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# MORPHOLOGICAL REDESCRIPTION OF ADULT *Diplonychus molestus* DUFOUR (HEMIPTERA: BELOSTOMATIDAE) FROM PENANG, MALAYSIA

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## ABSTRACT

*Diplonychus molestus* (Dufour 1863), (Hemiptera: Belostomatidae), has shown potential as a biological control agent in aquatic environments including paddy fields. However, the taxonomic history of this species has been marked by confusion, particularly due to its close resemblance to *Diplonychus rusticus* (Fabricius 1871). Thus, this study aimed to redescribe the species based on the key morphological characteristics. Using bucket light traps, specimens were collected from paddy fields in Pekan Darat, Butterworth, Penang, Malaysia. The collected adults were preserved and identified using established taxonomic keys. Detailed morphological examinations were conducted, focusing on key characteristics that distinguish *D. molestus* from other closely related species. High-resolution images were captured to support the redescription, addressing previous taxonomic ambiguities.

**Keywords:** Taxonomy, *Diplonychus,* bucket light trap, morphology

## ABSTRAK

*Diplonychus molestus* (Dufour 1863) (Hemiptera: Belostomatidae) telah menunjukkan potensi sebagai agen kawalan biologi dalam persekitaran akuatik termasuk sawah padi. Namun, sejarah taksonomi spesies ini seringkali diselubungi kekeliruan, terutama disebabkan oleh persamaan rapatnya dengan *Diplonychus rusticus* (Fabricius 1871). Oleh itu, kajian ini membuat deskripsi semula spesies ini berdasarkan ciri-ciri morfologi utama. Spesimen-spesimen telah dikumpulkan dari sawah padi di Pekan Darat, Butterworth, Pulau Pinang, Malaysia, menggunakan perangkap cahaya baldi. Serangga dewasa yang dikumpulkan diawet dan dikenal pasti menggunakan kunci taksonomi yang telah ditetapkan. Pemeriksaan morfologi terperinci dijalankan, dengan fokus pada ciri-ciri utama yang membezakan *D. molestus* daripada spesies lain yang berkait rapat. Imej beresolusi tinggi turut diambil untuk menyokong perihalan ini, sekaligus menangani kekeliruan taksonomi yang terdahulu.

**Kata kunci:** Taksonomi, *Diplonychus,* perangkap cahaya baldi, morfologi

## INTRODUCTION

Belostomatidae, commonly known as giant water bugs, are predatory insects that feed on a variety of aquatic organisms, including crustaceans, fish, amphibians and other insects. These insects possess powerful raptorial forelegs, which are highly effective in seizing prey. Using their sharp proboscis, Belostomatids pierce their prey and inject proteolytic saliva, which facilitates the extraction of liquefied tissues. Among the Belostomatidae, the genus *Diplonychus* stands out as a beneficial insect, particularly as an efficient predator of mosquito larvae, with individuals capable of consuming up to 87 larvae per day (Polhemus & Polhemus 2013). These insects typically inhabit clear, freshwater streams and ponds, favouring environments with aquatic vegetation. Yano et al. (1981) also observed the presence of this species in paddy fields and recognized its potential as a natural biological control agent against certain rice pests. Giant water bugs are generally found in slow-moving water, particularly in areas with emergent vegetation. They often attach themselves to plants near the water's surface, using their short breathing tubes to breathe while they lie in wait for prey. Belostomatids are also strong swimmers and nocturnal fliers, often becoming a nuisance in lighthouses, aboard ships, and residential areas (Tara & Kour 2014).

*Diplonychus molestus* (previously recorded under the genus *Sphaerodema*, *Sphaerodema molestum* (Dufour 1863), is a species of Belostomatidae commonly found in aquatic environments of Peninsular Malaysia. The occurrence of *D. molestus* in Mawai, Kota Tinggi, Johor, and Malacca, Malaysia, was documented by Distant (1906) and Fernando (1961). The taxonomic history of the genus *Diplonychus* is marked by significant confusion, with some studies classifying the species under *Sphaerodema*, while others place it under *Diplonychus*. This confusion stems from historical inconsistencies in the application of taxonomic principles and the close morphological similarities between species in these genera. Lauck and Menke (1961) clarified that *Sphaerodema* is synonymous with the genus *Diplonychus* within the subfamily Belostomatinae. *Diplonychus molestus* (Dufour 1863) resembles its closely related species, *D. rusticum* (Fabricius 1871), which may lead to potential misidentification. Morphological redescriptions are essential for resolving taxonomic ambiguities and ensuring accurate species identification. Previous descriptions may have been limited by the quality of available specimens or the lack of detailed photographic documentation. By providing a comprehensive redescription, this study aims to provide a detailed redescription of the morphological features of *D. molestus*, captured in paddy fields in Malaysia, using taxonomic keys and clearer photographic evidence.

## MATERIALS AND METHODS

### Study Site and Insect Sampling

The adults of *Diplonychus molestus* were collected from an experimental paddy field in Pekan Darat, Butterworth, Penang, in northern Peninsular Malaysia. The study area encompassed a 2-hectare paddy plot cultivated with the MR297 paddy variety, utilizing a direct seeding method under conventional farming practices. Insect specimens were collected at night between 8:00 PM and 11:00 PM using a bucket light trap. The sampling occasion was conducted during the reproductive and ripening stages of the paddy, specifically in December and January, which coincides with the wet season in Peninsular Malaysia.

### Specimens Collection

The collected samples were transferred into universal bottles and preserved in 80% ethanol before identification. The insects were identified using taxonomic keys of Chandra and

Jehamalar (2012); Distant (1906); Lauck and Menke (1961); Tara and Kour (2014) and Venkatesan and Rao (1981). The specific morphological characteristics were examined, and the photos of the external morphology were carried out with an Olympus DP72 attached to an Olympus SZX16 stereo zoom microscope. The identified materials were maintained at the Aquatic Insect Collection in the Aquatic Entomology Laboratory of the School of Biological Sciences, Universiti Sains Malaysia, Penang, Malaysia. The redescription of the species was carried out following the morphological terminology and diagnostic character standards of Chandra and Jehamalar (2012) and Lauck and Menke (1961), incorporating comparative analyses with previous descriptions to refine species delineation.

## RESULTS

**Taxonomy**
***Diplonychus molestus* (Dufour 1863)**
(Figures 1A- B)

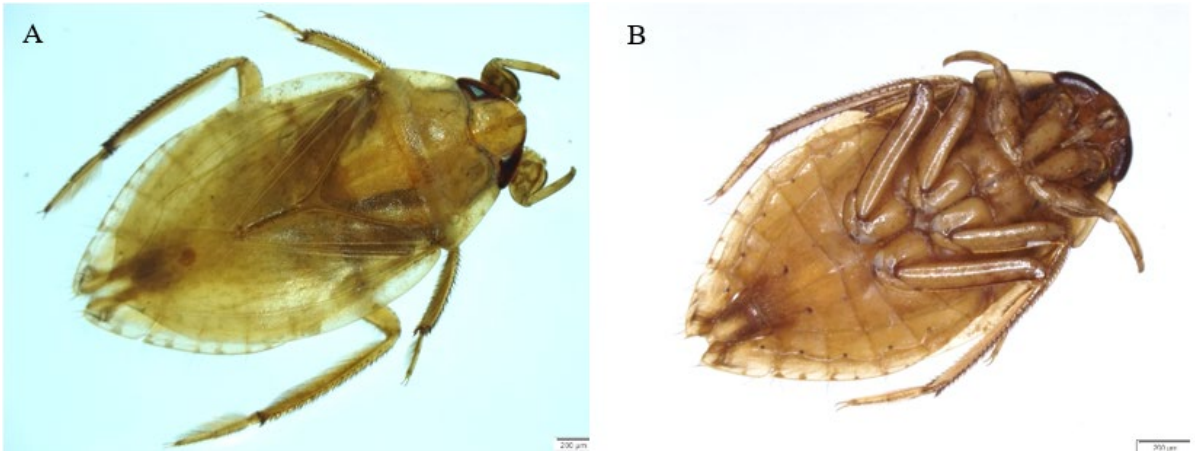


Figure 1. Adult male of *Diplonychus molestus* (Dufour 1863) (scale, 200µm); (A) dorsal view; (B) ventral view

***Synonyms Sphaerodema molestum* (Dufour 1863)**
**Distribution:** India, Peninsular Malaysia, Borneo, Vietnam, Sumatra
**Materials examined. –** 10 males, 8 females. MALAYSIA, Penang: 1 adult, Pekan Darat paddy field, (5.4806203, 100.4063125), 9.xii.2023, Rahim. A. M.; 16 adults, Pekan Darat paddy field, (5.4806203, 100.4063125), 29.xii.2023, Rahim. A. M.; 1 adult, Pekan Darat paddy field, (5.4806203, 100.4063125), 3.ii.2024, Rahim. A. M.
**Diagnosis:** *Diplonychus molestus* can be distinguished from the other species of the genus by referring to the following characteristics: (1) posterior pronotal angle obtuse, (2) wing membrane large and extended to inner margin, (3) male genital plate less acute, and (4) pubescent stripe of abdominal sternum obscure. All characteristics of adult females of *D. molestus* are similar to males, with only differences in the sexual organs.
**Redescription:**
**Adult (n=18):**
(Figure 1A-B). In alcohol. Body length: 1.7 – 1.9 cm; body width: 0.8 – 1.0 cm; hemelytra length: 1.2 – 1.3 cm; hemelytra width: 0.4 – 0.5 cm; head length: 0.15 – 0.18 cm; head width: 0.4 – 0.45 cm; general coloration: light brown.

**Head:** (Figure 2D) Head is relatively short in length compared to its width. Apex of the head is blunt, which is not sharply pointed (rounded or slightly flattened). Coloration of head is light brown, concolor to its body. Eyes are prominent and positioned laterally, darker in colour (reddish brown).
**Thorax:** Thorax appears robust with light brown coloration. The pronotum is visible and slightly raised, extending laterally and smooth and rounded without any distinct setae (Figure 2A). The posterior pronotonal angle is obtuse (Figure 2B).
**Wings:** Hemelytra are longer than broad with the wing membrane being large and extending to the inner margin (Figure 3A-B). The hind wing is linear (narrow, elongated shape). The spiny patch of the corium is round, and the inner sub apex of the corium is inwardly curved.
**Legs:** (Figure 4A-C) Forelegs are robust and slightly shorter than middle and hind legs. The anterior tarsus is one-segmented, terminated with two small, equal claws (Figure 3C-D).
**Abdomen:** Pubescent stripe of the abdominal sternum is obscure (not well-defined or faint), less sinuate and less prominent (Figure 2C). The long, dense tuft of setae on the respiratory strap is present (Figure 2E). In females, the respiratory straps do not possess any long setae, but bear one tuft of setae on lateral margins apically (Figure 2F).
**Genitalia:** Male genitalia plate appears to have a somewhat elongated, triangular shape with rounded edges (Figure 2E). The tip seems to be more pointed, and the sides are slightly convex, tapering towards the end. The male paramere is almost straight (Figure 3E). Females lack of paramere.

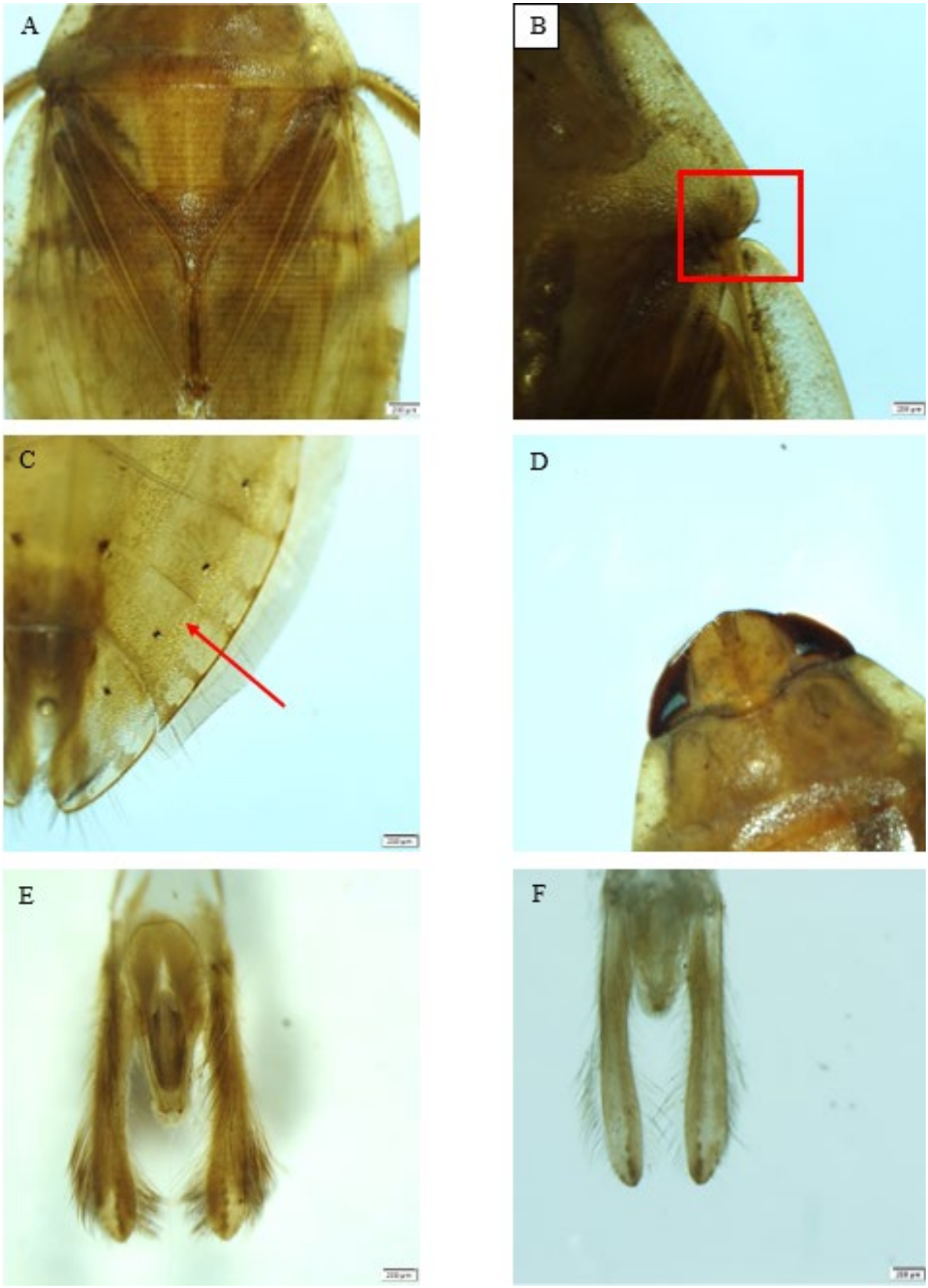


Figure 2. *Diplonychus molestus* adult (scale, 200µm); (A) corium; (B) part of pronotum showing posterior pronotal angle; (C) part of abdominal sternum showing pubescent stripe; (D) head; (E) male genital plate and respiratory straps; (F) female genital plate and respiratory straps

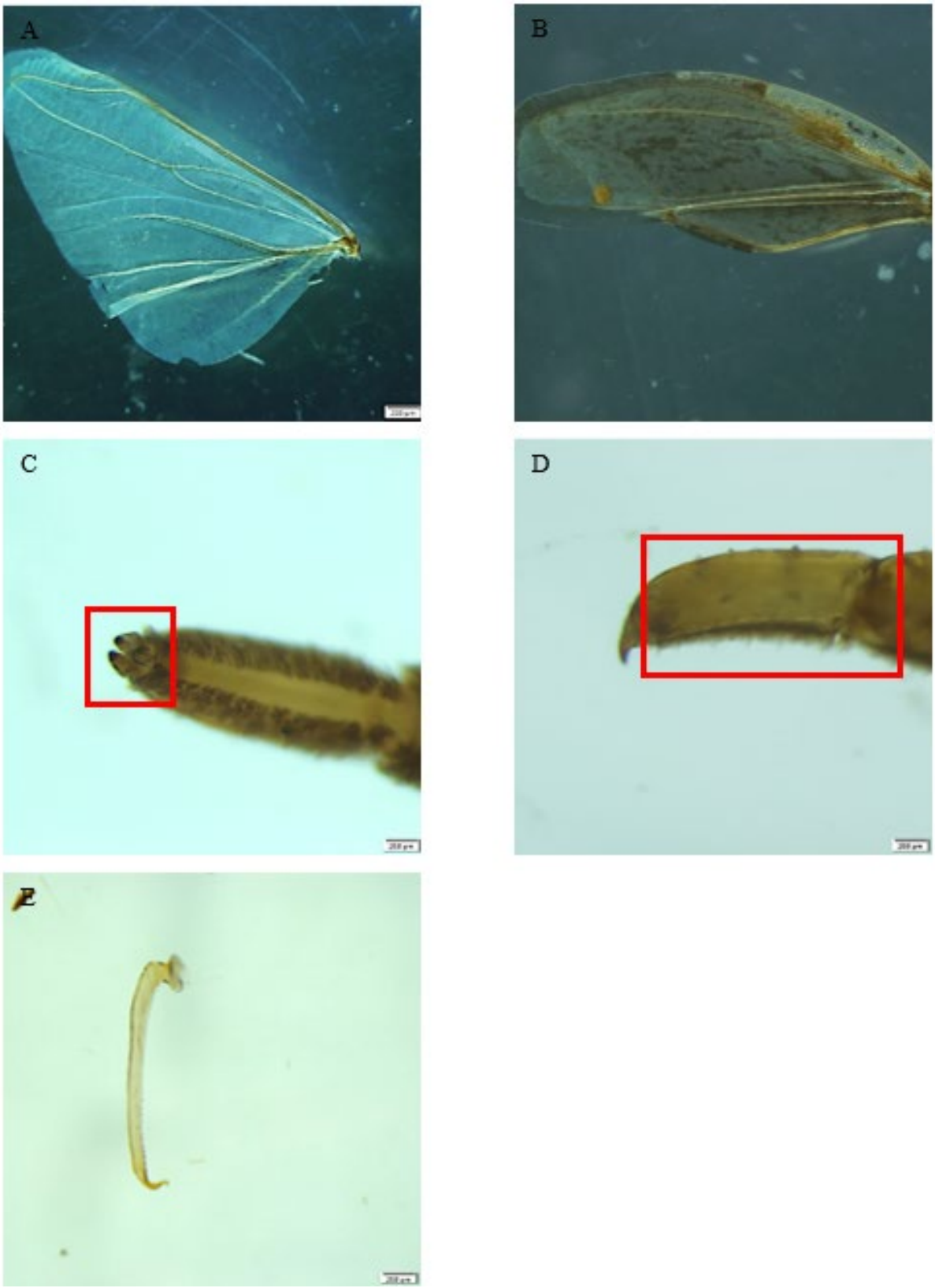


Figure 3. *Diplonychus molestus* adult (scale, 200µm); (A) hindwing (wing membrane); (B) hemelytra; (C) ventral view of anterior tarsus; (D) lateral view of anterior

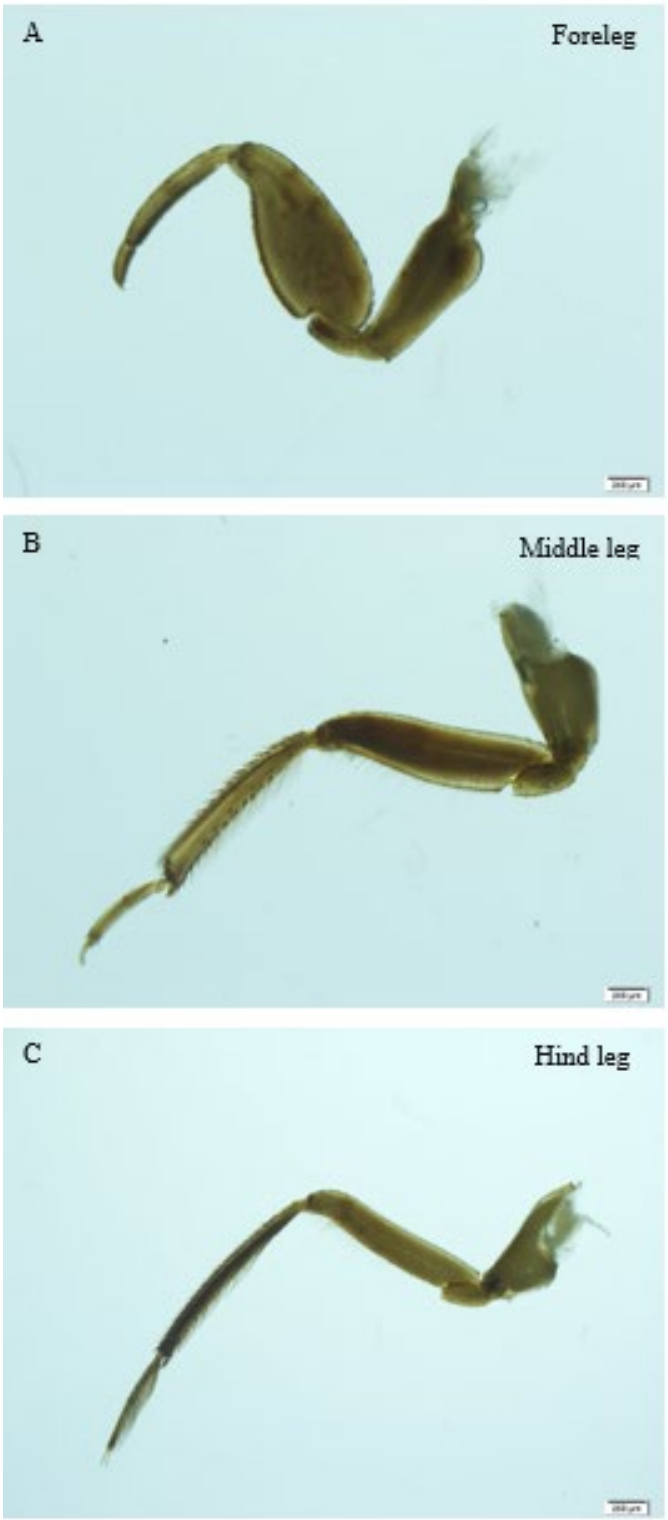


Figure 4. Legs of *Diplonychus molestus* (scale, 200µm); (A) foreleg; (B) middle leg; (C) hind leg.

## DISCUSSION

The occurrence of *Diplonychus molestus* in Southeast Asia remains poorly documented, with most records predominantly from India, including regions such as Delhi, Kerala, Manipur, Punjab, and West Bengal (Lyngdoh et al. 2021). In Malaysia, this species was previously

reported under the genus *Sphaerodema* (as *S. molestum*) in Mawai, Johor, and Malacca (Distant 1906; Fernando 1961b). However, Polhemus and Polhemus (2013) suggested that these earlier records from Peninsular Malaysia were misidentifications, likely referring to *D. rusticum* instead. In the present study, *D. molestus* specimens were captured using bucket light traps, indicating their ability to fly and their attraction to artificial light - a behavior consistent with previous findings by Fernando (1961a,b). This contrasts with *D. rusticum*, which has not been reported in isolated habitats or at light, further supporting the distinction between these two species. Although *D. molestus* is not as widely distributed as *D. rusticum*, its presence has been confirmed in Malaysia and Sumatra, in addition to India.

Chandra and Jehamalar (2012) suggested that *D. molestus* lacks the tuft of setae on the respiratory strap; however, this characterization is incorrect. In this study, all examined specimens of *D. molestus* exhibited setal tufts on the respiratory straps, confirming this feature as a distinguishing characteristic of the species. Additionally, the specimens were identified as *D. molestus* based on the presence of straight parameres and a large, extended wing membrane. These morphological traits differentiate it from *D. rusticum*, which is characterized by curved parameres and a smaller wing membrane. Furthermore, the pubescent stripe on the examined specimens of *D. molestus* was less defined and less prominent compared to other species, where this feature is typically more distinct. Chandra and Jehamalar (2012) also noted that the flight morph of *D. rusticum* closely resembles *D. molestus*; however, their study predominantly focused on the flightless morphs of *D. rusticum*, leading to a limited comparison between the flight morphs of these species. Consequently, their conclusions do not provide strong evidence to challenge the identification of *D. molestus* in this study. Our findings, which are based on a more comprehensive examination of morphological features, confirm the distinctiveness of *D. molestus* and highlight the need for more detailed comparative studies to refine the taxonomic boundaries between these species.

Despite the morphological evidence presented in this and other studies, there remains a lack of molecular data to conclusively identify and confirm the distinctiveness of *D. molestus*. The use of molecular techniques, including DNA barcoding and phylogenetic analyses, could provide additional support and resolve ambiguities in species identification, especially for closely related taxa with overlapping morphological traits. Future studies should incorporate molecular testing to complement morphological assessments, ensuring a robust and comprehensive approach to the taxonomy of *Diplonychus* species.

## CONCLUSION

The present study provides a comprehensive morphological redescription of *Diplonychus molestus* from Penang, Malaysia, resolving several taxonomic ambiguities that have historically confounded its identification. By examining key morphological traits, the differences between *D. molestus* and its closely related species have been made clearer. This redescription not only enhances the understanding of the species but also contributes to its proper identification and potential application as a biological control agent in aquatic environments, especially in paddy fields. Future research should include molecular identification techniques to support its taxonomy further and ensure precise species confirmation.

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## AUTHORS DECLARATIONS

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**Conflict of Interest**
The authors declare no conflict of interest.

**Ethics Declarations**
No ethical issue is required for this research.

**Data Availability Statement**
My manuscript has no associated data.

**Authors' Contributions**
Ahmad Mustaqim Rahim (AMR) and Suhaila Ab Hamid (SAH) conceptualized this research and designed experiments; AMR performed the experiment and analysis; AMR and SAH participated in the interpretation of the data and manuscript writing. All authors read and approved the final manuscript after review.

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