



New species in the bee subgenus *Leioproctus* (*Exleycolletes*) Maynard (Hymenoptera: Colletidae)

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Abstract

Two photogenic bee species from coastal areas of eastern Australia are described. *Leioproctus doreyi* n. sp. has bright orange hair on the face and thorax, unlike any other *Leioproctus* species in the area. *Leioproctus melanopsis* n. sp. is black with dense yellow hair on the scutum and has sometimes been misidentified as *Leioproctus* (*Exleycolletes*) *flavomaculatus* (Cockerell, 1905). Both should be readily recognisable from photographs. Both belong unambiguously in the subgenus *Leioproctus* (*Exleycolletes*) Maynard, 2013, which is nevertheless in need of revision.

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Introduction

The traditional approach of delaying descriptions of new species until they can be included in generic or subgeneric revisions may not always be the best policy. At a time of growing interest in natural history photography with the public exchange of electronic images, it may be preferable to create names for species that can be identified from photographs, provided that their generic placement is uncontroversial. The alternative is to leave them as unnamed species, possibly of an extended period.

The subgenus *Exleycolletes* Maynard, 2013 was proposed for seven *Leioproctus* species previously placed in other subgenera. At the same time, Maynard recognised *Goniocolletes* Cockerell, 1907 as a genus, reversing a previous decision to treat it as a subgenus of *Leioproctus* (Michener 1965, 2007). This decision was wel-

comed in some quarters (Almeida *et al.* 2019) and not in others (Houston 2020). Males of both *Exleycolletes* and *Goniocolletes* have a distinctively shaped eighth metasomal sternum but the two groups were separated by a number of characters of varying importance. Two of the characters used, metanotal tubercles and impressed facial fovea of females, are weak or absent in some species and often obscured by pubescence. Two further characters used to distinguish *Exleycolletes* species were features of the propodeal triangle of both sexes and the nature of the hind tibial scopa of females.

In *Exleycolletes*, as defined by Maynard, the subhorizontal part of the propodeal triangle is longer than the metanotum, separating it from *Goniocolletes*, and strongly sculptured, distinguishing it from several other *Leioproctus* groups. Female *Exleycolletes* have hind tibial scopa composed mostly of hairs branched on one side only in contrast to the dense plumose hair of the scopa

of many *Goniocolletes* females. Maynard added a further character for identifying *Goniocolletes*, suggesting that females have dense, branched hairs on the basitibial plate. The absence of such hairs may have been the unstated reason for rejecting Michener's decision (1965) that *Paracolletes albopilosus* Rayment, 1930 is a synonym of *L. (G.) microdontus* (Cockerell, 1929a). *Exleycolletes* and *Goniocolletes* are, therefore, closely related but presently there is no molecular data for *Exleycolletes* species that might clarify this relationship.

The new species described here, meet all Maynard's criteria for *L. (Exleycolletes)* and closely resemble the three species with orange or yellow hair on the mesosoma previously included in the subgenus. Like those three species, males have strong apical fringes on metasomal sterna S4, S5 and erect curly hair medially on S6.

Methods

The morphological terminology follows that used by Michener (2007) and Harris (1979), including interchangeable use of the words hair and seta. Abbreviations used for the relative measurements are as follows: FL flagellum length; HL head length; HW head width; LFW lower face width; MOD diameter of median ocellus; SL scape length; SW scape width; UFW upper face width (maximum width of face above antennae).

Metasomal terga are referred to as T1, T2 etc. and sterna as S1, S2 etc. The relative diameter and spacing for punctures is given by *d* and *i* respectively, as in $i < d$, or $i = 2d$. The hidden sterna, S7 and S8, of males provide useful diagnostic characteristics and were extracted for examination.

Hairs are described using the terms employed by Maynard, except that a hair branched on one side of the shaft is called pectinate (Hines *et al.* 2022) and one branched on opposite sides of the shaft is called bipectinate.

The following acronym is used in this paper: AMSA Australian Museum, Sydney, New South Wales.

In order to simplify discussion, both *Goniocolletes* and *Exleycolletes* will be referred to as subgenera without prejudice to the question of whether one or both should be regarded as a genus.

Discussion

The revised key includes information about females that was unavailable to the author of the previous key (Maynard 2013). Females of *L. pusillus* (Cockerell, 1929b) and *L. (Goniocolletes) argentifrons* (Smith, 1879) were identified by morphological similarity to and coincident collection with males identified by their hidden sterna and genitalia (Maynard 2013). The revised key also includes changes clarifying the wording of Maynard's couplet 5 (see description of *L. melanopsis*) and correcting a typographical error in couplet 8 of the earlier key. Couplet 8

should have read "S3 with .." and "S3 without..." (not "S4 with .." and "S4 without..."), with the corollary that the description of *L. microdontus* (p. 76) should end "S3–4 almost bare apart from the strong apical fringes".

Examination of the revised key suggests that questions remain about *Exleycolletes* as a taxon. The first is whether the suggested diagnostic features are appropriate and whether some are more important than others.

For example, the species *argentifrons* and *microdontus* were treated as *Leioproctus (Goniocolletes)* by Michener (1965, 2007), but transferred to *Exleycolletes* by Maynard (2013). The decision reflects the different criteria used to define *Goniocolletes*. Both of the transferred species meet one of Maynard's characteristics for *Goniocolletes*, namely a subhorizontal part of the propodeal triangle that is shorter than the metanotum, but presumably other features were regarded as more important. No detailed reasons were presented for the decisions. Without further molecular evidence no attempt is made here to resolve the relationship between *Exleycolletes* and *Goniocolletes* given that Michener's names for the two species remain available for anyone wishing to use them.

A related issue is that Maynard provided no reason for rejecting Michener's 1965 synonymisation of *Paracolletes albopilosus* Rayment, 1930 with *L. (G.) microdontus*. Having examined the holotypes of both species and collected several males and females in the same event, I support the Michener synonymy.

A second question arising from the key is whether *Exleycolletes* should be defined narrowly or more broadly. The female of *pusillus*, not seen by Maynard, is unlike other *Exleycolletes* females in having distinct metasomal hair bands. Superficially it looks like *Leioproctus alienus* (Smith, 1853) and is of a similar size, but Dr Joseph Monks of the Natural History Museum London examined the *alienus* holotype for me and found (J. Monk pers. comm. 2022) that the propodeal triangle differs in detail from that of *L. pusillus* (Cockerell, 1929).

Including species with metasomal hair bands in *L. (Exleycolletes)* would require the inclusion of several, presently undescribed, species with transverse rugae on the propodeal triangle and males with a large apical process on S8. The subgenus is in need of revision, preferably with the inclusion of new molecular evidence.

Taxonomy

Revised key to *Leioproctus (Exleycolletes)*

1a	Female (with scopa on hind tibia)	2
1b	Male (without scopa on hind tibia)	10
2a	Metasoma with basal and/or apical white hair bands on T2–4	8
2b	Metasoma with at most a few weak pale hairs	3

- 3a** Scutum and scutellum closely covered with orange hair **doreyi**
- 3b** Scutum medially with dark hair **4**
- 4a** Scutellum densely covered with yellow or pale hair **5**
- 4b** Scutellum not densely covered with pale hair **7**
- 5a** Facial hair black **melanopsis**
- 5b** Facial hair white **6**
- 6a** Metasomal foveae impressed **cristatus**
- 6b** Metasomal foveae not impressed **flavomaculatus**
- 7a** Anterolateral corners of scutum covered in dense orange or brown hair; apical fringe on S5 slightly shorter medially **leai**
- 7b** Anterolateral corners of scutum covered in black hair; apical fringe on S5 longest medially **tuberculatus**
- 8a** Subhorizontal part of propodeal triangle no longer than metanotum, with a posterior carina **9**
- 8b** Subhorizontal part of propodeal triangle much longer than metanotum, curving smoothly to vertical part **pusillus**
- 9a** Metasoma with dense apical and basal tergal hair bands; face with dense white hair on frons and paraocular areas **argentifrons**
- 9b** Metasoma with relatively weak hair bands; face with close white hair in paraocular areas, sparse elsewhere **microdontus**
- 10a** Median area of metasomal S6 with patch of dark, erect, curly hair **11**
- 10b** Median area of metasomal S6 glabrous or with straight hair **15**
- 11a** Scutum and scutellum closely covered with pale orange hair **doreyi**
- 11b** Scutum medially with dark hair **12**
- 12a** Scutellum densely covered in yellow hair, occasionally pale **13**
- 12b** Scutellum with dark hair peripherally, sparse medially **leai**
- 13a** Face with black hair adjacent to upper inner orbit **melanopsis**
- 13b** Face with pale hair only **14**
- 14a** Sparse hair on S2 & S3 dark brown to black **flavomaculatus**
- 14b** Sparse hair on S2 & S3 white **cristatus**
- 15a** Fringe on S3 very weak or absent **16**
- 15b** Fringe on S3 as long and dense as that on S4 **17**
- 16a** Fringe on S4 white of uniform length, on S5 black, longest medially **tuberculatus**
- 16b** Fringes on S4 & S5 white, of uniform length **pusillus**
- 17a** Moderately large, face and mesosoma covered with long white hair; vertex with erect white hair **argentifrons**

- 17b** Smaller, face and mesosoma with less dense, shorter white hair; vertex with dark brown hair **microdontus**

***Leioproctus (Exleycolletes) doreyi* n. sp.**

Figs. 1, 2

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Holotype: ♀ 3 km N Tintenbar, New South Wales, 28.7704°S 153.5204°E, 11 November 2022, ex *Cordyline stricta*, M. Batley [AMSA K.396035].

Paratypes: New South Wales: 2 ♂, 3 km N Tintenbar, 28.7704°S 153.5204°E, 3 November 2017, ex *Cordyline stricta*, M. Batley [AMSA K.517373-4]; 1 ♂, Victoria Park Nature Reserve, 28.9023°S 153.4105°E, 11 November 2022, ex *Cordyline stricta*, M. Batley [AMSA K.396036].

Diagnosis. Both sexes distinguished from other *Exleycolletes* by the orange hair on the scutum and scutellum. The hair is paler on the male, particularly on the face.

Description of female. [holotype] Body length 11.2 mm, head width 3.0 mm, wing length 7.4 mm. Relative head dimensions: HW 100; HL 85; UFW 65; LFW 56; MOD 7; SL 31; SW 6; FL 64.

Colouration. Integument and wing veins black, except segments 8-10 of flagellum brown ventrally, a small preapical length of mandible amber and tegulae amber.

Structure. Clypeus protuberant, transversely convex; ocelloccipital area flat; propodeal pit strongly depressed; claws cleft; second submarginal cell of forewing receiving first recurrent vein near proximal end; stigma moderately narrow, 0.65 times as long as anterior margin of marginal cell; jugal lobe of hind wing, extending well beyond cu-v; inner hind tibial spur with 6 stout teeth longer than width of shaft.

Pubescence. Paraocular areas and lower frons densely covered with semi-adpressed densely branched orange hair, 1×MOD, hair of clypeus and upper frons sparse (Fig. 1E); scutum, scutellum, metanotum and pronotal tubercle with open, erect, orange hair 1×MOD, denser and longer around margins (Figs 1A, 1B); mesepisternum and venter with sparse, weakly branched white hair ca 2×MOD; metasoma with sparse hair apart from black prepygidial fimbria, a dense dark brown apical fringe on S5, 1×MOD, weaker fringes of white hair on S2-4.

Surface sculpture. Integument polished between strong punctures; clypeus with dense small to medium punctures, i≈0.2d; upper frons with small punctures, i=1-2d, except absent laterad of ocelli; scutum and scutellum with moderately small close punctures, i=0.5-1d; basal half of propodeal triangle with transverse rugae; metasoma with small punctures, i=0.5-2d, except on T1 and the wide marginal areas of subsequent terga.

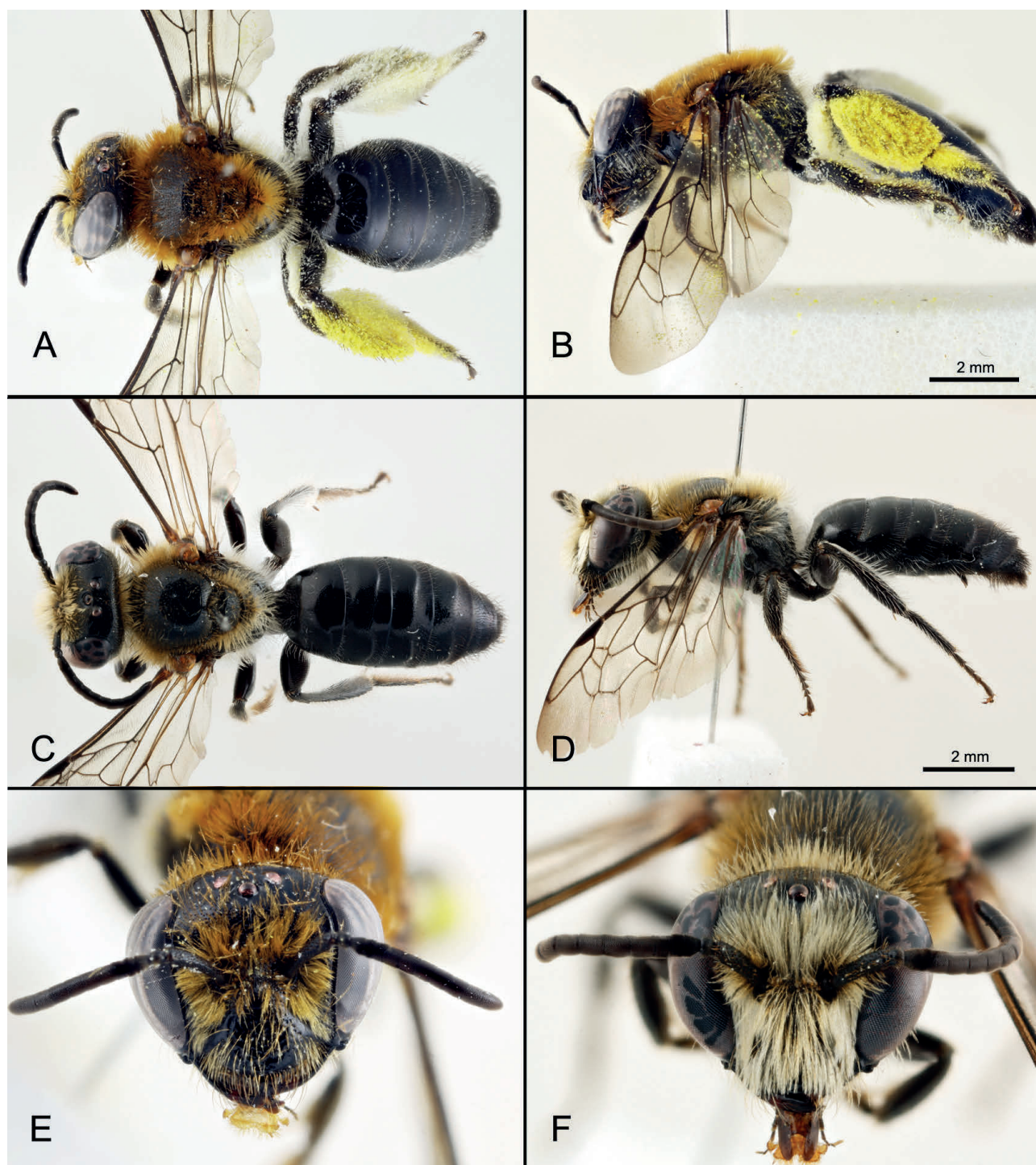


Figure 1. *L. (Exleycolletes) doreyi*: A, female dorsal view; B, female lateral view; C, male dorsal view; D, male lateral view; E, female head front view; F, male head front view.

Description of male. [K.396036] Body length 9.9 mm, head width 2.8 mm, wing length 6.9 mm. Relative head dimensions: HW 100; HL 84; UFW 60; LFW 43; MOD 7; SL 28; SW 7; FL 91.

Colouration. As for female except flagellum dark ventrally.

Structure. As for female except hind tibial spurs without long teeth and metasomal T7 with a triangular bare pygidium. For male terminalia see Figure 2.

Pubescence. Most of face densely covered with pale yellow tightly branched hair, 3–4×MOD (Fig. 1F); scutum, scutellum and metanotum with dense open pale orange plumose hair, 1–2×MOD, longer around margins (Figs 1C, 1D); pronotal tubercle with dense cover of pale hair. Metasomal sternum S4 with dark apical fringe of stiff hair, 2×MOD, S5 with similar black fringe of more openly branched hair and S6 medially with a large tuft of curly black hair; elsewhere, legs and metasoma with sparse hair only.

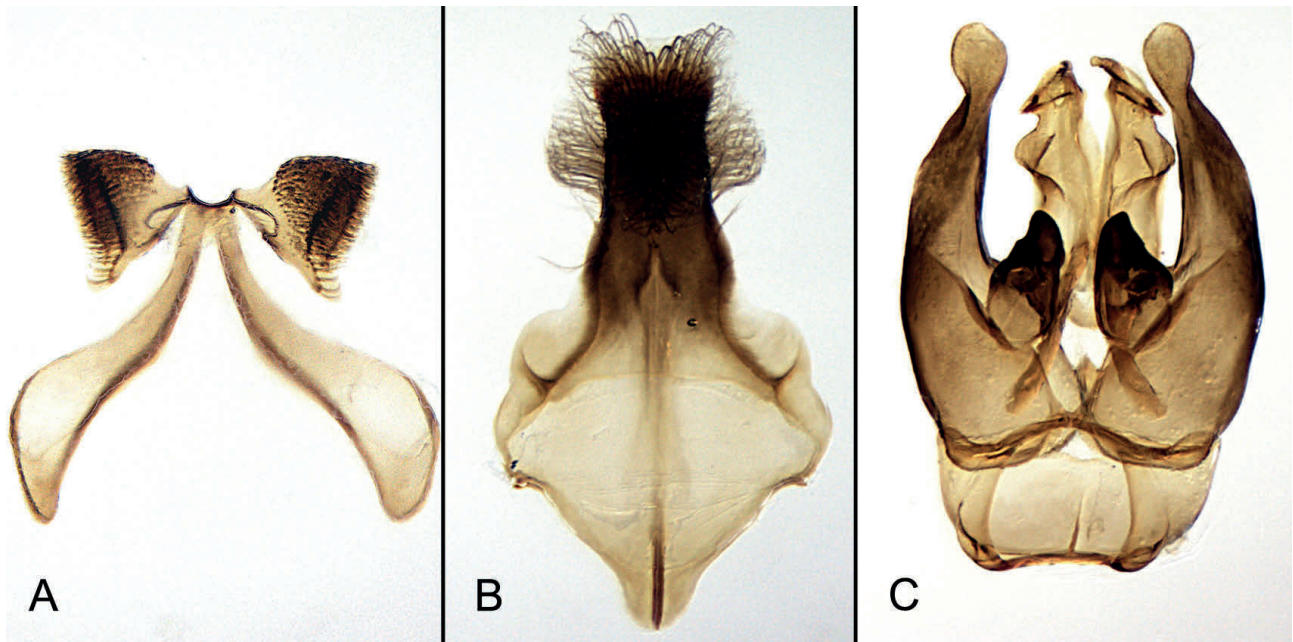


Figure 2. *L. (Exleycolletes) doreyi* male terminalia: A, S7 ventral view; B, S8 ventral view; C, genitalia ventral view. All images to same scale.

Surface sculpture. As for female except scutum and metasomal T1 openly punctate, $i=1-2d$.

Images of the species can be found in Dorey, 2018 and on the internet (<https://www.flickr.com/photos/learn-to-remember/34944922630>).

Etymology. The species is named for James Dorey, who first drew my attention to this species, for his sustained and enthusiastic promotion of Australian bees.

Floral record. The limited number of specimens available were all collected from *Cordyline stricta*, but the female shown in Fig. 1A was carrying differently coloured pollen on each hind leg so the species is expected to visit a range of flowers.

Remarks. The pale hair on *L. cristatus*, *L. melanopsis* and possibly *L. flavomaculatus* is variable in colour from bright yellow to white. A possible contributor to the hair colour of an adult may be the pollen provided for its larval stage.

Leioproctus (Exleycolletes) melanopsis n. sp.

Figs. 3A–F, 4A–C

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Holotype: ♀ Victoria Park Nature Reserve, New South Wales, 28.9023°S 153.4105°E, 4 November 2017, ex *Cordyline stricta*, M. Batley [AMSA K.517379].

Paratypes: NSW: 1 ♂, 3 km N of Harrington, 18 November 1985, G. Williams [AMSA K.396029]; 1 ♂, Brunswick Heads, 1 September 1986, N.W. Rodd [AMSA K.396028]; 1 ♂, Harrington, 11 January 1993, ex *Alectryon coriaceus*, G. Williams [AMSA K.396027]; 3 ♂, Port Macquarie, 31.4697°S 152.9303°E, 21 October 2001, ex *Guioa semi-*

glauca, M. Batley [AMSA K.396038–40]; 1 ♂, 3 km N Tintenbar, 28.7704°S 153.5204°E, 3 November 2017, ex *Cordyline stricta*, M. Batley [AMSA K.517372]; 1 ♂, Manning Point, 31.8924°S 152.6700°E, 21 March 2022, ex *Acronychia oblongifolia*, M. Batley [K.396083]; 1 ♀ Victoria Park Nature Reserve, New South Wales, 28.9023°S 153.4105°E, 11 November 2022, ex *Cordyline stricta*, M. Batley [AMSA K.396034]; 1 ♂, Harrington Lagoon, 31.8714°S 152.6983°E, 3 March 2023, ex *Avicennia marina*, G. & T. Williams [AMSA K.396016]. QLD: 1 ♀, Eungella, 21.1342°S 148.4922°E, 19 April 2015, ex *Callistemon* sp., M. Batley [AMSA K. 361120].

Diagnosis. Black with dense yellow or white hair on scutellum, subhorizontal area of propodeal triangle longer than metanotum with horizontal rugae. Females distinguished from those of *L. cristatus* (Smith, 1853) and *L. flavomaculatus* (Cockerell, 1905) by the absence of white hair on face and metasomal sterna. Males distinguished by erect black hair adjacent to upper inner orbit and by hidden sternum S7.

Description of female. [holotype] Body length 11.7 mm, head width 3.1 mm, wing length 7.8 mm. Relative head dimensions: HW 100; HL 90; UFW 62; LFW 57; MOD 7; SL 29; SW 6; FL 75.

Colouration. Integument and wing veins black except segments 3–9 of flagellum brown ventrally and claws dark brown.

Structure. Clypeus protuberant, transversely convex; ocelloccipital area flat; second submarginal cell of forewing receiving first recurrent vein near proximal end, stigma of moderate width, 0.6 times as long as anterior margin of marginal cell; basal half of propodeal triangle horizontal, with strong horizontal rugae, not

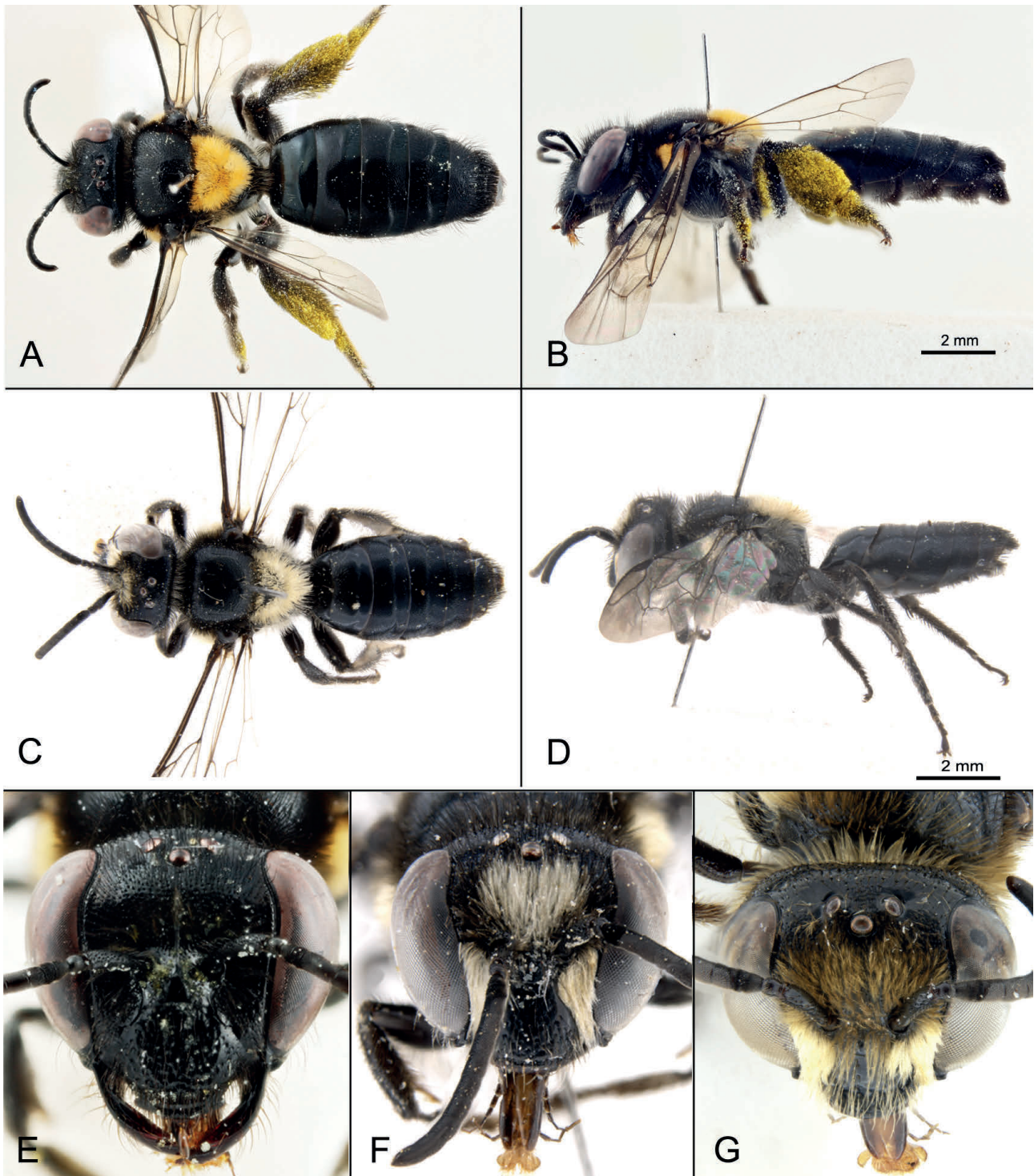


Figure 3. A–F: *L. (Exleycolletes) melanopsis*, A, female dorsal view; B, female lateral view; C, male dorsal view; D, male lateral view; E, female head front view; F, male head front view. G: *L. (Exleycolletes) flavomaculatus*, male head dorsofrontal view.

carinate but bending sharply to the vertical apical half; inner hind tibial spur with *ca* 6 strong well-spaced teeth, more than twice as long as width of shaft; pygidial plate flat, verrucose and apically truncate; claws cleft.

Pubescence. Facial hair black, sparse on lower face, open erect, plumose on frons, 2–3×MOD (Fig. 1E); scutum with open, erect, black plumose hair, 0.5–1×MOD; scutellum, metanotum, axillae and pronotal tubercle with dense, erect, yellow hair 1.5×MOD (Figs 3A, 3B);

propodeum, but not propodeal triangle with sparse, paler hair; ventral surfaces of mesosoma and legs with sparse white hair; hind tibial scopa with close black, mostly pectinate hair; metasomal hair black, sparse apart from dense prepygidial fimbria and apical fringes on S2–5.

Surface sculpture. Integument highly polished between strong punctures except with weak imbrication on metasomal terga; punctures mid-sized on clypeus, $i < 2d$;

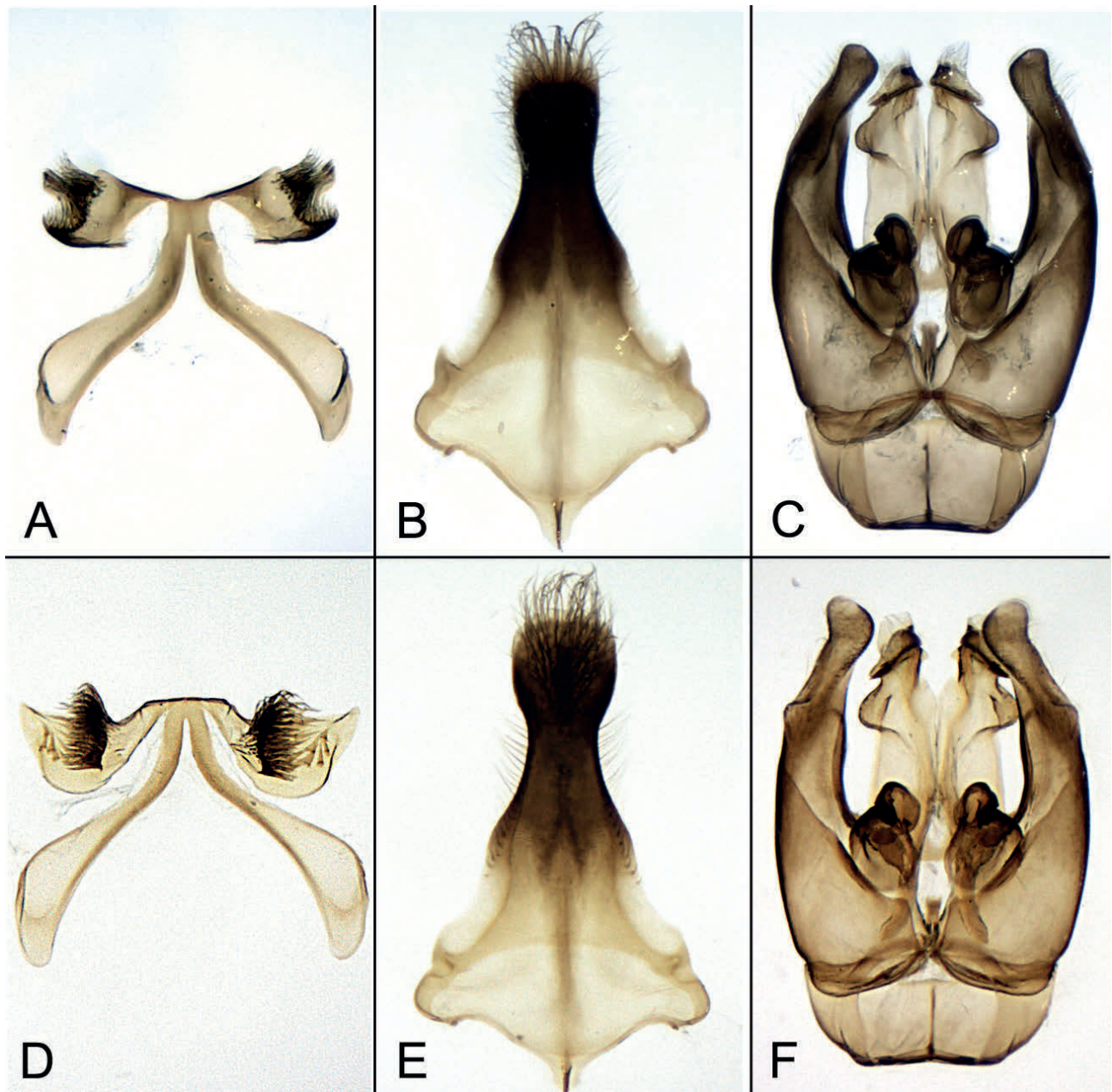


Figure 4. A–C: *L. (Exleycolletes) melanopsis* male terminalia. A, S7 ventral view; B, S8 ventral view; C, genital capsule ventral view; images to same scale. D–F: *L. (Exleycolletes) flavomaculatus* male terminalia. D, S7 ventral view; E, S8 ventral view; F, genital capsule ventral view; images to same scale.

smaller and dense on frons, $i \approx 0.5d$; small and open on scutum, $i = 1-4d$ and small on metasomal terga, $i = d$, more open on T1 and sparser in marginal areas of T3–6.

Description of male [K.3517372] ♂ Body length 9.6 mm, head width 2.7 mm, wing length 6.5 mm.

Relative dimensions: HW 100; HL 89; UFW 60; LFW 42; MOD 8; SL 28; SW 7; FL 98.

Colouration. As for female except mandible dark red apically.

Structure. As for female except vertical half of propodeal triangle has several fine transverse rugae and metasomal T7 has a bare, flattened pygidial area. For terminalia

see Figures 4A–4C. Terminalia of *L. flavomaculatus* are shown in Figures 4D–4F for comparison.

Pubescence. Hair of face mostly white, adpressed in lower paraocular areas, semi-erect on frons, tightly branched 2–3×MOD, except above the antennal sockets, adjacent to inner orbit, shorter, black, plumose and erect; clypeus with sparse hair, vertex with fine, sparse brown hair; gena with open, weakly branched hair, black on dorsal half, white on ventral half. Scutellum, metanotum and axilla with dense cover of white or pale yellow hair, erect, plumose, 2×MOD; pronotal tubercle with dense cover of pale hair; anterolateral corners of scutum in front of tegulae with close erect black hair, tightly branched, ca 1×MOD. Metasomal sternum S4 with dark

apical fringe of stiff hair, $2 \times \text{MOD}$, S5 with similar black fringe of more openly branched hair, S6 medially with a large tuft of curly black hair; elsewhere, legs and metasoma with sparse hair only.

Surface sculpture. Integument highly polished between strong punctures except with weak imbrication on clypeus and in marginal areas of metasomal terga T3–6; punctures small on clypeus, $i=1-2d$; smaller and dense on frons, $i < d$; small and open on scutum, $i=2-4d$ and metasomal terga with small punctures, $i \approx d$, more open on T1 and even sparser in the marginal areas of T3–6.

Variation. The black hair on the frons of males varies in extent from the large areas shown in Figure 2F to a narrow line adjacent to the inner orbit visible only with careful examination. Occasionally tegula, legs, some wing veins and T1 of males are dark brown. The body length of males ranged from 8.3 mm to 9.4 mm (av.=9.0, s.d.=0.3, n=9) and that of females from 9.4 mm to 11.5 mm.

Etymology. The specific epithet is a Latinized adjective from Greek words for “black” and “face”.

Floral record. Families visited: Asparagaceae, Sapindaceae, Rutaceae, Acanthaceae and Myrtaceae

Distribution. This species has frequently been misidentified as *L. flavomaculatus* making its distribution somewhat uncertain. Known specimens have been found in coastal areas of northern New South Wales and southern Queensland.

Remarks. Misidentifications as *L. flavomaculatus* may have been the result of incorrect interpretation of couplet 5 in Maynard’s key where the male *flavomaculatus* is described as having the frons covered with “whitish hair surrounded by dark hair”. Figure 3G shows the face of a male *L. flavomaculatus*, identified by its terminalia (Figure 4D–F). The facial hair is rather reflective and appears much brighter when illuminated perpendicular to the shaft, so that in Figure 3G hair on the frons, which is seen at an acute angle to the shaft appears darker than that in the paraocular areas. Viewed from directly in front, the facial hair is uniformly coloured. The dark hair on the upper face of the male *L. melanopsis* is black when viewed from any angle.

Acknowledgments

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