





Cephalodesmius carminya, a new flightless dung beetle species from the Central Mackay Coast, Queensland.

Kathryn M. Ebert^{1,2}, Nicole L. Gunter^{1*}

¹ Biodiversity and Geosciences Program, Queensland Museum.

² School of the Environment, The University of Queensland.

*Corresponding author: nicole.gunter@qm.qld.gov.au

Kathryn Ebert  <https://orcid.org/0000-0003-3408-7872>; Nicole Gunter  <https://orcid.org/0000-0002-8355-0862>



© Copyright of this paper is retained by its authors, who, unless otherwise indicated, license its content under a CC BY 4.0 license

Abstract

A new species from the genus *Cephalodesmius* Westwood (Coleoptera: Scarabaeidae: Scarabaeinae) is described from the Central Mackay Coast bioregion, Queensland extending the northern range of the genus. *Cephalodesmius carminya* Ebert & Gunter new species is known from two localities in the Pine Mountain, Carminya Forest Reserve and 2.5 km west of Eungella dam. A key to the four species of *Cephalodesmius* is provided and we discuss morphological similarities between *Cephalodesmius* and its closest relative *Canthonosoma* Macleay.

Cite this paper as: Ebert KM & Gunter NL (2024). *Cephalodesmius carminya*, a new flightless dung beetle species from the Central Mackay Coast, Queensland.. *Australian Journal of Taxonomy* 56: 1–9. doi: <https://doi.org/10.54102/ajt.h85un>
urn:lsid:zoobank.org:pub:7851A9F2-C0C7-402B-98FF-0166C33698BD

Introduction

The genus *Cephalodesmius* Westwood, 1841 is endemic to Australia and is currently comprised of three species: *C. laticollis* Pascoe, 1863 which occurs in closed montane forests of southeast Queensland and northeastern New South Wales; *C. armiger* Westwood 1841 which is found in closed forests from Nowra, New South Wales to Mt Wolvi, Queensland, and *C. quadridens* Macleay, 1871 which is found in forests and vine thickets in southeast Queensland. A fourth new species has been collected in dry rainforest west of Mackay, 630km farther north than the northernmost specimens of the other three species. Specimens were first collected in 1981 by Andrew Gillison (CSIRO) during a botanical study west of the Eungella region and were deposited alongside other insects from that survey in the Australian National Insect Collec-

tion. In 1998, a second population was recorded during a survey of Pine Mountain, Carminya Forest Reserve by Geoff Monteith (Queensland Museum) and colleagues. Additional sampling at both localities have amassed a series of approximately 60 specimens.

The new species is strikingly sexually dimorphic. The females possess four clypeal teeth, the medial pair are distinctly projected, are parallel in form and are characteristic of *Cephalodesmius*, while males only possess two clypeal teeth that are shorter and not markedly projected. The protibia display similar sexual dimorphism as recorded for *C. quadridens* with a supplemental protibial tooth on the distal edge absent in males but present in females. Interestingly, the protibiae of both species bear a broad, short downwards directed tooth below the tarsal insertion in males, which is absent in females.

This paper was submitted on 20 February 2024 and published on 25 March 2024 (2024-03-24T21:24:46.337Z). It was reviewed by Tom Weir and an anonymous reviewer, and edited by Subject Editor Erinn Fagan-Jeffries under the guidance of Associate Editor Mark Harvey. *Australian Journal of Taxonomy*. ISSN: 2653-4649 (Online).

Matthews (1974) lists the ventral tooth at the base of the protarsus as part of the generic description for *Cephalodesmius*, with the remark that it is sometimes absent. This tooth is also listed as a dimorphic character of the genus *Canthonosoma* Macleay. The male of the new species also shares other morphological affinities with *Canthonosoma* including a metaventral tubercle and depression in males, which is absent in females.

The close relationship between the *Cephalodesmius* and *Canthonosoma* has been well established. Harold (1868) described two *Canthonosoma* species that were originally placed in *Cephalodesmius*; Macleay (1871) described a third species and erected the genus *Canthonosoma*. The validity of the genus was discussed by Harold (1872) and Lansberge (1874), and is currently recognised as two separate genera (Matthews, 1974; Gunter et al. 2019). While there are sufficient characters to justify the separation of the two genera, the sexual dimorphism of this new species with males sharing many affinities with *Canthonosoma*, and females displaying many characteristic *Cephalodesmius* traits highlights the need to explore the relationships in further detail.

This new species exhibits the same unusual behaviour as other *Cephalodesmius* species. Beetles in this genus live in a permanent nest burrow and gather leaves, fruits, fungi and other organic material and work it into a large ball which they use to construct larval brood balls (Monteith & Storey 1981). This dung beetle genus is the only one known to process and culture its own substitute dung-like material. The adults continually gather material to maintain a composting brood mass for the lifetime of their larvae, constantly re-provisioning the larval brood balls with new material as the larvae grow. Nest excavation of this new species uncovered adults and brood balls with developing larvae (G. Monteith pers. comm). Adults maintained in culture exhibited the same unusual behaviour. Larvae of this new species were also found to have similar stridulatory structures on the last abdominal sternite as do the other three species (Monteith & Storey 1981). These stridulatory structures have not been documented in *Canthonosoma*, nor has the nesting biology. However, G. Monteith has observed brood ball re-provisioning with kangaroo dung in *Canthonosoma masteri* Macleay, 1871 that he kept in culture (pers. comm).

Methods

Fifty-eight specimens were examined by the authors at the Queensland Museum (QM), four other specimens were examined by Tom Weir at the Australian National Insect Collection, CSIRO (ANIC); no other specimens are currently known from other major holdings of Australian dung beetles. A total evidence approach was used to form the species concept and relies on morphological characters for diagnosis. Descriptions follow format of Matthews (1974) with terminology for adult

morphology updated as per Gunter & Weir (2019). We consider the striae on the pseudopipleuron to be striae 9 and 10, with stria 8 being lost.

Label data. The holotype labels are listed verbatim with lines separated by a slash (/) and individual labels separated by a double slash (//). Verbatim locality labels are listed for paratypes but for multiple specimens in the same series, secondary labels with institutional registration codes are listed following the // indicating a second label, then in sequential order with specimen sex in brackets, and separated by a comma. If geocoded data cannot be directly taken from labels it is listed in square brackets. Institutional registration numbers are listed for ease of subsequent validation. Most specimens with QM registration numbers are permanently housed at QM, however a small number of paratypes are transferred from QM to be lodged at ANIC, these are noted in brackets as "in ANIC".

Discussion

It is evident that *Cephalodesmius carminya* nov. sp. is closely related to *C. quadridens*. The sexually dimorphic configuration of the protibiae of these species appear to be a continuum of traits between *Cephalodesmius* and *Canthonosoma* which could warrant either synonymising *Canthonosoma* or erecting a third genus to place *Ce. quadridens* and *Ce. carminya* nov. sp. Additional sexual dimorphic traits observed in *Cephalodesmius carminya* nov. sp. are pleisomorphic, and share morphological affinities with either *Cephalodesmius* (clypeal teeth configuration of females) or *Canthonosoma* (metaventral ornamentation of males and clypeal teeth configuration, although *Canthonosoma* do not have an excision of any sort adjacent to medial teeth) raising further systematic questions. While revising the genera is beyond the scope of this paper and should await robust phylogenetic analyses, we discuss possibilities. If *Canthonosoma* is synonymised, defining *Cephalodesmius* becomes difficult as diagnostic characters of taxonomically informative features such as protibial or head ornamentation are variable, while the remaining shared traits such as complete eye canthus and presence of pseudopipleuron are homoplastic within the Australian Endemic Clade. The description of a new genus would necessitate redefining diagnostic characters of *Cephalodesmius* as well as detailed investigation of apomorphic characters of all three genera, as well as their closest relative *Aulacopris* White, 1859 which also bear a metaventral tubercle and depression. We refrain from making unwarranted taxonomic changes at this point in time, although suspect that a revision of *Cephalodesmius* is warranted to separate the evident two groups.

Taxonomy

Key to *Cephalodesmius* Westwood

The characters used in sexing *Cephalodesmius* are more evident in some species than others. The length of abdominal ventrite 6 is shorter and flat or concave in males, and longer and medially convex in females. Other dimorphic characters vary by species, including the form of clypeal teeth that are generally wider in females, or form of protibiae. The supplemental protibial tooth on distal edge is absent in males of some species.

- 1 Pronotal hypomeron deeply excavated anteriorly for the reception of the profemur. Prothorax about the same width as hind body. Outer distal edge of protibia of males without supplementary tooth (Fig. 2C); tooth is present in females (Fig. 2D). Wings absent. Generally smaller beetles, 6–9 mm, never larger than 10 mm **2**
- 1 Pronotal hypomeron not excavated anteriorly. Prothorax about a little or distinctly wider than hind body, generally widest at lateral angle. Outer distal edge of protibia of males and females with supplementary tooth. Wings reduced. Small to large beetles 8–19 mm **3**
- 2 Male with large, depressed area on medial lobe of metaventrite and prominent hooked tubercle at base of metaventrite (Figs. 1B–C, 3C). Female with four clypeal teeth, medially pair are distinctly projected and parallel in form (Fig. 2B), male with only two small clypeal teeth (Fig. 2A); U shape between all clypeal teeth, edge of head also with 2 small excisions in front of clypeogenal suture. Dense puncture on head and body, often with space as wide as punctures between. Anterior third of lateral edge rounded and converging to quadrate anterior angles. 7th stria on elytral disc appearing obsolete, evident only in part along pseudopleural edge

***Cephalodesmius carminya* Ebert and Gunter, new species**

- 2 Male metaventrite feebly convex, without tubercle at base of metaventrite. Male and female with 2 pairs of subequal clypeal teeth, V or U shape between central clypeal teeth, U shape between 2nd pair of median teeth; edge of head with 8 teeth including 4 clypeal teeth and a pair of small teeth adjacent to the clypeogenal suture. Very dense punctures on head and body, minimal space between punctures. Anterior third of lateral edge straight, strongly converging to subquadrate anterior angles. Seventh stria on elytral disc very fine and superficial

***Cephalodesmius quadridens* Macleay**

- 3 Median clypeal teeth subparallel, the space between them U-shaped. Anterior part of lateral pronotal edge strongly rounded and expanded.

Elytral striae indistinct. Disc of elytra nearly flat, hind body tapering posteriorly

***Cephalodesmius laticollis* Pascoe**

- 3 Medial clypeal teeth diverging, the space between them V-shaped. Anterior part of the lateral pronotal edge straight, not expanded. Elytral striae distinct, more nitid than intervals. Disc of elytra distinctly convex, hind body rounded

***Cephalodesmius armiger* Westwood**

Genus *Cephalodesmius* Westwood, 1841

Type species: *Cephalodesmius armiger* Westwood, 1841, by monotypy.

Remarks

Cephalodesmius carminya nov. sp. belongs in the genus *Cephalodesmius* that is characterised by the following characters: Elytron with pseudopleuron; elytron with 9 striae, 7 on disc, 2 on pseudopleuron; eye canthus completely dividing the eye; pronotal hypomeron with anterior hypomeral carina; protibia with three teeth on outer edge, anterior two teeth closer together; protibia with supplemental tooth on distal edge (always in female, absent in some males). The keys to genera in Matthews (1974) and Gunter et al. (2019), utilize many of these characters to identify the genus and separate *Cephalodesmius* from the closest relative *Canthonosoma*, Macleay (amongst other character) by number of having 4–8 clypeal teeth, the medial pair often prominent in *Cephalodesmius*, or two small clypeal teeth in *Canthonosoma*. The clypeal teeth of *Cephalodesmius carminya* nov. sp. are sexually dimorphic, only two small clypeal teeth are present in males, while females have four clypeal teeth the central two are distinctly prominent. Although male *Cephalodesmius carminya* nov. sp. have only two small clypeal teeth, all other characters for that separate the *Cephalodesmius* and *Canthonosoma* in their couplets are consistent with *Cephalodesmius* including the absence of a mesofemoral ventral suture, supplementary tooth on distal edge of protibia in females, and pronotal hypomeron anteriorly excavated anteriorly for reception of profemur. We therefore place the new species within *Cephalodesmius*.

***Cephalodesmius carminya* Ebert & Gunter, new species**

Figures 1–3.

Type series. Holotype (♂): CQ:21°45'Sx148°50'E/ Pine Mt summit, 680m/ 19–24 April 1998/ G.Monteith.Rainforest/ dung trap. **5776// QM Reg. No./ T90849//** Photographed/ Specimen". Paratypes (28 ♂, 31 ♀): CQ:21°45'Sx148°50'E/ Pine Mt summit, 680m/ 19–24 April 1998/ G.Monteith.Rainforest/ dung trap. **5776// QM Reg. No./ T90848 (♂), T90850 (♀), T90851 (♀), T90852 (♀), T90853 (♀), T90854 (♀), T90855 (♀);** CQ:21°45'Sx148°50'E/ Pine Mt summit, 680m/ 19–24 April 1998/ G.Monteith.Rainforest/ dung trap. **5776// ANIC Database No. // 25-053793 (1x ♂, 1x ♀);**

CQ:21°45'Sx148°50'E/ Pine Mt summit,680m/ 24Apr1998.G.Monteith/ Vine Scrub. **5785// QM Reg. No./ T90856** (♀); MEQ:21°45'Sx148°50'E/ Pine Mt, summit./ 5-6Oct1999. vine scrub./ Monteith,Burwell,Cook,/ Evans.500-633m.**7810// QM Reg. No./ T90821** (♂), **T90822** (♀), **T90823** (♀), **T90824** (♂), **T90825** (♂), **T90826** (♂), **T90827** (♀), **T90828** (♂), **T90829** (♀), **T90830** (♀), **T90831** (♀), **T90832** (♂), **T90833** (♂), **T90834** (♂), **T90835** (♂), **T90836** (♂), **T90837** (♀), **T90838** (♂), **T90839** (♀), **T90840** (♂) (in ANIC), **T90841** (♀) (in ANIC), **T90842** (♀), **T90843** (♀); MEQ:21°45'Sx148°50'E/ PineMt,0.6km S.420m/ 6Oct1999. vine scrub/ G.Monteith&D.Cook.dug/ from burrows. **7813// QM Reg. No./ T90844** (♀), **T90845** (♂), **T90846** (♀), **T90847** (♂); MEQ:21°45'Sx148°51'E/ Pine Mt,0.5kmESE/7 Oct- 17 Dec 1999/ D&I Cook. vine scrub,/ pitfall, 500m. **9039// QM Reg. No./ T94626** (♀), **T94627** (♀), **T94628** (♂); MEQ:21°45'Sx148°50'E/ Pine Mt, summit.620m/ 17-18 Dec 1999/ D&I Cook. hoop pine/ scrub, fungus pit.**9050// QM Reg. No./ T103368** (♂); MEQ:21°45'Sx148°50'E/ Pine Mt, summit.620m/ 17-18 Dec 1999/ D&I Cook. hoop pine/ scrub, dung pit.**9051// QM Reg. No./ T103369** (♂); MEQ:21°45'Sx148°50'E/ Pine Mt, summit. 620m/ 17Dec1999-24Mar2000/ Monteith. hoop pine/ scrub, pitfall. **9237// QM Reg. No./ T95066** (♂), **T95067** (♂); MEQ:21°45'Sx148°50'E/ Pine Mt, summit. 620m/ 24 Mar – 31 May 2000/ Monteith&Cook. pitfall/ hoop pine scrub.**9417// QM Reg. No./ T98866** (♂), **T98867** (♂), **T98868** (♀), **T98869** (♀), **T98870** (♀); MEQ:21°45'Sx148°50'E/ Pine Mt, summit. 620m/ 24 Mar – 31 May 2000/ Monteith&Cook.intercept/ hoop pine scrub.**9418// QM Reg. No./ T103367** (♀); MEQ:21°45'Sx148°51'E/ Pine Mt, 0.5km ESE/ 24 Mar – 31 May 2000/ Monteith & Cook. pitfall/ vine-scrub,500m.**9420// QM Reg. No./ T98871** (♂), **T98872** (♂); 21.10S 148.22E/ 14km WbyS/ Eungella QLD/ 18 Nov.1981/ A.Gillison 350m// Berlesate/ semi-deciduous/ vine thicket/ 17// *Cephalodesmius* /sp. nov. /det. T.A. Weir 1998/ **QM Reg. No./ T90858** (♀) [21°10'S, 148°22'E]; 21.10S 148.22E/ 14km WbyS/ Eungella QLD/ 18 Nov.1981/ A.Gillison 350m// Berlesate/ semi-deciduous/ vine thicket/ 17// **QM Reg. No./ T90857** (♂) [21°10'S, 148°22'E]; 21.10S 148.22E/ 14km WbyS/ Eungella QLD/ 18 Nov.1981/ A.Gillison 350m// Berlesate/ semi-deciduous/ vine thicket/ 17// *Cephalodesmius* /sp. nov. /det. T.A. Weir 1982// *Cephalodesmius* CQ1 /det T.A. Weir 2008 // **ANIC Database No./25-053792** (1x ♂, 1x ♀); QLD: 21.171°Sx148.371°E/ 2.5km W of Eungella Dam,/ 515m,6Mar2016, G./ Monteith. ex burrows in/ scrubby gully. **38604 //QM Reg. No./ T247107** (♀); QLD: 21.171°Sx148.371°E/ 2.5km W of Eungella Dam,/ 515m,6Mar2016, G./ Monteith. ex burrows in/ scrubby gully. **38604 //COL4554// COL4554/ Cephalodesmius/ CQ1// QM Reg. No./ T260149** (♂); QLD: 21.171°Sx148.371°E/ 2.5km W of Eungella Dam,/ 515m,6Mar2016, G./ Monteith. ex burrows in/ scrubby gully. **38604 //COL3194// QM Reg. No./ T260150** (♂); QLD: 21.171°Sx148.371°E/ 2.5km W of Eungella Dam,/ 515m,6Mar2016, G./ Monteith. ex burrows in/ scrubby

gully. **38604 //COL3195// QM Reg. No./ T260151** (♀); Q.21°10'S,148°22'E/ Eungella, 14kmWSW/ 2 Oct 2003 Vine Scrub/ G.Monteith. **11387//COL3195// QM Reg. No./ T118692** (♀).

Diagnosis. Medium oblong beetle (6.0 – 7.8 mm Total Length, 3.7– 5.0 mm Elytral Width), pronotum strongly convex, elytral disc convex with very sharp pseudopleural edges that lack a row of small setae. Dark brown with numerous curved blonde setae frequently holding fine layer of soil; teneral specimens may be reddish brown. Antennal clubs orange-brown. *Cephalodesmius carminya* can be easily diagnosed from all other species in the genus by distinctive shape of the clypeal teeth in females (Fig. 2B), protibial shape (Figs 2C-D), metaventral depression and basal hooked tubercle in males (Figs. 1B-C, 3C) and shape of the aedeagus (Figs 3A-B).

Description. Holotype measurements: Total length 7.5 mm, elytral width 4.5 mm. Note holotype missing left mesotarsomeres 2-5 and metaventrite is damaged by pin (Fig 1A-B).

Male:

Head (Fig. 2A): Broad U-shaped between clypeal teeth, which are short and upturned. Shallow excision adjacent to clypeal teeth, rest of edge more or less straight. Small incision at clypeogenal suture. Genal angle obtuse and rounded. Head surface microreticulate with reticulation of fine meshes, and with minute nitid granules; nitid area at base of clypeal teeth. Dense punctures on head with similar density on anterior and posterior of head; punctures large, round, with raised nitid edge, each with a short, curved seta. Dorsal part of eyes moderately small in size, only a little narrower than long, separated by interocular space approximately 20 times eye width; eye canthus completely dividing eye. Head 1.7 × wider than long (29:17).

Prothorax: About the same width as hind body, lateral edges parallel sided for posterior 3/4th, lateral angle rounded, anterior quarter of lateral edge rounded until quadrate anterior angle; lateral edges appearing finely serrulate. Hind angles rounded, basal margin evenly rounded without medial salience. Pronotum strongly convex with evident longitudinal sulcus in posterior half of disc. Surface microreticulate, matt with numerous minute nitid granules in space between punctures. Dense uniform punctures across disc; punctures large, shallow, elongate oval shaped, with raised nitid edges and with short, curved seta in centre of puncture. Hypomer surface microreticulate, mostly with dense punctures but with a small area devoid of punctures; punctures on hypomer surface round but otherwise similar to disc. Pronotal hypomer distinctly excavated for reception of profemora. Anterior hypomer carina fine and nitid extending from coxa to lateral edge. Pronotum 1.3 × wider than long (45:34).



Figure 1. Habitus of *Cephalodesmius carminya* Ebert & Gunter new species. A. dorsal habitus male (holotype T90849); B. ventral habitus male (holotype T90849); C. ventral habitus male (paratype T90832); D. ventral habitus female (paratype T90855), note specimen is teneral.

Elytra: Distinctly convex, about same width as prothorax, sides slightly converging posteriorly. Disc with 7 striae, 1-6 very fine, very shallow and contrastingly nitid,

stria 7 near obsolete with only very fine, partial traces along edge of the pseudopipleuron. Pseudopipleuron with 2 very fine striae, considered as stria 9 and 10,

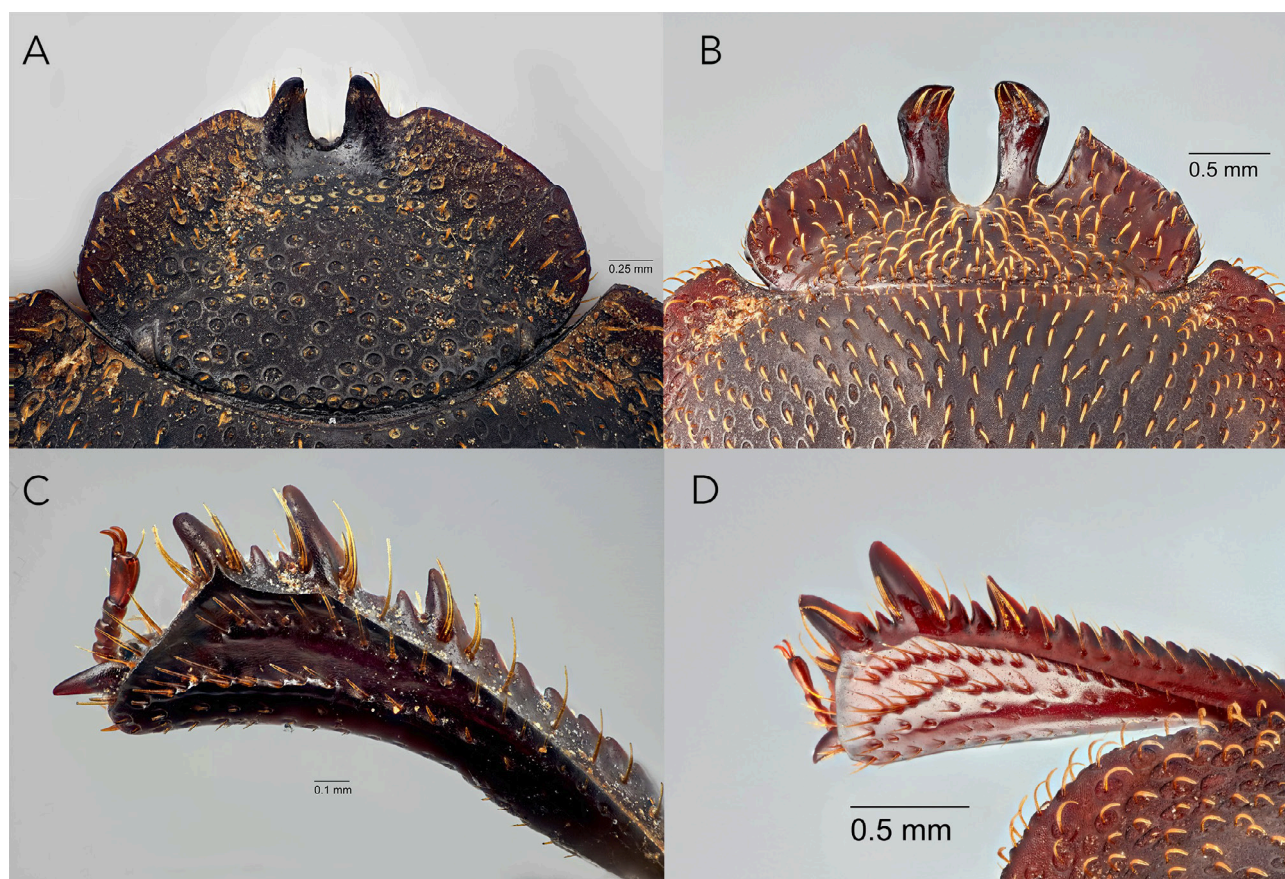


Figure 2. Some diagnostic characters of *Cephalodesmius carminya* Ebert & Gunter new species. A, Head of male (holotype T90849); B, head of female (paratype T90855); C, protibia of male (holotype T90849) showing tooth under protarsus; D, protibia of female (paratype T90855) showing supplemental tooth at outer distal edge.

with stria 8 absent. Stria 9 anteriorly effaced. Edge of pseudopipleuron without setae; pseudopipleural edge ends before elytral apex. Intervals flat, surface with reticulation of very fine meshes, matt with nearly obsolete minute nitid granules, sparse or in irregular rows; short, curved setae regularly spaced along interval edges. Elytra $1.1 \times$ longer than wide (45:41).

Legs: Protibia bearing short downward directed tooth below tarsal insertion; distal edge of protibia straight, meeting inner edge at an angle, inner edge concave; supplemental tooth at outer distal edge absent; outer edge with three teeth, distal two closer together and slightly larger than basal tooth, sharp serrations between teeth and proximal to them (Fig. 2C). Protibial spur at inner angle, large, acute and movable. Profemora uniformly punctate on ventral surface. Mesocoxa parallel, widely separated. Ventral surface of mesofemora without a longitudinal carina. Metatarsus with 5 tarsomeres, 1st and 2nd tarsomeres subequal. Tarsal claws simple.

Abdomen: Pygidium slightly convex, subtriangular, fully margined. Surface matt with fine, nitid marginal bead slightly broader medially. Disc with dense shallow punctures; punctures moderate size, round with raised nitid edges, and short, curved seta. Abdominal ventrite 6 with

small to moderate punctures and fine setae, surface mostly microreticulate and medial nitid area.

Adeagus: Symmetrical, as in Fig. 3A-B.

Pterothorax: Medial lobe of metaventrite exceptionally broad, narrowly margined beside the mesocoxae, and with medial depression and distinct raised tubercle at base of metaventrite (Figs. 1B-C). Metaventral tubercle nitid, from lateral view broad at base and curved forward to a blunt hook-like tip (Fig. 3C). Surface and punctuation on medial and lateral lobes of metaventrite differ; medial lobe nitid with a few small punctures only at the base, virtually impunctate anteriorly and in depression; lateral lobes of metaventrite microreticulate with large round punctures with raised edges. All punctures with short, curved seta. Mesoventrite, mesepimeron and metanepisternum with similar surface to lateral lobes. Meso-metaventral suture straight but with small medial notch; distal edge and lateral edges of medial lobe at almost 90° meeting at rounded corner.

Hind Wing: Absent.

Female: Head with four clypeal teeth, medial pair are distinctly longer, parallel in form with broadened, rounded apices; U shape between clypeal teeth wider than in male; head surface mostly nitid, punctures often less dense than in males (Fig. 2B). Protibia with sup-



Figure 3. Some diagnostic characters of *Cephalodesmius carminya* Ebert & Gunter new species. A. aedeagus lateral (paratype T90832) B. aedeagus dorsal (paratype T90832); C. lateral view of male (holotype T90849).

plemental tooth on outer distal edge; downward facing tooth under protarsus absent; protibia broader than in male, distal and inner edge meeting at approximate 90° angle, inner edge more or less straight (Fig. 2D). Metasternal tubercle and depression absent (Fig. 1D). Medial notch on mesometasternal suture absent. Nitid area on pygidial disc (marginal bead) broader than in male. Ventrite 6 slightly longer medially, more convex than male.

Etymology. Named for Carminya Forest Reserve from which most known specimens have been collected. This name should be treated as a noun in apposition.

Distribution. *Cephalodesmius carminya* sp. nov. is only known from two localities in the Central Mackay Coast bioregion.

Comments. *Cephalodesmius carminya* sp. nov. was previously given the informal code *Cephalodesmius* "CQ1". Care should be taken pinning male specimens as the metaventral depression is easily damaged; many males in the type series including the holotype have cracked metaventriles.

This species has been recorded in dry rainforest and vine scrub of the Central Mackay Coast IBRA bioregion



Figure 4. vegetation and understory at the type locality. Copy of 35mm slide taken by Geoff Thompson, 8:20am, 1 June 2000, Pine Mountain Summit, via Sarina, Location Code 8654-004.

(see Fig. 4 habitat image from Pine Mountain summit). Despite, surveying efforts in wet rainforests of Eungella and Conway National Parks, this species has not been recorded there. *Cephalodesmius*, including *C. carminya* sp. nov., have distinct burrows that are readily identifiable on the forest floor. Multiple adult specimens from the paratype series were collected from burrows. Larvae in brood balls were also collected, and were raised in culture, however they were not preserved. In culture, adults were fed a variety of fruit, vegetables, fungi and dung.

Three specimens from 2.5km W of Eungella have had DNA extracted following established protocols listed in Gunter & Weir (2017), they are listed with voucher "COL" codes and COI barcodes for COL3194, COL3195 and COL4554 are deposited on GenBank (Accession numbers PP498806, PP498807, PP498808 respectively). No barcodes have been generated for specimens from Pine Mountain as no tissue grade material was available to study.

Disclosures

No conflict of interests

Acknowledgments

This taxonomic project would not have been possible without the effort of collectors, Andrew Gillison who first collected specimen, and Geoff Monteith whose decades of fieldwork has amassed both positive and negative occurrence records which have established the known distribution of Australian dung beetles. We extend our gratitude to Geoff Thompson and Lily Kumpe for production of the incredibly detailed digital images published here and to Tom Weir for verifying the identification of specimens at ANIC and for his mentorship. We are grateful to the editor and reviewers that helped improve the quality of this manuscript. This material is based upon work supported by the National Science Foundation under grant NSF#1942193.

References

Gunter, N.L. & Weir, T.A. (2017) Two new genera of Australian dung beetles (Scarabaeidae: Scarabaeinae), with

the description of six new species and transfer of six described species, *Zootaxa*, 4290 (2), 201–243. <https://doi.org/10.11646/zootaxa.4290.2.1>

Gunter, N.L. & Weir, T.A. (2019) Revision of Australian species of the dung beetle genus *Lepanus* (Coleoptera: Scarabaeidae: Scarabaeinae): key to species groups and description of 14 new species from the *L. pygmaeus* species group. *Zootaxa*, 4564, 41–80. <https://doi.org/10.11646/zootaxa.4564.1.2>

Gunter, N.L., Lemann, C., & Weir, T.A. (2019). 30. Subfamily Scarabaeinae *In* Australian Beetles (Volume 2). Eds. Slipinski, A. & Lawrence, J. F. CSIRO Publishing. Pp 443–466

Harold, E. von (1868) Diagnosen neuer Coprophagen. *Coleopterologische Hefte*, 3, 80–86.

Harold, E. von (1872) Literatur. *Coleopterologische Hefte*, 9–10, 207–257.

Lansberge, G. van (1874) Observations sur la classification des Lamellicornes Coprophages. *Annales de la Société entomologique de Belgique*, 17, 177–193

Macleay, W. (1871) Notes on a collection of insects from Gayndah. *Transactions of The Entomological Society of New South Wales*, 2, 79–205.

Matthews, E.G. (1974) A revision of the scarabaeine dung beetles of Australia. II. Tribe Scarabaeini, *Australian Journal of Zoology*, Supplementary Series, 24, 1–211.

Monteith, G.B. & Storey, R.I. (1981) The biology of *Cephalodesmius*, a genus of dung beetles which synthesises "dung" from plant material (Coleoptera: Scarabaeidae: Scarabaeinae). *Memoirs of the Queensland Museum*, 20(2), 253–277.

Thackway, R. & Cresswell, I.D. (Eds.) (1995) An Interim Biogeographic Regionalisation for Australia: a Framework for establishing the National System of Reserves. Version 4.0. Australian Nature Conservation Agency, Canberra, 90 pp.



This paper was typeset using Prince

www.princexml.com