1 which are absent in *D. kelleri*. *Dolichogenidea agonoxenae* is described as having a strongly formed propodeal areola and costulae, distinguishing this species from *D. kelleri*, which has a more indistinct areola with formed by small diverging carinae rather than a single strong carina. The description of *D. upoluensis* was not clear enough to confirm any diagnostic differences, but we consider it almost certainly a distinct species based on the geographic location; *D. upoluensis* was bred from a leaf-roller on *Ficus* sp. in Samoa, whilst *D. kelleri* is from arid South Australia (Table 1).

Description. FEMALE. *Colour*: all dark, antenna dark; coxae (pro-, meso-, metacoxa) dark, dark, dark; femora (pro-, meso-, metafemur) dark to paler at posterior end, dark to paler at posterior end, dark; tibiae (pro-, meso-, metatibia) pale, pale, pale in anterior half, dark in posterior half; tegula and humeral complex dark; pterostigma dark; fore wing veins pale proximally, dark distally. *Head*: antenna slightly shorter than body length; body length (head to apex of metasoma) 2.2–2.6 mm; ocular–ocellar line/posterior ocellus diameter 1.7–2.0;

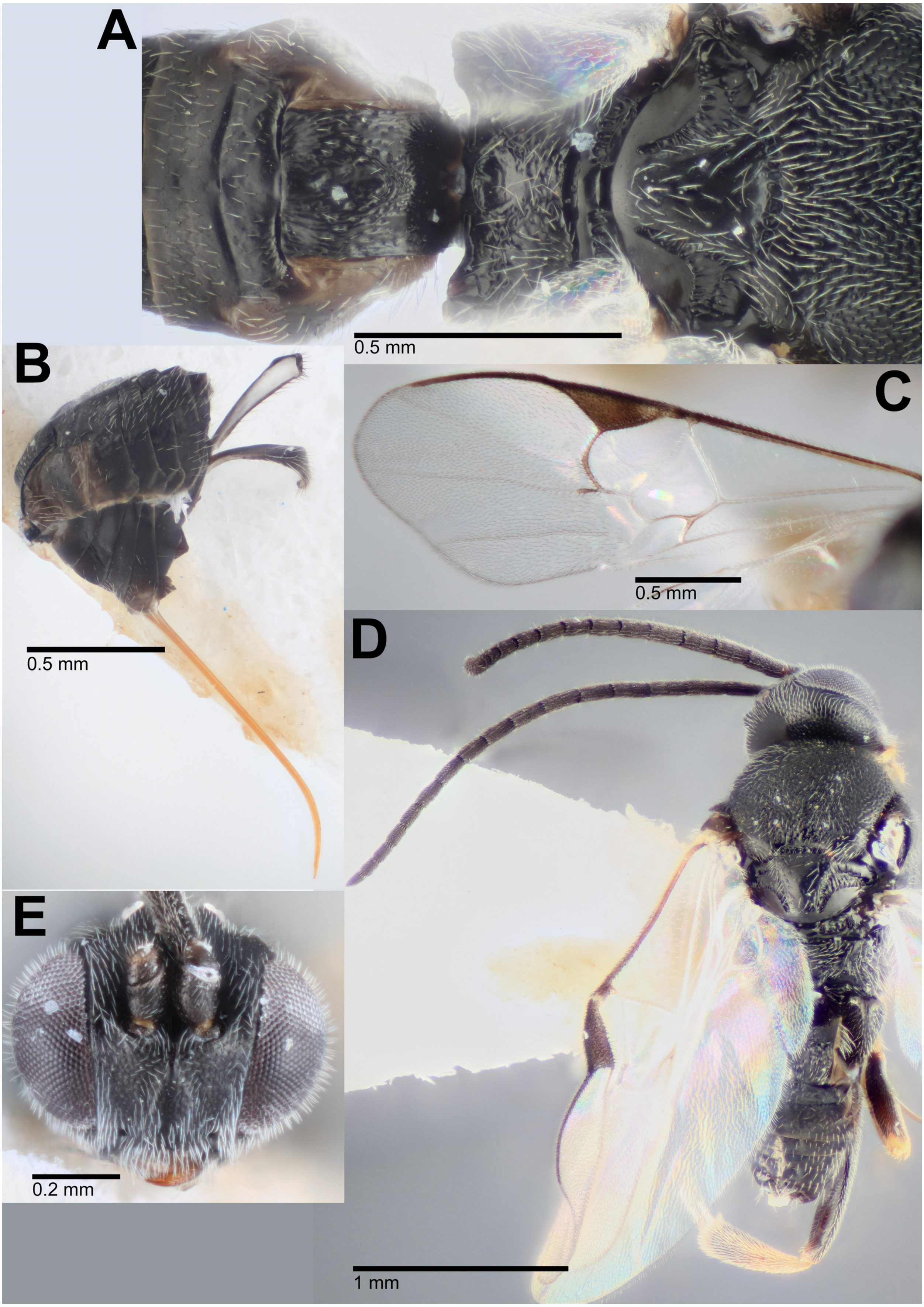

FIGURE 13. *Dolichogenidea kelleri* A. holotype, dorsal mesosoma and metasoma (part); B. holotype, lateral metasoma; C. paratype, fore wing; D. paratype, dorsal habitus; E. holotype, anterior head.

interocellar distance/posterior ocellus diameter 1.8–2.1. *Mesosoma*: anteromesoscutum evenly and densely punctate; mesoscutellar disc with a few fine punctures associated with setae; number of pits in scutoscutellar sulcus 12–14; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.5–0.6. *Wings*: fore wing length 2.3–2.5 mm; length of veins r/2RS 1.3–1.7; length of veins 2RS/2M 1.0–1.3; length of veins 2M/(RS+M)b 0.8–1.1; pterostigma length/width 2.5–2.8. *Legs*: metatibia inner spur length/metabasitarsus length 0.5. *Propodeum:* areola clearly defined in posterior half, anterior half less well defined, carinae forming anterior half of areola and lateral carinae formed of small diverging carinae rather than a single clear carina, areola open at anterior end, propodeum otherwise mostly smooth. *Metasoma*: T1 length/width at posterior margin 1.2–1.3; T1 shape broad, rectangular, almost parallel-sided; T1 sculpture rugose with irregularly shaped punctures, longitudinal strigosity or rugosity in posterior half, smoother area centrally; T2 width at posterior margin/length 3.5–4.0; T2 sculpture almost smooth, some sparse punctures associated with setae; T3 sculpture smooth and shiny; hypopygium with central membranous area mid-ventrally; ovipositor sheaths length/metatibial length 1.0.

MALE. As female, but with antenna longer than body, T1 and T2 slightly longer relative to width.

Etymology. This species is named for Professor Mike Keller, who hosted author EPF-J as part of the 'CSIRO Student Research Project' many years ago, and helped inspire a high school student to a career in entomology. The species name is an invariable genitive.

Distribution. This species is currently only known from the arid zone of central South Australia.

Remarks. The measurement of the ovipositor sheaths length was made difficult by the highly curved sheaths of the holotype, and the missing sheaths in the paratype. This species is closely related to *D. bonbonensis* based on both morphological and molecular evidence. The *WG* sequences of these two species differ by only 1–3 bp, however, the *COI* sequences are at least 10% different, far above the 2% divergence often used for species delimitation in microgastrines. Morphologically there are also clear differences that can be used to separate the two species (see diagnosis). No information is known about possible host species. The BOLD BIN for *D. kelleri* is BOLD:ADL2799.

Dolichogenidea lobesiae **Fagan-Jeffries & Austin sp. nov.**
(Fig. 14)
urn:lsid:zoobank.org:act:175C13D6-23DE-417C-8770-9E7B0B49F7B4

Material examined (including Genbank numbers of DNA barcodes). Holotype: Queensland: ♀ Tolga, Costa Berries Rangeview, 243 Marnane Road (Rocky Creek locality), 30.ix.2017, -17.193 145.438, J. Cheesman, ex. *Lobesia physophora* on blueberries (QM: T244829; Genbank *COI*: MK185730). **Paratypes: Queensland:** 2♀, same data as holotype (QM: T244830, T244831), 2♂, same data as holotype (QM: T244832, T244833).

Diagnosis. Of the currently described species from Australia, *D. lobesiae* most closely resembles *D. miris*, but can be separated by having a broadening T1 whilst *D. miris* has T1 almost parallel-sided, and by having a clearly curved vein r in the fore wing, whilst in *D. miris* it is much straighter. *Dolichogenidea lobesiae* can be separated from *D. biroi*, *D. lipsis, D. ilione* and *D. tasmanica* by the absence of a white gena blotch. *Dolichogenidea brabyi, D. hyposidrae*, *D. eucalypti, D. expulsa*, *D. garytaylori* and *D. orelia* all have ovipositor sheaths much shorter than the metatibia, *D. bonbonensis* and *D. acratos* have ovipositor sheaths slightly shorter than the metatibia and *D. kelleri, D. gentilis* and *D. heterusiae* have sheaths approximately equal to the metatibia. All these species can be easily distinguished from *D. lobesiae*, which has an ovipositor approximately 1.3 x longer than the metatibia. *Dolichogenidea coequata, D. cyamon, D. finchi*, *D. ilione*, *D. labaris*, *D. mediocaudata, D. platyedrae* and *D. xenomorph* all have ovipositor sheaths longer than 1.5 x the metatibia, and thus can be differentiated from *D. lobesiae* which has ovipositor sheaths 1.2–1.4 x the metatibia. In addition, *D. gentilis, D. mediocaudata, D. finchi and D. xenomorph* have the propodeal areola poorly defined, whilst *D. lobesiae* has a clearly carinate areola. *Dolichogenidea iulis* can be separated by T1 sculpturing (T1 in *D. iulis* is punctate, becoming strigate in the posterior one-third as opposed to reticulate rugose sculpturing in *D. lobesiae*) and general body colouration; *D. iulis* has the metasoma all black, and the hind legs dark. *Dolichogenidea carposinae* and *D. inquisitor* also possesses an all dark metasoma, as opposed to the lighter orange colouration of *D. lobesiae*, and in addition *D. carposinae* has punctate propodeal sculpturing as opposed to the nearly smooth propodeum of *D. lobesiae*, while *D. inquisitor* has punctate sculpturing on T1 as opposed to the reticulate rugose sculpturing of *D. lobesiae*. *Dolichogenidea agonoxenae* and *D. upoluensis* are both described as having a rugose propodeum, which separates

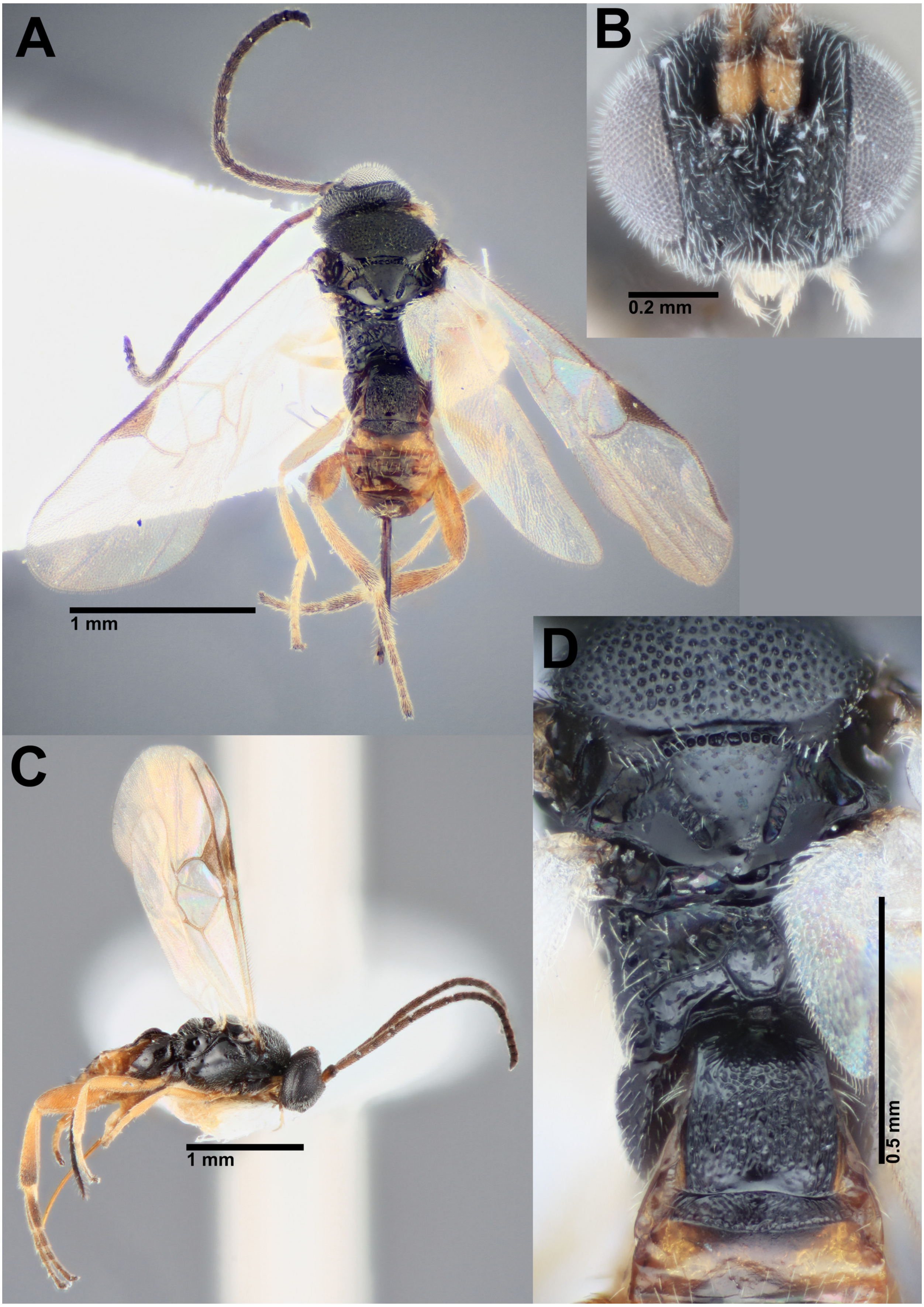

FIGURE 14. *Dolichogenidea lobesiae* A. holotype, dorsal habitus; B. holotype, anterior head; C. paratype, lateral habitus; D. holotype, dorsal meso- and metasoma (in part).

these species from *D. lobesiae* which has a mostly smooth propodeum (other than the areola and lateral carinae). *Dolichogenidea hyblaeae* can be separated by the presence of rugosity on the propodeum near the lateral carinae, as opposed to the smooth propodeum of *D. lobesiae*. It should be noted that the co-types of *D. hyblaeae* from Java differ in the form of the propodeum compared to the holotype from Samoa; the propodeum of the co-types is smooth with the areola indicated by a depression, and weak posterior carinae, and are therefore also easily distinguished from the propodeum of *D. lobesiae.* Based on what we currently know about the expected level of morphological variation in *Dolichogenidea*, we suspect that the paratypes of *D. hyblaeae* from Java are a different species to the holotype. *Dolichogenidea lobesiae* resembles *D. stantoni* in ovipositor length, propodeum and general body form and colouration, but it can be distinguished by the fore wing r vein, which is curved in *D. lobesiae* and straight, meeting vein 2RS at an approximately 145° angle in *D. stantoni* (Table 1).

Description. FEMALE. *Colour*: dark except for orange to light brown sclerites and areas of posterior tergites; antenna dark; coxae (pro-, meso-, metacoxa) orange, orange, orange; femora (pro-, meso-, metafemur) orange, orange, orange with darker area posteriorly; tibiae (pro-, meso-, metatibia) orange, orange, orange with darker area posteriorly; tegula and humeral complex dark; pterostigma dark; fore wing veins dark. *Head*: antenna similar length to body length; body length (head to apex of metasoma) 1.9–2.2 mm; ocular–ocellar line/posterior ocellus diameter 1.7–2.0; interocellar distance/posterior ocellus diameter 1.8–2.1; no white gena spot. *Mesosoma*: anteromesoscutum evenly and densely punctate; mesoscutellar disc mostly smooth, sparsely covered in fine setae; number of pits in scutoscutellar sulcus 12–13; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.5. *Wings*: fore wing length 2.3–2.7 mm; length of veins r/2RS 1.7–2.3; length of veins 2RS/2M 0.8–0.9; length of veins 2M/(RS+M)b 1.2–1.5; pterostigma length/width 2.6–2.8. *Legs*: metatibia inner spur length/metabasitarsus length 0.4–0.5. *Propodeum*: almost complete hexagonal areola, carina forming anterior side of hexagonal missing so that areola is open anteriorly, strong straight lateral carinae present, rest of propodeum mostly smooth with some reticulate rugose sculpturing in anterior half and small carinae emerging from posterior boundary approximately a third of the distance from lateral edge to centre. *Metasoma*: T1 length/width at posterior margin 1.0–1.2; T1 shape broad, broadening slightly posteriorly, T1 sculpture irregularly reticulate rugose; T2 width at posterior margin/length 4.5–5.2; T2 sculpture rugose with crenulate margin at border with T3; T3 sculpture smooth and shiny; hypopygium with membranous area mid-ventrally; ovipositor sheaths length/metatibial length 1.2–1.4.

MALE. As female, although antenna longer than body and T2 sculpturing much less defined.

Etymology. This species is named for the host, *Lobesia physophora* (Lower, 1901) (Tortricidae), a significant pest of blueberries in Australia, and could be a key parasitoid for its control (Ian Newton, pers. comm.). The species name is an invariable genitive.

Distribution. Currently this species is only known from the type locality, Tolga, north Queensland.

Remarks. The host, *L. physophora*, is also recorded from the Solomon Islands (Bradley, 1955) and possibly from Papua New Guinea (BOLD, data not publically released). *Dolichogenidea lobesiae* is reported to be gregarious on the host. A single *COI* barcode of *D. lobesiae* was sequenced, which is at least 7% divergent from the nearest relative, and from any sequences on Genbank. The BOLD BIN for *D. lobesiae* is BOLD:ADM1412.

Sathon Mason, 1981

Sathon Mason 1981: 78; Williams 1988: 540. Austin & Dangerfield 1992: 52. Type species: *Apanteles neornexicanus* Muesebeck, 1920, by original designation.

Diagnosis. *Sathon* is characterised by a large, inflexible hypopygium without striae mid-ventrally, ovipositor sheaths at least half as long as metatibia, propodeum lacking an areola and either with a complete longitudinal carina or carina reduced or absent, anterior margin of the metanotum with reduced lateral lobes, and the postero-lateral phragma of the scutellum exposed. Species have been described in the genus with fore wing areolet both present and absent, but currently all described species from Australia have a fore wing areolet present.

Remarks. There are only four described species of *Sathon* from Australia: *S. albicoxus* Austin and Dangerfield (1992), *S. moratus* (Wilkinson 1929), *S. naryciae* Austin and Dangerfield (1992), and *S. resplendens* (Wilkinson 1929), and one species (*S. belippae*) recorded from Fiji, although this may be a misidentification (Austin & Dangerfield 1992). The genus in Australia appears to be solely represented by species with a large fore wing areolet, and appears to be polyphyletic with regard to the lineage of *Choeras* that also has a large fore wing areolet (Fig. 1). See Fagan-Jeffries and Austin (2017) for further discussion on the relationship between these genera. There are only 14 species described worldwide (Yu *et al.* 2016) and limits of the genus are not well resolved.

FIGURE 15. Known distribution of *Sathon oreo*.

Sathon oreo **Fagan-Jeffries & Austin sp. nov.**
(Fig. 16)
urn:lsid:zoobank.org:act:C1A04487-C16E-4C93-912B-8E8CFF6713FA

Material examined (including Genbank numbers of DNA barcodes). Holotype: South Australia: ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 25/x/2000, C. Stephens, Malaise trap in bridal creeper invaded eucalypt woodland (SAMA: 32-036135; Genbank *COI*: MH138935). **Paratypes: Australian Capital Territory:** ♀ Black Mountain CSIRO land, Malaise trap, 9–14/xi/1991, Austin & Dangerfield (WINC). ♀ Canberra, Black Mtn, Behind CSIRO, 35°16'S 149°06'E, 23/ix/2002–31/x/2002, C. Lambkin (ANIC: 32 130223; Genbank *COI*: MH138874). ♀ Canberra, Black Mtn, Behind CSIRO, 35°16'S 149°06'E, 23/ix/2002–31/x/2002, C. Lambkin (ANIC: 32 130224; Genbank *COI*: MH138875). ♀ Canberra, Black Mtn, Behind CSIRO, 35°16'S 149°06'E, 23/ix/2002–31/x/2002, C. Lambkin (ANIC: 32 130225; Genbank *COI*: MH138877 in ethanol). **South Australia:** ♀ Ferries Macdonald Cons.

Pk., 1–14/i/1996, Malaise trap. J. Jennings (WINC). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 12/x/2000, C. Stephens, Malaise trap in bridal creeper invaded eucalypt woodland (SAMA: 32-036137; Genbank *COI*: MH138932). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 25/x/2000, C. Stephens, Malaise trap in bridal creeper invaded eucalypt woodland (SAMA: 32-036136; Genbank *COI*: MH138944; in ethanol). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 25/x/2000, C. Stephens, Malaise trap in bridal creeper invaded eucalypt woodland (SAMA: 32-036138; Genbank *COI*: MH138937). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 25/x/2000, C. Stephens, Malaise trap in native plot within bridal creeper invaded eucalypt woodland (SAMA: 32-036141; Genbank *COI*: MH138843). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 25/x/2000, C. Stephens, Malaise trap in native plot within bridal creeper invaded eucalypt woodland (SAMA: 32-036142; Genbank *COI*: MH138842). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 25/x/2000, C. Stephens, Malaise trap in native plot within bridal creeper invaded eucalypt woodland (SAMA: 32-036143; Genbank *COI*: MH138915; in ethanol). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 25/x/2000, C. Stephens, Malaise trap in native plot within bridal creeper invaded eucalypt woodland (SAMA 32-036144; Genbank *COI*: MH138914 in ethanol). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 35°27'13"S 138°36'22"E, 20/x/2016–05/xi/2016, E. Fagan-Jeffries, Malaise trap (SAMA: 32-036139; Genbank *COI*: MH138799). ♀ Mt Billy Con. Pk. Fleurieu Peninsula, 35°27'13"S 138°36'22"E, 05/xi/2016–20/xi/2016, E. Fagan-Jeffries, Malaise trap (SAMA: 32-036140; Genbank *COI*: MH138798; in ethanol). **Victoria:** ♀ Otway Ranges, Melba Gully, 4/ii/90, R. Wharton. ♀ Fleurieu Peninsula, Deep Creek Cons. Pk., 7–21/ii/90, Malaise trap, J. Bracken & R. Wharton (WINC). ♀ Grampians Bioscan site 406, 37°03'41"S 142°22'50"E, 19/xi/2012, J. Grubb, M. Mackenzie, P. Lillywhite, K. Pawley, Malaise trap, Cooinda Burrong Scout Camp, basecamp and surrounds (MV: HYM-61362; Genbank *COI*: MH138852; in ethanol). ♀ Grampians Bioscan site 407, Mount Difficult Road, between two intersections with Longpoint Track, 37°02’02”S, 142°28’02”E, 19–23/xi/2012, M. Mackenzie, P. Lillywhite, J. Grubb, K. Pawley, Malaise trap GRB407 (MV: HYM-61361; Genbank *COI*: MH138845 *WG*: MH139294). ♀ Grampians Bioscan site 426, Strachans Camp Ground near intersection Sawmill Track, Glenelg River Road, and Jensens Road, 37°22’32”S, 142°16’57”E, 24/xi/2012, P. Lillywhite & B. Patullo Malaise trap GRB426 (MV: HYM-61363; Genbank *COI*: MH138844).

Diagnosis. The conspicuous white stripe on the antenna of the female easily separates this species from the other species of *Sathon* described from Australasia.

Description. FEMALE. *Colour:* dark except for non-sclerotised areas around T–3 and sternites which are often a striking white; antenna dark other than flagellomeres 6–7 which are white; coxae (pro-, meso-, metacoxa) pale, pale, dark; femora (pro-, meso-, metafemur) dark with paler area posteriorly, dark, dark; tibiae (pro-, meso-, metatibia) dark, dark, dark; tegula and humeral complex light brown; pterostigma dark; fore wing veins dark. *Head*: antenna slightly longer than body length; body length (head to apex of metasoma) 2.4–2.9 mm; ocular–ocellar line/posterior ocellus diameter 2.3–2.5; interocellar distance/posterior ocellus diameter 1–1.4. *Mesosoma*: anteromesoscutum evenly and densely punctate; mesoscutellar disc with numerous shallow punctures associated with setae; number of pits in scutoscutellar sulcus 8–14; maximum height of mesoscutellum lunules/maximum height of lateral face of mesoscutellum 0.2–0.3. *Wings*: fore wing length 2.5–3.0 mm; length of veins r/2RS 0.5–0.7; length of veins 2RS/2M 1.0; length of veins 2M/(RS+M)b 0.9–1.2; pterostigma length/width 2.5–2.8, areolet large, enclosed, vein r-m unpigmented. *Legs*: metatibia inner spur length/metabasitarsus length 0.3–0.4. *Propodeum:* reticulate rugose, with very short medial longitudinal carina at anterior end, often diverging carinae from this medial carina that appear to form the anterior half of an areola, and diverging carinae from posterior centre also give the impression of an areola, but these carinae often indistinguishable from other sculpturing, often smooth sections at anterior corners. *Metasoma*: T1 length/width at posterior margin 2.7–3.3; T1 clearly narrowing posteriorly, mostly smooth but often with faint longitudinal branching carinae; T2 width at posterior margin/length 2–2.6, T2 with no clear sculpturing, but not completely smooth; T3 sculpture smooth and shiny; hypopygium with completely membranous area mid-ventrally; ovipositor sheaths length/metatibial length 0.5–0.6.

MALE. Known only from photograph on BOLD, antennal segments all dark.

Etymology. This species is named for the brown antenna with a thick white stripe caused by the white flagellomeres 6–7 resembling the brown-white-brown colouration pattern of the Oreo cream-centred chocolate biscuits. The species name is a noun in apposition.

Distribution. This species appears to occur in large numbers in specific areas of the country, including in South Australia, Victoria, and at Black Mountain, Canberra. There is also an associated BOLD sequence (see below) that extends the distribution to Tasmania (Fig. 15).

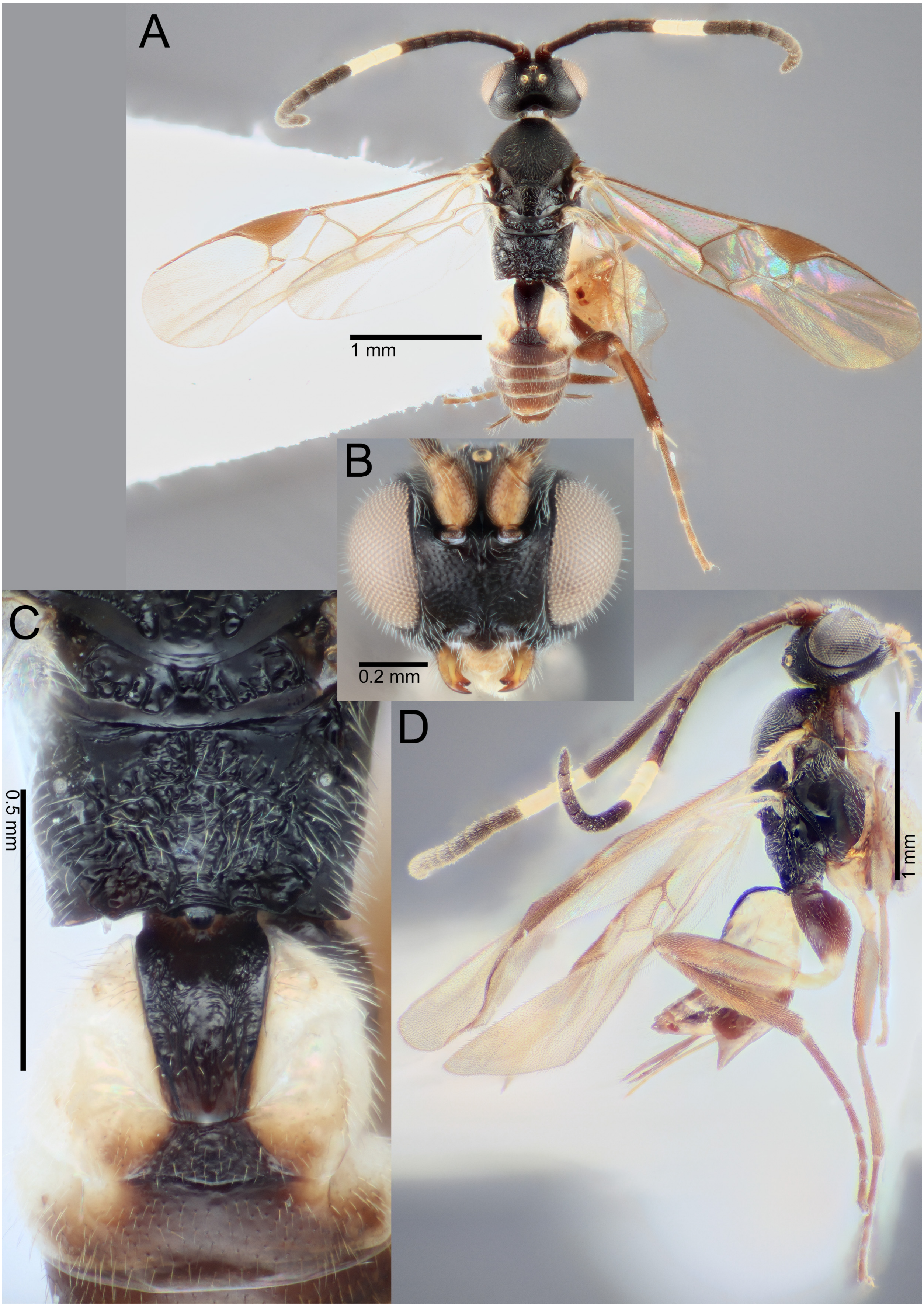

FIGURE 16. *Sathon oreo* A–C: holotype; D: paratype. A. dorsal habitus; B. anterior head. C. metanotum, propodeum and T1–3; D. lateral habitus.

TABLE 1. Summary of distinguishing characters for Australasian species of *Dolichogenidea*. * = type locality.

***Dolichogenidea* sp.**	**Distribution**	**White gena blotch**	**Propodeal areola**	**Propodeal sculpturing**	**T1 length/width at posterior margin**	**T1 sculpture**	**T1 shape**	**T2 sculpture**	**Ovipositor sheath length/metatibia length**	**Comments**
Australian spp.										
biroi (Szepligeti 1905)	Australia (NSW)	present					parallel-sided			Type not seen, description used, "ovipositor as long as abdomen"
bonbonensis sp. nov.	Australia (SA, WA)	absent	clearly defined, lateral carinae present	mostly smooth, some reticulate rugose sculpturing antero-medially	1.1–1.2	rugose with irregularly shaped punctures	almost parallel-sided	almost smooth, sparse punctures	0.7–0.9	
brabyi sp. nov.	Australia (ACT)	absent	clearly defined in posterior half, partially defined in anterior half, lateral carinae present	anterior half with shallow punctate sculpturing which is more pronounced antero-medially, posterior half and centre of areola mostly smooth	1.2	reticulate rugose with occasional irregularly shaped punctures	slightly broadening posteriorly	shallow sculpture, line of pits and ridges at border with T3	0.4	
eucalypti Austin & Allen 1989	Australia (SA)	absent	clearly defined, lateral carinae present	anterior half mostly smooth, posterior half with faint rugose-punctate sculpturing	1.1	mostly punctate, striate-punctate along lateral margins	slightly broadening posteriorly	mostly smooth, faint scattered punctures	0.2	
finchi Fagan-Jeffries & Austin 2018	Australia (NSW, Qld, WA, Vic)	absent	only indicated by smoother area medially and short carinae diverging from postero-medial margin, lateral carinae absent	rugose sculpturing in posterior half	1.2–1.8	mostly smooth with sparse punctures associated with short setae on lateral sides of posterior half	almost parallel-sided	smooth and shiny, few shallow punctures associated with setae	2.9–3.9	

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TABLE 1. (Continued)

Dolichogenidea sp.	Distribution	White gena blotch	Propodeal areola	Propodeal sculpturing	T1 length/width at posterior margin	T1 sculpture	T1 shape	T2 sculpture	Ovipositor sheath length/metatibia length	Comments
forrestae sp. nov.	Australia (SA)	absent	only indicated by slight depression and area of rugosity postero-medially and multiple short diverging carinae posteriorly, lateral carinae absent	generally smooth, scattered shallow punctures	1.2	punctate	broad, almost parallel-sided	almost smooth	0.6	
garytaylori sp. nov.	Australia (SA, WA)	absent	clearly defined in posterior half, anterior half with less well-defined carinae, lateral carinae present	irregular reticulate rugose and punctate sculpturing antero-medially and within areola, otherwise smooth	1.3	irregularly reticulate rugose and punctate	broad, almost parallel-sided	almost smooth, some shallow sculpturing in anterior half and scattered shallow punctures	0.2–0.4	
hyposidrae (Wilkinson 1928)	Australia (Qld), New Guinea, New Britain (also Java*, India, Burma, Malay peninsula)	absent	clearly defined, lateral carinae present	mostly smooth, some rugose sculpturing antero-medially	1.5	longitudinally strigose in posterior half	slightly broadening posteriorly	almost smooth	0.1	
kelleri sp. nov.	Australia (SA)	absent	clearly defined in posterior half, anterior half less well-defined with carinae, or areola and lateral carinae formed by small diverging carinae	mostly smooth	1.2-1.3	rugose with irregularly shaped punctures	broad, almost parallel-sided	almost smooth, sparse punctures	1	
lobesiae sp. nov.	Australia (Qld)	absent	clearly defined, lateral carinae present	mostly smooth with some reticulate rugose sculpturing in anterior half	1-1.2	irregularly reticulate rugose	broad, slightly broadening posteriorly	rugose with crenulate margin at border with T3	1.2–1.4	

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TABLE 1. (Continued)

Dolichogenidea sp.	Distribution	White gena blotch	Propodeal areola	Propodeal sculpturing	T1 length/width at posterior margin	T1 sculpture	T1 shape	T2 sculpture	Ovipositor sheath length/metatibia length	Comments
lipsis (Nixon 1967)	Australia (WA)	present	not well-defined, lateral carinae absent	mostly smooth, punctate sculpturing		mostly smooth, some punctures	almost parallel-sided	mostly smooth	1.5	
mediocaudata Fagan-Jeffries & Austin 2018	Australia (NSW)	absent	only indicated by central depression, lateral carinae absent	deep non-uniform punctures, posterior half with rugose sculpturing	1.6	rugose sculpturing	broad, almost parallel-sided	smooth	1.8	
miris (Nixon 1967)	Australia (ACT)	absent	clearly defined, lateral carinae present	some rugose sculpturing in posterior half, anteriorly		longitudinally strigose in posterior half, some general rugosity medially	almost parallel-sided	faintly sculptured	1.5	propodeum partly hidden by wings
tasmanica (Cameron 1912)	Australia (Tas*, Vic, ACT, Qld), New Zealand	present	Indicated by strong depression in centre	Strongly rugose in posterior half, punctate in anterior half.	1.6	ruogse, reticulate rugose	parallel-sided	mostly smooth, shallow punctures	1.6 but damaged	Some characters described from non-type specimens
xenomorph Fagan-Jeffries & Austin 2018	Australia (NSW, WA)	absent	only indicated by smoother area in centre of propodeum and short carinae diverging from centre posterior margin, lateral carinae absent	sparse punctures associated with setae	1.1-1.4	mostly smooth with sparse punctures associated with short setae on lateral sides of posterior half	broad, almost parallel-sided	smooth	3.7–4.2	
Non-Australian spp.										
acratos (Nixon 1967)	New Guinea	absent	complete, lateral carinae present	rugose		rugose with some longitudinal elements	parallel-sided	longitudinally strigose	0.5	wings obscuring T1

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TABLE 1. (Continued)

***Dolichogenidea* sp.**	**Distribution**	**White gena blotch**	**Propodeal areola**	**Propodeal sculpturing**	**T1 length/width at posterior margin**	**T1 sculpture**	**T1 shape**	**T2 sculpture**	**Ovipositor sheath length/metatibia length**	**Comments**
agonoxenae (Fullaway 1941)	Samoa*, Tonga, introduced into Fiji, Hawaii	absent	complete, lateral carinae present	rugose		rugose	"little wider at apex than base"	rugose		type not seen, description used. "ovipositor sheaths longer than basitarsus, almost as long as femora"
carposinae (Wilkinson 1938)	New Zealand	absent	complete but carinae small and indistinct due to surface sculpture	rugose-punctate, becoming smoother posteriorly	1.3	rugose-punctate	parallel-sided	rugose-punctate	1.4	
coequata (Nixon 1967)	Niue	absent	complete, lateral carinae indistinct due to surface sculpturing	moderately densely rugose-punctate	1.6	with dense fine granulate sculpture becoming longitudinally strigose laterally	margins slightly convex	mostly smooth	2	
cyamon (Nixon 1967)	Vanuatu	absent		at least partly rugulose		rugulose	margins slightly convex	mostly smooth with faint striae	1.9	4 specimens on one card; holotype ovipositor hidden so measured on paratype, wings obscuring propodeum and T1
expulsa (Turner 1918)	Fiji*, Samoa (also Marquesas Is., Ceylon).	absent	complete, lateral carinae present	mostly smooth	1	densely rugulose	margins evenly diverging so much broader posteriorly	densely rugulose	0.5	
gentilis (Nixon 1967)	New Guinea*, New Britain, Solomon Is (Banika Is)	absent	complete, lateral carinae difficult to discern due to surface sculpturing	coarsely carinate-rugulose	1	rugulose with some longitudinal elements	slightly convex, margins with prominent flange-like carina	strigose	0.9	

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TABLE 1. (Continued)

Dolichogenidea sp.	**Distribution**	**White gena blotch**	**Propodeal areola**	**Propodeal sculpturing**	**T1 length/width at posterior margin**	**T1 sculpture**	**T1 shape**	**T2 sculpture**	**Ovipositor sheath length/metatibia length**	**Comments**
heterusiae (Wilkinson 1928)	Fiji (also Ceylon*, India, Taiwan and China)	absent	complete, lateral carinae present	mostly rugulose, smoother inside areola		rugulose - punctate	broadening posteriorly, margins with prominent flange like carina	strigose	1	Austin and Dangerfield (1992) state that "Fullaway (1957) is the only record of this species occurring in Fiji. However, we have been unable to find any such material in world collections, so that this locality record may be based on a misidentification and the species may not occur in the Australasian region."
hyblaeae (Wilkinson 1928)	Samoa, Opolu Is.*, Fiji (also Java, Malay peninsula).	absent	Complete, lateral carinae difficult to discern due to surface sculpturing	rugulose						metasoma missing from holotype “ovipositor sheaths about as long as the hind tarsus”
ilione (Nixon 1967)	Fiji	present	complete, partially indistinct due to surface sculpture	coarsely rugulose	1.1	rugose -punctate	T1 broadening posteriorly	rugose strigate laterally, smoother medially	1.5	
inquisitor (Wilkinson 1928)	Fiji (also peninsula Malaysia* and China)	absent	complete, lateral carinae present	mostly smooth	1.3	punctate, becoming strigate in posterior 1/3	virtually parallel-sided	smooth in medial 2/3, partly rugose laterally	1.2	
iulis (Nixon 1967)	New Guinea	absent	complete, lateral carinae present	sparsely punctate in anterior part, becoming smoother posteriorly, smooth inside areola	1.4	punctate, becoming strigate in posterior 1/3			1.4	
labaris (Nixon 1967)	Fiji	absent	complete, lateral carinae present			punctate	virtually parallel-sided	rugose punctate, smooth medially	2.6	areola and T1 partly hidden by wings

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TABLE 1. (Continued)

Dolichogenidea sp.	Distribution	White gena blotch	Propodeal areola	Propodeal sculpturing	T1 length/width at posterior margin	T1 sculpture	T1 shape	T2 sculpture	Ovipositor sheath length/metatibia length	Comments
orelia (Nixon 1967)	Fiji	absent	complete, lateral carinae present	surface coarsely rugose	0.7	rugulose	strongly broadened posteriorly	rugulose, more strigate laterally	0.4	
platyedrae (Wilkinson 1928)	Fiji	absent				Punctate but smoother in posterior 1/3?	parallel-sided	moderately smooth, faint sculpturing	1.8	propodeum and T1 obscured by wings
stantoni (Ashmead 1904)	New Britain, Fiji, Philippines*, India *synonym, China, peninsula Malaysia	absent	complete, lateral carinae present	smooth	1.5	irregularly reticulate rugose in anterior half, becoming longitudinally strigose in posterior half	parallel-sided	mostly smooth, very faint striate sculpturing	1.3	
upoluensis (Fullaway 1941)	Samoa	absent	"indistinctly formed areola and costulae, of which the carinae are very weak"	rugose				smooth		Holotype male not seen

Remarks. In this species we also tentatively place the following seven specimens, which have been sequenced for the *COI* barcoding region by the Biodiversity Institute of Ontario, are stored in the Centre for Biodiversity Genomics, and are publicly available on the BOLD. The *COI* barcoding region is less than 1.2% divergent between these specimens and the others detailed above, and available images of these specimens agree in general morphology and possess the distinctive white band on the antenna. BOLD process identifiers: ASQAS157-11 (Australia), MCCAA2641-12 (ACT), HYAT465-11 (Tas), MCCAA1444-12 (ACT), ASQAS156-11 (Australia), CNBAN190-13 (ACT), MCCAA1052-12 (ACT). The BOLD BIN for this species is BOLD:AAV2186.

White or yellowish bands on the antenna of females are not extremely common in Microgastrinae, but have been reported for numerous species in the genera *Apanteles* (e.g. *A. taeniaticornis* Wilkinson (1928)), *Diolcogaster* (e.g. *D. duocolor* Gupta and Fernández-Triana (2015)), *Exulonyx* (e.g. *E. camma* (Nixon, 1965)), *Glyptapanteles* sensu lato (Fernández-Triana pers. comm.), *Prasmodon* (e.g. *P. bobpoolei* Fernández-Triana and Whitfield (2014d)) *Promicrogaster* (e.g. *P. leilycastilloae* Fernández-Triana and Boudreault (2016)), *Pseudoapanteles* (e.g. *P. alfiopivai* Fernández-Triana and Whitfield (2014b)), and *Rhygolplitis* (Fernández-Triana, pers. comm.). The only described species from Australia with white antennal bands is *Diolcogaster robertsi* Saeed *et al.* (1999) with flagellomeres 5–8 white. White bands also occur in many species of Ichneumonidae, and in a few other groups of braconids (Quicke 2015). The function of these white bands is not known, although suggestions include possible involvement in providing visual feedback of antennal separation (Quicke 2015).

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