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# Occurrence, distribution and description of *Harmonia dimidiata* (Fabricius), a predacious Coccinellid from West Bengal, India

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## Abstract

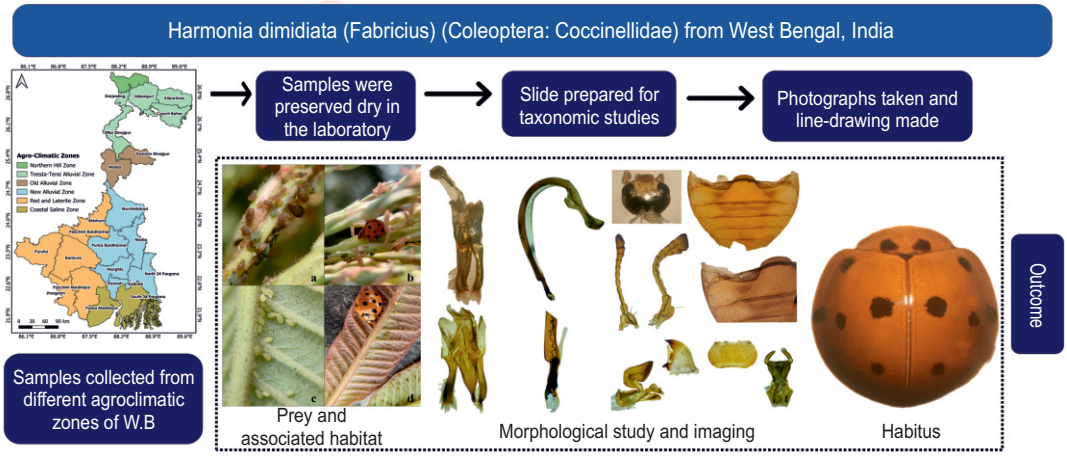
**Aim:** To provide information about the occurrence and distribution of *Harmonia dimidiata* from West Bengal and facilitate the identification of species based on morpho-taxonomy.

**Methodology:** Survey was done in different agro-climatic zones of West Bengal. Specimens were procured from their associated host plants, brought to the laboratory and investigated for taxonomic characters.

**Results:** The morpho-taxonomy of *H. dimidiata,* as well as its host record, and distribution, were fully explained in the present investigation. It is most common in hill, terai, and old alluvial zone of West Bengal. They have been observed preying on *Rhopalosiphum maidis (*Fitch) in corn and *Aphis gossypii* (Glover).

**Interpretation:** *H. dimidiata* population were recorded during survey from four different agro-climatic zones of West Bengal. They were observed to be preyed upon *A. gossypii* and *R. maidis.* The information about the biodiversity of *H. dimidiata* and their role as predator of numerous agriculturally important crop pests are extremely valuable that enrich our knowledge and immensely help in devising a pest management programme considering them as an important biocontrol agent. Furthermore, research on their biodiversity aids in learning about the predaceous behaviour in connection with the pest and crop populations, their reproduction and occurrence. This information is indeed praiseworthy while exploiting the ladybird species, *H. dimidiata* for a commercial biocontrol operation.

**Key words:** Coleoptera, Coccinellidae, *Harmonia dimidiata,* Predaceous, West Bengal

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## Introduction

A well-known and significant insect group, ladybird beetles (Coleoptera: Coccinellidae) are sometimes referred to as ladybirds or lady beetles. The popularity of ladybirds owes much to their bright colours, most often red or orange and black. Their wide appeal is manifested in the commercial and charitable organisation that use them as a motif. Ladybirds are considered as both fortune tellers and lucky omens in many parts of the world. A perusal of the history of biological control revealed that the ladybeetle *Coccinella undecimpunctata* Linn. was imported to New Zealand from Britain for the first time in 1874 for controlling aphids (Dixon, 2000), however, the successful utilization of ladybird beetles was made after fifteen years when an epidemic plague of cottony cushion scale, *Icerya purchase* Maskell threatened the orange production in California, USA. As a remedy to the threat imposed by the scale insects, a ladybeetle, *Rodolia cardinalis* Mulsant, was imported to California from Australia in 1888 and was successfully augmented and utilized for the management of scale insect (Doutt, 1958).

Coccinellidae is a speciose family of beetles with a worldwide distribution, currently including about 6000 species classified in 370 genera (Ślipiński, 2007). The Indian subcontinent is enriched with ladybird diversity which house more than 400 extant species belonging to 79 genera and 22 tribes (Poorani, 2002a). The coccinellid fauna of India is widespread and diversified. The tribe Coccinellini, which includes "true ladybird beetles," is one of the most well-known in Coccinellidae family in this area due to the fact that, in comparison to other tribes, they are generally less complicated to distinguish due to their attractive colour patterns. *Harmonia dimidiata* Fabricius is a thirteen-spot multivoltine predaceous ladybeetle that belongs to Coccinellini tribe and is found in India, Pakistan, Bhutan, Nepal, China, Taiwan, Japan and North America (Yu *et al.,* 2018). It was introduced into far Eastern Russia from China. It works incredibly well as a biocontrol agent against aphids that infest cucumbers, melons and peppers in greenhouses (Kuznetsov and Hong, 2002). It is a significant predator of the mustard aphid, *Lipaphis erysimi* (Kalt.) (Singh and Singh, 1985), cotton aphid, *Aphis gossypii* (Glover) (Yu *et al.,* 2018), and apple aphid, *Aphis pomi* de Geer (Kumari, 2018).

Composition of predatory coccinellids varies widely among various crop ecosystems. The vast variation in climate and vegetation at various altitudes and large land area are the key factors responsible for such an expanded biodiversity of coccinellids in the West Bengal. West Bengal has a tropical climate. Based on the soil characterization, rainfall, temperature and terrain, six main agro-climatic zones (Hill Zone, Terai Zone, Old Alluvial Zone, New Alluvial Zone, Red and Laterite Zone and Coastal and Saline Zone) have been identified in West Bengal. Looking to the unbounded alteration in climate at diverse elevation limited work has been done on taxonomy as well as biodiversity of coccinellids in West Bengal. *H. dimidiata* Fabricius is widely distributed from Kasmir to Assam and the Himalayas, one of the most common coccinellid from the north-eastern region of India (Poorani, 2023). In view of the above, this study aimed to offer information about the existence of *H. dimidiata* in West Bengal and facilitate the identification of species based on morphology.

## Materials and Methods

**Study area:** Adult specimens of ladybird, *Harmonia dimidiata* (Fabricius) were procured from six different agro-climatic zones (Northern Hill Zone, Teesta-Terai Alluvial Zone, Old Alluvial Zone, New Alluvial Zone, Red and Laterite Zone, Coastal Saline Zone) of West Bengal (Fig. 1).

**Insect sampling method:** Samples were drawn from a quadrat measuring 2m×2m. Three quadrates at random were selected at each collection site. The ladybird specimens were collected by a "sweep sampling method", as suggested by Gadagkar *et al.* (1990). Depending on the type of habitats studied, other strategies based on visual encounters, such as aspiration and hand picking were also employed for sampling the beetle specimens. Seventy specimens of adult *H. dimidiata* were collected from different agro-climatic zones of West Bengal. All collected ladybird beetles were brought to the laboratory for dry preservation and identification.

**Preservation and identification of specimens:** Immediately after field collection, the lady beetles were put into jars that contained cotton soaked with ethyl acetate. The killed insects were put to the glass vial, labelled properly and brought to the laboratory. Later, beetles were stretched and glued to a triangular card. Card mounted specimens were arranged on the wooden boxes and oven dried at 60°C for 72 hrs to preserve them. Each specimen was provided with a host tag, location tag and determination tag. Naphthalene balls were kept at the corner of the insect preservation box to keep the specimens free from infestations of detritivores. The beetle specimens were meticulously examined under a stereoscopic trinocular microscope (Model: SZM-T, Make: OPTIKA, Italy) fitted with camera for studying their morphological characters. For the record, following information were kept: agro-climatic zone – district, number and sex of specimens, locality, coordinates, altitude, collection date, collector biotope and collection. Male voucher specimens of lady bird beetles from each locality were kept in 70% ethanol in properly labelled glass vials to study the male genitalia. The vials were sealed with parafilm strip to check evaporation of ethanol. For genitalia extraction, the methodology described by Majerus and Kearns (1989) was followed. Terminology used for adult morphology, including genitalia, largely followed Ślipiński (2007).

**Imaging:** Photographs of the habitus and different body parts were taken by Samsung S22 Ultra smartphone. Later the images were edited in Adobe Photoshop 2020 and arranged in CorelDRAW 2018. Drawings were done by smart pen with the inbuild software PENUP of Samsung S22 Ultra smartphone. Salient diagnostic features of the species along with short notes were provided. Besides, to aid easy identification of species,

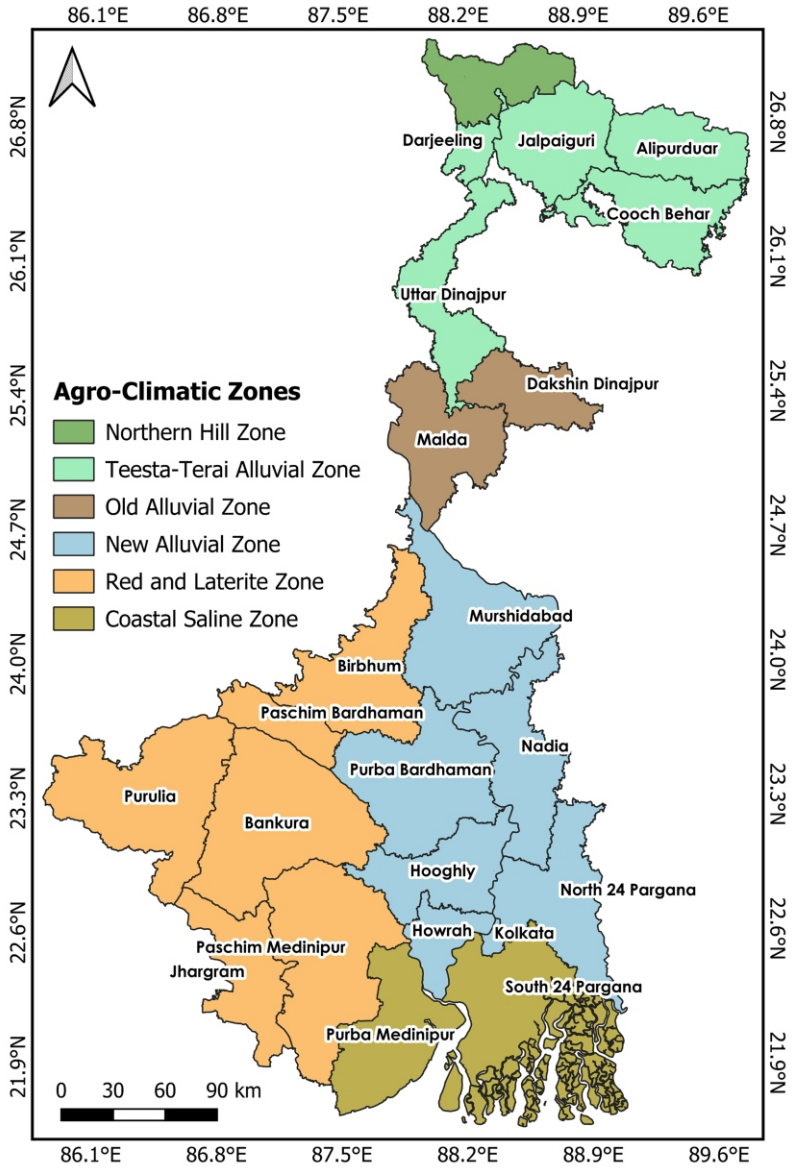


**Fig. 1:** Six different agro-climatic zones of West Bengal.

coloured images of the habitus along with male genitalia are presented.

## Results and Discussion

**Species account**
**Family : Coccinellidae**
**Subfamily : Coccinellinae**
**Tribe : Coccinellini**

*Harmonia dimidiata* (Fabricius); *Coccinella dimidiata* Fabricius, 1781: 94 (Type locality: 'Coromandel'); *Coccinella dimidia* Hope, 1831: 30 (Lectotype, BMNH; Type locality: Nepal)—Booth and Pope (1989): 352; *Leis dimidiata*: Mulsant (1850): 242; Crotch (1874): 119; Korschefsky (1932): 273; *Harmonia dimidiata*: Miyatake (1965): 62; Sasaji (1971): 281; Poorani (2002a): 330; Ren *et al.,* (2009): 194; Yu (2010): 124–125.

### Material examined

**Northern Hill Zone:** Kalimpong, 3♂, Pedong, 27˚09'21"N 88˚36'47"E, 1240m, 13.xi.2022, Tamoghno Majumder, open forest; Kalimpong, 1♂1♀, Delo hill, 27˚08'88"N 88˚50'26"E, 1704m, 15.xi.2022, Tamoghno Majumder, guava; Kalimpong,

**Fig. 2:** Field picture of *Harmonia dimidiata* (Fabricius). (a-d) live adult on guava plant.

**Fig. 3:** Preying of *Harmonia dimidiata* (Fabricius). (a) *Rhopasiphum maidis* (Fitch) on maize; (b) adult feeding on *R. maidis*; (c) *Aphis gossypii* (Glover) on guava; (d) adult feeding on *A. gossypii*.

4♂, Jhalong, 27˚02'24"N 88˚52'19"E, 600m, 19.xi.2022, Tamoghno Majumder, garden of homestay; Kalimpong, 2♂, Bindu, 27˚05'53"N 88˚52'18"E, 600m, 21.xi.2022, Tamoghno Majumder, banyan tree; Kalimpong, 5♂2♀, Lava, 27˚05'10"N 88˚39'38"E, 2200m, 24.xi.2022, Tamoghno Majumder, pine tree; Kalimpong, 2♂3♀, Gorubathan, 26˚97"N 88˚70"E, 417m, 11.xi.2022, Tamoghno Majumder, tea garden.

**Teesta-Terai Alluvial Zone:** Jalpaiguri, 2♂, Chalsa, Meteli, Malbazar, 26˚88"N 88˚78"E, 163m, 21.v.2022, Tamoghno Majumder, open field; Jalpaiguri, 3♀, Lataguri, 26˚70"N 88˚76"E ,102m, 23.v.2022, Tamoghno Majumder, open forest; Jalpaiguri, 1♂, Gajoldoba, 26˚75'15"N 88˚58'56"E,125m, 23.v.2022, Tamoghno Majumder, roadside bushes; Jalpaiguri, 3♀, Rocky island, Samsing, 26˚99" N 88˚81" E, 914m, 23.v.2022, Tamoghno Majumder, weed plant. Alipurduar, 6♂, Buxa National Park, 26˚39'0"N 89˚34'48"E, 1700m, 24.v.2022, Tamoghno Majumder, wild orchard; Alipurduar, 2♂, Rajabhatkhawa, 26˚62"N 89˚53"E, 221m, 26.v.2022, Tamoghno Majumder, guava plant; Alipurduar, 3♂4♀, Jayanti, 26˚70"N 89˚61"E, 320m, 26.v.2022, Tamoghno Majumder, riverside.

**Old Alluvial Zone:** Uttar Dinajpur, 4♂1♀, Rupahar, 25˚57"N 88˚13"E, 40m, 22.xii.2022, Tamoghno Majumder, jackfruit plant; Uttar Dinajpur, 5♂, Hemtabad, 25˚67"N 88˚22"E, 40m, 15.iv.2023, Tamoghno Majumder, maize field; Uttar Dinajpur, 1♂, Raiganj, 25˚62"N 89˚72"E, 40m, 22.xi.2023, Tamoghno Majumder, rose; Uttar Dinajpur, 7♂, Raiganj, 25˚62"N 89˚72"E, 40m, 14.xii.2023, Tamoghno Majumder, flower garden; Uttar Dinajpur, 4♂, Hemtabad, 25˚67"N 88˚22"E, 40m, 31.iii.2024, Tamoghno Majumder, maize field; Uttar Dinajpur, 1♂,Raiganj, 25˚62"N 89˚72"E, 40m, 8.iv.2024, Tamoghno Majumder, guava.

**New Alluvial Zone:** Hoogly,1♂, Balagarh, 23˚12"N 88˚46"E, 15m, 4.xi.2022, Tamoghno Majumder, mango orchard. No specimens were recorded from the Red and Laterite Zone and Coastal Saline Zone of West Bengal.

**Description:** The members of the species were medium to large, body length 6-9 mm, width 5.80-9 mm. The body was almost circular (Fig. 2 a-d, 4 a, b), dorsal side of the body was mostly convex and glabrous. Pronotum (Fig. 4c) amber coloured with a pair of black spots, sometimes fused into a 'M' shaped single marking. Elytra were vivid reddish orange to full orange in colour with sometimes twelve or thirteen black maculae forming 1-3-2/ 1-3-2-1/ 1-3-2-2 pattern (Fig. 7). On each elytron, the first one macula at anterio-lateral portion, second three maculae along medio-lateral portion across the mid elytral suture, third two maculae at posterior lateral to discal portion and last one/two maculae posteriorly on the edge of the suture margin (Fig. 4 a, e). Elytral epipleuron were broad and thick (Fig. 4 d). On head, a pair of black spots were fused together on the posterior portion of frons (Fig. 5 a). Antennae were dense, broad club, composed of 11 antennomeres, terminal antennomere broad scalene trapezium shaped (Fig. 5 b,c). Eyes approximately oval, moderately large, limitedly separated, interocular distance about 2x as wide as an eye (Fig. 4 c, 5 a). Mouthparts (maxilla, mandible, labrum and labium) are illustrated in Fig. 5 f-l. Ventral side of the body was reddish in colour with six abdominal ventrites could be seen (Fig. 4b). Abdominal postcoxal lines were incomplete with an associate line, curved, reaching towards the upper edge (Fig. 5 d, e). Male genitalia (Fig. 6 a-d, 8) as

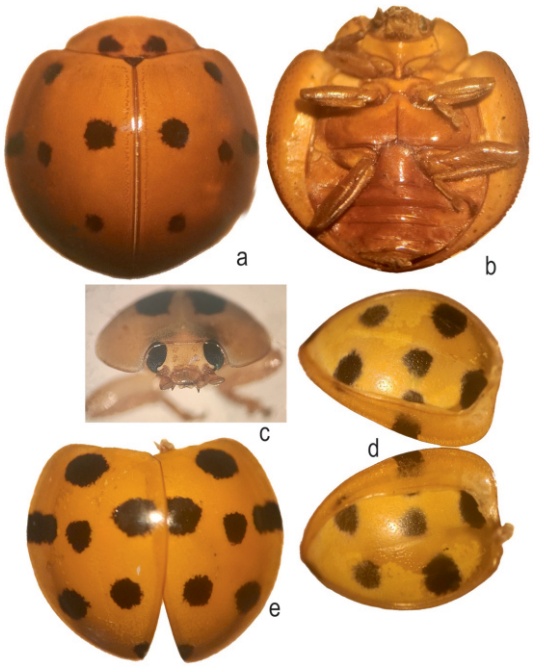


**Fig. 4:** *Harmonia dimidiata* (Fabricius): (a) adult, dorsal view; (b) adult, ventral view; (c) adult, frontal view; (d) elytra, ventral view; (e) elytra, dorsal view.

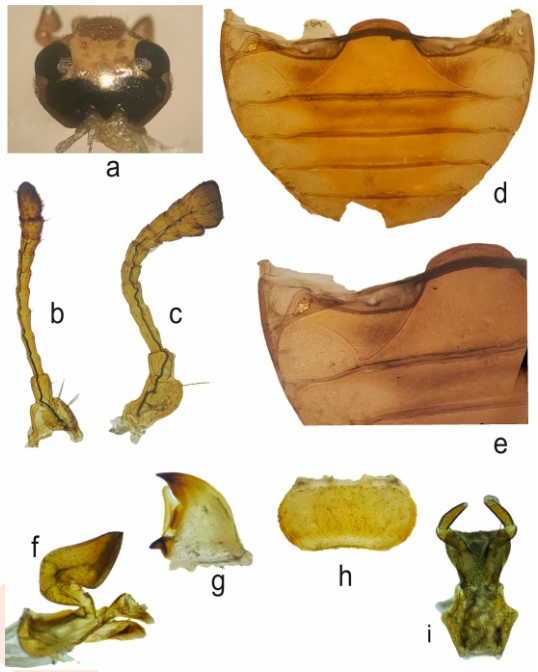


**Fig. 5:** *Harmonia dimidiata* (Fabricius): (a) head, dorsal aspect; (b, c) antenna; (d) abdomen; (e) abdominal postcoxal line, closed view; (f) maxilla; (g) mandible; (h) labrum; (i) labium.

**Fig. 6:** *Harmonia dimidiata* (Fabricius) male genitalia: (a) tegmen, ventral view; (b) tegmen, dorsal view; (c) penis; (d) penis apex.

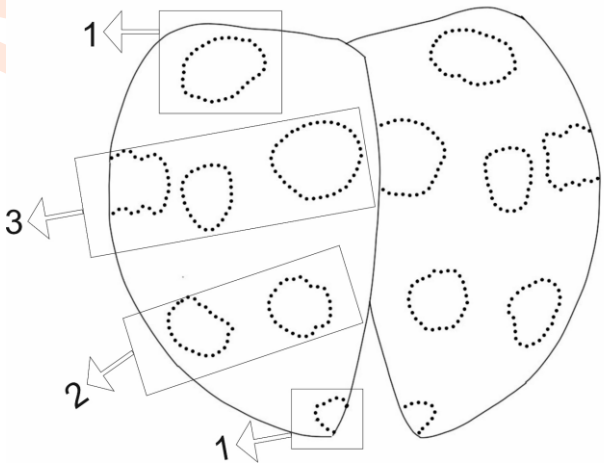


**Fig. 7:** *Harmonia dimidiata* (Fabricius): elytral maculae sketch showing 1-3-2-1 pattern.

illustrated, tegmen stout, penis guide in ventral view (Fig. 6 a) as long as parameres, parameres were gently curved on basal section with long dense setae on the inner sides and distal end; penis guide in dorsal view (Fig. 6b) nearly as long as parameres, apically wide, gradually narrowed to a short stem on the apex. Penis (Fig. 6 c) was stout, highly curved with a well-defined penis capsule, penis capsule with long outer arm and distinctly curved

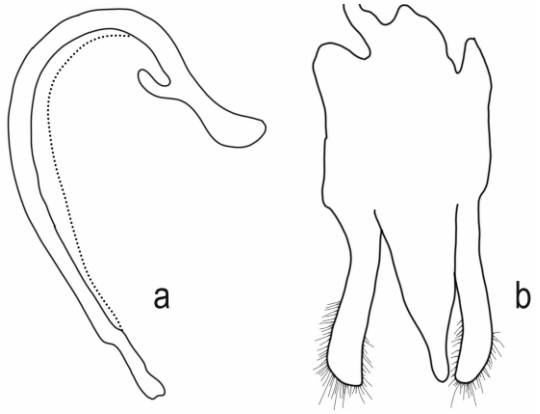


**Fig. 8:** *Harmonia dimidiata* (Fabricius): line drawing of male genitalia (a) penis and (b) tegmen.

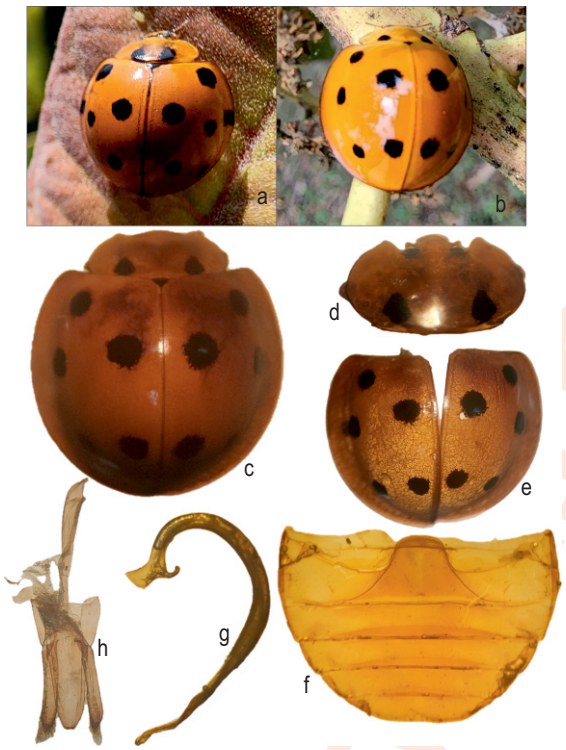


**Fig. 9:** (a). *Harmonia dimidiata;* (b). *Megalocaria dilatata:* (c). adult, dorsal view; (d). prothorax; (e). elytra (1-2-2 pattern); (f). abdomen; (g). penis; (h). tegmen.

inner arm, penis apex (Fig. 6 d) modified, truncate with membranous appendages. The type locality of *H. dimidiata* was listed as "Coromandel", India (Kapur, 1963). A detailed descriptions and illustrations of the habitus, genitalia and immature stages of *H. dimidiata* have been documented by earlier researchers (Sasaji, 1971; Gordon, 1985; Bielawski, 1972; Ren *et al.,* 2009; Yu, 2010). Colour variable but dorsum pale with dark maculae. Lateral margin of elytron weakly to strongly explanate; epipleuron abruptly descending externally; postcoxal line incomplete, of Nephus type, with irregular, oblique dividing line (Gordon, 1985). The design of the elytra is highly variable in this species, mainly three colouring types are predominant (Bielawski, 1972). Recently, Poorani (2023) documented distribution of *H. dimidiata* in the Indian subcontinent along with its habitus, genitalia, immature stages and polymorphic variants. Age and stage specific life table parameters of *H. dimidiata* and its preying efficiency on various aphid hosts have been studied by Sharmila *et al.* (2009), Yu *et al.* (2013) and Khan *et al.* (2022). *H. dimidiata* is an effective predator of *Ceravaphis quercus* Takahasi on oak trees and could be exploited as biocontrol agent in the rising phase of aphid population build up (Sharmila *et al.,* 2009). In natural condition, the ladybeetle *Leis dimidiata* develops on many aphid species affecting agricultural cultures and grassy plants; specimens introduced from China were found in the fields of South China Agricultural University on corn in the gatherings of *Rhopalosiphum maidis* Fitch (Kuznestov and Pang, 2002). Yu *et al.* (2013) compared the life histories and predation rates of ladybeetle *H. dimidiata* at different temperatures and found that *H. dimidiata* was more efficient in controlling *A. gossypii* at 20˚C and 25˚C compared to 15˚C. Based on the available literature, no authentic documentation of *H. dimidiata* from West Bengal state of India is available.

The present study unveiled a comprehensive account on the morpho-taxonomy of *H. dimidiata* along with its illustrations, host record and distribution. It is mostly prevalent in the hill, terai, and old alluvial zone of West Bengal. They were observed to be preyed upon *A. gossypii* (Glover) in guava and *R. maidis* (Fitch) in maize (Fig. 2 a-d). In mango orchard, they were found associated with *Megalocaria dilatata* (Fabricius). Superficially, the striking resemblance of the elytral pattern in *M. dilatata* and *H. dimidiata* frequently causes ambiguity in identifying the two species correctly. In *M. dilatata,* there were five black spots arranged in 1-2-2 pattern; in contrast *H. dimidiata* had 13 black spots arranged in 1-3-2-1 pattern (Fig. 9 a,b,c,e). Besides, *M. dilatata* were larger in size than *H. dimidiata,* found particularly active during March to November months. Short diagnostic illustrations of the species *M. dilatata* are provided (Fig. 9 c-h).

This article will provide a comprehensive graphic information on the physical traits of *H. dimidiata* for easier identification. The details regarding the biodiversity of *H. dimidiata* and their function as predators of many agriculturally significant crop pests are incredibly essential, adding to our understanding and greatly assisting in the development of a pest management programme. Additionally, studies on their diversification contribute to our understanding of predaceous behaviour, occurrence and distribution of the species. While using the ladybird species, *H. dimidiata* for a commercial biocontrol operation, this information is commendable in and of itself.

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**Authors' contribution: T. Majumder:** Collected samples, photographed, illustrated and drafted the manuscript; **K. Roy:** Edited and fine-tuned the draft manuscript.

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