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Trophobiosis between a blattellid cockroach (*Macrophyllodromia* spp.) and fulgorids *(Enchophora* and *Copidocephala* spp.) in Costa Rica

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Abstract

Three instances were observed in Costa Rica, of an adult cockroach feeding on or palpating the waxy material secreted on the tegmina of a fulgorid; in one instance, the cockroach was a female *Macrophyllodromia* sp. and the homopteran a fulgorid, *Enchophora sanguinea*. In another, the cockroach was *Macrophyllodromia maximiliani* and the fulgorid was *Copidocephala guttata*. These are the first observations of trophobiosis in a cockroach. Brief descriptions of known species of *Macrophyllodromia*, and the male genitalia of 2 species are given.

Key Words

Trophobiosis, cockroach, *Macrophyllodromia*, Fulgoridae, *Enchophora*, *Copidocephala*

Introduction

Examples of trophobiosis between cockroach, *Macrophyllodromia* spp., (Fig. 1B) and a fulgorid, *Enchophora sanguinea* Distant (Fig. 1A), were first observed by one of us (PN) 23 March - 4 April 1994, at La Selva Biological Station, Costa Rica. The insects were seen at night, and in the 1994 observations at least 2 pairs were observed; the cockroaches had their front legs on the hemipteran, faced in the same direction, and apparently were feeding on or palpating the white wax that normally covers the fulgorid tegmina. In the more recent observation (24 December 2000), the insects were on the door of the laboratory, the cockroach, *Macrophyllodromia maximiliani* (Saussure) (identified by the dark tegminal spots, Fig. 1C), rested at about a right angle to *Copidocephala guttata* (White) (identified from photographs only) and was licking or palpating the roach's wing covers (Fig. 1C); both insects flew away after they were photographed. Ants (possibly *Camponotus* sp.) also were seen to attend the homopteran.

E. sanguinea is very common at La Selva Biological Station, and large numbers, covered with white waxy secretion, are seen on the trunks of trees. The head of the fulgorid has little curved projections (Fig. 1A), and according to Lois O'Brien (personal communication, January 2000), one can scan the profile of trees and see these little insects 6-9 m up. Little is known of the biology of the 64 genera and 250 species of New World Fulgoridae. Few have been reported of economic importance. There are 14 species of *Enchophora*; *E. sanguinea* is known from Colombia, Costa Rica, Ecuador, Guatemala, Nicaragua, and Panama (O'Brien 1988).

Copidocephala guttata (White) occurs in Costa Rica, Honduras, Mexico, and Panama (O'Brien 1988). Many fulgorids produce large amounts of waxes and in a few species these materials have been chemically analyzed. Their biological role is essentially unknown, except that ". . . one of the apparent functions of these waxy, plume-like tails is protection against predators and parasites" (Mason *et al.*, 1989).

A form of conspecific trophobiosis occurs in most cockroach species whose mating behaviors have been studied: during courtship behavior, adult females feed on or palpate a secretion, produced by tergal glands on the backs of conspecific males, which serves as an arrestant and places the female in the proper position for the male to grasp her genitalia (Roth 1968, Sreng 1993). The present observations of adult female cockroaches mouthing a secretion on the backs of a fulgorid are the first observation of interspecific trophobiotic behavior between these different taxa, and the significanceof this behavior is well worth future investigation.

Abbreviations for Depositories

ANSP - Academy of Natural Sciences of Philadelphia, Philadelphia, PA, USA.
MCZ - Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA.
NMNH - National Museum of Natural History (formerly United States National Museum), Washington, D.C., USA.

Genitalia terminology follows McKittrick (1964).

Macrophyllodromia Saussure & Zehntner

Macrophyllodromia Saussure and Zehntner, 1893: 46 Albuquerque, 1962: 422 (revision).

Macrophyllodromia is a blattellid genus belonging to the Pseudophyllodromiinae. Princis (1969) lists only 5 species, namely: *maximiliani* (Saussure) (Mexico, Guatemala, Honduras, Costa Rica, Panama); *splendida* Hebard (Panama);

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panamae Albuquerque (Panama); *nigrigena* Hebard (British Guiana, Surinam, French Guiana, Bolivia); *ecuadorana* Albuquerque (Ecuador). Unfortunately, the cockroach specimen collected with the fulgorid is a female and usually males are needed to identify the species unequivocally (unless the species has distinctive tegminal markings as in *maximiliani*). The male subgenital plate, styles, and genitalia (Figs 2A-2E) show distinct differences and can be used to distinguish the species. The genitalia lie on the dorsal surface of the subgenital plate and are studied by cutting off the terminal segments, placing them in 10% KOH overnight, washing with water, dehydrating in 100% ethyl alcohol, clearing in xylol, and mounting in Permount.

Specimens of *Macrophyllodromia* are scarce in museums and most of them were intercepted in the United States by plant quarantine inspectors (Albuquerque 1962). Those collected in the field rarely have any ecological data, *e.g.*, *M. nigrigena* was collected under bark, and *M. panamae* was taken in a fruit fly trap. Fisk (1983) collected *M. maximiliani* "... by hand under the bark of a dead tree limb just reachable from the ground. Other species of *Macrophyllodromia*, all less common than *M. maximiliani*, may also be arboreal". Following fogging, Fisk (1983) sampled the cockroaches that dropped from canopies of large guacimo trees *(Luehea seemannii)*, in the Panama Canal Zone area during both the late dry and early wet seasons. *M. maximiliani* was one of 5 "canopy indicators"; adults were rarely taken but nymphs were relatively abundant. This cockroach also was collected after Vapona fogging of the upper story foliage in two Costa Rican forests during the dry season. No species of *Macrophylodromia* has previously been collected in association with a fulgorid.

Diagnosis.— Relatively large size. Interocular space narrow. Tegmina and wings fully developed, the former with oblique discoidal sectors (Fig. 1B). Wings with costal veins not enlarged distad, cubitus vein with 5 or more complete branches (some branched), incomplete branches absent, apical triangle subobsolete to absent (Fig. 1B). Anteroventral margin of front femur with relatively small stout spines that decrease in length mesad, succeeded by a row of stout spines slightly smaller than proximal ones, 3 larger terminal spines (Type A_3); pulvilli on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia well developed. Pronotal disk with pair of dark longitudinal bands that extend from anterior to posterior margins (reminiscent of some species of *Blattella*) (Figs 1B, C).

Male: abdominal terga unspecialized. Subgenital plate strongly asymmetric, styles dissimilar (Figs 2A, D). Genitalia with a slender, elongated genital hook on right side, median phallomere with an L2d sclerite, left phallomere large and highly complex (Figs 2B, E). The male's genital hook is on the right side, which places the genus in the Blattellidae: Pseudophyllodromiinae; in Blattellinae, the hook is on the left side.

A key to identify the 5 known species of *Macrophyllodromia* is given by Albuquerque (1962). The following are brief diagnostic features of species of *Macrophyllodromia*:

Macrophyllodromia maximiliani (Saussure)
Figs 1C, 2A-2C

Pseudophyllodromia maximiliani Saussure, 1873: 100, Pl. 10, Fig. 35; *Macrophyllodromia maximiliani* (Saussure), Albuquerque 1962: 422, Figs 1-5; Princis 1969: 772 (literature).

Specimen examined.— Panama: Canal Zone, Barro Colorado, 1♂, (terminalia slide 323), 21.vi.1924, N. Banks (det. by Ashley Gurney 1969); MCZ.

Remarks.— The subgenital plate and styles, genitalia, and supra-anal plate and paraprocts are shown in Figs 2A-C. The subgenital plate is asymmetrical with right and left styles huge and dissimilar; the interstylar margin is a large, rounded lobe, and a much smaller process occurs to the left of the left style (Fig. 2A). The median phallomere (L2vm) is filamentous, has a large sclerite (L2d) apically, and a membranous prepuce; the left phallomere is a large irregular sclerite with spine-like processes (Fig. 2B). The supra-anal plate is symmetrical, transverse, subtrigonal, the apex rounded and shallowly indented mesad; the paraprocts are subsimilar (Fig. 2C). The head has a dark brown band extending from the interocular region to, and including, the labrum. Pronotal disk with a pair of broad, black longitudinal bands extending to both anterior and posterior borders (Fig. 1C). Tegmina brown, with about 4 black spots (Fig. 1C).

Macrophyllodromia panamae Albuquerque
Figs 2D, 2E

Macrophyllodromia panamae Albuquerque, 1962: 424, Figs 6-9.

Specimen examined.— Panama: Canal Zone, Barro Colorado Is., 1♂ (terminalia slide 322), 21.vi.1924 (det. by Gurney 1969); MCZ.

Remarks.— Head with a dark interocular band from the vertex to the lighter clypeus, labrum pale. Tegmina brownish, without dark spots. Subgenital plate, styles (Fig. 2D), and genitalia (Fig. 2E), show clearly that this species is closely related to *M. maximiliani*. However, differences between the structures allow the two species to be separated.

Macrophyllodromia ecuadorana Albuquerque

Macrophyllodromia ecuadorana Albuquerque, 1962: 425, Figs 10-14.

Specimens examined (none).— The male holotype was intercepted in bananas in San Diego, California, and came from Guayaquil, Ecuador. Paratypes: all intercepted in bananas by plant quarantine inspectors: at New Orleans from Honduras and Ecuador; at San Diego and San Pedro, California; at Brownsville, Texas.

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Remarks.— According to Albuquerque, this species is closely related to *M. splendida* and *M. panamae*, but can be separated by differences in the male subgenital plate. The male's supra-anal plate is trigonal, the apex bilobate. The cubitus vein of the hind wing with 5 complete branches, apical triangle small. Head with a dark brown band from vertex to pale clypeus where it expands laterally. Lateral pale borders of the pronotum without brown dots. Tegmina without black spots.

Macrophyllodromia nigrigena Hebard

Macrophyllodromia nigrigena Hebard, 1926: 152, Plate XII, Figs 18, 19 (not 17-19 as indicated, Fig. 17 apparently is the caudal view of the subgenital plate of *Eudromiella maroni* Hebard); Bruijning, 1959: 55, Fig. 11; Albuquerque, 1962: 428.

Specimens examined (none).— The male holotype (Type No. 998), and a female paratype are from St. Jean du Maroni, French Guiana; the allotype is from St. Laurent du Maroni, French Guiana; ANSP.

Additional specimens.— British Guiana: Bartica District; ANSP.

Remarks.— The hind margins of the male and female supra-anal plates have a V-shaped excavation (deeper in the female). Pronotal disk with a pair of dark longitudinal bands, the translucent lateral zones with scattered blackish brown flecks.

Macrophyllodromia splendida Hebard

Macrophyllodromia splendida Hebard, (1919) 1920: 42, Pl. 3, Figs 1-4 (male); 1933: 113; Albuquerque, 1962: 422.

Specimens examined (none).— Holotype ♂, Porto Bello, Panama; NMNH.

Remarks.— Male supra-anal plate transverse, trigonal, hind margin shallowly cleft mesad, apex broadly rounded. Hebard (1933: 113) reported a female from Barro Colorado and stated "This specimen is distinguishable from that which we assign to *M. maximiliani* (Saussure) only by its smaller size and lack of maculations on the discoidal field of the tegmina. The former species was described from Mexico and males from the two countries are needed to verify the present determinations. Though the differences noted are decided, it is possible that they may be attributable to individual variation and *splendida* may indeed prove to be a synonym."

***Macrophyllodromia* sp.**
Fig. 1B, 2F

Specimen examined.— Costa Rica, Heredia Prov., Puerto Viejo, La Selva Biological Station, 1♀, 23.iii.-4.iv.1994, P. Naskrecki; MCZ.

Female (Fig. 1B): head with interocular space less than the distance between antennal sockets and ocelli. Pronotum subelliptical, widest behind the middle (Fig. 1B). Tegmina and wings fully developed (Fig. 1B), the former with oblique discoidal sectors. Hind wing radial vein simple, media vein with or without an apical fork, cubitus vein with 6 complete branches (some of them branched once or twice), apical triangle absent (Fig. 1B). Front femur Type A_3 (the first terminal spine is not much longer than the preceding row of small spines); pulvilli on 4 proximal tarsomeres, the one on the basitarsi small and apical, tarsal claws simple, unspecialized, arolia small. Supra-anal plate trigonal, apex with a distinct V-shaped excavation (Fig. 2F). Head with yellowish occiput, a blackish brown band extends from the vertex down the frons to the clypeus; cheeks and mandibles yellow, clypeus and labrum brownish; third maxillary palpomere pale, the fourth segment longitudinally divided into dark and pale surfaces, last segment dark; antennae almost completely missing, first 2 segments yellow. Pronotum with a pair of broad blackish bands, narrowly separated anteriorly and posteriorly, the medial area between them yellowish; the lateral margins of the bands are opaque yellowish, remaining zone subhyaline (Fig. 1B). Tegmina reddish brown without any dark spots on the veins (Fig. 1B). Hind wing anterior field yellowish, the anterior margin darker, posterior field infuscated. Abdominal terga light brown, supra-anal plate dark without a medial pale spot (Fig. 1B). Abdominal sterna chestnut, subgenital plate darker on distal half. Legs pale. Cerci dark dorsad (only a few segments of one cercus intact).

Measurements (mm).— Length, 17.0; pronotum length x width, 4.7 x 7.0; tegmen length, 16.5; interocular width, 0.5.

Remarks.— The head markings of this species do not agree with those of *M. maximiliani*, the only other *Macrophyllodromia* recorded from Costa Rica. According to Albuquerque (1962: 423), in *M. maximiliani*, the female's supra-anal plate is "...strongly bilobate at apex.", but her Fig. 5 shows it to be deeply incised with the lobes contiguous, whereas in the present female the excision is V-shaped and the lobes are distinctly separated (Fig. 2F). Also the tegmina of *M. maximiliani* have about 4 black dots distad, and these are absent in the present female. This specimen may prove to be a new species, but males are needed to determine this. The female of *M. panamae* is unknown.

Acknowledgment

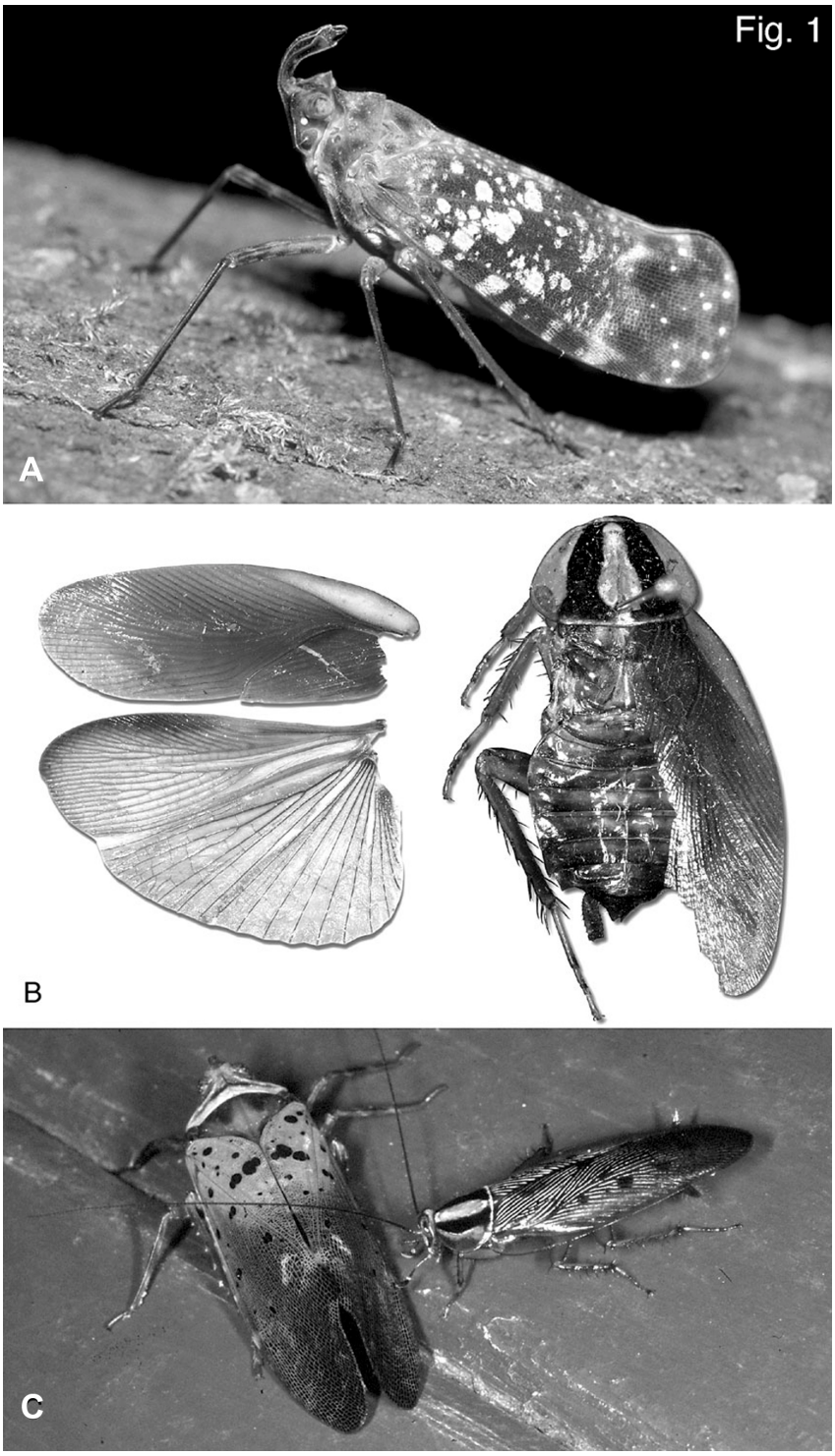
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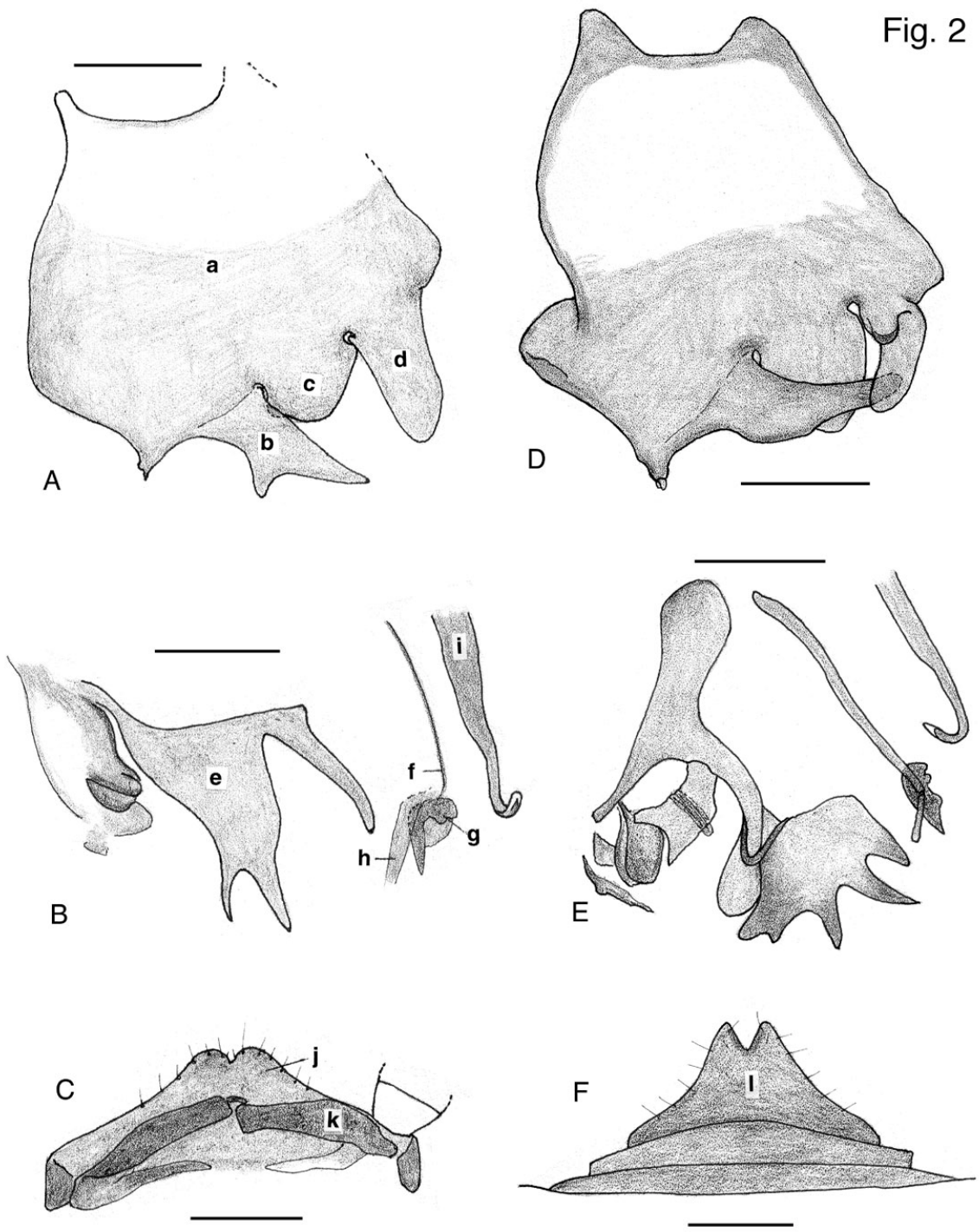
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Figs 1. A-C. 1A The fulgorid, *E. sanguinea*; **1B** *Macrophyllodromia* sp., female, the left tegmen and wing removed and shown separately; **1C** Trophobiotic behavior of the cockroach *M. maximiliani*, palpating the elytra of the fulgorid *C. guttata* White.

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Figs 2A-F. *Macrophyllodromia* spp.. **2A-E** males from Barro Colorado Island, from slide preparations **2A-C** *M. maximiliani*. **2A** subgenital plate and styles (dorsal); **2B** genitalia (dorsal); **2C** supra-anal plate and paraprocts (ventral); **2D, 2E** *M. panamae* Albuquerque; **2D** subgenital plate and styles (dorsal); **2E** genitalia (dorsal); **2F** female, from Costa Rica, abdominal terga 8 - 10 (supra-anal plate; dorsal, pinned specimen). Scale lines = 1 mm. Abbreviations: a, subgenital plate; b, left style; c, interstylar margin; d, right style; e, left genital phallomere; f-h, median genital phallomere (aedeagus, penis): f, L2vm, median sclerite (L2 ventromedial), g, L2d (L2 dorsal); h. prepucial membrane); i, R2, genital hook, sclerite of the right phallomere; j, supra-anal plate; k, right paraproct; l, supra-anal plate. Genitalia terminology from McKittrick (1964).

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