

## A new species of *Diplothyrus* (Parasitiformes: Neothyridae) from Brazil

Ma. Magdalena VÁZQUEZ<sup>1</sup>, Marcel Santos de ARAÚJO<sup>2</sup> and Reinaldo José Fazzio FERES<sup>3</sup>

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<sup>1</sup> Universidad de Quintana Roo, Division de Ciencias e Ingenierias, Chetumal, Quintana Roo, Mexico. [marvazqu@uqroo.edu.mx](mailto:marvazqu@uqroo.edu.mx)

<sup>2</sup> Programa de Pós-Graduação em Biologia Animal, Departamento de Zoologia e Botânica, IBILCE, Universidade Estadual Paulista (UNESP) Rua Cristóvão Colombo 2265, CEP 15054-000, São José do Rio Preto, SP, Brazil. [marcelsantosa@gmail.com](mailto:marcelsantosa@gmail.com)

<sup>3</sup> Departamento de Zoologia e Botânica, Instituto de Biociências, Letras e Ciências Exatas (IBILCE), Universidade Estadual Paulista (UNESP), Rua Cristóvão Colombo 2265, São José do Rio Preto CEP 15054-000, Brazil. CNPq – Brazil researcher. [reinaldo@ibilce.unesp.br](mailto:reinaldo@ibilce.unesp.br)

**ABSTRACT** — *Diplothyrus lehtineni* n. sp. is described from adults females and males collected on surveys in the Brazilian Amazon forest. Measurements and illustrations of both sexes are provided. The presence of two modified setae on the palp genu, the absence of fringed seta on the palp genu and the absence of complex branched outgrowths on the chelicera characterizes this species. A description of Haller's organ solenidia is also presented.

**KEYWORDS** — Acari; Holothyrida; Taxonomy; Neotropical

### INTRODUCTION

The suborder Holothyrida is a small group of mites including 13 genera and 27 described species arranged into three families, Allothyridae, Holothyridae and Neothyridae (Beaulieu *et al.* 2011), although a considerable larger species-level diversity is suspected, estimated to be between 160 and 320 species (Walter and Proctor, 2013).

Records of Neothyridae are limited to the Neotropical region, including *Neothyrus ana* Lehtinen 1981 from Peru, *Diplothyrus schubarti* Lehtinen 1999 from Brazil, *Caribothyrus barbatus* Kontschán & Mahunka 2004 from Dominican Republic and *Diplothyrus lecorrei* Klompen 2010 from French Guiana.

In Brazil, the Amazon forest is considered a biodiversity hotspot (Lewinsohn *et al.* 2005), but the distribution of many groups of mites, including

to Neothyridae, is still poorly known. The only recorded species is *D. schubarti*, based on a male collected from Amazonas state and females from Para state (Bernardi *et al.* 2011).

Material collected in a survey in Para state allows us to describe here a new species of this poorly known group.

### MATERIALS AND METHODS

#### Study area

The specimens were collected in Martírios-Andorinhas National Park, located in the municipality of São Geraldo do Araguaia, along the Araguaia river in the south of Pará state, Brazil (Figure 1). The Park is located in a transition area between the central Brazilian savanna, ecoregion Cerrado and the Amazon rainforest biomes, com-

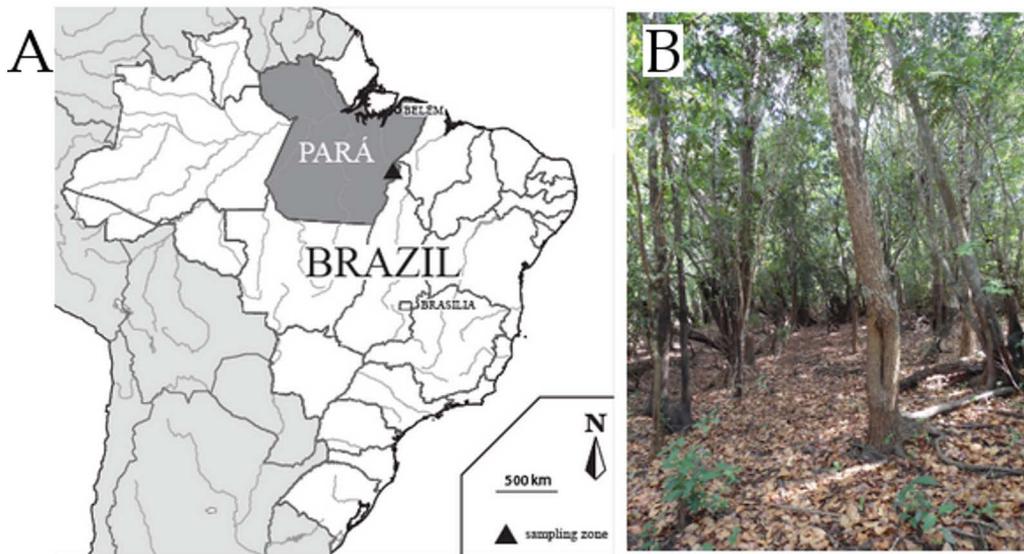


FIGURE 1: A — Brazil, Para State. B — The samplig area of the Martírios-Andorinhas National Park.

TABLE 1: Morphological measurements ( $\mu\text{m}$ ), minimum and maximum, of *Diplothyrsus lehtineni* n. sp.

	Female	Male
Idiosomal length	1851-2400	1852-2410
Idiosomal breadth	1257-1430	1230-2250
Palp total length	655-840	680-760
Thon's organ	170-290	200-270
Peritreme	750-850	730-870
Subcapitulum width	287-340	275-307
Chelicera, total length	1380-1630	1270-1480
Genital opening, length	500-600	110-150
Genital opening, width	550-650	160-170
Anal opening, length	140-200	110-180
Anal opening, width	80-130	60-110
Leg I	1700-2230	1730-2090
Leg II	1400-1740	1410-1700
Leg III	1140-1890	1460-1738
Leg IV	1850-2350	1860-2230

posing mosaic ecotones with high biological diversity (Gorayeb *et al.* 2008). The Cerrado is a vegetation type of greater extent in Martírios-Andorinhas National Park, occupying over 80 km<sup>2</sup>. The second most important vegetation of region is the lower

montane forest, found on the slopes and tops of mountains, and may occupy altitudes greater than 400 m, commonly interspersed with the Cerrado (Amaral *et al.* 2008).

## Methods

The specimens were collected by Winckler extraction from litter and preserved in 70 % ethyl alcohol. The specimens were cleared in lactic acid, washed with distilled water, dissected and legs, infracapitulum, dorsal and ventral idiosoma and genital plates were mounted in Hoyer's medium on multiple slides.

Description and drawings were done with the aid of a Leica DM2500 phase contrast microscope equipped with a drawing tube. Uncoated specimens were also studied and photographed using a Scanning Electron Microscope (SEM, FEI Quanta 250) in environmental mode (ESEM). Measurements were taken using an ocular micrometer and are presented in micrometers ( $\mu\text{m}$ ) (Table 1).

## Nomenclature

The nomenclature of setae and other morphological characters follows that of Hammen (1961).

Specimen depository abbreviations: DZSJRP: Acari Collection of the Department of Zoology and Botany, Universidade Estadual Paulista (<http://www.splink.cria.org.br>), São Paulo, Brazil; MPEG: Museu Paraense Emílio Goeldi, Pará, Brazil.

## RESULTS

### Family Neothyridae Lehtinen 1995

#### Genus *Diplothyrys* Lehtinen 1999

Type species: *Diplothyrys schubarti* Lehtinen 1999

#### *Diplothyrys lehtineni* n. sp. (Figures 2-6)

Differential diagnosis — Thon's organ with 2 orifices inserted parallel to dorsal shield border, similar as in *D. schubarti*, but with two big and conspicuous membranous structures like funnels. Tibio-tarsus with 6 modified serrated setae (5 inserted in line, plus 1 lateral). Two modified serrated setae on palp genu, but neither of them like the modified setae present on that of *D. schubarti*. Chelicera without complex branched outgrowth. Leg I with Haller's

organ composed of a group of 7 highly modified sensillae.

**Description.** Females (N=7), males (N=7).

Idiosoma — Dark brown, well-sclerotized, in shape of a large dome, with numerous long, serrated, terminally acute setae. Dorsal shield with light reticulation interrupted by numerous shallow, round indentations. Two pairs of dorso-lateral orifices (Thon's organ), the posterior orifice larger, surrounded by an ornamented funnel, the anterior one with an inverted funnel under the cuticle; both orifices are connected by a cuticular strip, inserted parallel to the dorsal shield margin (Figures 2A, 5B and 5D). Ventral shield lightly granulate; with reticulate patterning around genital plate in male. Peritremes well-developed, at the lateral border of the dorsal shield (Figures 2B, 5A and 5C), extending as a patch of papillate cuticle (Figures 2B, 5A and 5C) from anterior to coxa I to coxa IV. Stigma inserted beyond level of coxa III, in peritrematal area (Figure 5C) which is extended between coxa I to coxa III.

Gnathosoma — Deutosternum well developed with numerous small teeth. Cuticular patterning limited to papillate zones on each side of deutosternum (Figures 5C-D).

Subcapitulum (Figures 2C-D) with 8-11 setae (males with 8, females with 11), hypostomal lobes with two median long setae. Corniculus horn-like inserted dorso-lateral. Lateral lips well developed with numerous small projections. Labrum well developed. Chelicera (Figures 3A-B) well developed, 2 basal segments without setae; fixed digit with a small seta. Movable digit with one large tooth, a large terminal hook and numerous small, median teeth; fixed digit with two large and numerous small teeth. Membranous outgrowth not present, chelicerae covered by a membranous structure (Figure 3A-B).

Palp (Figures 3C-D) — Trochanter with 2 setae, one with a bifurcate tip; femur with 20-21 setae and papillate cuticle; genu with 8-10 setae, two of them wide and serrate, the others acuminate; tibia with 60 curved, simple setae, and two *al* serrated setae, 6v strong and serrated setae and one sensilla. The modified setae on the genu are like a doubled setae, with serrated border (Figure 3D).

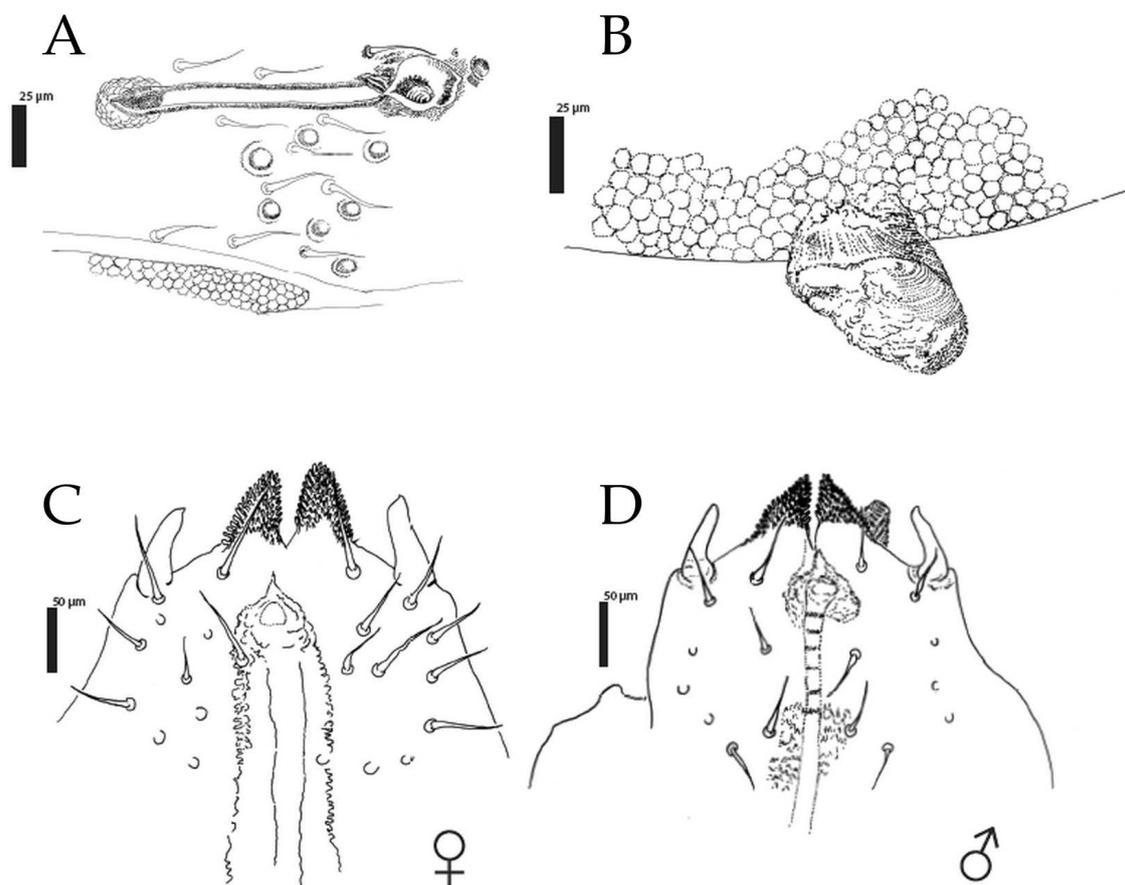


FIGURE 2: *Diplothyryx lehtineni* n. sp.: A — Detail of the Thon's organ and the internal connection by the membranous funnel; B — Detail of the peritreme and stigma; C — Subcapitulum of the female; D — Subcapitulum of the male.

Genital region (Figures 3E-G and 5E-F) — Sternal lyrifissures not observed. Female genital shields include four plates (Figures 3E-G and 5E): progenital valve (*pgv*) with 15-16 acuminate setae (Figure 3E); two laterogenital valves (*lgv*) (Figure 3F) with 4 setae each, large trapezoid mesogenital valve (*mgv*) with numerous acute setae (Figure 3G). Under mesogenital valve a globose hyaline sac with long slim channels is visible and interpreted as a part of the ovipositor. One female was observed with two eggs. Male genital area (Figures 4A and 5F) consisting of two plates positioned between coxae IV, anterior one with 17-18 large, lanceolate setae and posterior one without setae but with papillate cuticle. Males with distinct epiandrum.

Anal region (Figures 4B-C) — Each anal plate with large and acute setae, 9 in females (Fig. 4B) and 10 in males (Fig. 4C).

Legs (Figures 4D-F and 6A-B) — Leg I Haller's organ (Figures 4D-E and 6A-B) in the distodorsal part, comprising seven sensillae (Figure 4D-E). All legs with a distinct basifemur. Leg I without acro- or basitarsus. Leg setation on all segments based on whorls of 8 or 9 setae each. Tarsus I: The subterminal Haller's organ is in a depression with dense cluster of highly modified sensillae (Figure 4D). Pretarsus I with almost sessile claws (Figure 4E); pretarsi II-IV (Figure 4F) with an ambulacral stalk carrying 1 pair of small setae, with well developed claws, and a large empodium.

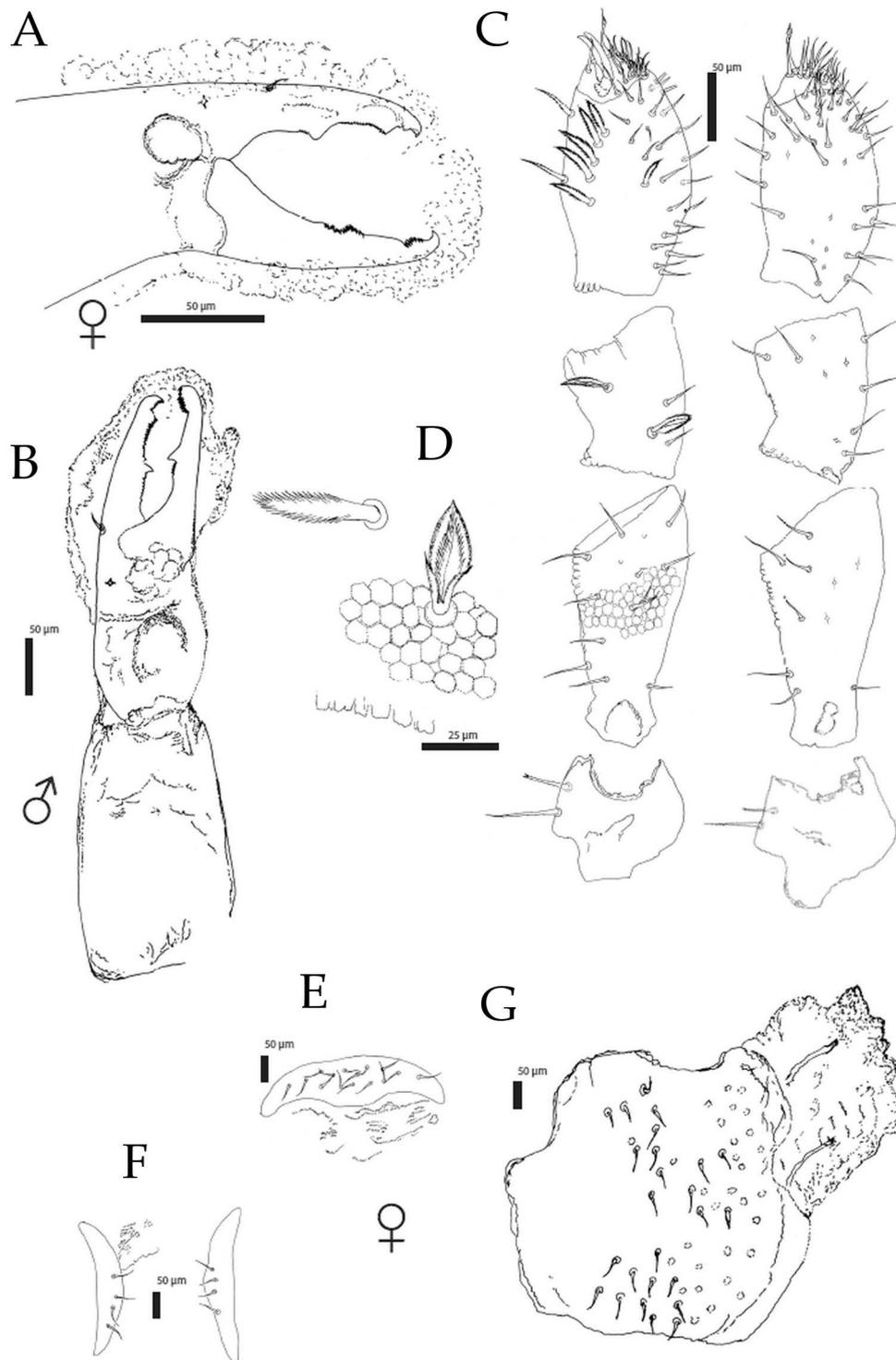


FIGURE 3: *Diplothyrys lehtineni* n. sp.: A — The chelicera, right side, lateral view, detail with visible hyaline membrane; B — whole chelicera; C — The palp, antero and posterodorsal views; D — Detail of the modified setae of the genu; E — Female anterogynal plate; F — laterogynal plate; G — mesogynal plate.

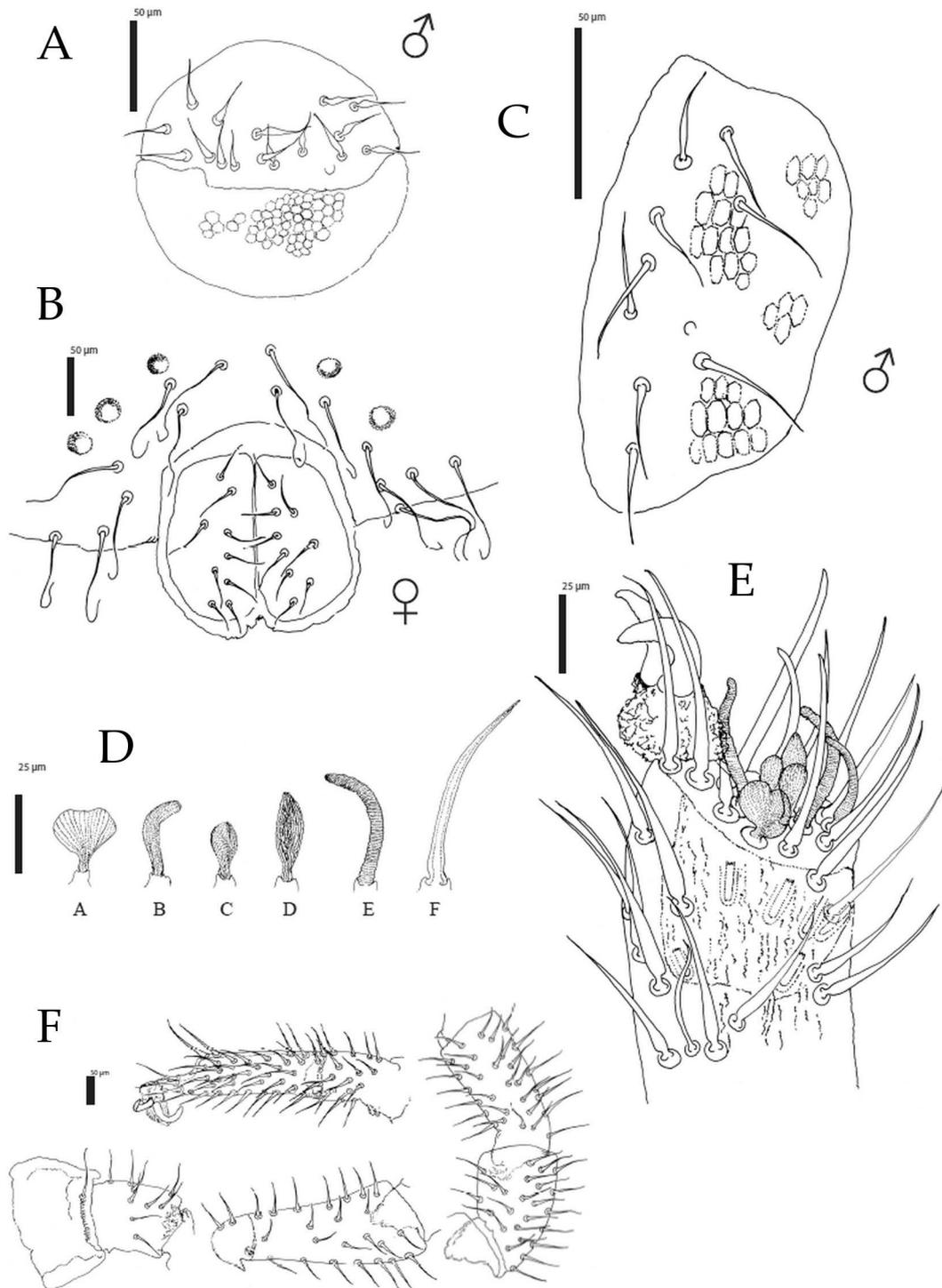


FIGURE 4: *Diplothyrys lehtineni* n. sp.: A – male genital plates; Anal plates: B – female; C – male; D – Set of modified sensillae (Haller's organ); E – Leg I tips of the female; F – Leg II male.

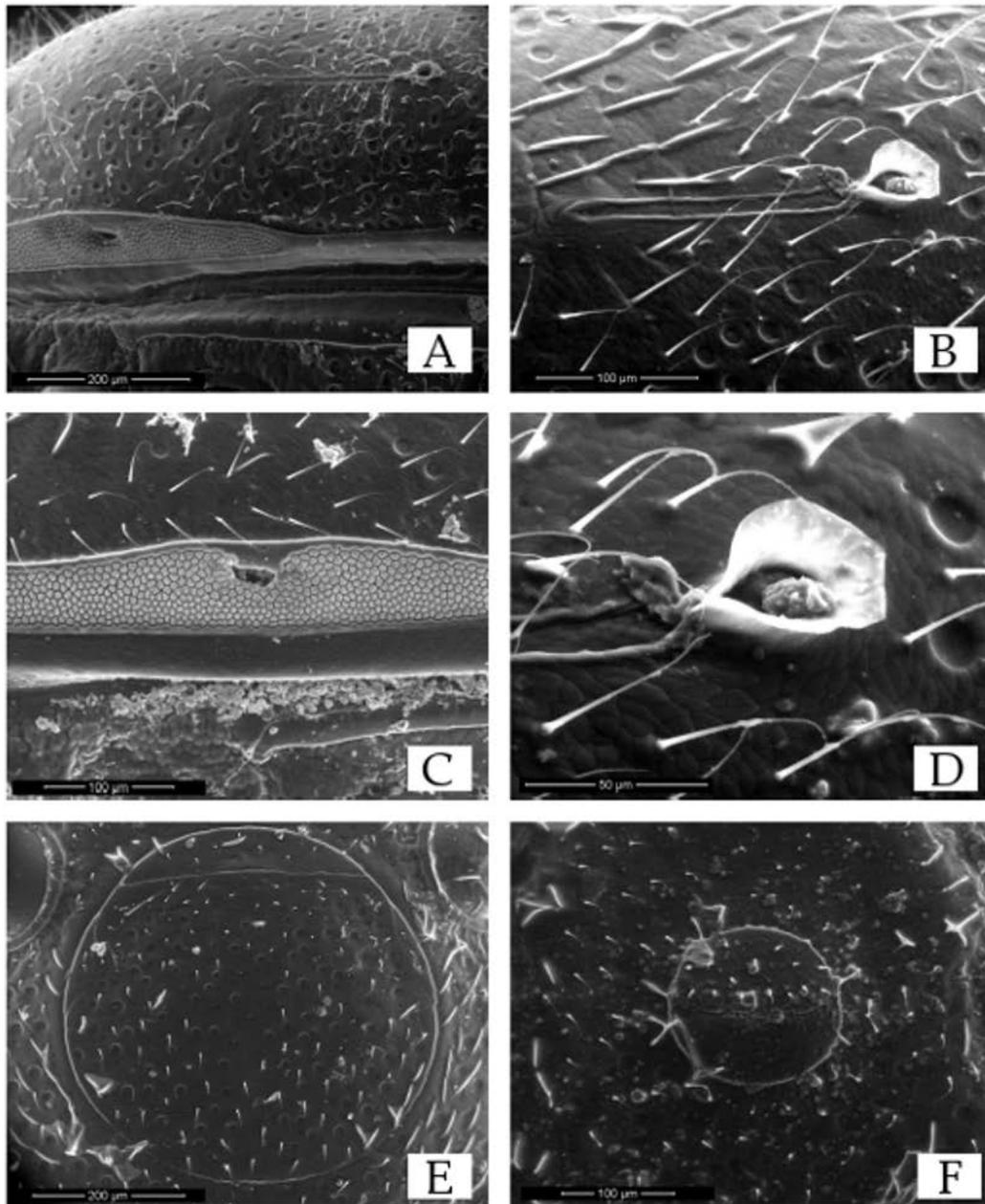


FIGURE 5: *Diplothyrus lehtineni* n. sp. SEM images: A – Thon's organ, peritreme and stigma; B – Thon's organ; C – detail of peritreme and stigma; D – details of funnel structure of Thon's organ; E – female genital plates; F – male genital plates.

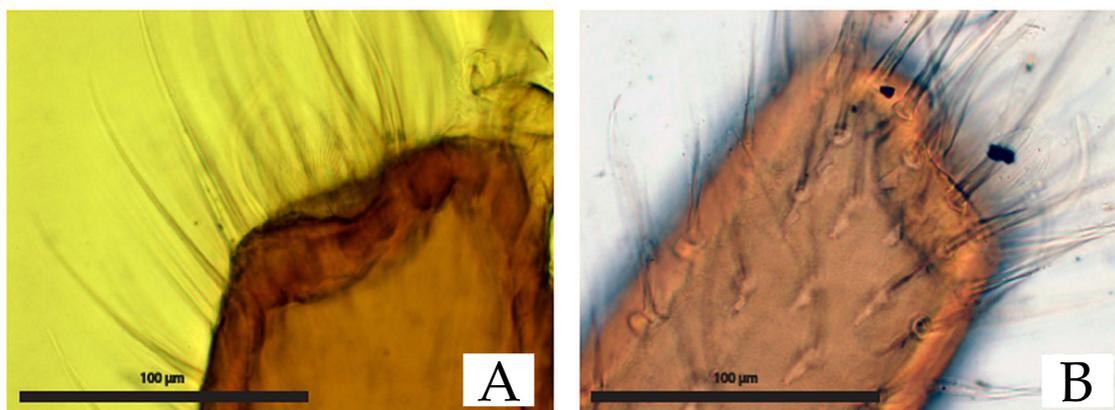


FIGURE 6: *Diplothyrys lehtineni* n. sp.: A-B – Phase contrast images of Leg I tip and Haller's organ

#### Holotype and male paratype measurements (Table 1)

Female: Idiosoma. Length 1851, width 1257. Palps (total length 655), trochanter 77, femur 213, genu 145, tibiotarsus 218. Leg I (total length 2009), coxa 167, trochanter 200, femur 495, genu 286, tibia 362, tarsus 498. Leg II (total length 1624), coxa 138, trochanter 212, femur 357, genu 235, tibia 265, basitarsus 157, telotarsus 257. Leg III (total length 1710), coxa 137, trochanter 214, femur 384, genu 253, tibia 276, basitarsus 164, telotarsus 279. Leg IV (total length 2192), coxa 127, trochanter 288, femur 510, genu 323, tibia 367, basitarsus 207, telotarsus 367.

Male: Idiosoma — Length 1852, width 1230. Palps (total length 663), trochanter 80, femur 222, genu 137, tibiotarsus 222. Leg I (total length 2068), coxa 158, trochanter 197, femur 501, genu 324, tibia 392, tarsus 494. Leg II (total length 1699), coxa 145, trochanter 178, femur 397, genu 253, tibia 302, basitarsus 172, telotarsus 250. Leg III (total length 1738), coxa 134, trochanter 225, femur 390, genu 244, tibia 296, basitarsus 180, telotarsus 267. Leg IV (total length 2228), coxa 133, trochanter 271, femur 486, genu 335, tibia 380, basitarsus 245, telotarsus 375.

Material examined — Holotype ♀. BRAZIL, Pará, São Geraldo do Araguaia, Serra das Andorinhas, coll. A.B. Bonaldo *et al.*, 06°13'29.9"S 48°26'04.2"W, 03 Nov. 2011, Winkler extraction. Paratypes, same location and collectors as for holotype, 4♀, 5♂, 06°13'10.47"S 48°26'17.97"W, 30 Oct. 2011; 1♀, 1♂, 06°13'08.1"S 48°26'17.4"W, 31 Oct.

2011; 1♂, 06°13'29.9"S 48°26'04.2"W, 03 Nov 2011; 1♀, 06°13'36.9"S 48°30'02.1"W, 05 Nov. 2011.

Deposition of types — Holotype female in MPEG. Paratypes females and males in MPEG and DZSJR.

Etymology — The species is dedicated to Dr Pekka T. Lehtinen, who has made significant contributions to the knowledge of Holothyrida.

#### DISCUSSION

The poorly made descriptions of Neothyridae species makes difficult to a proper comparison to *D. lehtineni*, besides their diagnoses are enough to confirm the new taxon. The main difference within *Diplothyrys* species are related to Thon's Organ position in relation to the dorsal shield border (Klompfen, 2010), and number of modified setae on palps (Lehtinen, 1999). According with Lehtinen (1999) the Thon's organ is composed by two pairs of excretory glands furnished with a protruding membranous funnel.

The striking difference existing between *D. schubarti* and *D. lehtineni* is the different structure of Thon's organ. *D. schubarti* has one pair of membranous funnel in lightly more posterior position and another pair without funnel like extensions immediately posterior to the stigma. In *D. lehtineni* the Thon's organ is composed by two pairs of funnels. One of them, the posterior is striking and membranous funnel, and the second funnel which is the an-

terior, is located inside of the body but visible. Both of them are connected by a channel.

Another main difference in between *D. schubarti* and *D. lehtineni* is the absence in *D. lehtineni* of the specialized seta of the palpal genu, present in other holothyrids.

None of material analyzed of *D. lehtineni* present the antiaxial branched seta observed in *D. schubarti*, which is homologous with fringed seta presented on Holothyridae.

*Diplothyrys lecorrei* presents striking differences to *D. schubarti* and *D. lehtineni*, as the diagonal position of Thon's organ, superior number of subcapitulum setae (12, compared to 8-9 on *D. schubarti* and *D. lehtineni*) and smaller body size. All Neothyridae species present six modified palp tibia setae, but only *D. schubarti* presents the antiaxial branched seta on palpal genu. The depression on tip of tarsus I, a homologous structure to the Ixodida Haller's Organ, presents a broad solenidia in *D. lehtineni*, which is lacking in *D. lecorrei*. This comparison is not possible do *D. schubarti* due the absence of this information.

Chaetotaxy of tarsus I, palp articles and Thon's Organ position seem good characters to Neothyridae species comparison. We strongly recommend proper Neothyridae descriptions focusing on those to better comprehension of diversity and possible variations within such group.

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