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Budginmaya eulae gen. et sp. nov., a myrmecophilous planthopper (Hemiptera: Fulgoromorpha: Flatidae) from Western Australia

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Abstract *Budginmaya eulae* gen. et sp. nov. is described from the nest of a *Camponotus terebrans* (Lowne) ant from Western Australia. The species shows adaptations for subterranean life, including reduction in the tegmina, wings and eyes and increased hairiness around the head, body, tegmina and legs. This is the first record of an Australian planthopper (Fulgoromorpha) cohabiting with ants and the first record of an inquiline species in the family Flatidae. Furthermore, this flatid is most likely a short-range endemic species currently restricted to Bandalup Hill.

Key words mutualism, myrmecophily, planthopper, short-range endemism.

INTRODUCTION

The Australian Flatidae (Hemiptera: Fulgoromorpha) were reviewed by Fletcher (1988) who recognised 88 species in 22 genera. Subsequently, the monotypic genus *Cryptobarsac* was described by Fletcher and Moir (2002) and an additional species of *Siphanta* Stål was described by Fletcher (2002). Changes to generic placements made by Medler (1988, 1989, 2001) brings the number of flatid species in Australia to 90 in 25 genera.

Intensive environmental surveys of invertebrates in Western Australia (e.g. Moir *et al.* 2005; Majer *et al.* 2008a,b), particularly using pitfall traps and vacuum sampling, has revealed a number of novel forms of Auchenorrhyncha living at ground level or in cryptic situations) (e.g. Fletcher & Moir 2002; Fletcher 2008; Fletcher & Zahniser 2008). One of these, representing a new genus of Flatidae, is described here from nests of the ant species *Camponotus terebrans* (Lowne). This is the first record of a species of the family Flatidae living in such a close relationship with ants. The known specimens of this planthopper were all collected under a single rock within the same ant nest on Bandalup Hill, east of Ravensthorpe, WA. The habitat at this site is characterised by mallee heath and includes a number of rare plant species such as *Kunzea similis* Toelken and *Eucalyptus purpurata* Nicolle. The flatid itself was discovered by a small seasonal stream on the south-western slopes of Bandalup Hill. Despite intensive sampling in the vicinity, no additional ant colonies were found with the flatid. This strongly suggests that the flatid represents a short-range endemic species which, as defined by Harvey (2002), is a native species occupying a range size of less than 10 000 km^2. Current threats to the known population include mining on Bandalup Hill itself, and thus conservation of the species is of immediate concern.

MATERIALS AND METHODS

The photographic images were produced using a MZ16 stereo microscope and Auto-montage Pro version 5.02(p) (Syncroscopy, Cambridge, UK) at the Western Australian Museum. The line drawings were produced from pencil originals scanned into Photoshop CS at 600 dpi using an HP Scanjet 7400C. The scans were resized, cut and pasted into a 50% opaque layer to lighten the lines. A new layer was added and the images traced using line tool. Once the copy was completed, the original scans were deleted and the resultant image flattened.

Budginmaya gen. nov.

Type species: *Budginmaya eulae* sp. nov. designated here and by monotypy.

Description

Short flattened planthoppers (Figs 1,2). Head short, face (Fig. 3) convex, flatter medially, with obscure lateral carinae and scattered short erect setae over surface and along margins. Eyes small. Antennae with short scape and elongate cylindrical pedicel. Vertex (Fig. 4) short, separated from face with obscurely carinate margin. Pronotum (Fig. 4) short, anterior margin medially emarginate, posterior margin broadly concave. Scutellum (Fig. 4) relatively large. Tegmina (Figs 1,2) partially brachypterous, leaving apical abdominal segment exposed. Apical and sutural angles broadly rounded, continuous with convex apical margin. Costal margin lobed at base. Costal area broad basally, then narrower than costal cell. Subapical lines and angled cross vein between M and Cu

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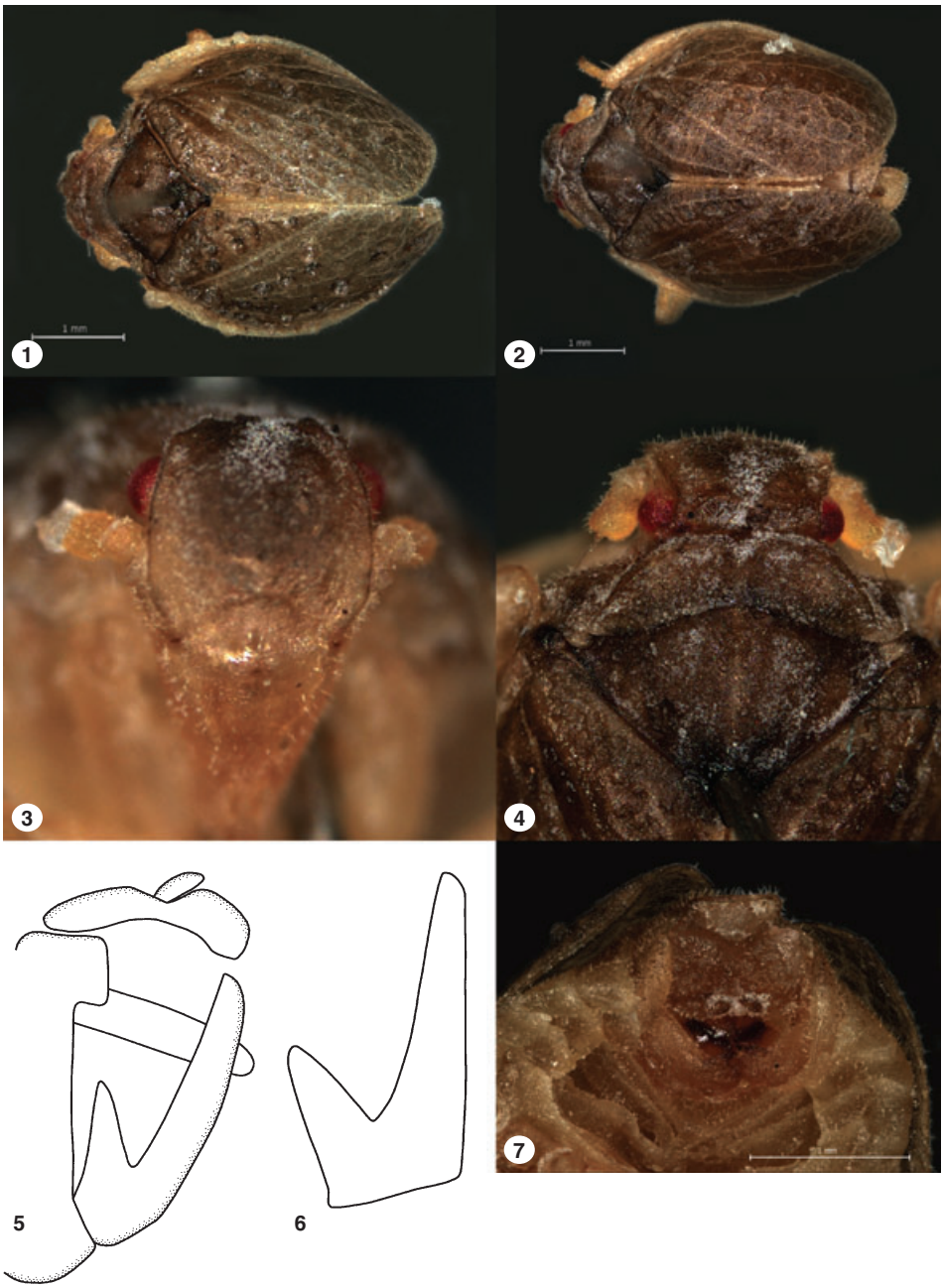

Figs 1–7. *Budginmaya eulae sp. nov.* **(1)** Holotype male, *habitus*; **(2)** Paratype female, *habitus*; **(3)** facial view of head; **(4)** dorsum; **(5)** male terminalia, lateral view; **(6)** male paramere, posteroventral view; **(7)** female terminalia, ventral view.

absent. Hind tibia with one spine on shaft. Head, pronotum, margins of tegmina and legs lined with short, erect, sensory setae.

Etymology

The generic name, which is feminine, is derived from 'budgin' (= ant) and 'maya' (= shelter) from the Nyungar language of SW coastal Western Australia (Thieberger & McGregor 1994). This reflects the association of these planthoppers living in the nests of ants.

Notes

Despite its short and broad appearance, the species is not placed in the subfamily Flatoidinae, characterised by the tegmina being held more or less horizontally over the body, but rather in the Flatinae, the flattened appearance presumed to be an adaptation to a troglobitic life style. The structures of the head and tegmen indicate a relationship with the genera *Phantiopsis* Melichar and *Falcophantis* Fletcher and the genus is therefore placed with them in the tribe Phantiini.

Budginmaya eulae sp. nov. (Figs 1–8)

Holotype male

In nest of *Camponotus*, Bandalup Hill, Ravensthorpe Range, 33°39′40″S 120°23′02″E (GPS), 29.v.2007, M.L. Moir (WAM: reg no. 71229).

Paratypes, 1 female, 5 nymphs same data as holotype (all specimens in Western Australian Museum).

Description

Length, male ($N = 1$) 4.8 mm, female ($N = 1$) 5 mm.

Colour pale greyish brown, body and tegmina bearing clear crystalline deposit, eyes dark red.

Male genitalia (abdomen lost after examination). Pygofer (Fig. 5) short with dorsal oblong process. Parameres (Fig. 6) long triangular with dorsal triangular process near base. Aedeagus narrow, dorsally mounted.

Female genitalia (Fig. 7). Anal segment enlarged to form flat vertical basal area. Ovipositor valves short, lobate.

Final-instar nymphs (Fig. 8). Pale golden yellow. Flattened, with short sensory hairs on entire body and legs, including around margins of wingbuds. Wingbuds each with 10 sensory pits.

Etymology

The species is named in honour of the first author's mother, Eula Fletcher, whose encouragement of a fledgling interest in insects has led to a life-long passion for entomology.

Notes

The specimens were found by the second author under a rock in the nest of *C. terebrans* and, when exposed, were herded towards tunnels deeper into the nest by the ants. Only seven specimens were captured before the planthoppers had escaped underground. The loss of the male genitalia is a major disappointment because structural details of the aedeagus cannot now be provided. However, the figures of the external features (Figs 5,6) were produced from sketches made of the genitalia while they were still attached to the holotype.

Fig. 8. Late instar nymph, *habitus*.

DISCUSSION

This is the first record of a flatid planthopper living in such close association with ants. Adenuga (1975) recorded ant attendance of nymphs of an unidentified flatid in Nigeria but this appears to have been ants tending the nymphs on aerial parts of plants and not within their nests. Bourgoin (1985) has provided evidence that two species of Tettigometridae (Fulgoromorpha) live with species of ants and suggested that this might be a characteristic habit for species in that family. He later (Bourgoin 1997) explored the phylogenetic significance of this behaviour in Tettigometridae and showed that ant association in Auchenorrhyncha had developed independently several times. This contradicted a proposal by Schaefer (1987) who had suggested that the association of Hemiptera with ants was a plesiomorphic characteristic derived from a lifestyle originally based on the ground. China and Fennah (1952) described a new family of planthoppers, the Hyphochthonellidae, based on a single collection of 82 specimens (adults and nymphs) of maggot-like, brachypterous planthoppers living in the soil on the roots of tobacco plants in Southern Rhodesia. The planthoppers were tended by ants but the details of the association are unknown. Three reports of cixiid planthoppers (Fulgoromorpha: Cixiidae) in association with ant nests have appeared from North America. Myers (1929) reported that nymphs of the cixiid *Mnemosyne cubana* Myers were found living with ants but, although adults were reared from late instar nymphs, no adults were found in the ant nests. A similar association between nymphs of the cixiid *Oliarus vicarius* (Walker) with mounds of red imported fire ants, *Solenopsis invicta* Buren, was reported by Sheppard *et al.* (1979) where nymphs were using the periphery of the mounds either in unused galleries or in inactive mounds. Thompson (1984) described nymphs of the cixiid *Oecleus borealis* Van Duzee living in nests of the ant *Paratrechina arenivaga* (Wheeler) but, again, no adults were found in the nests. Thompson (1984) noted that ants were seen carrying *O. borealis* nymphs in their mandibles to safety after nest disruption and appeared to use the honeydew secreted by the nymphs as a food source. These planthopper/ant interactions were reviewed by Delabie (2001) who concluded that ant mutualisms had developed from simple interactions in which ants collected honeydew from sessile sapfeeders such as scale insects to more complex associations involving true symbioses between ants and several groups of Auchenorrhyncha and Sternorrhyncha.

In Australia, numerous species of Auchenorrhyncha are known to be tended by ants, including species of Eurymelinae, Membracidae and the stenocotine leafhopper *Smicrocotis obscura* Kirkaldy (Cicadellidae: Ledrinae) which was reported to feed nocturnally and be tended by ants by Shcherbakov *et al.* (2000), but these associations do not include cohabitation. Australian Auchenorrhyncha recorded cohabiting with

ants as true inquilines include *Myrmecophryne formiceticola* Kirkaldy (Cicadellidae: Xestocephalinae) (Kirkaldy 1906) and five species of Pogonoscopini (Cicadellidae: Eurymelinae) (Day & Pullen 1999). However, no Australian Fulgoromorpha has been previously recorded in such an association. The morphological adaptations found in *B. eulae* are similar to those found in cavernicolous Meenoplidae (Hoch 1990, 1993) and Cixiidae (Myers 1929; Hoch & Howarth 1989a,b; Hoch 1993), and include pale coloration, reduction in the size of the wings and eyes, increase in the size of the antennae and presence of sensory hairs on the head and thorax.

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