African Invertebrates Vol. 50 (1) Pages 205–212 Pietermaritzburg June, 2009

Field observations on *Milichia patrizii* ant-mugging flies (Diptera: Milichiidae: Milichiinae) in KwaZulu-Natal, South Africa

Alexander L. Wild[1] and **Irina Brake**[2]

[1]Department of Entomology, University of Illinois, 505 S. Goodwin Ave., Urbana, IL 61801 USA; alexwild@illinois.edu
[2]Department of Entomology, The Natural History Museum, Cromwell Road, London, SW7 5BD UK; i.brake@nhm.ac.uk

ABSTRACT

Kleptoparasitic behaviour of a myrmecophilous fly, *Milichia patrizii* Hennig, 1952, towards the ant *Crematogaster castanea tricolor* Gerstaecker, 1859 in South Africa is documented, illustrated by photographs, and discussed.

KEY WORDS: Afrotropical, Milichiidae, *Milichia*, Formicidae, *Crematogaster*, behaviour, myrmecophily, kleptoparasitism.

INTRODUCTION

Myrmecophily, or ant-loving behaviour, has been known in Milichiidae for more than a hundred years. Most cases involve larvae that live in ant nests (Donisthorpe 1927; Sabrosky 1959; Moser & Neff 1971; Waller 1980), but a group of short-faced *Milichia* species exhibit myrmecophilous behaviour in the adult stage, mostly in connection with myrmicine ants in the genus *Crematogaster*. *Milichia dectes* Collin, 1922, *M. proectes* Collin, 1922, *M. prosaetes* Collin, 1922 and probably also *M. farquharsoni* Collin, 1922 solicit regurgitated food from *Crematogaster* (Farquharson 1919, 1922). In one case involving *Milichia dectes*, the ant was identified as *Crematogaster buchneri* Forel, 1894. Two species have been observed licking the anal secretions of ants: *Milichia myrmecophila* de Meijere, 1909, those of *Crematogaster difformis* Smith, 1857, and *Milichia brevirostris* (de Meijere, 1910), those of *Dolichoderus bituberculatus* Mayr, 1862.

Milichia patrizii Hennig, 1952 has not been previously known as a myrmecophile. However, the holotype label states that the species is a commensal of *Crematogaster*, and an unidentified *Crematogaster* worker specimen (possibly *C. schultzei* Forel, 1910) is mounted on the same pin as the fly. *Milichia patrizii* belongs to the *myrmecophila* species-group within the short-faced group of *Milichia* species (Brake 1999). The purpose of the present paper is to report a recent observation on the myrmecophilous behaviour of *Milichia patrizii* in South Africa.

MATERIAL AND METHODS

On 5 July 2008, AW encountered by chance numerous individuals of *Milichia patrizii* patrolling *Crematogaster castanea tricolor* Gerstaecker, 1859 trails on two different *Acacia* trees. Interactions between the flies and the ants were observed and photographed for two hours between 11:00 and 13:00 hr. The habitat was along the edge of a clearing in a coastal forest in the St Lucia Estuary, KwaZulu-Natal, South Africa (28.3872°S: 32.405°E). Voucher specimens (two female flies and three ants) were collected into 95 % ethanol and have been deposited at BMNH. The ants were identified by AW and the flies by IB.

Photographs were taken with a Canon EOS 20D digital SLR using an MP-E 65 mm 1–5× macro lens and an MT-24EX twin flash. Images were processed using Adobe Photoshop CS2 for minor adjustments to colour balance, brightness and contrast.

In describing the milichiid antenna we prefer to use the term 'basoflagellomere' (Thompson 1999) for the structure that Stuckenberg (1999) called 'postpedicel'.

RESULTS

Flies patrolled both vertical ant trails on *Acacia* trunks and horizontal trails along the upper surfaces of branches (Fig. 1). The behaviour of the ants and the flies did not appear to show differences in either situation. Flies were spaced along the trails at least 10 cm apart and usually considerably longer. On the first *Acacia* tree, between two and four flies were observed along a vertical trail, while on the second tree more than a dozen flies were active along a single horizontal trail. The sex of all the observed flies was not determined in the field, nor was mating observed, but based on the sample of collected and photographed individuals we believe all were likely female.

To attack an ant, a fly moves into the ants' trail and attempts to isolate a single individual (as in Fig. 2). Successful attacks generally result from a fly being able to immobilize an ant either from the front or the side; once an ant passes, the fly is normally unable to catch it even though it may continue to follow the ant for up to a few centimetres. The flies use their cup-shaped basoflagellomeres to grasp the terminal antennomeres of an ant (Fig. 3). The ant responds by standing still and crouching down (Fig. 4), allowing the fly to extend its proboscis into the ant's mouthparts to trigger the regurgitation response (Figs 4–6). Either before or after the initiation of the food exchange, the terminal segments of the ant's antenna are released from the basoflagellomeres and enfolded instead by the pilose clypeal membrane of the proboscis (Fig. 6). Disengagement is apparently initiated by the fly, which withdraws its proboscis (Fig. 7). The ant remains relatively motionless for a brief period following the interaction, while the fly usually moves back to patrolling the trail. In one timed interaction, the sequence of events from first contact to disengagement lasted 23 seconds, with the food exchange itself occurring in the final 10 seconds.

Most kleptoparasitic attempts (roughly 80–90 %) were unsuccessful, the ants either outrunning or outmanoeuvring the flies. A fly would pursue a particular ant for a few seconds, and if unsuccessful would disengage and return to face the ant trail again. Interestingly, the flies did not pursue other ant species present on the same branches (*Tetraponera* spp., *Cataulacus brevisetosus* Forel, 1901), including *Camponotus troglodytes* that apparently mimics *Crematogaster*. Throughout the observation period, the *Crematogaster* engaged in regular trophallaxis behaviour with nestmates along the trail (Fig. 8).

DISCUSSION

A similar behaviour to the one observed here was described by Farquharson (1919) for *M. dectes*, *M. proectes* and *M. prosaetes*, though he did not provide as much detail. It is not possible from the publication to verify whether the behaviour is present in all three species or just one, but Farquharson classified all three as "mendicants". Farquharson wrote that the fly approaches the ant from the side, the ant either continues

on or stops and partly rotates its head. The fly drinks a little at one side, then moves around to the other side before the ant has time to move away and drinks a little more.

Figs 1, 2. (1) *M. patrizii* next to a *C. castanea tricolor* trail on an *Acacia* branch; (2) A *Milichia* darts into the middle of the *Crematogaster* trail to pursue an individual ant. This attempt was unsuccessful, as the ant was able to move past the fly without stopping.

Figs 3, 4. (3) *Milichia patrizii* pacifies an ant in a successful attack by grabbing the ant's antennal club between the paired basoflagellomeres of its own antennae; (4) The same attack as pictured in Fig. 3. The ant crouches down while the fly initiates regurgitation process by extending its proboscis into the mouthparts of the ant.

Figs 5, 6. Food exchange between *Milichia patrizii* and *Crematogaster castanea tricolor*: (5) General view; (6) An enlargement showing details of the food exchange interaction. The ant's antenna is enfolded by the pilose clypeal membrane of the fly's proboscis. The long hairs on the fly's proboscis likely serve to capture liquids from the mouth of the ant.

The use of the basoflagellomeres in *M. patrizii* to grasp the ants' antennae is probably restricted to this species, as the scape (first antennal segment) is enlarged and strongly sclerotized in *M. patrizii* (Hennig 1952, fig. 17) compared to the other short-faced species. From the photographs (Figs 4–6), the palpus does not appear to have any function in the myrmecophilous behaviour, instead the clypeal membrane between the palpi, which is covered in a short microtomentum, seems to surround the tip of the ant's

Figs 7, 8. (7) Food exchange ends when the fly retracts its mouthparts. The ant briefly sits motionless following the interaction; (8) Trophallaxis food-sharing behaviour between two *Crematogaster castanea tricolor* nestmates.

antenna after the basoflagellomeres let go. Dissection of the proboscis did not reveal any sclerotized structures between the palpi which could be used to grasp or hold the ant's antenna.

The shape and setation of the proboscis might trigger the trophallaxis-like behaviour. Both *Milichia patrizii* and its sister species *M. farquharsoni* are characterized by an unusual shape of the palpus and proboscis (Hennig 1952, figs 18, 19). At the tip of each labellum there are three or four setae about 1.5 times as long as the labellum itself. These likely serve to capture liquids from the mouth of the ant. *M. farquharsoni* was observed to 'haunt' the nest of *Crematogaster* ants (Farquharson 1922), although its feeding behaviour is unknown. The other species of the short-faced *Milichia* group have enlarged, flat palpi and flat spear-head shaped labella that are quite different from the homologous structures in *M. patrizii* and *M. farquharsoni*.

Trophallaxis food exchange among social insects presents an opportunity for exploitation. *Milichia patrizii* is one of many myrmecophiles to have independently acquired an ability to co-opt the food-sharing behaviour. Trophallaxis-based parasitism appears to evolve readily, as similar behaviour is sporadically present in the insect orders Thysanura, Orthoptera, Coleoptera, Lepidoptera, Diptera, and Hymenoptera (Hölldobler & Wilson 1990; Sivinski *et al.* 1999). The other dipterans known to engage in kleptobiosis with ants, mosquitoes of the genus *Malaya* and at least two phorid species (Sivinski *et al.* 1999), and some shore flies of the genus *Rhynchopsilopa* (Wirth 1968), indicate convergent evolution as they are not closely related to Milichiidae. Additionally, *Crematogaster* ants seem vulnerable to the attention of kleptobionts; in addition to the solicitation of liquid foods from the mouth of the ants, thievery of their anal exudates may also occur (Wirth 1968; Freidberg & Mathis 1984).

The novelty of the *M. patrizii*/*Crematogaster* interaction seems to lie in the unique antennal-grasping mechanism used to initiate the exchange. Additional research is needed to reveal the specificity and extent of the interaction.

ACKNOWLEDGEMENTS

We thank John Noyes, John Sivinski, Steve Marshall, Ray Miller, and late Brian Stuckenberg for helpful comments on the manuscript.

REFERENCES

Brake, I. 1999. *Prosaetomilichia* de Meijere: a junior subjective synonym of *Milichia* Meigen, with a phylogenetic review of the *M. myrmecophila* species-group (Diptera, Milichiidae). *Tijdschrift voor Entomologie* **142**: 31–36.

Collin, J.E. 1922. XII. Description of a new genus and two new species of Cecidomyidae, and six new species of acalyptrate Muscidae (Ephydridae and Milichiidae). *Transactions of the Entomological Society of London* **1921**: 504–517, 4 pls.

Donisthorpe, H.S.K. 1927. *The guests of British ants: their habits and life-histories*. London: George Routledge & Sons.

Farquharson, C.O. 1919 (1918). *Harpagomyia* and other Diptera fed by *Cremastogaster* ants in S. Nigeria. *Transactions of the Entomological Society of London* **66**: xxix–xxxviii.

———1922 (1921). Notes on the life-history of *Milichia argyratoides*, and the habits of other Milichiidae. *Transactions of the Entomological Society of London* **69**: 444–447.

Freidberg, A. & Mathis, W.N. 1984. On the feeding habits of *Rhynchopsilopa* (Dipt.: Ephydridae). *Entomophaga* **30**: 13–21.

Hennig, W. 1952. Bemerkenswerte neue Acalyptraten in der Sammlung des Deutschen Entomologischen Institutes (Diptera: Acalyptrata). *Beiträge zur Entomologie* **2**: 604–618.

HÖLLDOBLER, B. & WILSON, E.O. 1990. *The Ants*. Cambridge: Harvard University Press.

DE MEIJERE, J.C.H. 1910 (1909). Drei myrmecophile Dipteren aus Java. *Tijdschrift voor Entomologie* **52**: 165–174, pl. 10.

MOSER, J.C. & NEFF, S.E. 1971. *Pholeomyia comans* (Diptera: Milichiidae) an associate of *Atta texana*: Larval anatomy and notes on biology. *Zeitschrift für angewandte Entomologie* **69**: 343–348.

SABROSKY, C.W. 1959. A revision of the genus *Pholeomyia* in North America (Diptera: Milichiidae). *Annals of the entomological Society of America* **52**: 316–331.

SIVINSKI, J., MARSHALL, S. & PETERSSON, E. 1999. Kleptoparasitism and phoresy in the Diptera. *Florida Entomologist* **82**: 179–197.

STUCKENBERG, B.R. 1999. Antennal evolution in the Brachycera (Diptera), with a reassessment of terminology relating to the flagellum. *Studia dipterologica* **6** (1): 33–48.

THOMPSON, F.C. 1999. A key to the genera of the flower flies of the Neotropical Region with the description of two new genera and eight new species. *Contribution on Entomology, International* **3**: 319–378.

WALLER, D.A. 1980. Leaf-cutting ants and leaf-riding flies. *Ecological Entomology* **5**: 305–306.

WIRTH, W.W. 1968. The genus *Rhynchopsilopa* Hendel (Diptera: Ephydridae). *Annals of the Natal Museum* **20** (1): 37–46.