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RESEARCH ARTICLE

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A new species of *Celatoblatta* cockroach that coincides with the distribution of kauri forests in New Zealand

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ABSTRACT

A new species of Blattidae cockroach is described from northern Aotearoa New Zealand. *Celatoblatta kauri* sp. nov. can be distinguished from similar conspecific species by its distinctive facial markings. The recorded distribution of *Celatoblatta kauri* sp. nov. matches that of the historic distribution of kauri forest (*Agathis australis*) in northern New Zealand.

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Aotearoa; biodiversity; Blattidae; *Celatoblatta*; cockroach; Polyzosteriinae

Introduction

Aotearoa New Zealand is home to a radiation of approximately 18 endemic species of Blattidae cockroach in the genus *Celatoblatta* Johns, 1966 that was established for them. The New Zealand *Celatoblatta* species are not closely related to species from Papua New Guinea and Australia that have subsequently been assigned to this New Zealand genus (Malem et al. 2023). No new cockroach species have been described from New Zealand since the monograph by Peter Johns in 1966. However, Johns (1966) did refer to four endemic *Celatoblatta* taxa not described due to lack of material and an inability to match male and female specimens. Since then, two undescribed *Celatoblatta* species from Fiordland were the focus of a postgraduate thesis (Bolton 1976) and one undescribed alpine Canterbury *Celatoblatta* species was included in a phylogeny of the southern members of the genus (Chinn and Gemmell 2004). In addition to these undescribed species, two taxa morphologically similar to *C. undulivitta* (Walker 1868) from northern New Zealand were included in keys (Johns 1966). Adults of *Celatoblatta undulivitta* have well developed tegmina that meet each other at the midline and extend to the first abdominal tergite (Figure 1A). This trait distinguishes it from three forest species found in North Island: *C. sedilotti* (Bolivar 1883), *C. subcorticaria* Johns 1966; *C. vulgaris* Johns 1966. The inclusion of northern *Celatoblatta* specimens in a phylogenetic hypothesis using mtDNA sequences confirmed the presence of the additional undescribed taxa in this genus that Johns (1966) recognised (Goldberg and Trewick 2011; Morgan-Richards et al. 2023).

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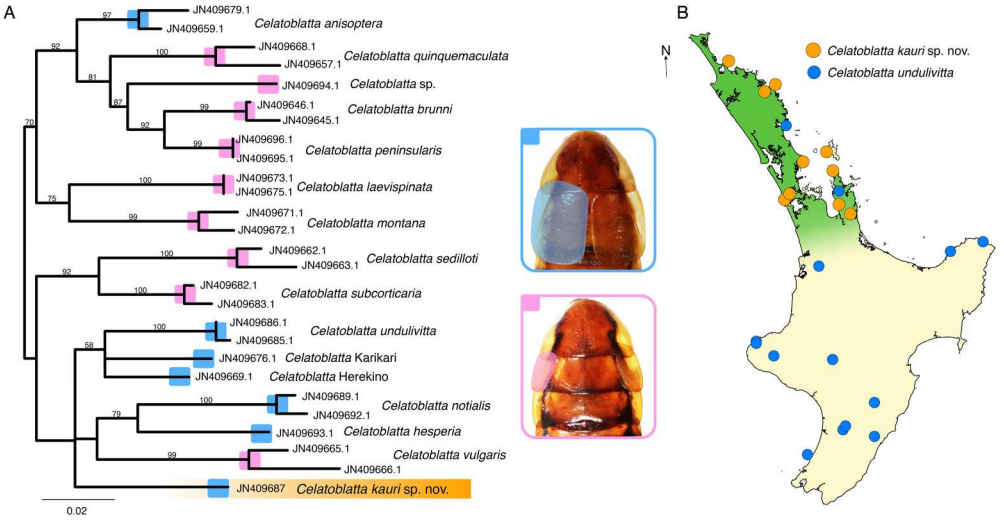

Figure 1. A, Phylogenetic hypothesis of 16 species of New Zealand *Celatoblatta* cockroach based on Maximum Likelihood analysis of mtDNA sequences (610 bp of COI) implementing best fit model TIM + F + G4 and mid-point rooting. Scale bar represents number of DNA substitutions per site. Bootstrap values >50% are indicated at nodes. Data from Goldberg and Trewick (2011). Inset shows two distinct forms of tegmina of adult *Celatoblatta*: blue box = large tegmina, pink box = small tegmina. **B**, Distribution of two morphologically similar New Zealand *Celatoblatta* cockroach species in North Island. *Celatoblatta kauri* sp. nov. (orange spots) has a distribution similar to historic kauri (*Agathis australis*) forest range (green shading) and overlaps with widespread *Celatoblatta undulivitta* (blue spots).

Four Northland lineages of *Celatoblatta* with well-developed tegmina were resolved (Goldberg and Trewick 2011; Figure 1A). With increased sampling from North Island, we can now distinguish males and females of *Celatoblatta kauri* sp. nov. from *C. undulivitta* and the other undescribed lineages. We do not have adult female specimens of the taxa restricted to the Far North, so they are left undescribed.

Materials and methods

All specimens were collected by hand and preserved in 95% ethanol. Holotype and paratype are lodged with Museum of New Zealand Te Papa Tongarewa (MONZ), and other material is part of the insect collection at Massey University Manawatū (MPN). Specimens were examined using an Olympus SZX7 stereomicroscope with an attached SC100 digital camera. Photographs were stacked with Adobe Photoshop software to create images. Genitalia removed from adult males were cleared in 10% Potassium hydroxide (KOH) for 25 mins before photographing.

Twenty-seven DNA sequences were download from GenBank representing 12 described New Zealand *Celatoblatta* species plus four unassigned: accession numbers JN409645, JN409646, JN409657, JN409659, JN409662, JN409663, JN409665, JN409666, JN409668, JN409669, JN409671–JN409673, JN409675, JN409676, JN409679, JN409682, JN409683, JN409685–JN409687, JN409689 and JN409692–JN409696. Sequence alignment and analysis used DNADynamo (Blue Tractor Software Ltd) with Maximum Likelihood analysis in iQ-Tree2 through IQ-Tree tools (Trifinopoulos et al. 2016; Minh

et al. 2020) using model selection (Kalyaanamoorthy et al. 2017) and ultrafast bootstrapping (Hoang et al. 2018).

Systematics

Class: **Insecta**
Order: **Blattodea** Latreille, 1810
Family: **Blattidae** Latreille, 1810
Genus: ***Celatoblatta*** Johns, 1966

Celatoblatta kauri sp. nov.
Figure 2A, B, C, D, E, F, G, H, I. Figure 3A, B, C, D. Figure 4A, B, C, D

Diagnosis

Flightless gold/brown/black cockroach of native forest in Northern New Zealand. Adults (~15 mm long) have large square tegmina (Figure 2A, G), meeting each other at the dorsal midline of the thorax and extending to and partly or completely covering the first abdominal tergite. Morphologically similar to *C. undulivitta* but adult male can be distinguished by pit (tergal gland) in dorsal surface of abdominal tergite-1 with medial ridge without hairs (Figure 3C, D), cerci with pale blunt apex, style straight (without curve). Black colour marks on a pale face form a pair of stripes between the base of antennae (socket), running from the vertex (top of head) to clypeus (Figure 2C, I). In contrast, the face of *C. undulivitta* is pale between antennae sockets (Figure 2J).

Etymology

Named for the species' distribution which matches that of the natural range of kauri (*Agathis australis*) which formed the principal canopy tree of lowland forest north of 38°S latitude in New Zealand prior to forest removal by humans (Figure 1B).

Material examined

Holotype

NEW ZEALAND • ♂, adult; Auckland, Tawharanui Peninsula (Lat/Lon: –36.37341, 174.84361), inaturalist.nz/observations/260416418, 2 Feb 2025, Shaun Lee leg. [MPN_CK496] museum code MONZ **AI.083185** (Figure 2A, B, C, D, E, F).

Paratype

NEW ZEALAND • 1 ♀, adult; Coromandel Peninsula, Waiomu Track (−37.02613, 175.53704), 19 Dec 2004, Julia Goldberg leg. [MPN_CK80] museum code MONZ **AI.083186** (Figure 2G, H).

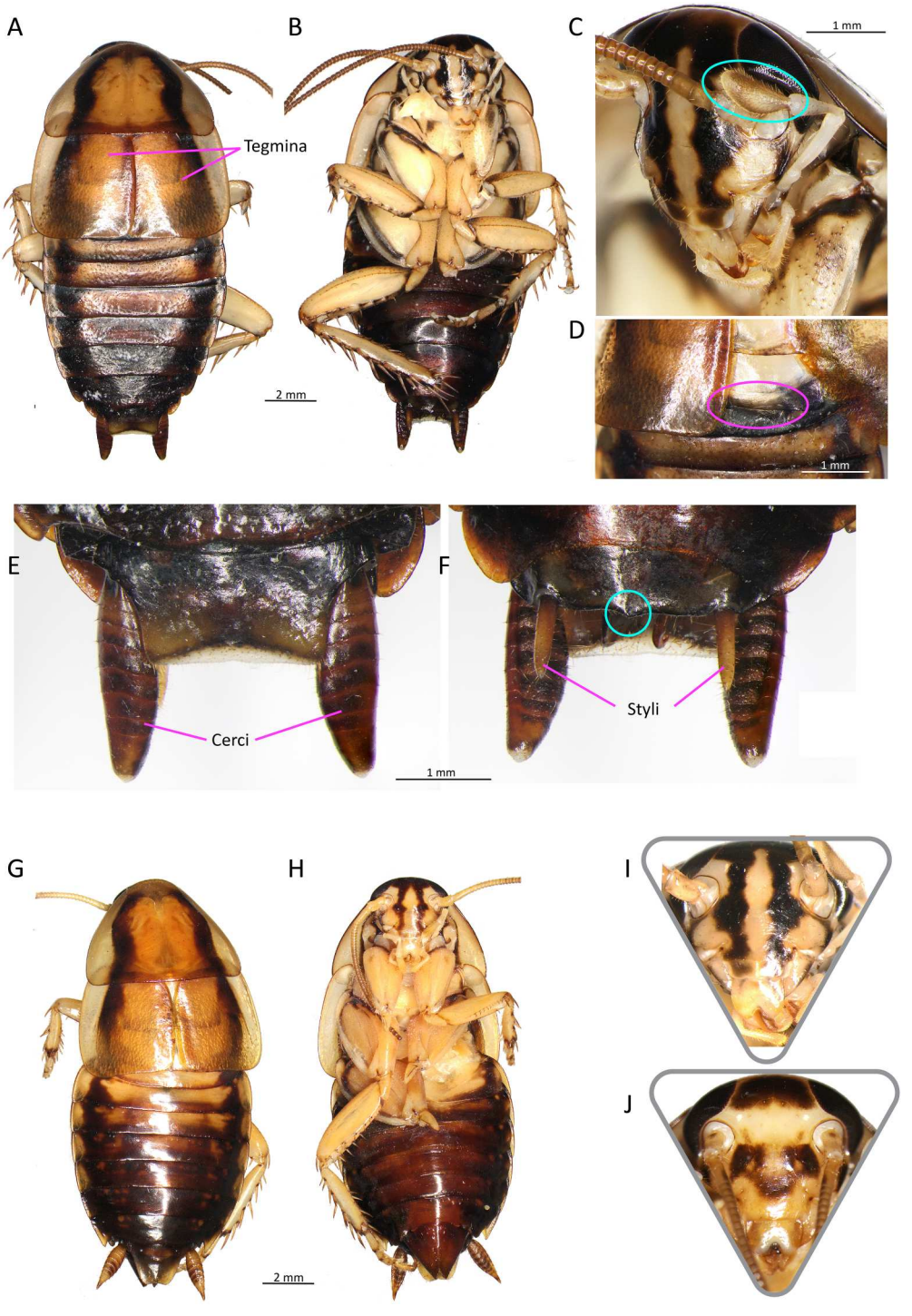

Figure 2. *Celatoblatta kauri* sp. nov. **A**, Adult male dorsal view (holotype). **B**, Male ventral view. **C**, Face with distal segment of maxillary palps circled. **D**, Posterior margin of male tegmina and pit in abdominal tergite-1. **E**, Male terminalia (dorsal view) with suranal plate and cerci. **F**, Male terminalia (ventral view) centre of posterior margin of subgenital plate circled. **G**, Adult female dorsal view (paratype). **H**, Female ventral view. **I**, Diagnostic black markings on face of *Celatoblatta kauri* sp. nov. **J**, Face of *Celatoblatta undulivitta*.

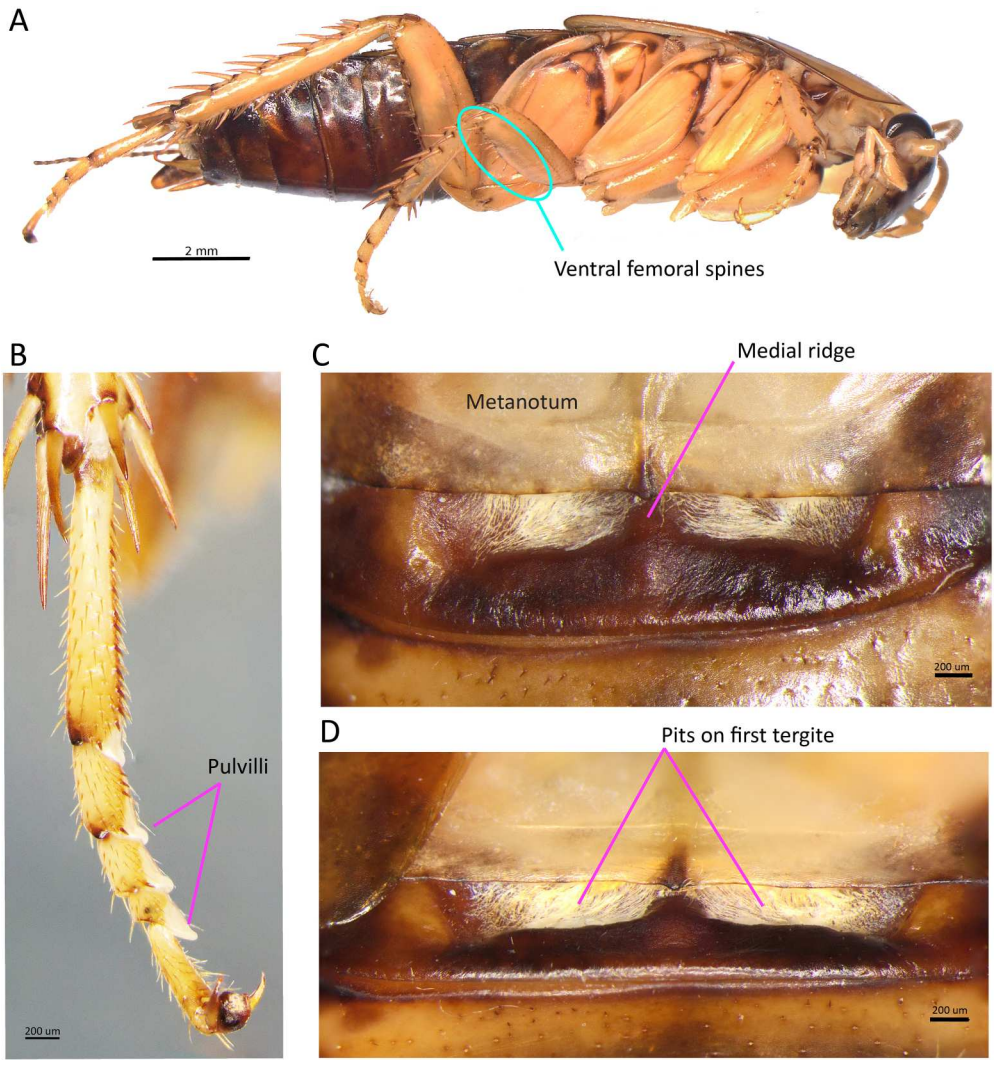

Figure 3. *Celatoblatta kauri* sp. nov. **A**, Adult male profile with ventral spines of mid-femur circled. **B**, Tarsi of hind leg. **C**, Dorsal surface of male showing first tergite with specialised pit. **D**, Hair-lined pits house tergal glands.

Other material

NEW ZEALAND – 1 ♂ adult; Tawharanui Peninsula (−36.37341, 174.84361), 2 Feb 2025, Shaun Lee leg. [MPN_CK495]. • 2♂ adults; Aotea Great Barrier Island (−36.220, 175.296), 12 Feb 2025, Shaun Lee leg. [MPN_CK519, CK520]. •1 ♂ adult; Piha (−36.9507, 174.4858), 6 April 2025, Shaun Lee & Amanda Choy. •1 ♂ adult; Coromandel Peninsula, Stony Bay (−36.5088, 175.4209), 4 Jan 2007, Steven Trewick & Esta Chappell leg. [MPN_CK157]. • 1 ♀ adult; Northland, Cape Brett (−35.1907, 174.3096), inaturalist.nz/observations/102126117, 26 Nov. 2021, Danilo Hegg leg. [MPN_CK-401]. •1 ♂ juvenile; Karikari Peninsula, Matai Bay (−34.8296, 173.4073), 1 Aug 1997, Mary Morgan-Richards leg. [GenBank: JN409687; CK069]. • 1 ♂ adult; Bay of Islands,

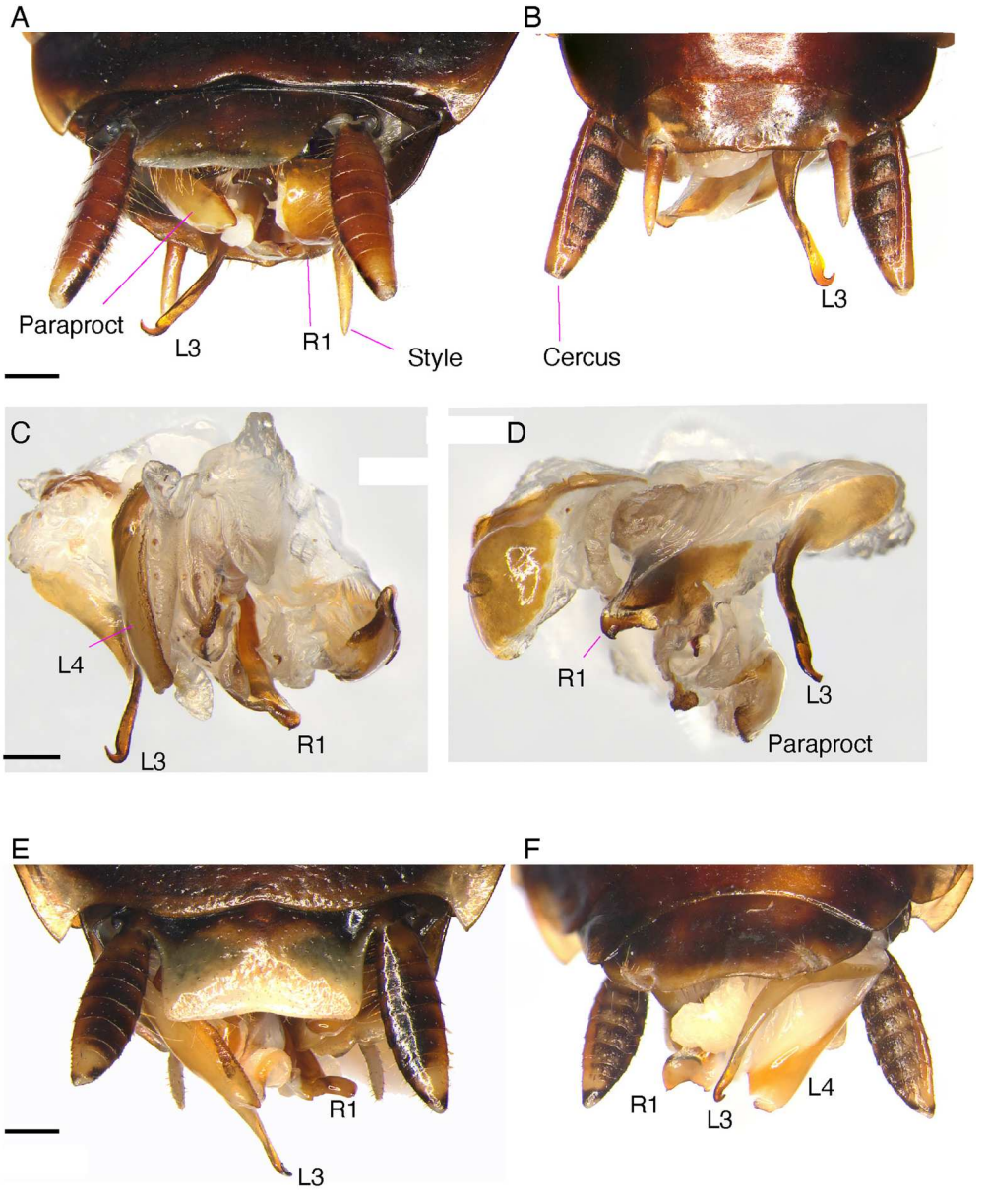

Figure 4. Male genitalia of two New Zealand cockroach species. **A**, Adult male *Celatoblatta kauri* sp. nov. [MPN_CK519] dorsal view. **B**, *Celatoblatta kauri* sp. nov. [MPN_CK519] ventral view. **C**, Genitalia removed from *Celatoblatta kauri* sp. nov. [MPN_CK566] dorsal view. **D**, Genitalia removed from *Celatoblatta kauri* sp. nov [MPN_CK566] ventral view. **E**, Adult male *Celatoblatta undulivitta* [MPN_CK553] dorsal view. **F**, *Celatoblatta undulivitta* [MPN_CK553] ventral view. Sclerotized elements (phallomeres) are labelled following Luo et al. (2025) but homology is not assumed. Right sclerite-1 = R1, Left sclerite-3 = L3, Left sclerite-4 = L4. Scale bar = 0.5 mm.

Paihia (−35.2995, 174.1018), 4 May 2002, Steven Trewick & Mary Morgan-Richards leg. [CK46.1]. • 1 ♂ adult; Coromandel Peninsula, Waihi (−37.3982, 175.8468), inaturalist.nz/observations/280177146, 11 May 2025, Danilo Hegg leg. [MPN_CK566]. • 1 ♀

adult; Coromandel Peninsula, Waihi (−37.3982, 175.8472), inaturalist.nz/observations/280177145, 11 May 2025, Danilo Hegg leg. [MPN_CK567], inaturalist.nz/observations/269000823.

Description

Size. Adults about 15 mm long and 7 mm wide (Figure 2A, B, G, H, Figure 3A).

Head. Black/brown colour marks on face form pair of stripes between base of antennae (socket), running from top of head (vertex) past frons to clypeus (Figure 2I). These black stripes are not seen on the face of other North Island *Celatoblatta* species (Figure 2I, J). Distal segment of maxillary palps darker than preceeding segments (Figure 2C).

Thorax. Tegmina/elytra square, without trace of venation, covering meso- and metanota and reaching and partly or completely covering first abdominal tergite (Figure 2A, G). Wings thin, short, fused to metanotum but distinctly outlined, no venation.

Legs. Legs typical blattid form. Femoral ventral spines: fore 7–10 (prolateral), 2 (retrolateral), mid: 7 (prolateral), 6 (retrolateral), hind: 6–8 (prolateral), 5–6 (retrolateral). Metatarsi of hind leg equal in length to following tarsal segments, pulvilli small, metatarsi with two ventral rows of spinules, other tarsal segments with at least one spinule on each side of pulvillus (Figure 3B). There are normally five tarsal segments but specimens are known with four on one leg and five on the other (e.g. inaturalist.nz/observations/269000823).

Abdomen. *Male*: first abdominal tergite with hair-lined double pit (pocket-like tergal gland; Figure 2D, Figure 3D), the central ridge without hairs (Figure 3C); corners of abdominal tergites-6 and 7 weakly acute. *Female*: abdominal tergite-7 corners distinctly produced, acute. Dorsal colour of tergites with pale spots or blotches as seen in *C. vulgaris* (Figure 2G).

Terminalia. *Male*: suranal plate rectangular (Figure 2E) scattered short setae on top and posterior edge; cerci elongate, tips blunt and pale, smooth dorsally, many hairs on ventral surface which is more pigmented than dorsal surface; subgenital plate simple, posterior edge with central rise (Figure 2F), few setae. Styles tapering straight. Genitalia asymmetrical as for Blattinae (Figure 4). *Female*: suranal plate (Figure 2G) truncate, the hind edge emarginate; cerci sharply pointed (Figure 2H).

Biology. Nocturnal arboreal species found under tree bark during the day. Present in lowland native forest habitats in Coromandel Peninsula, Auckland and in Northland as far north as Karikari Peninsula (Figure 1B). Distribution matches that of historic kauri forest distribution, where *Celatoblatta kauri* sp. nov. is sympatric with the morphologically similar *Celatoblatta undulivitta* as well as two species with small tegmina; *C. sedilotti* and *C. vulgaris*. The northern *Celatoblatta* species with large tegmina are related but this trait may not be phylogenetically informative (Figure 1A). In adult males the square tegmina cover hair-lined pits in their 1st tergite which probably house tergal glands analogous to those on the 7th and 8th tergites of *Blatella germanica* (Linnaeus 1767). In many cockroach species the specialised tergite of males produces both volatile chemical attractants and a glandular secretion. During mating the receptive female places her mouthparts in this region of the male to acquire a nuptial gift (Roth 1969; McPherson et al. 2022). Male genitalia of Blattinae cockroaches are asymmetrical and variation in the chitinous structures that are responsible for spermatophore transfer can be diagnostic for some species and

genera (Luo et al. 2025). However, variation in both the identity of elements of the male genitalia and the terms and codes used to refer to each element (e.g. phallomere, sclerite, epiphallus), as well as the great array of forms, make comparative studies challenging (Grandcolas 1996; Klass 1997; Luo et al. 2025).

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Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Bolívar I. 1883. Description d'Orthoptères et observations synonymiques diverses. Annales de la Société Entomologique de France. 6:459–464.
Bolton LA. 1976. Two new *Celatoblatta* (Johns) species from Fiordland [Unpublished Hons thesis (zoology)]. University of Canterbury, Christchurch, NZ.
Chinn WG, Gemmell NJ. 2004. Adaptive radiation within New Zealand endemic species of the cockroach genus *Celatoblatta* Johns (Blattidae): a response to Plio-Pleistocene mountain building and climate change. Molecular Ecology. 13:1507–1518.
Goldberg J, Trewick SA. 2011. Exploring phylogeographic congruence in a continental island system. Insects. 2:369–399. doi:10.3390/insects2030369.
Grandcolas P. 1996. The phylogeny of cockroach families: a cladistic appraisal of morpho-anatomical data. Canadian Journal of Zoology. 74:508–527.
Hoang DT, Chernomor O, von Haeseler A, Minh BQ, Vinh LS. 2018. UFBoot2: improving the ultrafast bootstrap approximation. Molecular Biology and Evolution. 35:518–522. doi:10.1093/molbev/msx281.
Johns PM. 1966. The cockroaches of New Zealand. Records of Canterbury Museum. 8(2):93–136.
Kalyaanamoorthy S, Minh BQ, Wong TKF, von Haeseler A, Jermiin LS. 2017. Modelfinder: fast model selection for accurate phylogenetic estimates. Nature Methods. 14:587–589. doi:10.1038/nmeth.4285.
Klass KD. 1997. The external male genitalia and the phylogeny of Blattaria and Mantodea. Bonner Zoologische Monographien. 42:1–341. https://www.biodiversitylibrary.org/item/157021.

Linnaeus C. 1767. Systema naturae 1. 12th ed. Holmiae: Laurentius Salvius.
Luo X, Deng W, Han W, Lo N, Cai J, Che Y, Wang Z. 2025. Revision of the cockroach subfamily Blattinae based on morphological and molecular analyses. Systematic Entomology. 1–19. doi:10.1111/syen.12680.
Malem J, Robillard T, Cluzel D, Bellier L, Nattier R, Grandcolas P, Legendre F. 2023. Origins of old lineages in New Caledonia: a geologically informed test of the island-hopping hypothesis. Journal of Biogeography. 50:1587–1601.
McPherson S, Wada-Katsumata A, Hatano E, Silverman J, Schal C. 2022. Nutritional condition affects tergal gland secretion and courtship success of male cockroaches. PLoS One. 17(8): e0271344-1–20. doi:10.1371/journal.pone.0271344.
Minh BQ, Schmidt HA, Chernomor O, Schrempf D, Woodhams MD, von Haeseler A, Lanfear R. 2020. IQ-TREE 2: new models and efficient methods for phylogenetic inference in the genomic era. Molecular Biology and Evolution. 37:1530–1534. doi:10.1093/molbev/msaa015.
Morgan-Richards M, Marshall CJ, Biggs PJ, Trewick SA. 2023. Insect freeze-tolerance downunder: the microbial connection. Insects. 14:89-1–17. doi:10.3390/insects14010089.
Roth LM. 1969. The evolution of male tergal glands in the Blattaria. Annals of the Entomological Society of America. 62(1):176–208.
Trifinopoulos J, Nguyen L-T, Haeseler v, Minh A, Q B. 2016. W-IQ-TREE: a fast online phylogenetic tool for maximum likelihood analysis. Nucleic Acids Research. 44(1):W232–W235. doi:10.1093/nar/gkw256.
Walker F. 1868. Catalogue of the Specimens of Blattariae in the Collection of the British Museum. London: British Museum (Natural History), E. Newman, Printer; p. 239.