

Morphological Study of Cocopet *Euborellia arcanum* (Order: Dermaptera) in the Muhammad Sabki Urban Forest Area, Jambi City

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ABSTRACT

Euborellia arcanum, an insect from the Dermaptera Order, plays a crucial ecological role as both a predator and a decomposer. However, the genus *Euborellia* is notoriously challenging to identify. Despite its ecological importance, studies on the genus *Euborellia*, particularly in Indonesia, remain limited. This study aimed to describe the morphological characteristic of *E. arcanum* as a reference for identification and scientific information. The study was conducted from August to September 2024 in the Muhammad Sabki Urban Forest Area, using direct sampling and morphological examination by microscopic approach. The Dermaptera Order is characterized by cerci, appendages at the abdomen's end, shaped like tweezers. *E. arcanum*, a wingless (apterous) species of *Euborellia*, measures 18–26 mm in total length, including forceps. Specimens collected in this study measured approximately 20 mm. *E. arcanum* has biting-chewing mouthparts, blackish-brown compound eyes for detecting light and movement, and filiform antennae with 19 antennomeres. The 12th to 15th antennomeres are yellow. The prothorax of *E. arcanum* is rectangular, slightly longer than wide, with a smooth surface. The mesothorax and metathorax are transverse, wider than long, and also have smooth surfaces. The abdomen consists of nine convex tergite segments, except for the last segment, which is transverse and slightly convex posteriorly.

Keyword: Cocopet, *Euborellia arcanum*, Morphology, Muhammad Sabki.

Abstrak

Euborellia arcanum, serangga dari Ordo Dermaptera, memainkan peran ekologis yang sangat penting sebagai predator dan pengurai. Namun, genus *Euborellia* terkenal sulit untuk diidentifikasi. Meskipun memiliki peran ekologis yang penting, penelitian mengenai genus *Euborellia*, khususnya di Indonesia, masih sangat terbatas. Penelitian ini bertujuan untuk mendeskripsikan karakteristik morfologi *E. arcanum* sebagai acuan identifikasi dan informasi ilmiah. Penelitian dilakukan pada bulan Agustus hingga September 2024 di Kawasan Hutan Kota Muhammad Sabki, dengan menggunakan metode pengambilan sampel secara langsung dan pemeriksaan morfologi secara mikroskopis. Ordo Dermaptera memiliki ciri khas berupa cerci, pelengkap pada ujung abdomen yang berbentuk seperti pinset. *E. arcanum*, spesies *Euborellia* yang tidak bersayap (apterous), memiliki panjang total 18-26 mm, termasuk forsep. Spesimen yang dikumpulkan dalam penelitian ini berukuran sekitar 20 mm. *E. arcanum* memiliki bagian mulut yang menggigit dan mengunyah, mata majemuk berwarna coklat kehitaman untuk mendeteksi cahaya dan gerakan, dan antena filiform dengan 19 antena. Antena ke-12 hingga ke-15 berwarna kuning. Prothoraks *E. arcanum* berbentuk persegi panjang, sedikit lebih panjang dari lebar, dengan permukaan yang halus. Mesotoraks dan metatoraks melintang, lebih lebar daripada panjang, dan juga memiliki permukaan yang halus. Abdomen terdiri dari sembilan segmen tergit cembung, kecuali segmen terakhir yang melintang dan sedikit cembung ke arah posterior.

Keyword: Cocopet, *Euborellia arcanum*, Morfologi, Muhammad Sabki.

INTRODUCTION

Insects, the most dominant members of the Arthropoda phylum, play a crucial role in maintaining ecosystem balance due to their adaptability to various habitats. One group of insects that has a fairly important ecological role is ground insects. Ground insects are essential in accelerating soil decomposition and maintaining ecosystem balance (Erniwati, 2009; Fauziah, 2016). As organic material decomposers, they play a pivotal role in the nutrient cycle (Rachmasari et al., 2016). One of the ground insects that is still rarely studied in Indonesia is Cocopet (Genus

Euborellia) from the Order Dermaptera. The Dermaptera order consists of 16 families, including Anisolabididae, with most species acting as predators and a few as herbivorous pests (Setiawati et al., 2023).

Euborellia, one of the most speciose genera in the Anisolabididae family, is notoriously challenging to identify at the species level, requiring considerable time and effort (Kamimura et al., 2023). So that identification to the species level will take a long time. In addition, scientific studies on Dermaptera, especially the genus *Euborellia* in Indonesia, have not been widely carried out. Despite its

ecological importance, studies on the genus *Euborellia*, particularly in Indonesia, remain limited. Scientific information related to *Euborellia* is considered necessary to be studied because the presence of members of the Dermaptera order is very common in various types of forest and plantation habitats. Setiawati et al. (2023) found four types of Dermaptera in oil palm plantations in West Sumatra, namely *Chelisoches morio*, *Doru aculeatum*, *Euborellia arcanum* and *Vostox apicedentatus*. Based on the results of observations conducted in the Muhammad Sabki Urban Forest Area, Jambi City, members of the Dermaptera order were found, namely *Euborellia arcanum*.

This study aims to describe the morphological characteristics of *E. arcanum* as a basis for identification and to fill the gap in scientific knowledge on the Dermaptera order in Indonesia. Given the importance of the existence of *Euborellia* (Order: Dermaptera) in the ecosystem and the lack of scientific information related to this group of insects, this is the background for conducting a morphological study of *E. arcanum* found in the Muhammad Sabki Urban Forest area of Jambi City.

METHODS

The collection *Euborellia arcanum* (Order: Dermaptera) samples was conducted from August-September 2024 at two stations in the Muhammad Sabki Urban Forest area, Jambi City. Mapping of the area in the Muhammad Sabki Urban Forest, Jambi City was carried out based on the intensity of area utilization. Station I (low utilization zone) had dense canopy cover and thick litter, while Station II (moderate utilization zone) featured sparse canopy cover and thin litter (Figure 1). Each station consisted of three 100-meter transects, with 10

pitfall traps placed at 10-meter intervals along each transect.



Figure 1. Observation stations;
(a) Station I: Low utilization zone,
(b) Station II: Moderate utilization zone

Pitfall traps, totaling 10 per transect, were installed 15 cm into the soil and filled with 70% alcohol and detergent. Traps were covered with plastic bags and left for 24 hours before sample collection, which was repeated three times. Samples were stored in bottles containing 70% alcohol.

Samples were transferred to labeled bottles containing 70% alcohol, specifying station and sampling date. Identification was conducted in the Laboratory of the Faculty of Science and Technology, University of Jambi, using a stereo microscope and insect determination keys, supplemented by online resources such as www.bugguide.net.

RESULTS AND DISCUSSION

Based on the results of identification and calculation, the number of *E. arcanum* collected varied between the two locations: 52 individuals at Station I and 31 at Station II. According to Setiawati et al. (2023) *E. arcanum* is a saprophagous insect that is often found in rotting oil palm plants and acts as a decomposer in a habitat. The vegetation in these two areas is dominated by woody plants that can produce litter on the forest floor. In this study, it was found that *E. arcanum* was found more at Station I (low utilization zone) where the forest

floor was covered with a lot of litter, while at Station II (moderate utilization zone) which was more open and the forest floor was covered by undergrowth, less *E. arcanum* was found. In addition, there were differences in the physical conditions of the environment at the two research stations (Table 1).

Table 1. Results of measuring physical and chemical parameters of soil

No	Parameter	Station I	Station II
1	Soil temperature	28 (°C)	27,45 (°C)
2	Soil moisture	10,25 (%)	25,75 (%)
3	Soil pH	7,05	7,05

According to Nonci (2005), the order Dermaptera is one of the insect orders that has an important ecological role. In its habitat, Dermaptera acts as a predator, either as prey in the adult stage, larvae or eggs of other insects. *E. annulata* (Dermaptera) is known as an effective predator because it can prey on eggs, larvae, and pupae of the corn stem borer *Ostrina furnacalis*. Busniah et al. (2024) stated that members of the order Dermaptera are generally predators in oil palm plantations, not only that, members of the order Dermaptera are also prey for the palm head beetle (*Elaeidobius kamerunicus*). Therefore, the presence of Dermaptera in a habitat greatly influences the existence of other types of insects.

The distribution of the Dermaptera order in Indonesia is quite wide, covering the islands of Sumatra, Java, Sulawesi, Kalimantan, and Papua. This is inseparable from the suitability with the weather conditions in Indonesia which have high rainfall and humidity. Busniah et al. (2024) found three types of Dermaptera in the oil palm plantation area in Damasraya, namely *Chelisoches mario*, *Forficula auricularia*, and *Vostox brunneipennis*. While Setiawati et al. (2023) found four

types of Dermaptera, namely *Chelisoches morio*, *Doru aculeatum*, *Euborellia arcanum* and *Vostox apicedentatus* in oil palm plantations in West Sumatra. Most species of the Dermaptera order require an environment with high humidity, in addition to other environmental components. According to (Haas and Matzke, 2005) in addition to environmental factors, for species of the Dermaptera order that are predators are also influenced by the availability of prey in an ecosystem.

1. Morphology of *Euborellia arcanum* (Order: Dermaptera)

Morphologically, *E. arcanum* and other members of the Dermaptera order have the characteristics of insects in general, which are characterized by segmented legs, three pairs of legs, and a body covered with cuticle. A very distinctive characteristic of members of the Dermaptera order is the presence of an appendage at the end of the abdomen called cerci which is shaped like tweezers (Figure 2). Cerci in Dermaptera function to clamp prey, folded hind wings and cerci like forceps. Dermaptera wings are not used for flying, but only to cover their bodies (Siriayah, 2018). Members of the Dermaptera order are characterized by elytra (wing bases shaped like mica or leather) that are very short so that the abdomen looks open with 3-segmented tarsi (Subyanto and Sulthoni, 1991). However, based on identification characters according to Kalaentzis et. al. (2021) several types of members of the genus *Euborellia* have wings for flying and some have wings that are not developed at all. *E. arcanum* is a type of *Euborellia* whose wings are absent or undeveloped (apterous), and is a large *Euborellia*, namely the total body length with forceps is 18-26 mm. *E. arcanum* collected in this study had a total body length of around 20 mm (Figure 3).



Figure 2. Morphology of *Euborellia arcanum* (Dermaptera) (a) front leg, (b) antenna, (c) head, (d) thorax, (e) middle leg, (f) cerci, (g) abdomen, (h) hind leg



Figure 3. Body size of *Euborellia arcanum* (Dermaptera)

A. Head

The head of *E. arcanum* features compound eyes, filiform antennae, and biting-chewing mouthparts with strong mandibles (Figure 4). The mouth type in *E. arcanum* is the biting-chewing type. The mouth is orthopteroid and mostly unmodified. The strong mandibles have two or three pointed apical teeth connected by sharp edges, and the molar part that is clearly developed is found in the basal part (Figure 5). The eye type in *E. arcanum* is a compound eye that is blackish brown in color. The eyes function to detect light (photoreceptors) and movement in the environment. In addition, the eyes also function to recognize the environment and avoid predators (Matzke et. al., 2015) (Figure 6).

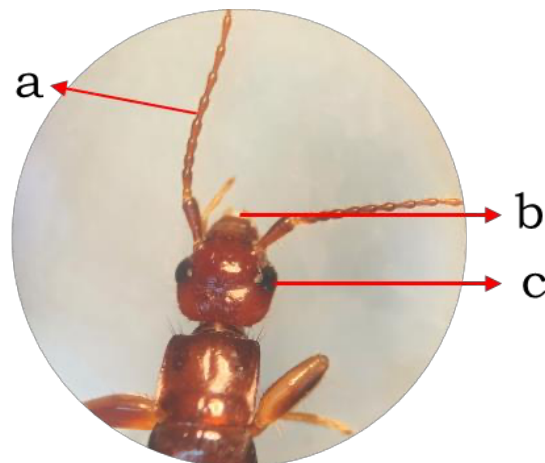


Figure 4. Mouth morphology of *Euborellia arcanum* (a) antenna, (b) mouthparts, (c) eye



Figure 5. Mouth morphology of *Euborellia arcanum*



Figure 6. Eye morphology of *Euborellia arcanum*

The antenna type of *E. arcanum* is filiform (Elzinga, 2004), consisting of 19 blackish brown antennomeres. The

12th to 15th antennomeres are yellow. This is in accordance with the statement of Matzke et. al. (2015), which states that the antennae on *E. arcanum* are blackish brown, with 2-3 yellow antennomeres in the range of 12th to 15th. The first antennomer is long, narrows at the base and widens at the terminal, while antennomeres 2-4 have different characteristics: antennomer 2 is transverse and wider than long, antennomer 3 is longer than antennomer 4. Antennomeres 2-6 are cylindrical, while the other antennomeres are cone-shaped. Antennae function as sensory organs that help *Euborellia* find eggs and larvae of other insects that are prey (Solin et al., 2019).

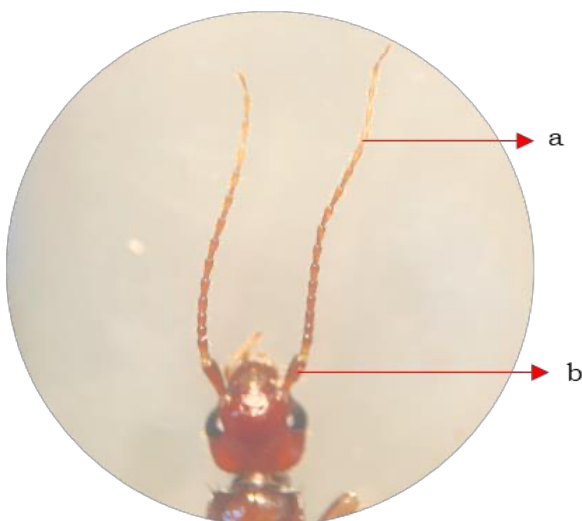


Figure 7. Antenna morphology of *Euborellia arcanum* (a) 12th antennomer, (b) antennomer

B. Thorax

The sternal plate is a characteristic of the genus *Euborellia*. The thorax of *Euborellia arcanum* is divided into three parts, namely the prothorax, mesothorax, and metathorax. The prothorax has a rectangular shape (slightly longer than wide) with a smooth surface, parallel sides, almost straight anterior edges, straight lateral edges, and convex posterior edges. There is a median gap that looks smooth but clear. According to (Matzke et. al., 2015) the typical characteristics of *E. arcanum* are the

rectangular pronotum with a size that is longer than wide. Furthermore, the mesothorax and metathorax have a transverse shape, in contrast to the prothorax, these two parts are wider than long with a smooth surface. The mesothorax looks convex in the posterior part, while the metathorax has a wide edge. The median gap is also seen in the mesothorax and metathorax (Matzke et., al., 2015). One of the identification characters of *E. arcanum* is that the tegmina and wings are completely absent (Kalaentzis et. al., 2021). In addition to these characteristics, the thorax has three pairs of yellowish legs, with sturdy femora. The tibia is covered by thick and smooth setae, while the length of metatarsomere 1 is almost the same as the length of metatarsomere 2 and 3 combined.

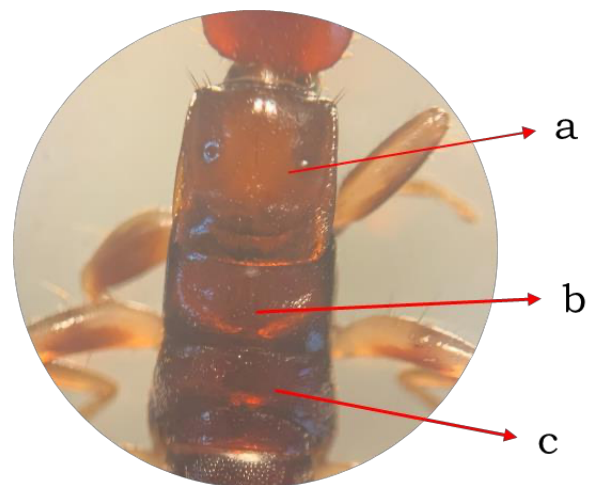


Figure 8. Thorax morphology of *Euborellia arcanum* (a) prothorax, (b) mesothorax, (c) metathorax

C. Abdomen

The abdomen of *E. arcanum* consists of 9 segments (tergite). The segments are convex except for the last transverse segment and slightly convex in the posterior part. Lateral glandular folds are visible on segments 3-4, segments 7-8 with low blunt lateral longitudinal protrusions. At the end of the abdomen there is a pair of reddish brown forcep-shaped cerci. The male

forceps are slightly curved on the right and tapered at the tip. In females, the forcep arms are straight and tapered only slightly curved at the tip. The forceps function to catch prey by directing the forceps to the mouth by curving the abdomen above the head (Setiawati et al., 2023).



Figure 9. Forcep Abdomen of *Euborellia arcanum*

2. Life Cycle and Reproduction of *Euborellia arcanum*

E. arcanum undergoes five nymphal stages, with instar lengths ranging from 4 to 13 mm. The fifth instar nymph period is 4 to 6 days for females and 2 to 3 days for males. The first mating period is shorter, the shortest is 2 minutes and the longest is 70 minutes. Both males and females are able to mate several times with intervals of several seconds or minutes. The average natural mortality of *E. arcanum* is 10.5% which means that 89.5% of the eggs deposited hatch into nymphs (Nonci, 2005).

After mating, the female constructs a deep brood chamber in the soil containing 35–65 eggs. The eggs are cleaned regularly and unfertilized or damaged eggs are discarded. Depending on the ambient temperature, embryonic development

can take 12–15 days. The larvae are then cared for by the mother for 8–12 days until they become independent at the second molt. The female lays another clutch of eggs after 43–55 days. Larvae typically molt five times. Development from hatching to adulthood takes 98–293 days, with the fourth and fifth instars taking the longest (Matzke et al. 2015).

In this study, most of the samples collected were in the adult phase. However, both of research stations can be a good habitat for *E. arcanum* so that can support all phases of their life cycle.

CONCLUSION AND SUGGESTIONS

Euborellia arcanum is a wingless (apterous) species of Euborellia (Order: Dermoptera). In average *E. arcanum* measures approximately 20 mm. *E. arcanum* has biting-chewing mouthparts, blackish-brown compound eyes for detecting light and movement, and filiform antennae with 19 antennomeres. The *E. arcanum* is characterized by 12th to 15th antennomeres are yellow. The prothorax of *E. arcanum* is rectangular, slightly longer than wide, with a smooth surface. The mesothorax and metathorax are transverse, wider than long, and also have smooth surfaces. The abdomen consists of nine convex tergite segments, except for the last segment, which is transverse and slightly convex posteriorly. The abdomen's ended by cerci, shaped like tweezers.

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