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Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Ph: +91 9385339863 | www.threatenedtaxa.org
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Cover: The nine vultures of India, digital art made on Krita by Dupati Poojitha.

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COMMUNICATION

First record of *Euclimacia nodosa* (Westwood, 1847) and two species of the genus *Mantispilla* Enderlein, 1910 (Neuroptera: Mantispidae) from the sub-Himalayan foothills of West Bengal, India

Abhirup Saha [1], Ratnadeep Sarkar [2], Subhajit Das [3], Prapti Das [4] & Dhiraj Saha [5]

[1–5] Insect Biochemistry and Molecular Biology Laboratory, Department of Zoology, University of North Bengal, Raja Rammohanpur, Darjeeling, West Bengal 734013, India.
[1] rs_abhirup@nbu.ac.in, [2] ratnadeepsarkar37@gmail.com, [3] dsubhajit644@gmail.com, [4] rs_prapti@nbu.ac.in, [5]dhirajsaha@nbu.ac.in (corresponding author)
[1,2] Both the authors contribute equally and share the first authorship.

Abstract: A year-long light trap study records three neuropteran mantidfly species, namely *Euclimacia nodosa*, *Mantispilla indica,* and an unidentified *Mantispilla* sp. from the sub-Himalayan Terai region of West Bengal. Among the three species, a colour variant of rare wasp-mimicking mantidfly *E. nodosa*, and an unknown species of *Mantispilla*, are significant. A redescription of all three species, with illustrations, is provided, which will enrich information about neuropteran fauna from this biodiverse landscape.

Keywords: Darjeeling, Mantidfly, Mantisipids, Neuropteran fauna, NBU, new distribution records, taxonomic update, terai region.

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Author details: Saha, A, Das, S and Das, P are researchers under supervision of Saha, D, professor and head, Department of Zoology, University of North Bengal. Their work primarily focuses on studying mosquito-vectors, while also exploring the rich insect diversity of the area. Sarkar, R worked as a researcher at ATREE and NBU, cherishes his close interest in insects.

Author contributions: AS, RS—conceptualization, data curation, formal analysis, methodology, writing–original draft; SD, PD—investigation, writing-review and editing; DS—supervision, writing-review and editing.

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INTRODUCTION

Mantispids (Neuroptera: Mantispidae) or mantidflies are interesting creatures of the insect world who feature mantid-like traits, particularly the raptorial forelegs used for catching prey. The intra-specific colour pattern, size variability, polymorphism, and sexual dimorphism are very common in the members of Mantispidae (Handschin 1961; Opler 1981; Redborg & MacLeod 1983; Snyman et al. 2018; Kaur et al. 2021). Some groups of mantidflies, for example of the genus *Euclimacia* Enderlein, 1910, mimic the colour pattern and morphology of certain vespid wasps (Hymenoptera: Vespidae) (Ohl 2004; Bhattacharjee et al. 2010). These insects display a variety of behaviours too and carry out important ecological functions (Ohl 2004). Mantispids are cosmopolitan in distribution and explore a wide range of habitats, e.g., arboreal to aquatic and forests to grasslands (Snyman et al. 2020). Their larvae exhibit remarkable predatory behaviour at different life history stages. This developmental process is known as 'hyper-metamorphosis', each stage of which has a distinct shape, and behaviour (Redborg 1998; Snyman et al. 2018). Their food habits include spider eggs, larvae & pupae of different insect orders (Mansell 2010). They clearly have a parasitic connection since they go through several growth stages while inside egg sacs of spiders and eat the eggs or spiderlings (Redborg 1998). Adults are typically observed preying on other insects or consuming pollen gains, and nectar on flowers (Redborg 1998; Mansell 2010). As mantidflies are both parasites and predators, their ecological effects on other arthropod populations are substantial (Redborg 1998; Ohl 2004). This dual role helps to maintain ecological balance by managing the number of various insect species, particularly the agricultural pests (Ohl 2004).

Across the world, 395 neuropteran species, described under 44 genera, are known, of which 22 species under eight genera were recorded from India (Oswald & Machado 2018; Kaur et al. 2021; Pandher 2024) and all extant mantidflies are represented by a single subfamily Mantispinae. The remarkable works on mantidflies from our country were by Westwood (1848, 1852), Walker (1853), Needam (1909), Enderlein (1910), Banks (1933), Ghosh & Sen (1977), Ghosh (1977, 1998, 2000a,b), mostly from northeastern India and a few southern Indian states. In the post-independence period, Ghosh (1977, 1998, 2000a,b) pioneered in studying neuropteran diversity from the nine northeastern Indian states, including Darjeeling (West Bengal), and Sikkim. As a result of these exploratory surveys, four mantidfly species, namely—*Austroclimaciella quadrituberculata* Westwood, 1852, *Mantispilla indica* Westwood, 1852, *Mantispilla coorgensis* Ohl, 2004, and *Mantispa alicante* Banks, 1913 (Ghosh 1998; Bhattacharjee et al. 2010) were reported from West Bengal (Table 1).

Darjeeling-Sikkim Himalayan region (part of the central Himalaya), situated at the northernmost part of West Bengal, holds six mantispid species (Halder et al. 2018). Despite this historical assemblage of mantispid fauna in Darjeeling-Sikkim Himalayan region and northeastern Indian states, studies on this group from West Bengal remain extremely limited. Apart from checklists, there are no studies that document detailed photos, biology, and young stages of the species. Since 2000, only a single record by Bhattacharjee et al. (2010), included a rarely known species, *Euclimacia nodosa* Westwood, 1847, for the first time from Buxa Tiger Reserve (BTR) (Table 1). The species was first recorded from the Garo hills, Meghalaya, erstwhile in the Assam State, as '*Mantispa nodosa*' (Ghosh 2000a; Bhattacharjee et al. 2010; Kaur et al. 2021). In later studies, all the concerned species of genus *Mantispa* were transferred under genus *Mantispilla* Enderlein, 1910. Our present paper records *Euclimacia nodosa* from the sub-Himalayan foothills (Terai region) for the first time and with revised nomenclature for the other two *Mantispilla* species (Table 1).

MATERIALS AND METHODS

The University of North Bengal (26.709° N, 88.354° E) is well known for its vast biodiversity in the terms of flora as well as fauna, spanning around 315.99 acres, located in the sub-Himalayan region of West Bengal. The university campus is surrounded by lush vegetation, including natural & plantation forests of deciduous, evergreen plants, grasslands, and wetlands. Within the campus, two semi-perennial streams gave rise to ecotone

Table 1. An updated list of Mantispidae from West Bengal, India.

	Species name	Literature source
1.	*Austroclimaciella quadrituberculata* Westwood, 1852	Ghosh 1998, 2000a,b
2.	*Mantispilla indica* Westwood, 1852	Ghosh 1998, 2000a,b
3.	*Mantispilla coorgensis* Ohl, 2004	Ghosh 1998; Kaur et al. 2021
4.	*Mantispa alicante* Banks, 1913	Ghosh 1998; Kaur et al. 2021
5.	*Euclimacia nodosa* Westwood, 1847*	Bhattacharjee et al. 2010

*First time record from Terai region in this study.

zones between grasslands, and riversides. Notably, a considerable portion of the campus experiences seasonal accumulation of water during the monsoon. Biological richness of the area has been highlighted by earlier studies of Mukhopadhyay et al. (2015), Pal (2017), and Saha et al. (2023). However, there were no previous records of any neuropterans from this area or the terai region.

For the collection of adult mantidflies, a year-long light trap study using mercury vapour bulb (160 Watt) was carried out once a month from September 2023–August 2024 in North Bengal University (NBU) Campus. The study within the campus was conducted with permission from the Department of Zoology and the Watch and Ward Department, NBU. In each month, three consecutive nights (one new moon night and the next two nights) were chosen for light trap study. We used small-sized insect nets for capturing the species when they were found sitting on the light sheet or near the trap during the survey. After capturing, the specimens were killed using ethyl acetate vapour in a killing jar. The specimens were subsequently pinned and stretched to study in dry condition under a stereoscopic binocular microscope Magnus MS-24 and measurements of different parts were taken in mm using an ocular micrometre. All the specimens were dissected for genitalia identification and preserved in 80% ethyl alcohol. Permanent preservation was carried out as per Ghosh (1998, 2000b). Terminalia of all collected specimens were externally examined for the identification of sexes.

Specimen identification was done using identification keys (Ghosh & Sen 1977; Ghosh 1998, 2000a,b; Bhattacharjee et al. 2010; Snyman et al. 2018; Kaur et al. 2021; Choudhury 2023), relevant websites (https://www.inaturalist.org; https://bugguide.net) and in consultation with neuropteran specialists (Dr. Manpreet Singh Pandher, ZSI) for a conclusive identification. The genus-level identification was done as described by Snyman et al. (2018) and species-level based on keys by Ghosh & Sen (1977), Bhattacharjee et al. (2010), and Choudhury (2023). Photographs of dried specimens were taken using a cell-phone camera (Google Pixel 6a). The wasp species was identified using key provided by Kumar & Sharma (2015). The photo plates were prepared in Adobe© Photoshop© 10.

RESULTS

Three mantidfly species, belonging to different genera, were found in NBU campus during the study period. These were: a single individual of *Euclimacia nodosa* (Image 1) and *Mantispilla* sp. (Image 4) each, and three individuals of *Mantispilla indica* (Image 3) collected (Table 2).

Taxonomic account

Order Neuroptera

Suborder Planipennia

Family Mantispidae Westwood, 1840

Subfamily Mantispinae Enderlein, 1910

I. Genus *Euclimacia* Enderlein, 1910

Euclimacia Enderlein, 1910: 362.

Type species: *Euclimacia partita* Enderlein, 1910: 366 (original designation).

Diagnosis: Members of genus *Euclimacia* are distinguished from other genera in having the following characteristics: Antennae perfoliate; symmetrical, perfoliate flagellomeres; pro-thorax distinctly very short, wrinkled and 'humped'; wing venation and colouration are prominent with extended pterostigma; large sized species; species are often found in bright and dark colours; resemble several vespoid wasps (*Vespa* spp.) species.

Distribution of the genus: Australasian, Oriental, and Palaearctic regions.

1. *Euclimacia nodosa* (Westwood, 1847)

Mantispa nodosa Westwood, 1847: 70.

(Image 1A–H)

Material examined*:* Male, 28.vi.2024, ground of animal house, Dept. of Zoology, NBU, Darjeeling, West Bengal, India. Collected by Abhirup Saha and Ratnadeep Sarkar.

Diagnostic characters: Antenna reddish-brown; prothorax very short and 'nodose'; costal part of forewing brownish or orange yellow; large sized species, body colour rust red to brownish-black, abdomen wasp-like.

Redescription: Wings. Costal portion of fore and hindwings with dark colouration; wing venation prominent, veins brownish (Image 1C,D). Head. Head triangular with broad vertex; eyes large (Image 1H); antenna reddish brown in colour, proximally dark, and distally reddish-yellow, consisting 48 articles (Image 1G). Body. Head, antenna, prothorax, abdomen, and legs rust red (Image 1A,B); neck constricted, prothorax short, distally broader, wrinkled or 'nodose' and 'humped'

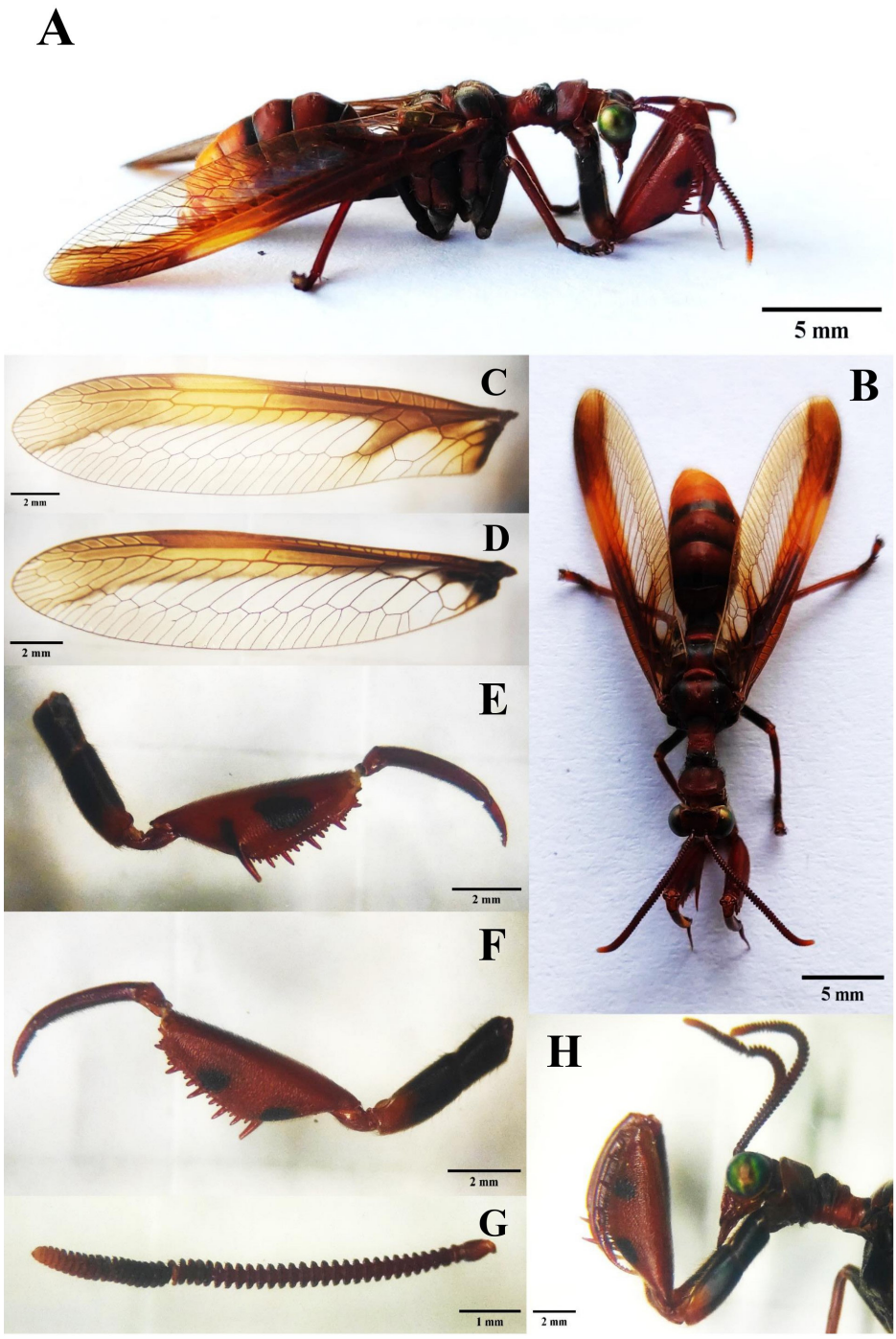

Image 1. ***Euclimacia nodosa*****, male (1A–H): A—General habitus in lateral view | B—General habitus dorsum | C—Forewing | D—Hindwing | E—Raptorial foreleg in inner view | F—Raptorial foreleg in outer view | G—Antenna | H—Head and thorax in lateral view. © Abhirup Saha & Ratnadeep Sarkar.**

(Image 1H). Terminal four segments of abdomen yellowish-orange (Image 1A,B). Legs. Coxa of fore legs brownish-black, fore femur rust red with two black spots at the base of anteroventral spines (Image 1E,F). All measurements of different body parts are presented in Table 2.

Distribution: India (Figure 1): Assam (Ghosh 2000a,b), Chhattisgarh (Kaur et al. 2021), Kerala, Madhya Pradesh (Kaur et al. 2021), Meghalaya (Ghosh 2000a,b), West Bengal (Bhattacharjee et al. 2010).

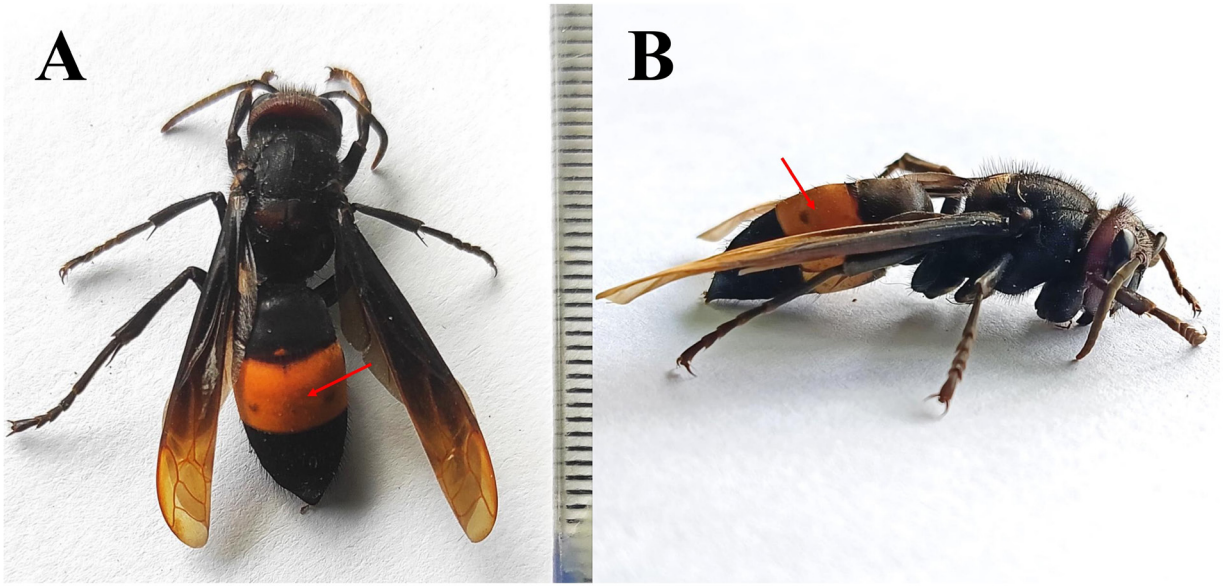

Image 2. *Vespa tropica* L., a putative model for *Euclimacia nodosa*: A—General habitus dorsum | B—General habitus in lateral view. Arrow showing typical orange colour band in abdomen. © Abhirup Saha, NBU.

Remarks: After reviewing available description of the *Euclimacia* species given by Kaur et al. (2021), this species is found to be *Euclimacia nodosa*, recorded from Meghalaya (Ghosh 2000a,b), and BTR, West Bengal (Bhattacharjee et al. 2010) as it matches with the descriptions and illustrations given by Kaur et al. (2021) and the images on iNaturalist websites (https://www.inaturalist.org/observations?taxon_id=1100298). Intraspecific colour pattern variability is very common in the different genera under family Mantispidae but not profoundly known for the genus *Euclimacia* (Ehlers et al. 2024). Here, the individual recorded from NBU campus possesses a yellowish-orange colour in the terminal four segments of abdomen, while yellowish banding was found on the abdominal segments II and III in the record of BTR or its first record from Meghalaya. *Euclimacia nodosa* mimics the vespoid wasp *Vespa tropica* L. and similarity lies in the structure, and colouration of the abdominal segments (Image 1A–H & Image 2A–B). The male specimen from NBU is larger in all body-size metrics with a comparatively broader abdomen than the male specimen from BTR (Table 2).

II. Genus *Mantispilla* Enderlein, 1910

Mantispilla Enderlein, 1910: 346.

Type species: *Mantispa indica* Westwood, 1852: 268 (original designation).

Diagnosis: *Mantispilla* lacks pronotal setae, mesothorax bald or pubescent. Longitudinal line (pigmentation) on dorsum or inner lateral side of fore coxae present. *Mantispilla* species are generally yellow coloured accompanied by black or brown.

Distribution of the genus: Afrotropical, Oriental, and Palaearctic region.

2. *Mantispilla indica* (Westwood, 1852)

Mantispa indica Westwood, 1852: 268.

(Image 3A–H)

Material examined: 3 females, 15.ix.2023 and 28.vi.2024, ground of animal house, Dept. of Zoology, NBU, Darjeeling, West Bengal, India. Collected by Abhirup Saha and Ratnadeep Sarkar.

Diagnostic characters: Antenna black except two basal segments, prothorax yellow with two brown lines anterior, and postero-laterally brown, pterostigma elongate and red, head yellow with brown patterns, abdomen with alternate black & yellow bands in lateral view.

Redescription: Wings. Pterostigma elongate and reddish in colour, hyaline, and veins black (Image 3B,C). Head. Head yellow with brown patterns; antenna dark and consists of 28 articles; eyes large with metallic appearance (Image 3F,G). Body. Prothorax dorsally yellow with two brown lines at the anterior part and ventro-laterally dark brownish (Image 3F,G), meso & metathorax yellow with black lines (Image 3A). Eight segmented abdomens, with black lines at the junction of each tergite (Image 3A). Legs. Fore femur with a small black spot anteriorly and inner side brownish (Image 3D,E); mid and hind legs yellow with brown claws (Image

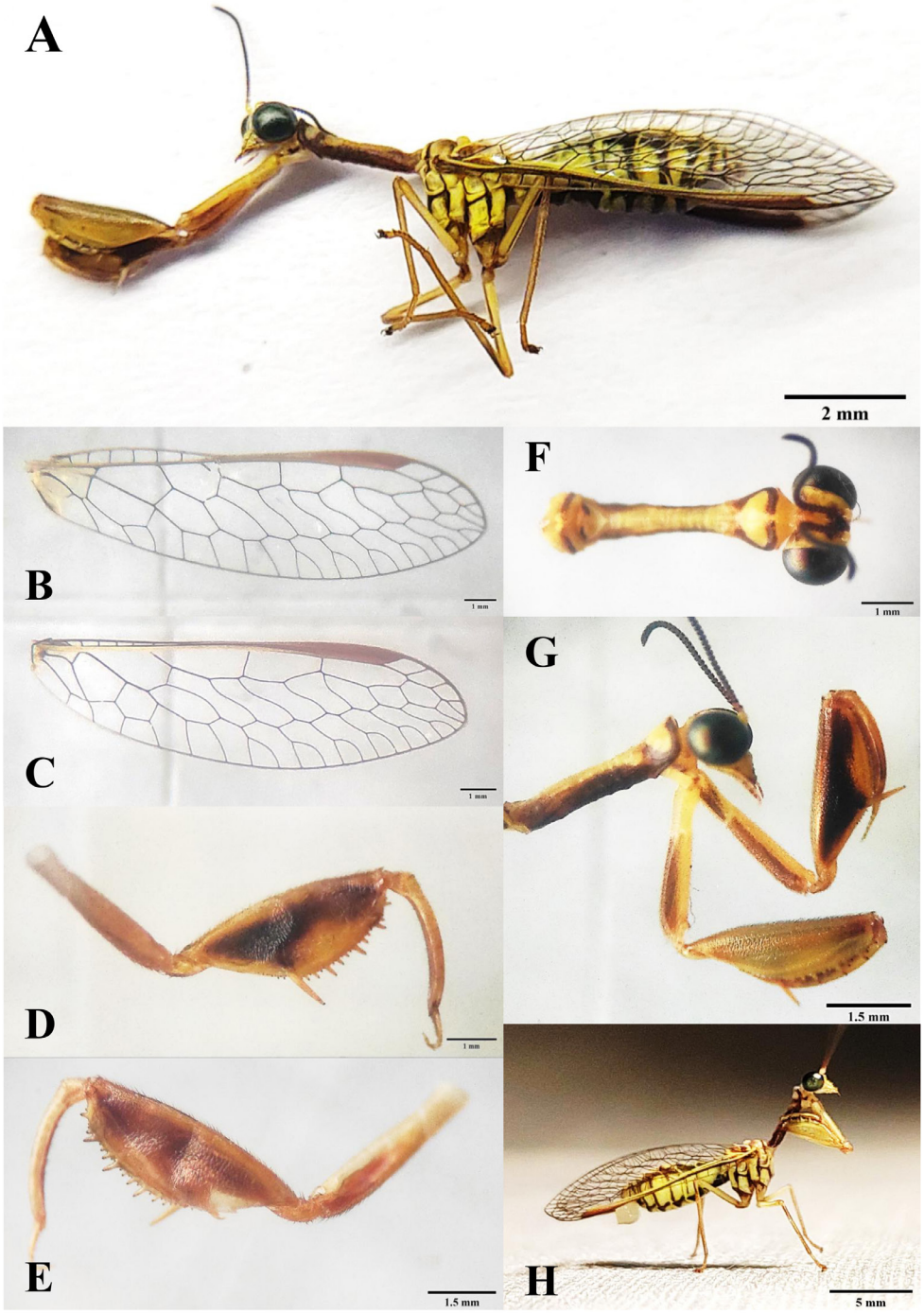

Image 3. ***Mantispilla indica*****, female (3A–H): A—General habitus in lateral view | B—Forewing | C—Hindwing | D—Raptorial foreleg in inner view | E—Raptorial foreleg in outer view | F—Head and antennae dorsum | G—Head and antennae in lateral view | H—Alive individual. © Abhirup Saha & Ratnadeep Sarkar.**

3A). All measurements of different body parts are presented in Table 2 and are compatible with those of Suryanarayanan & Bijoy (2021), and Choudhury (2023).

Distribution: India (Figure 1): Assam (Ghosh 1998; Choudhury 2023); West Bengal (Kolkata and Darjeeling) (Ghosh & Sen 1977); Meghalaya (Ghosh, 1998); Sikkim (Ghosh 2000a,b); Karnataka; Himachal Pradesh (Western Himalaya); Rajasthan (Ghosh 1977); Western Ghats (Suryanarayanan & Bijoy 2021).

Remarks: *Mantispilla indica* is one of the most widely distributed species of the genus *Mantispilla* but after consulting relevant literature, no good quality

illustrations of this species were found. Colour pattern variability has also been observed in this species (Kaur et al. 2021).

3. *Mantispilla* sp. (close to *indica*)

(Image 4A–G)

Material examined: Female, 28.vi.2024, ground of animal house, Dept. of Zoology, NBU, Darjeeling, West Bengal, India. Collected by Abhirup Saha and Ratnadeep Sarkar.

Redescription: Wings. Pterostigma elongate and reddish, hyaline with prominent black veins, venation almost similar to *Mantispilla indica* (Image 4B,C). Head. Head brownish-yellow with brown marks, antenna brownish, consists of 28 articles. Body. Specimen with darker complexion in comparison *Mantispilla indica* (Image 4A,G), prothorax dorsum is not yellow but light brownish (Image 4E), the anterior surface has two brown lines but are not as prominent as *M. indica* (Image 4F); meso and metathorax also brownish. Abdomen. Dark yellow with black lines at the junction of tergites, additionally, a pair of black lines extended

Table 2. Measurements of different body parts of the collected specimens (all measurements in mm; for *Euclimacia nodosa*, one individual was measured; for *Mantispilla indica*, the average of three individuals and for *Mantispilla* sp., one individual, were measured).

Different body attributes	*Euclimacia nodosa*	*Mantispilla indica*	*Mantispilla* sp.
(Length from head to tip of abdomen)	24	12.5	12
Total antennal length	9	3	2.5
Eye	2	1.25	1
Prothorax length	4.5	3.5	3
Mesothorax length	2.3	1	1
Metathorax length	2.3	1	1
Abdomen	13	6	5.5
Fore coxa	4.8	3	3
Fore femur	6.3	3.4	3.4
Fore tibia	3.8	2	2
Fore tarsus	1.5	0.9	0.6
Total midleg length	11	7	6
Total hindleg length	14	9	8
Total forewing length	20	10.5	11
Total hindwing length	18.5	9	9.5

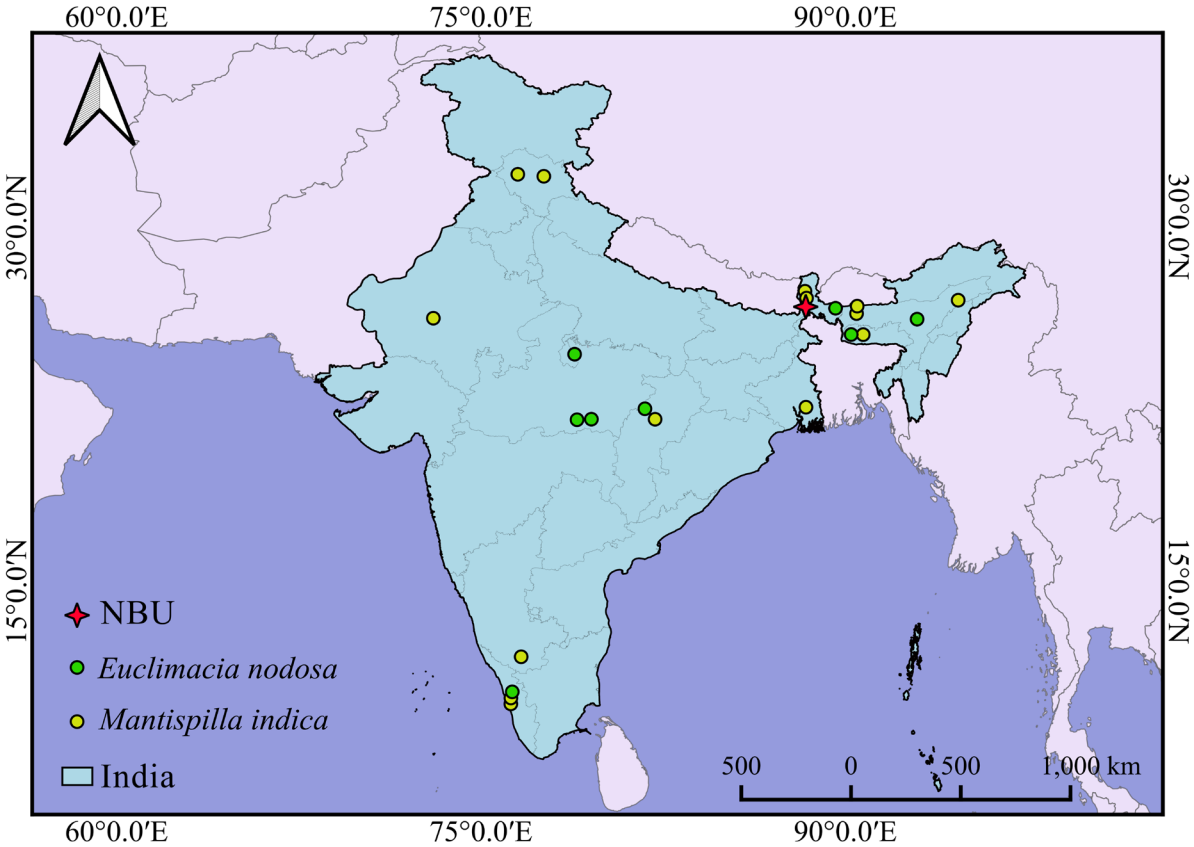

Figure 1. Distribution map of *Euclimacia nodosa* and *Mantispilla indica* in India along new records from NBU, West Bengal. The map was created using QGIS software version 3.30.0.

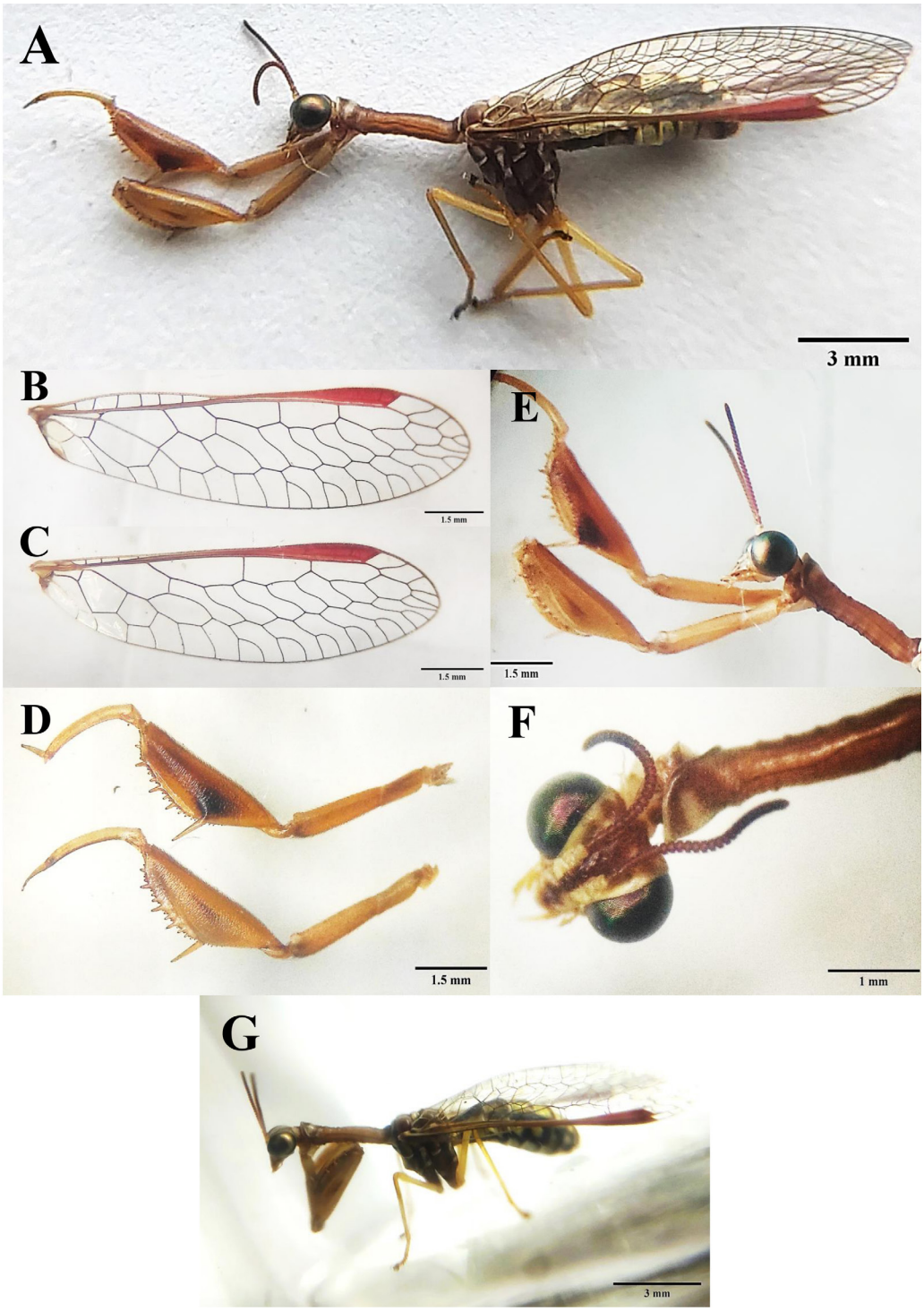

Image 4. ***Mantispilla*** **sp. female (4A–G): A—General habitus in lateral view | B—Forewing | C—Hindwing | D—Raptorial foreleg in inner view (upper) and in outer view (lower) | E—Head and thorax dorsum | F—Head and antennae in lateral view | G—Alive individual. © Abhirup Saha & Ratnadeep Sarkar.**

on both lateral surfaces when seen from the sides. Fore coxae and femora dull yellowish but inner side brownish (Image 4D); mid and hind legs yellowish with brown claws (Image 4A). All measurements of different body parts are presented in Table 2.

Remarks: All measurements of the specimen are found very close to *Mantispilla indica*, but the body colouration and colour pattern are different. Colour of

the pro, meso, and metathorax, and colour patterns of abdomen are noticeably different. Since 'colour pattern variability' is commonly observed in *Mantispilla indica* (Kaur et al. 2021), may be this specimen is a colour-variant.

DISCUSSION

During this year-long study, only five individuals were found, probably due to relatively small population, and complex life-history traits (Ohl 2007; Suryanarayanan & Bijoy 2021; Choudhury 2023). Though *Euclimacia nodosa* is rare, *Mantispilla indica* is relatively more common. All the species were recorded between June–September, which is late summer and monsoon season, and corroborated with the other findings across India (Bhattacharjee et al. 2010; Kaur et al. 2021).

In *Euclimacia nodosa*, the colour pattern variation was also found in several other records of the species across India (Snyman et al. 2018; Kaur et al. 2021; https://www.inaturalist.org/). This phenomenon might proclaim, the variety of *Euclimacia nodosa* found in this region mimics greater banded hornet, *Vespa tropica* L. which is widespread in India, and southeast Asia (Image 2). Mantids and mantidflies are broadly similar due to convergent evolution. Although the identity of first two species, *Euclimacia nodosa*, and *Mantispilla indica* can be established, the identity of third one is still uncertain. Is it a different species under the genus *Mantispilla* or a colour variant of *Mantispilla indica* still needs more investigation.

Considering these species recorded for the first time in Terai, an updated distribution map of the two mantidfly species in India, namely—*Euclimacia nodosa* and *Mantispilla indica* in India—are included (Figure 1) at the end. All available previous records from the various Indian states (Ghosh 1977, 1998, 2000a,b; Ghosh & Sen 1977; Bhattacharjee et al. 2010; Sharma & Chandra 2013; Kaur et al. 2021; Suryanarayanan & Bijoy 2021; Choudhury 2023), along with the new records from the sub-Himalayan region of West Bengal are included in this map.

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