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IMPARIPES (IMPARIPES) TOCATLPHILUS N. SP. (ACARI, TARSONEMINA, SCUTACARIDAE) FROM MEXICO AND BRAZIL: FIRST RECORD OF RICINULEIDS AS PHORESY HOSTS FOR SCUTACARID MITES

by Ernst EBERMANN & José G. PALACIOS-VARGAS

ABSTRACT: The female of Imparipes (I.) tocatlphilus n. sp. is described. Male and larva are unknown. The new species was discovered in two Mexican caves (Guerrero State), both in soil and guano and upon the Ricinuleid Cryptocellus boneti. This is the first demonstration of ricinuleids as phoresy host for scutacarids. Further findings in southeast Brazil indicate that the new species is widely distributed in the Neotropical Region.

RESUMEN: Se describe la hembra de Imparipes (I.) tocatlphilus n. sp. Se desconocen aún el macho y la larva. Esta nueva especie fue descubierta en dos grutas mexicanas (Estado de Guerrero), tanto en suelo y guano como sobre el ricinulido Cryptocellus boneti. Esta es la primera ocasión que se registran ricinulidos como huéspedes de escutacáridos foréticos. Datos adicionales del sureste de Brasil indican que esta nueva especie está ampliamente distribuida en la Región Neotropical.

INTRODUCTION

Recent studies of fauna from Mexican caves provided plentiful arthropod material, including a number of new species (PALACIOS-VARGAS 1981; PALACIOS-VARGAS et al., 1985). There were also scutacarids among the Acari found, which is remarkable in that of the some 130 species known from the Neotropis, only six from Mexico have been reported or newly described. These are Scutacarus athiashenrioti Mahunka, S. tazolteotli Storkán, Imparipes (I.) apicola (Banks), I. (I.) liome-topi Mahunka, I. (I.) mexicanus Delfinado & Baker and I. (T.) opisculus Mahunka.

The present article describes a new Imparipes species found by the junior author in soil samples and guano from caves in Mexico, as well as on Cryptocellus boneti (ordo Ricinulei), collected in the same biotope. Soil samples collected in Brazil by Prof. Dr. R. SCHUSTER and Dr. U. KRASSER (both Graz) and given to the senior author for examination provided further scutacarid material that proved to belong to the new species. For this reason, details on the intraspecific morphological variability of the new species can be given.

1. Institut für Zoologie der Universität, Universitätsplatz 2, A-8010 Graz, Austria.
2. Laboratorio de Acarología, Departamento de Biología, Facultad de Ciencias, UNAM, 04510-México, D.F.

LOCALITIES

Mexico

Me-1: Acuitlapan cave (Guerrero State), soil and guano, 26 May 1979, coll. J. Palacios-Vargas.
Me-2: As above, 12 December 1981.
Me-4: As above, 18 February 1983.

Brazil

(Samples numbers preceded by BP, BR or BS were collected by R. Schuster, and those by B-KR by U. Krasser).

a) State São Paulo

BS-28: Serra do Mar, region Serra da Caraguatatuba, near road between Caraguatatuba and Paraíbuna, rain forest, soil sample includes litters, 17 July 1960.
BS-33/35: Same forest, about 40 meters distant from above site. Date as above.
BR-228/230: Sao Roque, about 40 km W of São Paulo, forest, soil sample includes litter, 25 November 1960.
BP-07: Repreza Santo Amaro near São Paulo, forest, soil sample includes litter, 24 July 1960.
BP-09: Same forest, about 100 meters distant from above site, same date.
B-KR 2/a: Palmelirinha, SW of São Paulo, BR 116 in the direction of Curitiba at km 38, soil litter, 1 April 1979.
B-KR 2/b: Site and date as above, soil sample with humus and litter.
B-KR 2/c: Site and date as above.

b) Rio de Janeiro

BR-128: Alto de Boa Vista, forest, soil sample includes litter, 23 August 1960.

DESCRIPTION

Imparipes (Imparipes) tocat philus n. sp. (Fig. 1-5)

Female

Measurements in \( \mu m \) of the type material from Mexico: Body length 197-244 (average of 7 specimens 222), holotype 244; body width measured from the posterior margin of the clypeus 162-200 (average of 7 specimens 179), holotype 197; anterior width of the posterior sternal plate 95-117 (average of 7 specimens 109), holotype 117.

Measurements in \( \mu m \) of material from Brazil (body length, body width, anterior width of the posterior sternal plate): Sample BS-28, 2 \( \varphi \): 240, 186, 108; 250, 187, 106. BS-33/35, 2 \( \varphi \): 258, 204, 109; 240, 168, —. BP-07, 1 \( \varphi \): 282, 216, 124. BP-09, 1 \( \varphi \): 324, 246, 131. BR-128, 1 \( \varphi \): 266, 187, 110. BR-162, 7 \( \varphi \): 192-324 (average of 6 specimens 274), 152-237 (average of 6 specimens 203), 90-125 (average of 7 specimens 112). BR-228/230, 2 \( \varphi \): 330, —, 126; 342, 240, 137. BR-242, 1 \( \varphi \): 258, 186, 105. B-KR 2a, 2 \( \varphi \): 312, 234, 130; 300, 204, 118. B-KR 2b, 2 \( \varphi \): 258, 228, 125; 276, 222, 130. B-KR 2c, 1 \( \varphi \): 240, 192, 133.

Dorsum (Fig. 1 a): Setae \( c1 \) and \( c2 \) well developed, nearly of the same length, sparsely barbed; \( c2 \) with hair tube. Setae \( f > h1 \approx d > e \approx h2 \), all barbed. Posterior margin of tergits \( C, D \) and \( EF \) smooth or scalloped; posterior margin of tergit \( H \) wavy. Cupulae \( ia \) and \( ip \) rounded or ovate.

Venter (Fig. 1 b): Apodemata I and II strongly developed, complete; apodeme III weakly; apodeme IV attains about half the width of the posterior sternal plate; apodeme \( V \) not present. Setae \( 1a, 1b \) and \( 2a \) barbed, \( 2b \) smooth and dagger shaped. Setae \( 3a \) and \( 3b \) of the same length, \( 3c \) shorter but sometimes thicker, all barbed. Setae \( 4a \) inserted before \( 4b \), \( 4b \) longer and thicker than \( 4a \), sometimes \( 4a \) reach the posterior edge of the body or extend beyond it, \( 4c \) about the same length as \( 4b \), but thicker, all barbed. Setae \( ps1 \) and \( ps3 \) about the same length and thickness, barbed, \( ps2 \) short, thin and smooth.

Body surface of dorsum and venter finely stippled; free margin of clypeus with fine, longitudinal stripes.

Trichobothrium (Fig. 2 a): Thin-stemmed, club-shaped, distal with fine barbs, the anterior bothridial seta strong.

Gnathosoma (Fig. 2 b, 2 c): Dorsal with three pairs of setae, the outer pair is the shortest; palps with two setae each. Ventral with two setae and two pairs of solenidia, the median pair stamplike, the outer pair club-shaped.
FIG. 1: *Imparipes tocatphilus* n. sp. ♀ (holotype). — a) Dorsal side, b) Ventral side; body length 244μm.

Leg I (Fig. 2 d, 2 e): Claw of tibiotarsus distal with thin, hair-like tip. Of the 4 solenidia $\varphi$2 are the stoutest, $\omega$2 and $\omega$1 are variable in length and thickness (see below). Formula of setae: trochanter 1, femur 3, genu 4, tibiotarsus 16.

Leg II (Fig. 2 f): Formula of setae: trochanter 1, femur 3, genu 3, tibia 4, tarsus 6. Tibia and tarsus with one solenidion each, of these, the tibial one is shorter and thinner. Tarsus with two claws and empodium.

Leg III (Fig. 2 g): Formula of setae: trochanter 1, femur 2, genu 3, tibia 4, tarsus 6. Tibia with a slender solenidion, tarsus with two claws and empodium.

Leg IV (Fig. 2 h): Formula of setae: trochanter 1, femur 2, genu 1, tibia 3, tarsus 5. Tibia with very long and thin solenidion. Tarsal seta $q$ very reduced, only sometimes recognizable as a tiny tip; seta $r$ well developed; $t$ extends to the distal part of the praetarsus. Praetarsus with empodium and two claws, these as well as the tibial solenidion are variable in length (see below). Relation in length between tarsus and praetarsus = 1 : 0.70-0.79 (material from Mexico) and 1 : 0.67-0.81 (material from Brazil).

Male and larva: Unknown.

**Variability of examined material**

The body and leg setae are very uniform as to length and thickness in the animals from the compared Mexican and Brazilian populations. The positions of the ventral setae 4a and 4b, however, are variable, sometimes even among animals from one population (Fig. 3 a-3 e).

The outline of the gnathosoma varies from triangular to nearly rectangular. The outer gnatho-
FIG. 2: *Imparipes tocatphiulus* n. sp. ♀. — a) trichobothrium, b) gnathosoma, dorsal, specimen from Mexico, c) gnathosoma, ventral, specimen from Brazil, d) leg I, ventrolateral, e) leg I, dorsolateral, f) leg II, g) leg III, h) leg IV.
The somal solenidia pair is always longer in animals from Brazil than in those from Mexico, and is bent backward (Fig. 2 b, 2 c).

![Diagram of setae positions]

**Fig. 3**: Examples of the variability in the positions of setae 4a and 4b in relation to each other; insertions of the respective animals are connected by lines; a-c, sample Me-2; d-e, sample BR-162.

Fig. 4 shows the relative length of solenidia \( w_2 \) and \( w_1 \) (leg I) via the length ratio \( w_2 : w_1 \). The specimens of samples Me-1, Me-2 and BR-162 show a wide range with regard to this characteristic. A morphological series from \( w_2 > w_1 \) to \( w_2 < w_1 \) can be arranged. With \( w_2 \approx w_1 (\bar{x} = 1 : 0.97) \), the Mexican material is in the middle of the series. Fig. 4 also shows that for the values for \( w_2 : w_1 \), there is a distinct hole between \( 1 : 1.10 \) and \( 1 : 1.70 \), but no definite conclusions can be drawn from this fact owing to the small number of animals examined.

There is little variability among the solenidia \( \varphi_2 \) and \( \varphi_1 \) (leg I) in all animals examined; \( \varphi_2 \) is always longer and thicker than \( \varphi_1 \).

The length of the tibial solenidion \( \varphi \) (leg IV) varies remarkably. This is shown in fig. 5 with the length ratio of tarsus IV to \( \varphi \). For the Mexican material it is \( 1 : 0.63 \) to \( 0.98 \), and for the Brazilian, \( 1 : 0.51 \) to \( 1.11 \). Samples rich in individuals show great variation in length, e.g. \( 1 : 0.63 \) to \( 0.90 \) (samples Me-1, Me-2) or \( 1 : 0.51 \) to \( 0.67 \) (sample BR-162). Individual populations cannot be systematically differentiated on the basis of mutually exclusive minimum-maximum values, e.g. \( 1 : 0.51 \) to \( 0.67 \) (BR-162) and \( 1 : 1.05 \) to \( 1.11 \) (BS-28), as the different populations include animals representing intermediate forms of this characteristic and permitting the establishment of an uninterrupted morphological series (Fig. 5). With increasing length of \( \varphi \), the insertion of seta \( t \) "slips down" toward the distal end of the tarsus; the relative length of \( t \), however, remains constant as it always reaches or slightly exceeds the distal end of the praetarsus.

There is a significantly high correlation (correlation coefficient = 0.82) between the length ratio \( w_2 : w_1 \) and the length of the tibial solenidion \( \varphi \). As \( \varphi \) increases in length (shown in fig. 4 as ratio \( Ta : \varphi \)), \( w_2 \) becomes shorter; the latter is shown in the increase in the value of \( w_2 : w_1 \). The values for \( Ta : \varphi \) reach a maximum of \( 1 : 1.11 \). The animals from three Brazilian populations (B-KR 2a, B-KR 2b, BS-33/35) show a greater shortening of \( w_2 \) along with a lengthening of \( w_1 \), leading to an increase in the value of \( w_2 : w_1 \) up to \( 1 : 1.94 \).

The length of the claws on leg IV is distinctly greater in the Mexican than in the Brazilian material. In the Mexican animals it is 22-29 % of the praetarsal length, in the Brazilian animals 8-22 %. Fig. 5 shows the resultant claw forms (thornlike to elongated with a hairlike extended tip). The length of the claw does not show any correlation with any other characteristic.

**SYSTEMATIC POSITION OF THE NEW SPECIES**

Ebermann (1988) indicated the relative lack of distinguishing characteristics in most *Imparipes* species and the consequent difficulty in telling them apart. *Imparipes tocatisphilus* is also a member of this group with few relevant distinguishing characteristics at the species level. Among the species with five tarsal setae on leg IV, *Imparipes tocatisphilus* is characterized by an unusually long tibial solenidion \( \varphi \). This characteristic is also found in less extreme form in *Imparipes (I.) longinquis* Mahunka, 1969 (Bolivia), *Imparipes (I.) diminutarsus* Ebermann,
1984 (Brazil, sample number B-KR 2) and Imparipes (I.) indicus MAHUNKA, 1975 (India). The new species differs from I. longiunguis in that it has hair tubes (c2) and a different form of the praetarsus IV and its claws. The new species differs from I. diminutarsus in its differing form of tarsus IV and of solenidion ω2. Imparipes tocatphilus differs from I. indicus in its hair tubes (c2), its well-developed apodema II and in the length ratio from ps1 to ps2.

Fig. 4: Correlation between the relative length of the tibial solenidion ϕ (leg IV) and the relative length of solenidia ω2 and ω1 (leg I). For details see text. Each symbol corresponds to a single animal; mites from the same site have identical symbols. For better understanding, two extremes and one intermediate form (c) of the length ratio ω2 : ω1 are figured.
The general morphological agreement seems to justify classification of the above-mentioned material from Brazil as belonging to the new species. Further material will have to be examined to determine whether a division into subspecies of the Mexican and Brazilian material is justified on the basis of the morphological differences found (length of claws on leg IV, length of the outer gnathosomal solenidia).

**Source of material**

**Mexico**

Acuitlapán cave = Locus typicus (samples Me-1, Me-2) : 5 ♀♀ from soil and phoretic on the ricinuleid *Cryptocellus boneti*. Juxtlahuaca cave (samples Me-3, Me-4) : 2 ♀♀.

**Brazil**


**Deposition of the type material**

Holotype and 3 paratypes from Acuitlapán cave (samples Me-1, Me-2) and 2 paratypes from Juxtlahuaca cave (Me-3, Me-4) in collection of the Zoologisches Institut und Zoologisches Museum der Universität Hamburg (FRG); one paratype from the last mentioned locality in the collection of the junior author; 22 paratypes from Brazil in the collection of the senior author.

**Derivatio nominis**

"tócatl" (from the Nahuatl-language = spider) and "philus" (gr. = friend of) indicating the association of the new species to an arachnid.
Remarks on behavior of Imparipes tocatophilus n. sp.

In the laboratory the junior author observed that specimens of the new species attach to Cryptocel·lus boneti by the first pair of claws, mainly in the soft intersegmental integuments of legs. When the mites are perturbed, they move on the ricinuleid and seek another place on the body. When the ricinuleid dies, all the scutacarids leave the body and return to the soil.

DISCUSSION

The first demonstration of a phoresy relationship between ricinuleids and scutacarids is of special interest as arachnids have seldom been mentioned in the literature as transport hosts for species of the family Scutacaridae. Of the nine arachnid orders, this function is only known for the Acari; there are several species of Mesostigmata (Gamasina : Parasitus, Haemogamasus) whose deutonymphs serve as phoresy hosts for two species of the genus Scutacarus. At present, phoresy hosts for the genus Imparipes are known from six insect orders, but there are as yet no known arachnid phoresy hosts for Imparipes (EBERMANN, 1988). Neither Imparipes tocatophilus n. sp. nor the ricinuleid Cryptocellus boneti (see BOLIVAR y PIELTAIN, 1941) are strictly troglobiontic, but both species apparently also find satisfactory living conditions in caves, especially in guano. The phoresy relationship resulting from this association gives I. tocatophilus the chance to colonize new environments. This does not, however, explain the extensive distribution of the new species, as Cryptocellus boneti has so far been found only in Mexico (Guerrero State) and El Salvador (BECK & SCHUBART, 1968). Other species of the genus Cryptocellus have been found in Central America and South America into the Amazon basin; whether they play a role as phoresy hosts for I. tocatophilus is not known. Probably other arthropods, especially flying insects, must be taken into consideration as phoresy hosts. It has been demonstrated repeatedly that some phoretic Imparipes species are not very specific in their choice of host. A pertinent example is Imparipes histrionicus BERLESE. Female of this species have been found to choose as phoresy hosts not only different genera of ants but also beetles (Pselaphidae) and forficulids (PAOLI, 1911).

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