

*PSEUDOANAPLECTINIA YUMOTOI*, A NEW  
OVOVIVIPAROUS MYRMECOPHILOUS COCKROACH  
GENUS AND SPECIES FROM SARAWAK  
(BLATTARIA: BLATTELLIDAE; BLATTELLINAE)

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ABSTRACT

*Pseudoanaplectinia yumotoi*, a new myrmecophilous cockroach genus and species, is described from Sarawak. Based on the male genital phallomeres, it is placed in the Blattellidae: Blattellinae. The genus is ovoviviparous and probably arose from an anaplectinoid-like ancestor. This is the third case of ovoviviparity arising in the Blattellidae. The cockroach has a symbiotic relationship with an ant *Crematogaster* sp.

INTRODUCTION

Dr. Takakazu Yumoto is involved in a Canopy Biology Program in Sarawak and is studying the relationship between epiphytes and animals. He found that a large number of cockroaches live on a fern in association with a species of ant (*Crematogaster* sp.), and he will publish a detailed study of the epiphyte-cockroach-ant relationship elsewhere.

The new cockroach is ovoviviparous, making this the third case of a blattellid genus (Blattellinae, because its ootheca is rotated before being retracted into the uterus, and the male's genital hook is on the left side) that evolved ovoviviparity. The other ovoviviparous blattellid genera are *Stayella* Roth (Blattellinae) from Africa (Roth, 1982; 1984) and *Sliferia* Roth (Pseudophyllodromiinae, because the ootheca is not rotated before being retracted internally,

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and the male's genital hook is on the right side) from the Seychelles (Roth, 1989; 1996a).

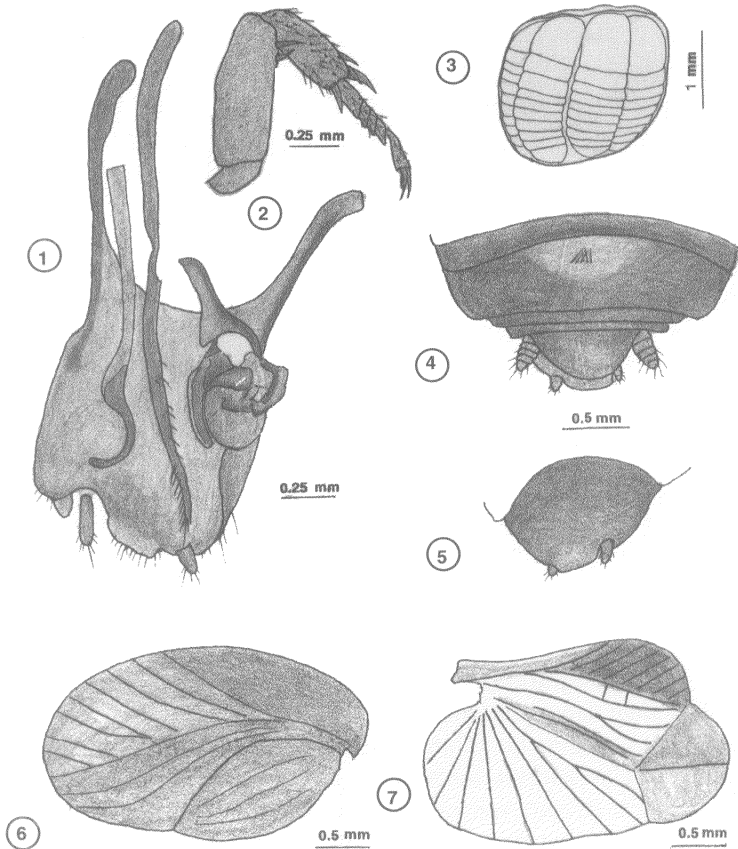
In this paper I describe the cockroach that occurs in the above association with ants. The holotype and paratypes are deposited in the Museum of Comparative Zoology, Harvard University (MCZ). A pair of adult paratypes has been deposited in the following museums: Hope Entomological Collections, Oxford, England (HECO); the Academy of Natural Sciences of Philadelphia (ANSP); Naturhistoriska Riksmuseet, Stockholm, Sweden (NRSS); Naturhistorisches Museum zu Wien, Vienna, Austria (NMVA); and Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands (RNHL).

*Pseudoanaplectinia*, new genus

*Diagnosis:* Very small. Tegmina and wings present, reduced (smaller in the female), not reaching the end of the abdomen. Hind wing (Fig. 7), male subgenital plate and genitalia (Fig. 1) blattellid-anaplectoid-like. Antennae reduced, reaching to about the middle of the abdomen. Legs reduced in length; all femora with only two, three, or four large distal spines on antero- and posteroventral margins; pulvilli absent, tarsal claws symmetrical, their ventral margins minutely serrated, arolia minute (Fig. 2). Cerci segmented, short, not reaching beyond supraanal plate (Fig. 4). Male seventh abdominal tergum specialized (Fig. 4). Male genital hook on the left side (Fig. 1). Female subgenital plate not valvular. Ovoviviparous; ootheca (Fig. 3) with three to five eggs in a membranous, transparent egg case, carried internally, with the keel region directed to the left side of the female.

*Pseudoanaplectinia yumotoi*, new species

Material: Holotype, ♂, Sarawak, Lambir Hills National Park, ix.1995, T. Yumoto, collected in association with an ant *Crematogaster* sp. living on an epiphyte, *Platyserium coronarium* (Koenig) Desv., a stag's horn fern; Type No. 34763 in MCZ. Paratypes. MCZ: same data as holotype, 37♂♂, 28♀♀, 69 nymphs, 7 oothecae (adult legs and male terminalia on slides 295 and 296, the pinned specimens destroyed).



Figs. 1-7. *Pseudoanaplectinia yumotoi* Roth, from Sarawak (paratypes). 1,2,4,5, males; 6,7, female. 1. subgenital plate and genitalia (dorsal); 2. front leg (anterior surface; note only 2 distal spines on the ventral margin); 3. ootheca removed from a female abdomen; the embryos are well developed and show segmentation; eyes are present but not visible in this view; 4. terminal abdominal segments (dorsal); 5. subgenital plate (ventral); 6. tegmen; 7. hind wing.

Pairs of adult paratypes ( $\sigma$  and  $\varphi$ ) have been deposited in ANSP, HECO, NMVA, NRSS, and RNHL.

*Description.* Male: Less than 5 mm long (average, 4.0 mm). Body in profile strongly convex. Head, pronotum, tegmina, and abdomen with widely spaced fine setae. Head almost completely

hidden, eyes wide apart, interocular space greater than the distance between antennal sockets; fifth maxillary palpomere about twice as long as the fourth. Antennae short, not reaching beyond the middle of the abdomen, proximal segments stout, becoming more slender and filamentous distad; the antennae of most of the specimens were missing many segments and these were probably clipped off by the ants. Pronotum parabolic. Tegmina and wings (Figs. 6, 7) reduced, the former reaching to about the supraanal plate, wings slightly smaller. Hind wing with costal vein region enlarged, strongly arched; radial and media veins simple; cubitus vein with a single pseudocomplete branch that reaches the basal margin of the appendicular field (in most other cockroaches, complete branches reach the apical margin of the wing); the wing is folded longitudinally along the plical fold, and the appendicular field, which occupies about 30% of the length of the wing, is reflexed when the wing is at rest. (The relative length of the appendicular field is determined, when the wing is fully extended and flattened, by measuring the field from its base to apex and dividing this by the total length of the wing from the point of attachment to the apex of the appendicular field.) Legs short and stocky; forefemora with two relatively close distal spines on both ventral margins, genicular spine absent (Fig. 2); mid- and hindfemora with two to four (usually three) more widely separated distal spines, genicular spine present; foretibia about as long or shorter than all tarsomeres combined, mid- and hindtibiae slightly longer than the tarsi; pulvilli absent, tarsal claws symmetrical, ventral margins minutely serrated, the teeth contiguous and clumped together, arolia minute. Seventh abdominal tergum with a broad medial depression bearing some setae (Fig. 4; note the tergal gland area showing a few setae; a slide preparation reveals many more setae which are not visible in the pinned specimen); supraanal plate convexly rounded, entire. Subgenital plate asymmetrical, styles cylindrical, the left one slightly longer than the right one, interstyler margin weakly produced (Fig. 1). Genitalia as in Fig. 1: hook on the left side, curved hook portion sclerotised, with a preapical incision; median phallomere is an elongated rod, its distal region with setae; right phallomere consisting of several sclerites. Cerci greatly reduced, consisting of five segments, not reaching beyond the hind margin of the supraanal plate (Fig. 4).

Female: Habitus similar to the male. Tegmina and wings usually reaching to about the sixth tergum. Supraanal plate convexly rounded reaching the convexly rounded hind margin of the subgenital plate. Subgenital plate not valvular.

Ootheca: A large number of females were pregnant and some of them (with stout abdomens) were dissected, each revealing a complete ootheca lying in the abdomen, showing that the species is ovoviviparous. The eggs are arranged in essentially two rows (Fig. 3) with their heads directed to the left. The number of eggs per ootheca varied (number of females in parentheses) from 3(2), 4(4), or 5(4). The size of the embryos varied, depending on the degree of their development, with the smallest being 1.5 mm long, and the largest 2 mm (Fig. 3). Segmentation is already present, as are eyes (not visible in the figure because of the orientation). The oothecal membrane is colorless, completely covers the eggs initially, and lacks a serrated keel and calcium oxalate crystals. As the eggs get larger, the two margins of the keel region become separated.

The fact that the eggs are enclosed in an oothecal membrane shows that they are first extruded and arranged in two rows, keel and head region upright, enclosed by a membrane, and then rotated 90° (keel region directed to the left side) and retracted into the abdomen (Roth and Willis, 1958; Roth, 1970); they are not simply transferred directly into the uterus where they lie in a jumbled mass, as in some genera of Panesthiinae (Rugg and Rose, 1984). With so few eggs in an ootheca (e.g., when only three eggs are produced), it is possible that none of them actually protrude from the end of the abdomen and the egg case may be formed and rotated in the vestibule, without being exposed. Protrusion of eggs beyond the end of the abdomen during oothecal formation apparently depends on the size and number of eggs, and the size of the female. In a much larger viviparous cockroach, *Diploptera punctata* (Eschscholtz), there are only about a dozen initially small eggs in an ootheca; during oothecal formation few eggs protrude beyond the female's body, and protrusion occurs rather infrequently (Roth and Willis, 1955).

Color. Head brown with clypeus, labrum, maxillary and labial palps, and antennae pale. Legs and cerci pale. Tegmina brown. Hind wing with costal vein area dark, appendicular field lightly

infuscated (Fig.7). Abdomen brown; glandular fossa on the male's seventh abdominal tergum yellowish brown.

Measurements (mm) [N = 10♂♂ and 10♀♀ (shown in parentheses); averages in brackets]: Length, 3.8-4.1 [4.0] (3.8-4.1) [4.0]; pronotum length x width, 1.1-1.3 × 1.8-2.0 [1.2 × 1.9] (1.0-1.3 × 1.8-2.0) [1.2 × 1.9]; tegmen length, 2.3-2.6 [2.5] (2.1-2.4) [2.3]; interocular width, 0.9 [0.9] (0.9) [0.9].

Nymphs: The immature specimens of both sexes resemble the adults except for the absence of tegmina and wings.

*Etymology*: The genus denotes the relationship, based on wing venation, male genitalia and subgenital plate, to some species that have been placed (by Princis) in the Anaplectinae (e.g., *Anaplectella*, *Anaplectoidea*, and *Malaccina*). The specific name is dedicated to Dr. Takakazu Yumoto, of the Center for Ecological Research, Kyoto University, who collected the material.

*Comments*: Large numbers of *Pseudoanaplectinia* live in association with an ant (*Crematogaster* sp.) on the epiphytic stag's horn fern, *Platyserium coronarium* (Koenig) Desv. (Yumoto, personal correspondence).

There are very few records of myrmecophilous cockroaches and these are mostly anecdotal (Roth and Willis, 1960; Hölldobler and Wilson, 1990). The polyphagid cockroach *Myrmecoblatta wheeleri* Hebard inhabits the nest of *Solenopsis geminata* (Fabricius) (Hebard, 1917) in Guatemala. It has also been taken in a nest of *Camponotus abdominalis* (F.) in Costa Rica (Fisk et. al, 1976), and with *Camponotus abdominalis floridanus* (Buckley) in Florida by Deyrup and Fisk (1984), who found them under a dead slash pine log in a scrubby flatwoods habitat. Myrmecophilous crickets (*Myrmecophila* sp.) occurred in the same nest. The ants did not try to carry off the cockroaches, which hid under bits of bark and in cracks of the dead tree. The cockroaches ran rapidly and withdrew their appendages under the body and adhered tightly to the substrate. Legs, antennae, and cerci generally showed no evidence of being damaged by the ants.

Probably the best known cockroach myrmecophile is *Attaphila fungicola* Wheeler, a Texas species that lives in the fungus cavities and tunnels made by the fungus growing ant *Atta texana* (Buckley). Wheeler (1900) originally thought that the cockroaches fed on the fungus but later (Wheeler, 1910) decided that they obtained

nourishment by mounting and licking the backs of soldiers; the antennae of the cockroaches are always mutilated, probably when the ants are pruning their fungi. Moser (1964) found that the cockroaches respond positively to the ants' odor trail substance, and they also ride on the ant queens during mating flights. The cockroach's arolium is greatly developed and allows the blattellid to adhere firmly to the queen during swarming, thus facilitating the myrmecophile's dispersal (Brossut, 1976, fig. 3). *Attaphila bergi* Bolívar inhabits the nests of the ant *Acromyrmex lundi* in Argentina and Uruguay. The cockroach's antennae are always mutilated. The myrmecophile sits on the back, neck, or head of sexual individuals, and when they swarm it is carried out of the nests still attached to the host (Bolívar, 1901). Just how *Pseudoanaplectinia* is dispersed is unknown. Its small arolia indicate that it does not attach itself to the ants; although the female's wings are reduced it is possible that they are large enough to allow some flight and, if true, this may be their method of dispersal.

Wing venation and male genitalia of *Pseudoanaplectinia* are similar to and suggest a relationship to species of oviparous *Anaplectella* spp. (Roth, 1996b) but their leg armament and type of reproduction are markedly different. *Attaphila fungicola* is oviparous, has an ootheca that lacks a keel, contains about 6 eggs (Roth, 1970, fig. 21), and resembles the ootheca of *P. yumotoi*. It has been considered to be a polyphagid, but its ovaries and male genitalia are those of a blattellid; the male's genital hook is on the left side placing it in the Blattellidae: Blattellinae (McKittrick, unpublished observation). The two species can be separated as follows:

Character	<i>Attaphila fungicola</i>	<i>Pseudoanaplectinia yumotoi</i>
Reproduction	oviparous	ovoviviparous
Cerci	unsegmented	segmented
Arolia	very large	very small
Tarsal claws	presumably simple*	serrated
Tegmina & wings	(male) vestigial (female) absent	(male) reduced (female) reduced
Abdomen (male)	unspecialized	gland on T7

\*Neither Wheeler (1900) nor Hebard (1917) stated that the claws are serrated.

## ACKNOWLEDGEMENTS

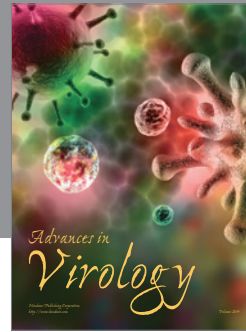
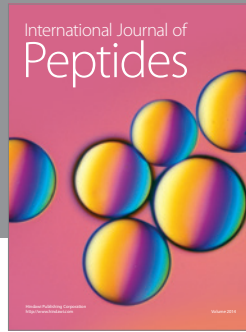
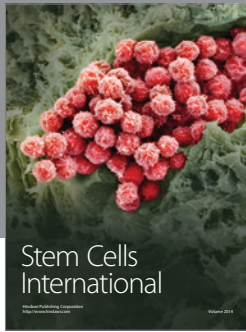
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