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First record on *Imparipes bengalensis* sp. nov. (Acari: Scutacaridae) on *Labidura bengalensis* Dohrn (Forficulidae: Dermaptera) from Tamil Nadu, India

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Abstract

First record on *Imparipes bengalensis* sp. nov. (Acari: Scutacaridae) is documented as phoretic from *Labidura bengalensis* Dohrn (Forficulidae: Dermaptera) from Tamil Nadu, India are described below. *I. bengalensis* sp. nov. might disperse through phoresy, but the possible hosts were not known till now. Most of the scutacarid mites are associated with various insect orders viz., Coleoptera, Hymenoptera, Diptera, etc. The specimens collected from the field and laboratory are thoroughly examined with the morphological characters and compared with closely related species are illustrated.

Keywords: Phoresy, Scutacaridae, Dermaptera, Coleoptera, morphological characters

Introduction

Mites in the family Scutacaridae (Acari: Heterostigmata) associated with different groups of animals, plants and soil [1-4] and it live the inconspicuous life of a typical soil mite, spending their entire lifespan in their habitat where they move around, feed and reproduce, some have evolved remarkable behavioral traits [5]. The family Scutacaridae (Acari: Heterostigmata) includes 25 genera and more than 800 species; all of them are fungivorous [6-8]. These have been described from various insects families viz., Formicidae [9], Andrenidae and Halictidae [10], Phoridae [11] and Pselaphidae were reported. In most of these mites are phoretic on the host insects. Scutacaridae family [12, 13] was thoroughly reviewed with all available literature. These have been described from various insects families viz., Formicidae, Andrenidae and Halictidae, Phoridae and Pselaphidae were reported. In most of these mites are phoretic on the host insects. The association of scutacarid mites with coleopteran and hymenopteran insect [14] was studied. Many of the scutacarid mites are phoretic on various ants [15].

Imparipes burgeri have been reported from ground nesting or parasitic or ground-nesting hosts apoid bees as well as upon mutillid and pompilid wasps [16]. *Imparipes latispinus* also reported from the nests of ant, *Pogonomyrmes occidentalis* from United State of America. During the course of study, the Acari-Insect association was elaborately studied in Tamil Nadu, of which, scutacarid mites new to science was discovered. They are found in the forewing of earwig and this was the first study in Dermaptera insect order. This paper presents the descriptions of the new mites along with necessary taxonomic drawings.

Materials and Methods**Survey**

The study was conducted in various places of Tamil Nadu including plains and hilly regions to collect insects and identify the Acari-Insect association. Host insects were collected through direct survey and collection from various locations. In addition, some of the preserved insect specimens in the Department of Agricultural Entomology at Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Madurai, Trichy; Horticultural College and Research Institute, Periyakulam and Forest College and Research Institute, Mettupalayam were also examined for the presence of mites. Earwig adults *Labidura bengalensis* Dohrn (Forficulidae: Dermaptera), collected from the forest ecosystem at Mettupalayam, Tamil Nadu, India and the same was used for the present study. Both live and dead insect specimens were used for examining the presence of mites.

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Examination of host insects

Initially, the collected insect specimens were examined for the presence of mites under a Carl Zeiss Stemi 2000 stereozoom binocular microscope. The point of attachment of mites to various body parts of insect specimens *viz.*, wing bases, legs, leg joints, acarinarium, elytra, abdominal cavities and head regions were observed. Two methods *viz.*, individual examination and mass scale examination were followed depending on the availability of host insects both in terms of number and volume ^[17]. After initial observation, the mites were carefully removed from the point of attachment with a fine needle or forceps or camel hair brush and processed for permanent mounting.

Microphotography of mites associated with insects

After examination, the insect specimens containing mites were photographed with the help of image analyzer (GAIA Red software) and camera (Nikon F10). Special emphasis was given to visualize the exact place of attachment of mites in various insect specimens.

Softening of tissues

Various chemicals were used to soften internal tissues of preserved mites with little or no damage to the exoskeleton. Generally, lactophenol is used and it was prepared with the following ingredients added in sequence.

Lactic acid	- 50 ml
Phenol	- 25 ml
Distilled Water	- 25 ml

Normally, the delicate soft bodied mite specimens need very short exposure period to lactophenol than the heavily sclerotized mites (48-72 h with slight warming). Larger specimens were punctured to allow easy entrance of lactophenol into the body cavity. Blood-engorged mites or mite containing large amounts of pigments were punctured and gently squeezed so as to remove much of these substances. Additional material was squeezed out after immersion in lactophenol for 24-48 hours. Immersion of dried or brittle mite specimens in lactophenol for 48 hours at room temperature restores treated specimens to a condition from dried or freshly collected insects.

Mounting and preparation of permanent slides

Before mounting the specimens in an appropriate medium, the lactophenol treated mite specimens were cleaned 2-3 times in distilled water until the cloudy interface of lactophenol and water disappeared. Permanent slide preparations are desirable for building up a readily accessible reference collection as well as providing an alternative to temporary micro slide preparation for routine identification. Hoyer's medium was used for preparing permanent slides and it consists of the following components ^[18].

Distilled water	- 50 ml
Gum arabic (Crystals)	- 30 g
Chloral hydrate	- 200 g
Glycerine	- 20 g

Labeling of slides

The scientific value of an insect specimen depends to a larger extent on the information regarding the date and locality of its capture. All the permanent slides were provided with two labels, one on either side of the slide. Information on the

right-hand side includes date of collection, host insect, locality and accession number and the left-hand side includes mite family, genera, species and collector's name. Details are written using a black/ green gel pen (0.5 mm) or Rotring pen. All slides were given a serial collection number for identification of the specific slide.

Microphotography of permanent slides

The permanent slides were placed under a phase contrast microscope and the photographs were taken using image analyzer and camera for easy identification up to family level.

Drawing of mite specimen and Taxonomic observation

Drawing of mite structure paves way for identification of the genus and family characters. Aim of acarological drawing is accuracy rather than artistry, and simple line drawings often serve better than elaborately shaded. Using a Carl Zeiss Phase Contrast Microscope (Model: Axiostar Plus), all the mite specimens on permanent slides were closely examined for taxonomic identification. The dorsum, ventrum, legs, gnathosoma and other striking characters were drawn using a drawing tube. In this study, Zeiss drawing tube is used, which fits into the light path between the eyepiece and objective lens of a microscope. It contains a system of prism and mirrors so arranged that, by looking through it, both the object under the microscope and the paper on which the drawing is to be made and traced exactly the image could be seen through microscope. This is the ideal method of making drawings of mites attached to the insects. Elaborate projection can be obtained that will give magnifications ranging from 10 X to 100 X up to several hundred folds increase. Drawing was initially done on a tracing sheet with a pencil and inking was performed by means of rotting isograph (0.1mm to 0.6 mm). Then, the measurements of the important taxonomic structures of mite specimens were made with the help of a calibrated ocular micrometer and expressed in microns. Identification and fixing of the systematic position was undertaken with the help of all the available literatures. In the description, all the measurements made in this study have been reported in microns. Morphological and structural terminologies used in the description of various mite families are given in the appendices.

Voucher slides

The voucher specimens of this species in this paper have been retained in the collection curated by Radhakrishnan as mentioned in the deposition of type material in Department of Agricultural Entomology, Acarology Lab, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Abbreviations

Different abbreviations used in the description are as follows: aGe- anterior genital sclerite; pGe - posterior genital sclerite; α_1 , α_2 , α_3 - enclosed angles of pGe; b - anterior margin of ge; I - length of genital sclerite; s1 and s2 - lateral margins of pGe; ap - apodeme; Co- Coxa; Tr - trochanter; Fe - femur; Ge - genu; Ti - tibia; Ta - tarsus; TiTa - tibiotarsus; sol - solenidion; about the same length < - shorter than; > - longer than; = the same length.

Measurements

All the terminology followed ^[19] in this studied. All the measurements are given in micrometers (μm).

Results and Discussion

Imparipes bengalensis sp. nov.

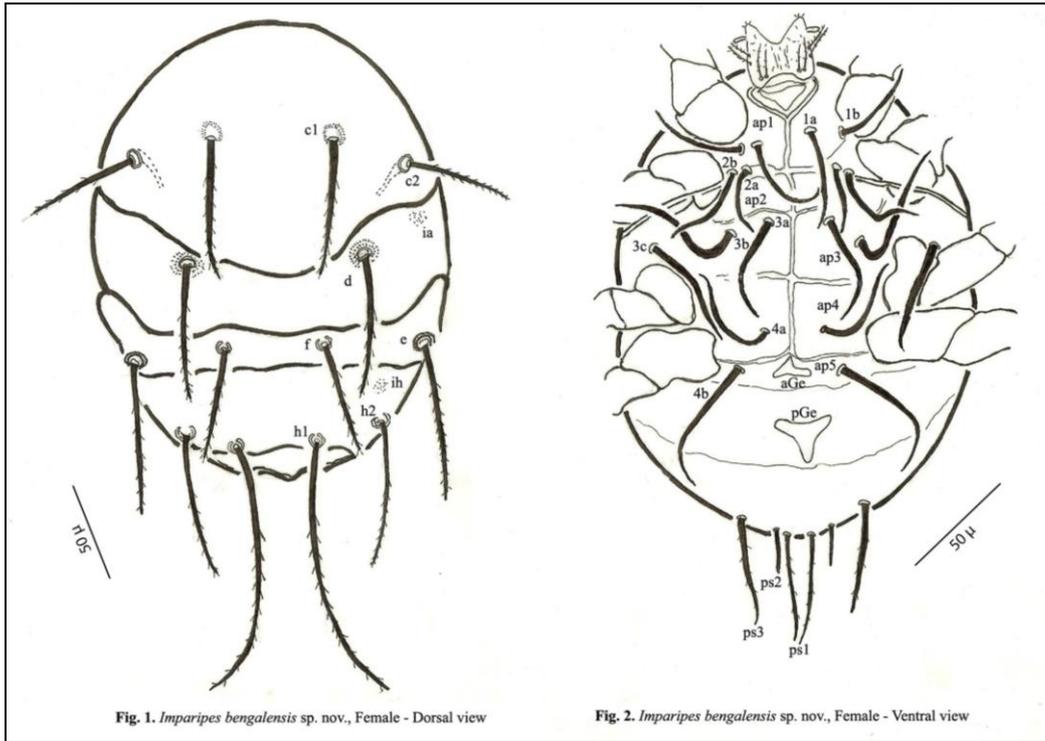


Fig. 1. *Imparipes bengalensis* sp. nov., Female - Dorsal view

Fig. 2. *Imparipes bengalensis* sp. nov., Female - Ventral view

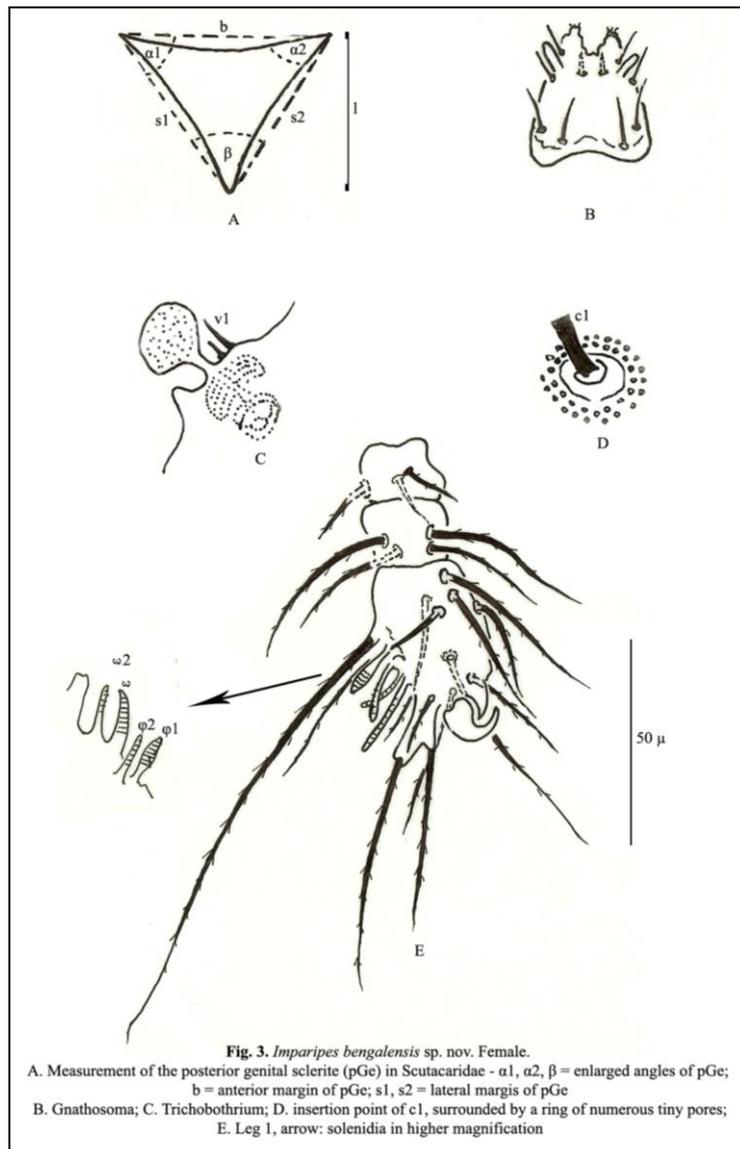


Fig. 3. *Imparipes bengalensis* sp. nov. Female.

A. Measurement of the posterior genital sclerite (pGe) in Scutacaridae - α_1 , α_2 , β = enlarged angles of pGe; b = anterior margin of pGe; s1, s2 = lateral margins of pGe
 B. Gnathosoma; C. Trichobothrium; D. insertion point of c1, surrounded by a ring of numerous tiny pores;
 E. Leg 1, arrow: solenidia in higher magnification

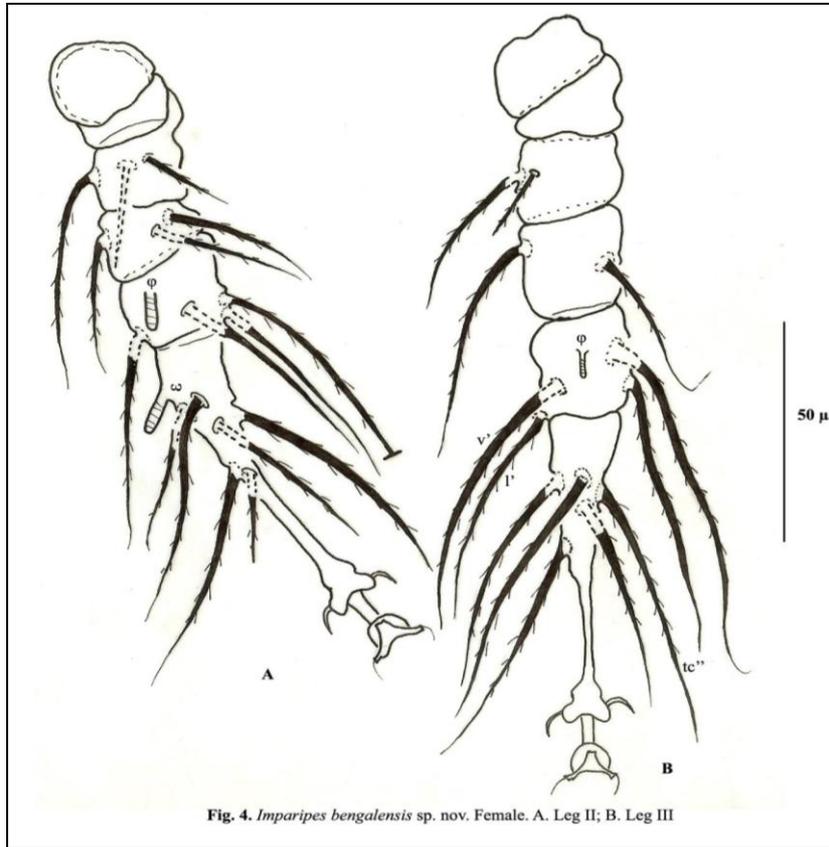


Fig. 4. *Imparipes bengalensis* sp. nov. Female. A. Leg II; B. Leg III

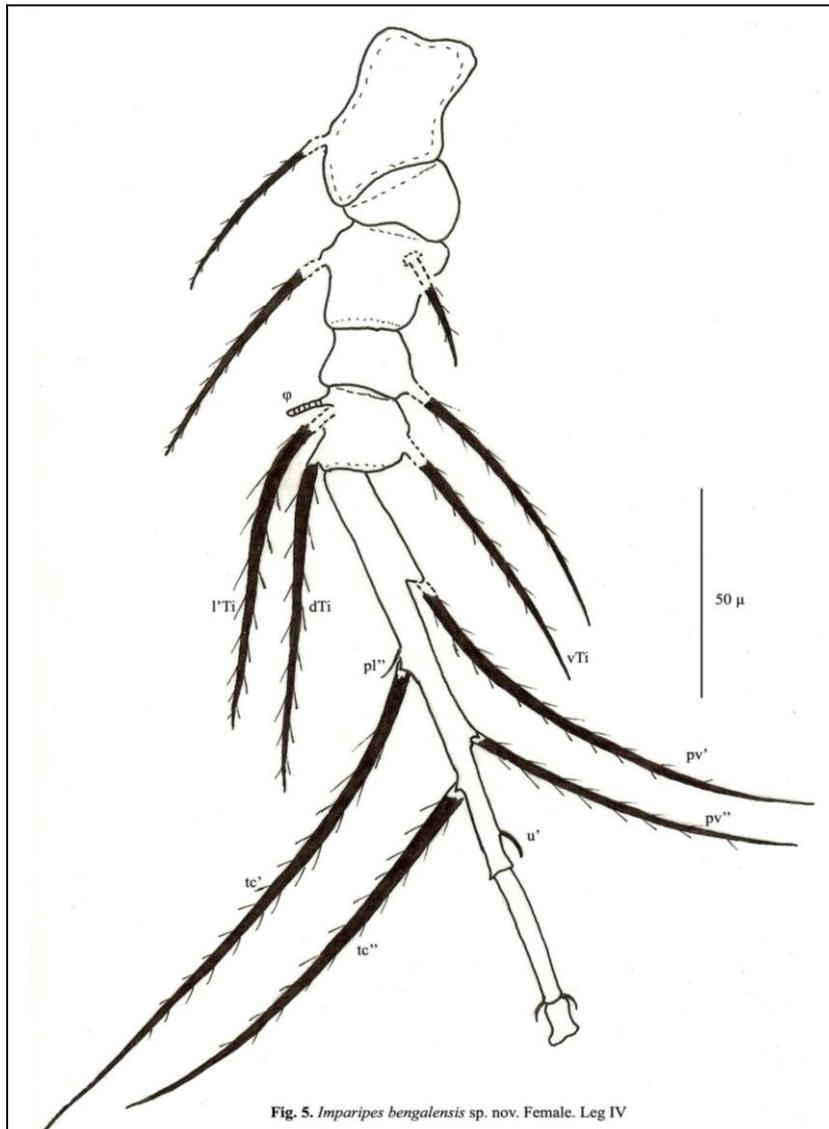


Fig. 5. *Imparipes bengalensis* sp. nov. Female. Leg IV

Body dimension

Idiosoma length 186 and width 155 measured from the widest part of the plate. Entire surface of body with tiny pores, cupulae ia and ih round. Free margin of tergite C broad; insertion points of c1 and d surrounded by a ring consisting of numerous tiny pores.

Body setation

Length of some dorsal setae slightly variable. Dorsal setal pattern entirely differ from the ventral setae i.e., barbed setae and simple setae, respectively.

Female dorsum

Insertion point of c1 with a ring of tiny pores and it measures 65 and c2 (53) with long alveolar canal; Setae d=65; f=53, e=60, h₁=100, h₂=65; hi>c1=d=h2>e>c2=f.

Venter

Apodeme 1, 2 and 3 well developed, ap 4 and ap5 reduced. All the ventral setae simple, with exception of posterior setae ps1 and ps3 very sparsely barbed. Length of setae 1a, 1b, 2a, 2b, 3a, 3b, 3c, 4a and 4b are 35, 32, 31, 37, 39, 51, 41, 43 and 51, respectively. 4b=3b>4a>3c>3a>2b>1a>1b>2a. Posterior setae ps1, ps2 and ps3 are 43, 16 and 45, respectively. Setae 3b and 4b are longer among the ventral setae and Ps₂ is tiny. ps3>ps1>ps2

Posterior genital sclerite (pGe)

Ventral surface smooth and slightly sclerotised. Its anterior margin (b) runs without any transition in to the anterior margin of segments PS; Measurements of pGe: b > s1 and s2; I < b; β > α1 and α2.

Trichobothrium

Club shaped, thin stemmed, with fine scales, outer setae v1 relatively short, longer than v2.

Gnathosoma

Gnathosoma 28 long and 25 wide. Palp with four pairs of setae and one pair of ventral setae; one pair of solenidia visible, 5 long.

Legs: Relative length: Leg I < Leg II < Leg III < Leg IV.

Leg I

Setal formula: Fe 3, Ge 4, TiTa 16 (4 sol); Relative length of sol: ω₂<ω₁>φ₂<φ₁

TiTa with well-developed claw, tip of claw elongated. Leg I measures 78 long.

Leg II

Setal formula: Fe 3, Ge 3, Ti 4 (sol φ), Ta 6 (2 sol ω); sol ω > φ; ω- finger shaped, free; φ - partly embedded. Ta with 2 claw and empodium. Leg II measures 138 long.

Leg III

Setal formula: Fe 2, Ge 2, Ti 4 (sol φ), Ta 5; Ta with 2 claw and empodium. Leg III measures 158 long.

Leg IV

Setal formula: Co 1, Fe 2, Ge 1, Ti 3 (sol φ), Ta 4; relative length of tibial/tarsal setae: tc'>pv'>tc''>dTi=I,Ti>pv''>u'; u' tiny. PrTa with 2 tiny claw and empodium. Leg IV measures 213 long.

Male and Larva: Unknown.

Types

A holotype female marked on slide INDIA: Tamil Nadu, Mettupalayam, 31.X.2006. Eg: *Labidura bengalensis* Dohrn (Forficulidae: Dermaptera), Coll: V. Radhakrishnan, (No: 2006-179/1). Two paratype slides with female, collection data same as type.

Etymology

The species "*bengalensis*" refers to the insect host species.

Type locality: Mettupalayam, Tamil Nadu, India.

Relationship to the host

The orange coloured mites found attached to the forewing of the earwig. It is presumed to be phoretic in nature.

Diagnosis

This new species *Imparipes bengalensis* sp. nov. is closely related to *Imparipes (Imparipes) louisianae* and *Imparipes haeseleri* in most of the character, but can be differentiated by the absence of coxal setae in I - III legs and trochanter setae in all the legs as against one trochanter setae is in *Imparipes (Imparipes) louisianae* and *Imparipes haeseleri* in all the legs. All the ventral setae are simple except ps1 and ps3 (sparsely barbed) in the new species, but it differs with *I. louisianae* by the presence of sparsely barbed setae, except 2b and ps2. Presence of 5 setae in Ta in Leg III in the new species as against 6 in *I. louisianae* and *I. haeseleri*.

Setae c I short and very thin, smooth; c2 much longer and thicker, with only a few barbs in *Imparipes pselaphidorum*, In contrast with the present study, the setae c I was barbed and measured about 65 μm in the dorsal side.

Smooth and short setae was observed in *Imparipes bengalensis* in the ventral region, whereas barbed, smooth and dagger shaped setae was observed in *Imparipes pselaphidorum* and *Imparipes latispinus*.

Dorsal setae d is barbed and long in *Imparipes bengalensis* sp. nov., whereas d is stout and smooth *Imparipes latispinus* The new species differs the following features as against *Imparipes pselaphidorum* and *Imparipes discordens*.

<i>Imparipes bengalensis</i> sp. nov.	<i>Imparipes discordens</i> Mahunka, 1972	<i>Imparipes pselaphidorum</i> Ebermann, 1988
Setae c2 without hair tube	c2 without hair-tube	Setae c2 with hair-tube
Setae hi>c1=d=h2>e>c2=f	Setae e> h2>/>hl > d	Setae e> h2>/>d>hl
Setae ps2 tiny and smooth	ps2 long, barbed	Setae ps2 tiny, smooth
Trichobothrium distal with fine barbs	Trichobothrium distal smooth	Trichobothrium distal with fine barbs
Trochanter IV short, compact	Trochanter IV longer and slender	Trochanter IV short, compact
Tarsus IV with 4 setae	Tarsus IV with 5 setae (q are not present)	Tarsus IV with 6 setae

Imparipes bengalensis was differs from the above said characters, it clearly shows that it is a new species. Moreover,

it is reported for the first time in *Labidura bengalensis* Dohrn in India and the potential hosts are also unknown.

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