



## A natural history note on the *Pseudoneoponera* ant-mimicking behaviour of *Naddia* sp. (Staphylinidae: Staphylininae: Staphylinini: Staphylinina), from Kalyani University campus, Kalyani, Nadia, West Bengal, India

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### Abstract

A unique ant-mimicking behaviour has been observed in the rove beetle genus *Naddia* sp. (Coleoptera: Staphylinidae: Staphylininae: Staphylinini: Staphylinina) from the campus of the University of Kalyani, Kalyani, Nadia, West Bengal, India. The individual has been observed to undergo imperfect Batesian mimicry by mimicking ants of the genus *Pseudoneoponera* (Hymenoptera: Formicidae: Ponerinae: Ponerini).

### সারাংশ

পিঁপড়ে অনুকরণ করী একটি নতুন প্রজাতির রোভ বিটল পোকা (বর্গ: কোলিওপ্টেরা; পরিবার: স্ট্যাফাইলিনিডেই; উপ-গোত্র: স্ট্যাফাইলিনিই; গণ: ন্যাডিয়া) কে, ভারতের পশ্চিমবঙ্গ রাজ্যের অন্তর্ভুক্ত নদীয়া জেলার অন্তর্গত কল্যাণী বিশ্ববিদ্যালয়ের প্রাঙ্গণ থেকে আবিষ্কার করা হয়েছে। এই বৈজ্ঞানিক নিবন্ধে, এই পোকাটির আকৃতি গত ও রঙের সাদৃশ্যের ভিত্তিতে এই পোকাটিকে সিউডোনিওপোনেরা পিঁপড়ের ব্যাটসিয়ান মিমিক (অনুকরণ) হিসাবে চিহ্নিত করা হয়েছে।

**Key words:** Ant mimic, Myrmecomorphy, Coleoptera, Staphylinidae, imperfect Batesian mimicry, West Bengal, India

### Introduction

The rove beetle subtribe Staphylinina Latreille, 1802, comprises of some large and aesthetic species of rove beetles (Mazur & Melke 2022). The genus *Naddia* Fauvel, 1867 is comprised of morphologically large and robust species that are strictly Asian in distribution. Indian species of the genus are poorly studied and only three species, viz-a-viz, *Naddia assamensis* Cameron, 1932, *Naddia decipiens* Cameron, 1932 and *Naddia westermanni* Erichson, (1840) are known from India (Cameron 1932). The deep occipital emargination (rarely moderate) of the base of the head forming salient posterio-lateral lobes helps to distinguish it from other genera of Staphylinina (Rougemont 2015). Phylogenetic analysis of Staphylinina revealed that *Naddia* is close to *Emus* Leach, 1819 forming a monophyletic group that was sister to all other members of the *Platydracus* group (Brunke & Smetana 2019).

In terms of morphology, insects have been found to mimic a vast range of models that either provides them protection against predators or help them to camouflage themselves and live in close proximity of their prey species (von Beeren *et al.* 2018). Myrmecomorphy is a common phenomenon in several groups of beetle species, where

they morphologically and chemically mimic ant species on which they predate (Vander Meer *et al.* 1982; May 1983). Several myrmecophilous beetles are often found to be nest associates of the host ant species. For example, the beetle species, *Thorictus bengalensis* Háva & Chakrovorty, 2024 (Dermestidae: Thorictinae: Thorictini) resides as a nest associate of its host ant species *Trichomyrmex destructor* (Jerdon, 1851) (Formicidae: Myrmicinae: Crematogastrini) (Háva *et al.* 2024). In terms of defensive adaptations, Batesian mimicry has been found to be an efficient mode of defence for a vast range of arthropods. Visual resemblance of a mimic with its toxic, unpalatable or behaviourally aggressive model has been found to efficiently deter predators and add to the overall fitness of the mimic species, provided that the mortality of the mimic is higher than that of the model (Mappes & Alatalo 1997; Lindström *et al.* 1997). Not every mimic needs to be in perfect resemblance of their model. A wide range of adaptive significance has been found to associated with imperfect Batesian mimics, those that manifests a “jack-of-all-trades” phenotype, serving a diverse or broad range of models. This phenomenon has been found to be common in examples of Batesian mimicry (Edmunds 2000; Speed & Ruxton 2010).

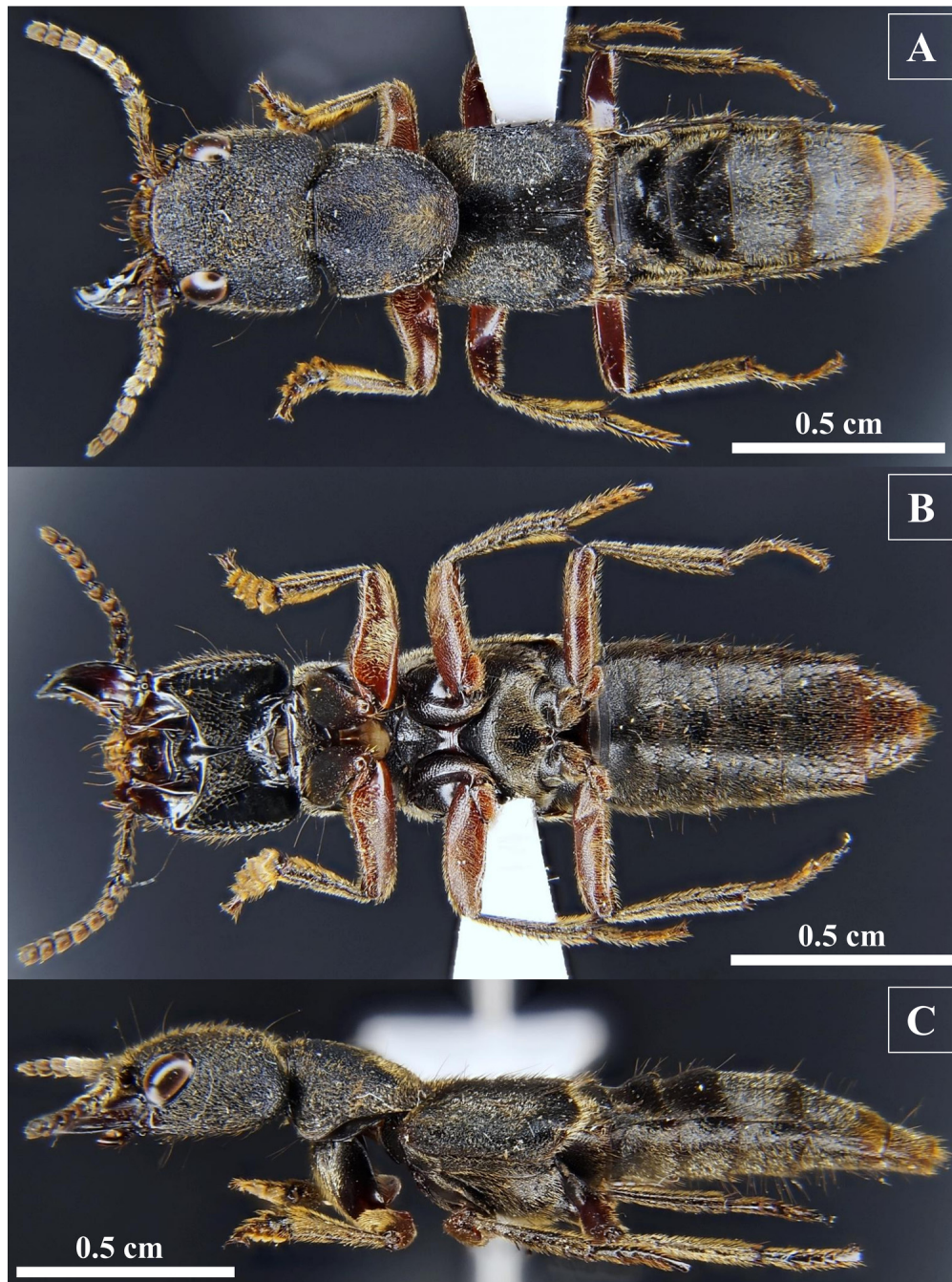


FIGURE 1. *Naddia* sp. (female): (A) Dorsal habitus, (B) Ventral habitus, (C) Lateral habitus

## Materials and Methods

### Microscopy and Illustrations

The specimen was examined using Radical Stereo Zoom Trinocular Microscope -RSM-9F (180x magnification) with circular Led illuminator- Mfg. No. B201116 (Radical Scientific Equipments Pvt. Ltd., Ambala Cantonment, Haryana, India) and images were captured using Hayear 41 megapixels HDMI microscope camera with 0.5x trinocular adapter (Shenzhen Hayear Electronics Co. Ltd., China) and SONY alpha-58 (SLT-A58) camera with Cyruss 1.25" T adapter and T2/T ring adapter for SONY DSLR (SS enterprises, India). Images were analysed using original software provided by the manufacturer (HAYEAR USB microscope camera measure software, version x64, 4.10.17214.20200601). Images were captured at different layers of focal depth and were then stacked as a single image using Helicon Focus 8 software. Measurements were calibrated using Erma Stage Micrometer (1 mm -100 divisions) Model- Galaxy SMM101 (Erma Inc., Yushima, Bunkyo-ku, Tokyo, Japan). Standard measurement techniques were followed (Chakrovorty *et al.* 2023; Háva *et al.* 2024).

The following abbreviations are used:

EL	elytra length (from the humeral angle to the distal-most elytral margin);
ELS	length of elytra along the suture (from the apex of scutellum to the posterior margin of the elytra);
EW	combined width of both the elytra measured along the mid-portion;
HL	length of the head from the frontal margin to the posterior angle, excluding labrum and mouthparts;
HW	greatest width of the head;
PL	greatest length of the pronotum;
PW	greatest width of the pronotum;
TL	total length of the body from the frontal margin of the head to the tip of the abdominal segment;

The morphological terminologies used in this paper follows Schillhammer (1996), Yang & Zhou (2010) and Byeon *et al.* (2022).

### Taxonomy

#### Subfamily Staphylininae Latreille, 1802

#### Tribe Staphylinini Latreille, 1802

#### Subtribe Staphylinina Latreille, 1802

#### Genus *Naddia* Fauvel, 1867

#### Species *Naddia* sp.

**Material Examined.** (Female): glued on cardboard point with labels as follows “INDIA, West Bengal, Nadia, Kalyani, University of Kalyani campus [22°59'14.3"N & 88°27'03.5"E], alt. 11 m, 3.Aug.2023, Arnob Chakrovorty” “Staphylinidae, Staphylininae, Staphylinini, Staphylinina, *Naddia* sp.” (iForNature—Nature Club Educational Collection).

**Diagnosis:** Base colouration of the body black, including the head, thorax, elytra and antenna, legs are dark rufous brown. Few long black setae are present throughout the body. Body covered with golden-yellow pubescence. Measurements (mm): TL 186, HL 3.68, HW 3.9, PL 3.19, PW 3.28, EL 3.89, ELS 2.2, EW 4.05,

**Head (Fig. 1).** Dorsal surface of the head is coarsely punctured, base of the head is deeply emarginated forming distinct dorso-lateral lobes. Head width greater than head length.

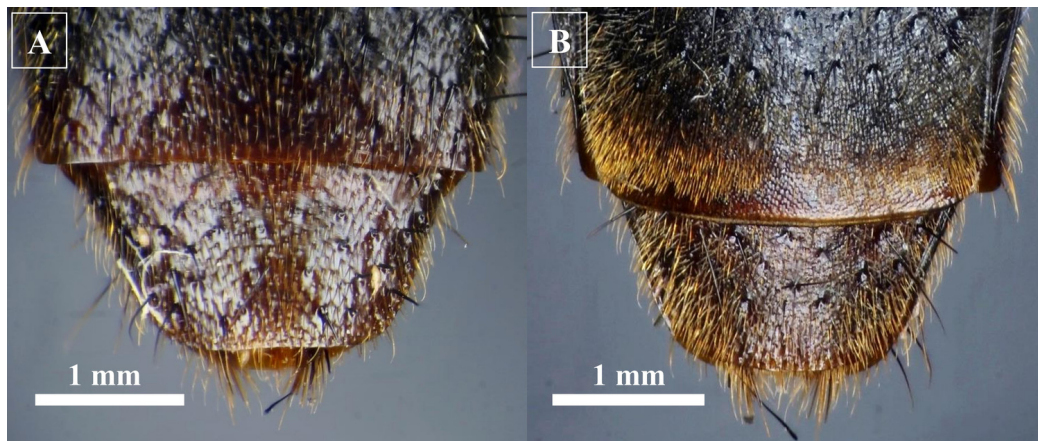


**Antenna.** 11 segmented, scape and 3<sup>rd</sup> antennomere subequal. Long yellow setae present, the setation frequency and length both decrease towards the penultimate antennomere. The width of the antennomeres increases gradually from 3<sup>rd</sup> to 11<sup>th</sup>.

**Legs.** Coxa deep brown-black, trochanter and femur reddish-brown, tibia and tarsomeres are darker than the femur. Trochanter to last tarsomere with dense yellow pubescence. Tarsal claw simple. Tarsal formula 5-5-5. Tibia bears two simple thick spurs with longitudinal striations at the distal end. Tibia bears short blunt bristles, additionally foreleg tibia bears golden-yellow pubescence.

**Pronotum.** Anterior margin of the pronotum near the hamuli is moderately pointed, no secondary projections along the lateral margin, the posterior margin is ovoid. Dorsal surface of the pronotum has coarse and fine punctures. Prosternal area has a raised median ridge, setose. Coxal cavity is deep.

**Elytra.** Elytra bears short white and golden-yellow pubescence along with long black pubescence throughout the dorsal surface. An ovoid patch of small hairs near the mid-lateral region, gives an appearance of a distinct oval marking on each elytra touching the lateral margin, the posterior margin bears a thick dense patch of golden-yellow pubescence pointing towards the dorsum.



**FIGURE 2.** *Naddia* sp. (female): (A) Abdominal sternite VI & VII, (B) Abdominal tergite VI & VII.



**FIGURE 3.** Habitus of *Pseudoneoponera* sp., the model for imperfect Batesian mimicry photographed from the same locality of the *Naddia* mimic.

**Abdomen.** Tergite III and IV shiny, coarsely punctate near anterior and posterior margins and densely setose bearing long black setae, the lateral margin bears a triangular patch or golden-yellow pubescence, pointing towards dorsum, and few long greyish-black bristles. Tergites III–VI are coarsely punctured. Tergite V and VI has golden-yellow pubescence, which thickens along the lateral margins and bears few black stiff setae along the mid transverse line of each segment. Tergite VI and VII bears a thick patch of reddish-brown pubescence nears the posterior margin of each segment. The sternites have golden-yellow pubescence, not very dense, along with few stiff black setae. Sternite VI and VII are black with a thin band of brown colouration along the posterior margin and a thin patch of reddish-brown pubescence, but not as dense as the tergites.

## Discussion

Based on the morphometric features and genitalia (not provided here) the species is a member of the *Naddia atripes* species group. The species is diurnal and ground-dwelling, and hid under leaf litter when approached. Upon comparison of body characters like size, general habitus, punctuation on the head and yellow pubescence on the posterior dorsal surface of the last two visible gastral segments, the species has been identified as an imperfect Batesian mimic of *Pseudoneoponera* ant (Fig. 3) (Hymenoptera: Formicidae: Ponerinae: Ponerini), which co-occurred with the beetle. *Pseudoneoponera* spp. is a moderately aggressive genus of ants, and a generalist predator, so mimicking this species is expected to ward off potential predators and thereby improve survival efficiency and overall fitness of the species.

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