ORIGINAL RESEARCH ARTICLE

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Original Research Article

NEW AQUATIC *Sminthurides* Börner SPECIES (COLLEMBOLA: SMINTHURIDIDAE) FROM TABASCO, MEXICO

Una nueva especie acuática de *Sminthurides* Börner (Collembola: Sminthurididae) de Tabasco, México

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ABSTRACT. Complement to the diagnosis of *Sminthurides* Börner is given and illustrated with Scanning Electron Microscopy (SEM) photos, and a new Mexican species of this genus is described with specimens from Tabasco State. It belongs to penicillifer group, characterized by the presence of two trichobothria on second antennal segment. Males of the new species are distinguished by a triangular cavity in Ant II and a reduced labial chaetotaxy, females with Ant. IV subdivided into 9 subsegments and abundant labial chaetotaxy. A discussion of the variability of some characters, as teeth and empodial filament of unguis III are discussed and illustrated, and the use of new morphological structures, as postlabial chaetotaxy and setation of ventral Abd. IV for the taxonomy of this genus are proposed and included in this contribution.

Keywords: Taxonomy, morphological variation, sexual dimorphism.

RESUMEN. Se da un complemento a la diagnosis de *Sminthurides* Börner y se ilustra con fotos en el Microscopio Electrónico de Barrido (MEB); se describe una nueva especie mexicana del género con ejemplares del estado de Tabasco. Pertenece al grupo penicillifer, que se caracteriza por la presencia de dos tricobotrias en el segundo artejo antenal. Los machos de esta especie nueva se distinguen por una cavidad triangular en el Ant II y quetotaxia labial reducida; las hembras con el Ant IV subdividido en 9 subartejos y abundante quetotaxia labial. Se discute sobre la variación de algunos caracteres como los dientes del ungues y el filamento empodial del ungues III, mismos que son discutidos e ilustrados; se propone el uso de estructuras morfológicas nuevas para la taxonomía de este género, como la quetotaxia postlabial, y el número de sedas ventrales del Abd. IV que son usadas en esta contribución.

Palabras clave: Taxonomía, variación morfológica, dimorfismo sexual.

INTRODUCTION

Aquatic collembolans are very common, they have been found in epicontinental water such as lakes and rivers, in caves, and even sand or on rocks at marine littoral zones, but rarely in submerged plants or bottom sediments. Palacios-Vargas et al. (2018) have gathered information about 26 species in aquatic environments in Mexico, most of which are marine littoral; and they added 12 new records from Montebello lakes, Chiapas, including two undescribed Sminthurides in deep benthos of lakes at more than 20 m deep.

Among the Symphypleona, Sminthurididae Börner, is one of the families with most interesting sexual dimorphism (Palacios-Vargas and Castaño-Meneses, 2009), it has 12 genera and close to 150 valid species. Most speciose genera are Sphaeridia Linnaniemi with 70 taxa, Sminthurides Börner with 60 and Denisiella Folsom & Mills with 15 (Bellinger et al. 2020), other genera are monospecific or have only 2 or 3 taxa. Most members of Sminthurides are aquatic, marine littoral or fresh water and few are terrestrial. Males of this family are characterized by antennal segments II and III modified for sexual mating behavior and are smaller than females (Betsch 1980); the complexity of morphological modifications varies among the genera.

The genera *Sminthurides* is cosmopolitan, with 23 species cited from the Americas, but only *S*. *bifidus* Mills, *S*. *globocerus* Folsom & Mills, *S*. *hyogramme* Pedigo, *S*. *macnamarai* Folsom & Mills, *S*. *plicatus* (Schött) Folsom & Mills, and *S*. *terrestris* Maynard, have been cited from Mexico (Palacios-Vargas, 1997; Magaña-Martínez et al. 2019). Recently Ferreira et al. (2021) described *S*. *cihuatlensis* Ferreira, Arango & Palacios-Vargas living in litter, soil and moss from Iztaccíhuatl volcano at estado de México, and *S*. *fridakahloae* from Lagoon Las Garzas, Colima, and also on water surface of river Agua Limpia at Anenecuilco, Morelos state.

A recent modified diagnosis for this genus was given by Ferreira et al. (2021); most important characters which allow to isolate *Sminthurides* from the two other genera living in Mexico (*Sphaeridia* and *Denisiella*) are: 4 trochanteral setae and one tibiotarsal organ on leg III, Th III in males with one pair of vesicles; females bigger than males but with similar trochanteral organ on leg III, and Ant IV undivided in males; annulate or subdivided in females. New characters are used in this study, as the postlabial setae, ventral setation of Abd. IV and variation of ungual teeth.

Materials and Methods

Specimens were collected in small pools (Fig. 1) close to Emiliano Zapata city and other places in Tabasco state at the South-East of Mexico; by epineustic traps, as described by Palacios-Vargas (1990) with 75% alcohol (Fig. 2). Before mounting the specimens under slides, they were cleared in KOH 10%, later in warm lactic acid and mounted under slides in Hoyer's solution for their study under a contrast phase microscope Carl Zeiss and drawn with the aid of a camera lucida. For Scanning Electronic Microscope (SEM) study, specimens were dehydrated by ethanol graduate series and then dried up in a critical point dryer Baltec CPD030; and covered by gold in the ionizator Denton Vacuum Desk II.

The nomenclature for of Ant. II and Ant. III follows Betsch (1980); tibiotarsi and furcular chaetotaxy follow a simplified system of Nayrolles (1988, 1990); head and great abdomen chaetotaxy follows Betsch and Waller (1994), and Vargovitsh (2009) for posterior setae of great abdomen; Betsch (1997) was used for Abd VI. The chaetotaxy of postlabium is a proposal of the author of this contribution. All measurements are given in µm, specimens were measured and "n" refers to number of specimens used in each case, and average is given and follows the range in parenthesis.

Abbreviations: **a**, anterior seta; **ae**, anterior external seta; **b1-b5**, modified setae of **Ant. II** of male; **c1-c2**, modified setae of **Ant. III** of male; **Ant.**, antennal segment; **Ga,** dental anterior seta; **Gai**, dental anterior internal seta; **Ge**, dental external seta; **Gi**, dental internal seta; **Gp**, dental posterior seta; **Gpi**, dental posterior internal seta; **LESM**, Laboratorio de Ecología y Sistemática de Microartrópodos, UNAM, Mexico; **m**, middle seta; **p**, posterior; **pe**, posterior external seta; **SS**, sensillum, sensilla; **Th.**, thorax; **Tri**, trichobothrium; trichobothria; **o.c.**, opening of cavity; **o.o.**, oval organ; **t.c.**, triangular cavity; **X**, assymetric lack of setae.

Figure 1. Small pools close to Emiliano Zapata City, Tabasco.

Figure 2. Epineustic trap and *Sminthurides* specimens.

RESULTS

TAXONOMY
Class Collembola Lubbock, 1870
Order Symphypleona Börner, 1901
Superfamily Sminthuridoidea Börner, 1906 sensu Fjellberg, 1989
Family Sminthurididae Börner, 1906 sensu Betsch, 1980
Genus *Sminthurides* Börner, 1900

Complement to the diagnosis of Sminthurides Börner modified from Ferreira et al. (2021). Cuticular primary ornamentation hexagonal, as that found at big alveoli of trichobothria (Fig. 3), and the thoracic vesicles of males (Fig. 4); secondary granulations resulting from the fusion of some of them is mainly in aquatic forms. Body setae smooth and short in males (Fig. 5) and longer in females (Fig. 6, 36); female labral and postlabial setae longer and thicker than in males (Fig. 33, 35).

Postlabial setae in two rows in males (A, M) and 3 in females (A, M, P). Male antennae very modified and species specific. Ant II thick with **Tri 1**, and seta **B1** barbulate (*aquaticus*-group) (Fig. 9) or with and **Tri 2** (*penicillifer*-group) in posterior surface; ciliate seta **b1** on the biggest process; **Tri 1 b2–b4** on middle process and **b5** in the distal part (**b6** usually missing) (Fig. 7, 13); 3 main spines: c1 long with ciliated and broadened tip (Fig. 11); c2 short of different shape; c3 long, thick and with spiral ornamentation on a big process (Fig. 7); **b1** in

Ant. II and c3 in Ant. III are the most important for clasping on female antennae (Fig. 8). Dens often with increase setae numbers in additional rows, sometimes in females those of inner side longer than others (Fig. 39). Mucro with 3 lamellae often wide and undulated, but sometimes thin, slightly crenulated, or serrated, or ending before apex (Fig. 21, 22). Metathoracic vesicles always present in males, very rare and reduced in females. Mucronal seta always present.

Remarks. One of the main problems for the study of this family is the small length of adults from 0.12 to 0.5 mm in males and from 0.3 to 1 mm in females, and that most characters used for species identification are those of adult males. Ant II and III of males are transformed to clasp the antennae of female in courtship behavior. Ant. I in males is about twice the size of the female and Ant. IV of female is about 2.5 times the size of the male. Furcula, dens chaetotaxy have not been described in many species but it seems to be a good character for their isolation in different groups. Mucro has 3 lamellae, and they often are broad and crenulate, it is an important adaptation to epineustic life (living on water surface), another is the increasing number of dental setae, and their length mainly those of inner side of the females.

Type species: *Sminthurus aquaticus* Bourlet

Sminthurides pejelagarto sp. nov. (Figs. 13-39)

Type material. Mexico: State of Tabasco, Municipality of Emiliano Zapata; Usumacinta River region (17° 44' 35.8" N, 91° 46' 30.4" W), 29.II.2019, J. G. Palacios-Vargas Col., on surface 29.II.2019, J. G. Palacios-Vargas Col., on surface of water with epineustic traps. Holotype male (FC-UNAM:LESM-AC:QL 22551), and 15 paratype females on slides. (FC-UNAM:LESM-AC:QL 22552-16). All deposited in LESM, Sciences Faculty, UNAM, México.

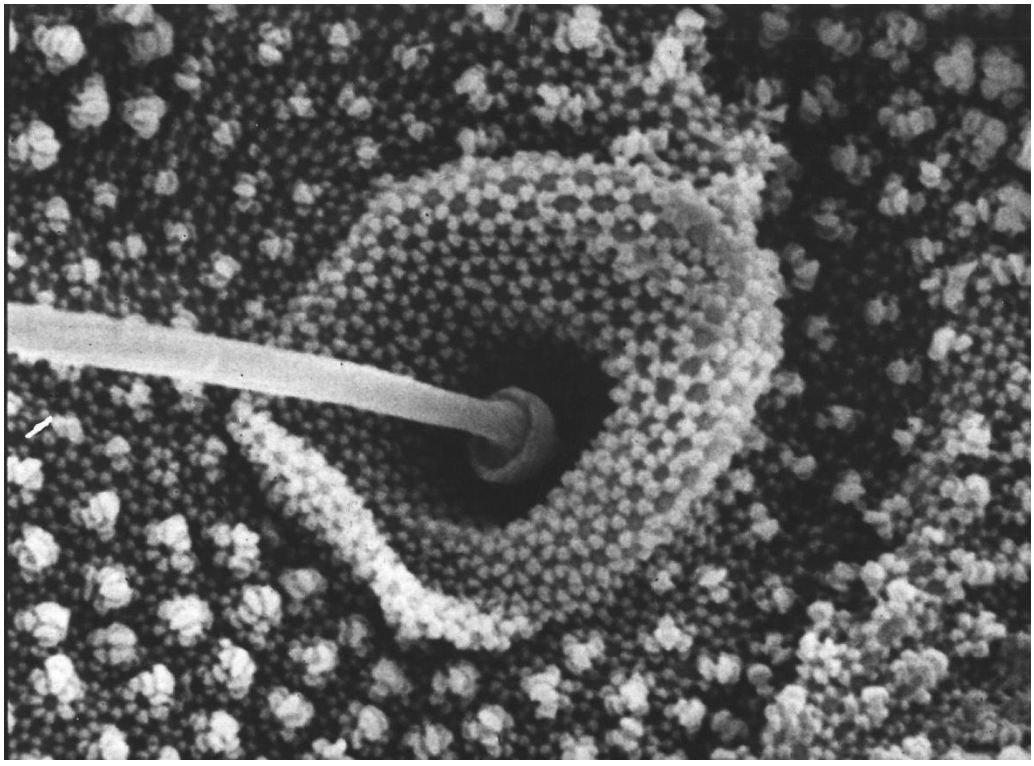


Figure 3. Cuticle of *Sminthurides fridakalohae*; trichobotrium and alveolus.

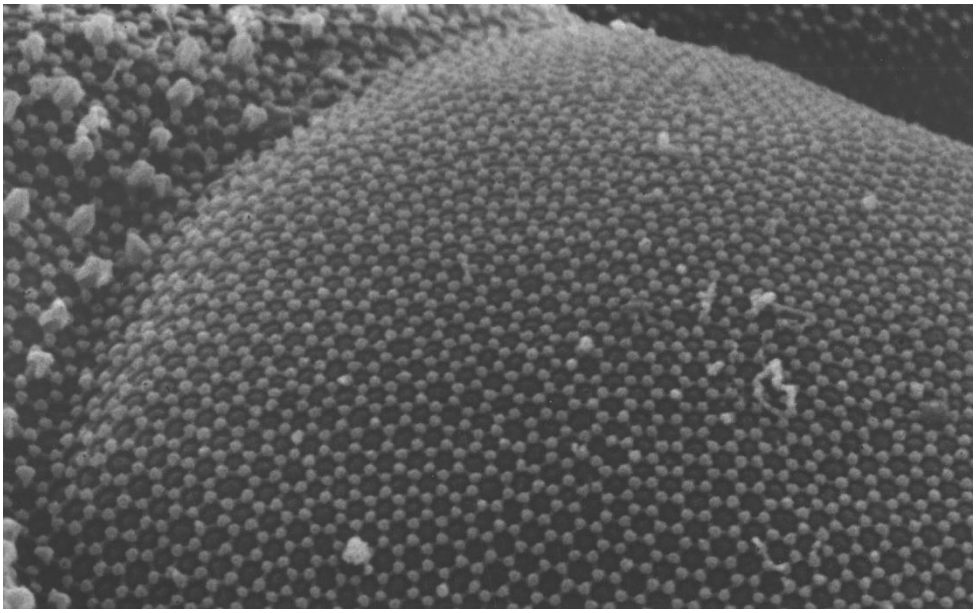


Figure 4. Cuticle of *Sminthurides fridakalohae*; thoracic vesicle of male.

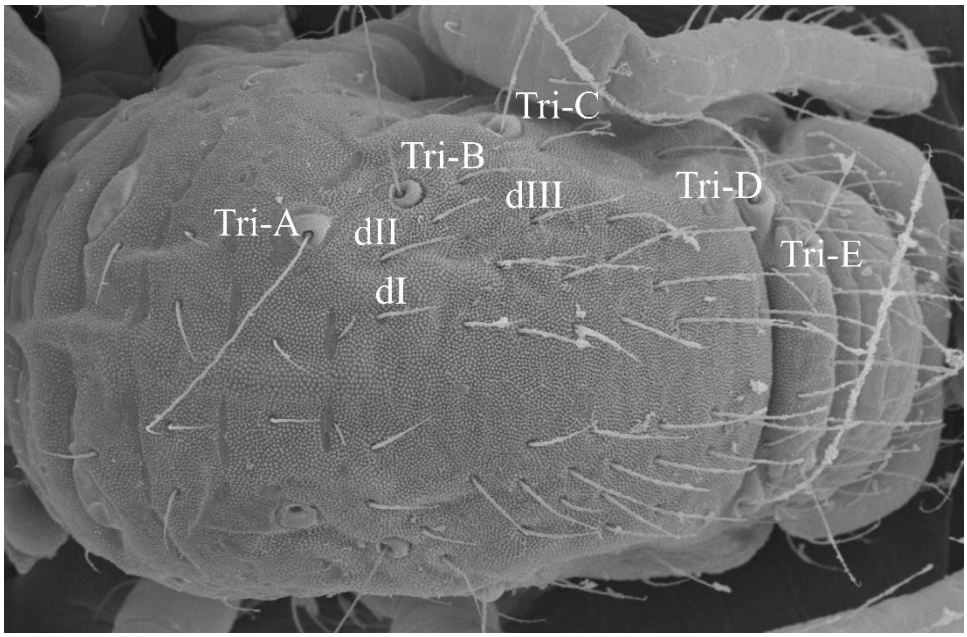


Figure 5. Dorsal chaetotaxy of *Sminthurides cihuatlensis*; male.

Additional material: México, Tabasco: Macuspana: Agua Blanca (17° 38' 30.0" N, 92° 27' 18.0" W), 4 males and 4 females (Collection numbers FC-UNAM:LESM-AC: 14922 and 3; 14931 and 2).

México, Veracruz: Tlacotalpan, 5 males, 1 juvenil and one female. Collection numbers FC-UNAM:LESM-AC: 22566 to 22570 and 22574.

Description. Male. Head length (n = 6) 181(range 150-200); antennae 336 (range 315-352); ratio head: antenna = 1.85; abdomen length (n = 5) 326 (270-400). Ratio Ant. I:II; III; IV = 1:1.2; 0.7; 1.3. Antennae classically bent as in all Sminthurididae males, elbowed between Ant. II and Ant. III (Fig 13); Ant I with 7 setae, one small. Ant. II with 18 setae, two trichobotria (**Tri 1** and **Tri 2**), one

microsensillum on posterior side; modified setae b1-b5 ciliated, b2 b4 on the same tubercle, and b5 on separate tubercle (Fig. 9, 13). After seta b5 there is a triangular cavity (Fig. 32) with a small opening (Fig. 10), it can be a gland or a vestige of tubercle and seta b6 (Fig. 10, 32). Ant. III with 13 setae, Ant. organ III with a pair of oval sensilla, modified setae c1-c3, c1 ciliate broad and flat, c2 short sharp tubercle, c3 has shape of strong sharp spine with spiral ornamentation and with two small elements between c1 and c3. Ant. IV simple with about 48 setae and 5 sensilla difficult to distinguish (Fig. 14).

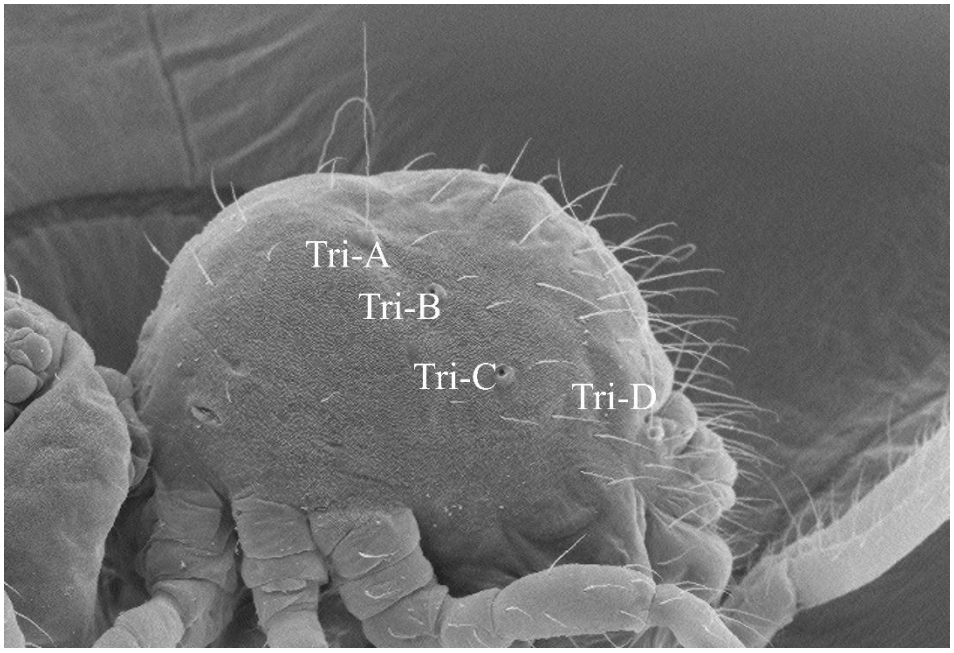


Figure 6. Lateral chaetotaxy of *Sminthurides cihuatlensis*; female.

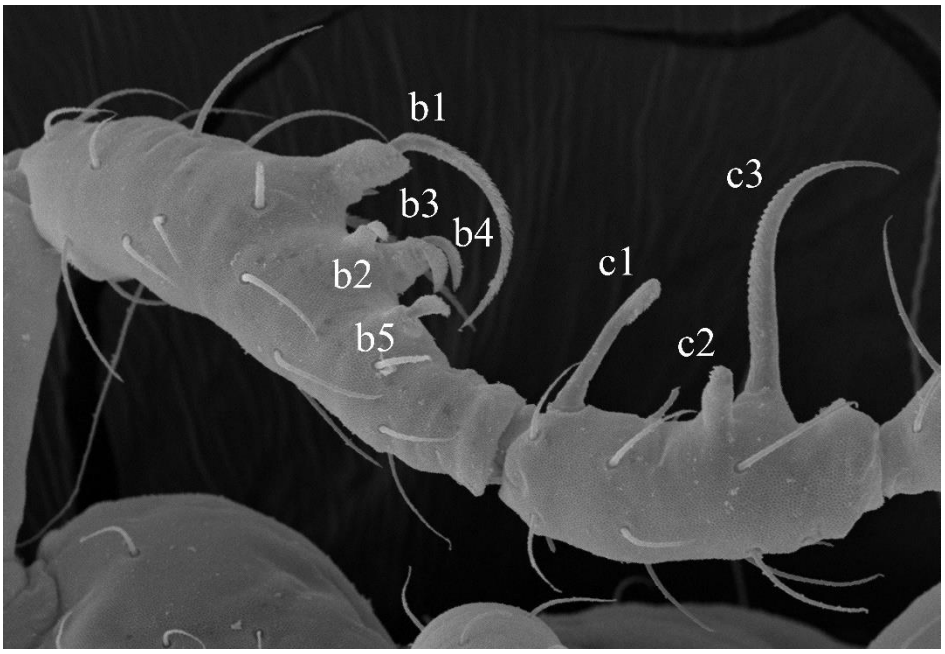


Figure 7. *Sminthurides cihuatlensis*; morphology of Ant II and III.

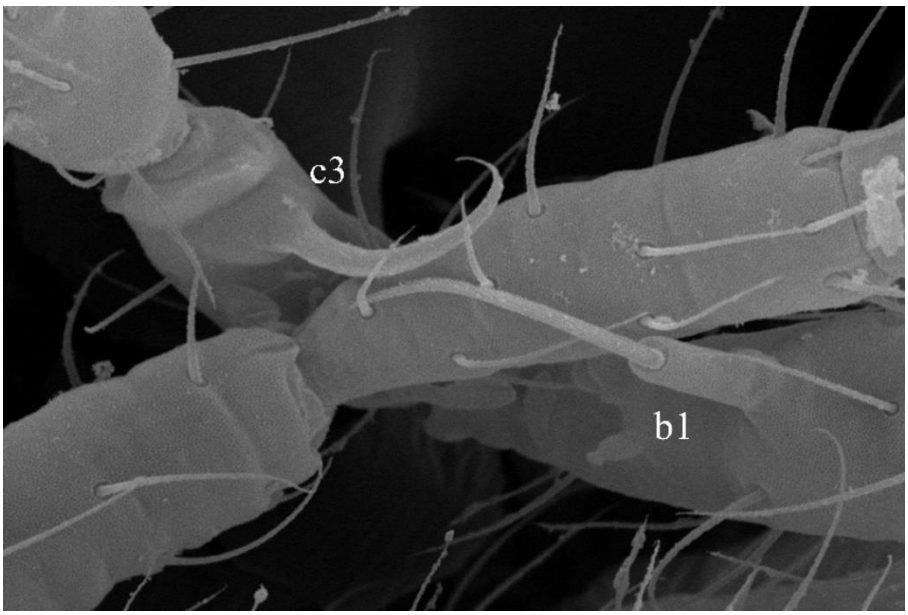


Figure 8. Coupled antennae of male and female *Sminthurides cihuatlensis*.

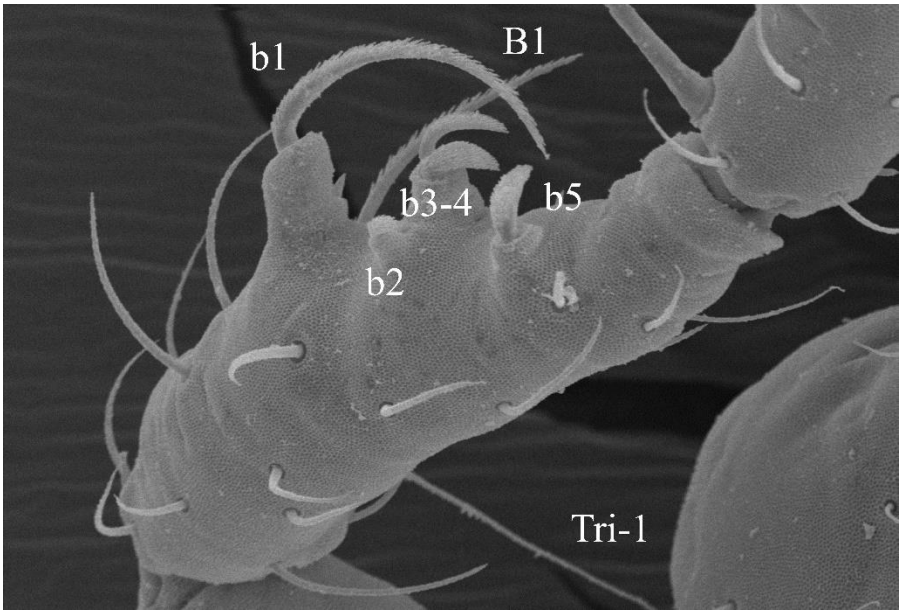


Figure 9. Ant II and III of male male *Sminthurides cihuatlensis*, showing characters of *aquaticus* group: Tri 1 and barbulate seta "B1".

Head. 7+7 clear eyes with smooth cuticle and one additional eye covered with cuticle granulation. **G** small, **C** reduced and covered with cuticular granulation. Three ocular tubercles and one pair of interocular setae on each side (Fig. 15). Inter-antennal region **α** and **β** with 4 setae and one pair of pores (Fig. 25); labral chaetotaxy **pl**/**m**, **p**, **a** with 6/554 respectively thin setae, those of **m** and **a** row on small tubercles. Cephalic seta A (n= 6): 11 (range 9-13); Prelabral seta **pl** (n= 5) 13 (range 10-15). Two rows of thin postlabial pairs of setae, A1, A2, A4 and M1 (Fig. 34).

Leg I (Fig. 19). Coxa with one seta; trochanter with three setae; femur with 11 setae, one is thick, curved turned perpendicularly; tibiotarsus with 35 setae: whorl I with 8 setae, **Ja** not curved and **Jp** absent; whorl II with 8 setae; whorl III with 6 setae **IIIi** absent and two oval organs **3ae** and

3pe present; whorl IV with 7 setae; whorl V with 5 setae Va, Vp and Vpe absent. Length of leg I (n= 6) 81 (range 90-100).

Leg II. Coxa with one seta; trochanter with three setae; femur with 12 setae and one polycarinate seta; tibiotarsus with 33 setae: whorl I with 8 setae, Ja is slightly curved, Ipi and Jp absent; whorl II with 8 setae IIpi absent; whorl III with 8 setae and two oval organs 3ae and 3pe present; whorl IV with 8 setae; whorl V with 6 setae Va and Vp absent. Length of Tita. II (n= 6) 95 (90-100).

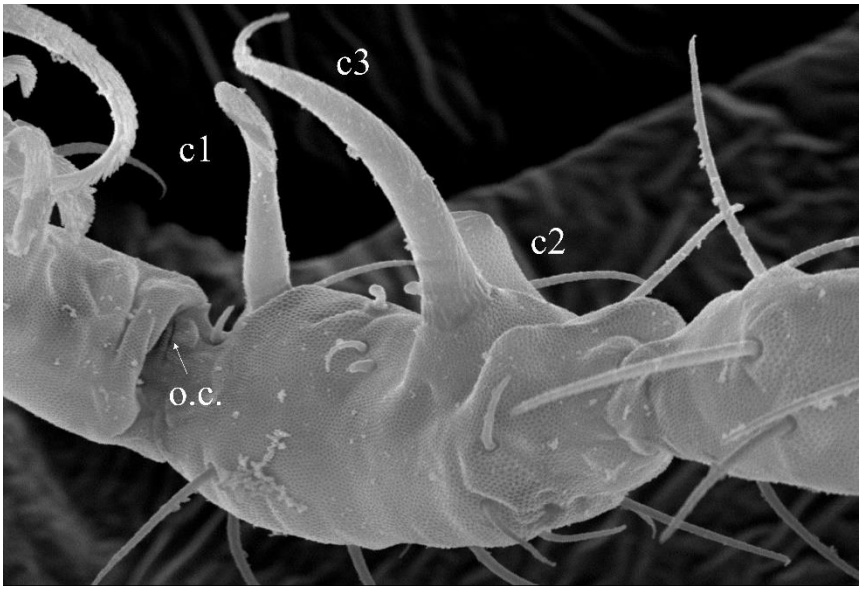


Figure 10. Ant II of *Sminthurides cihuatlensis* with opening of the cavity and main structures of Ant III.

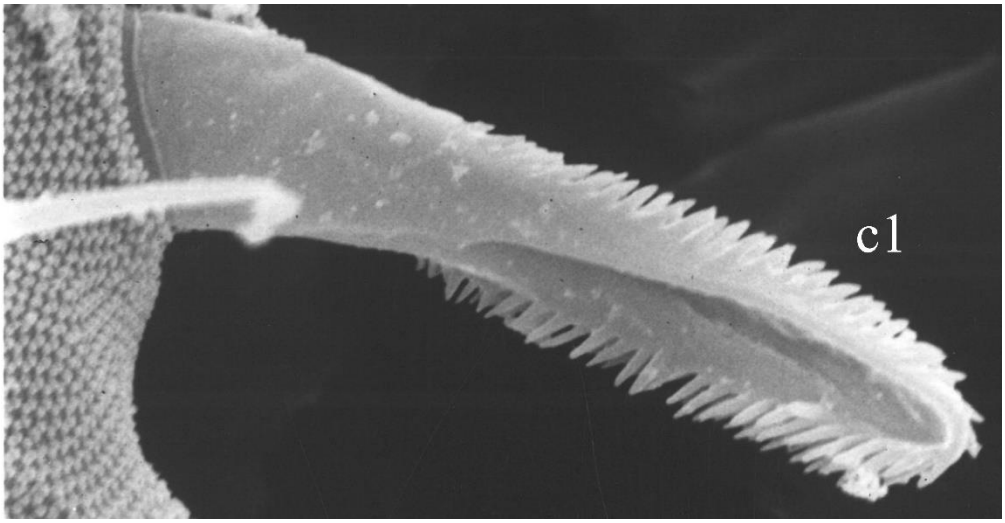


Figure 11. Element c1 of *Sminthurides cihuatlensis*, big magnificaction.

Leg III (Fig. 20). Coxa with three setae; trochanter with four setae, one short and thin in ventral position; femur with 13 setae; tibiotarsus with 33 setae: whorl I with 9 setae, Ja is slightly curved and tibiotarsal organ III Ipe short hook shape and Ip bifid long seta (Fig. 20, 38); whorl II with 6 setae, IIpe and IIpi absent, tibiotarsal organ III IIp short hook shape, whorl III with 8 setae IIIpe and IIIa absent, two oval organ 3ae and 3pe present; whorl IV with 8 setae IVp absent; whorl V with 5 setae Va and Vp absent. Length of Tita. III (n= 6) 107 (100-120).

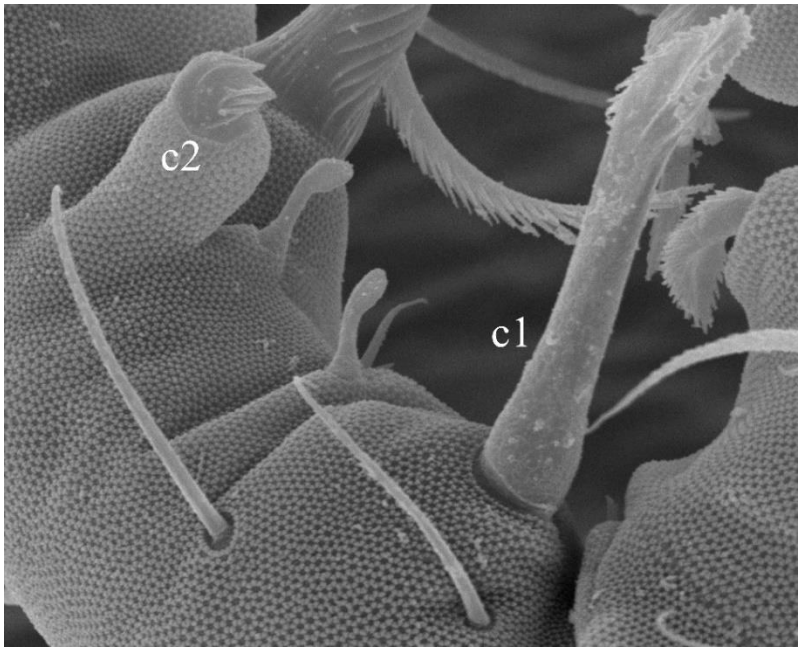


Figure 12. Shape on c2 element of *Sminthurides cihuatlensis*.

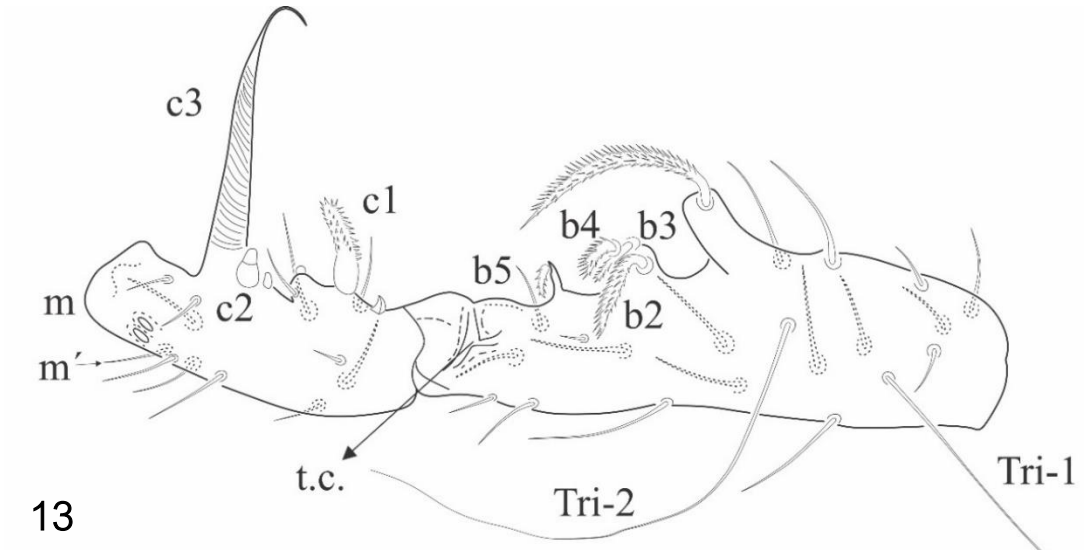
Unguis without tunica and pseudonychia; unguis I with internal tooth; unguis III without inner tooth; unguiculus I, II and III with lanceolate filament surpassing the unguis. Pretarsus with one anterior and one posterior seta on each leg.

Ventral tube 1+1 seta. Corpus of tenaculum with three setae and each rami with three teeth and basal appendix. Ventral Abd. IV with 6+6 setae.

Furcula. Manubrium with 7+7 setae, dens (n = 6) 185 (range 180-200) without strong plurichaetoses: anterior surface **Ge** with 6 setae, **Ga** with 7, **Gai** with 5 and **Gai** with 2; about 50 posterior setae; mucro 50 (n = 6) broad, shaft broad with lamellate edges, inner lamella narrowed, smooth and ending before the apex, outer lamella entire and median posterior lamella crenulate (Fig. 21, 22). Ratio dens: mucro = 4.

Great abdomen (Fig. 17, 29). All setae short and smooth. Th. II and III with one pair of small pores and one pair of vesicles (Fig. 17, 18). Trichobothria ABC form an obtuse angle opening anteriorly, **Tri B** short and **Tri-C** very long. Seta **b1** below **Tri-B**; **c1** above and **c2** below **Tri-C**. Posterior dorsal complex **dl**, **dll**, and **dlll**: 6, 5, 6 setae respectively. Seta circa Tri-B, (n= 6) 14 (range10-18). Six setae on ventro-lateral Abd IV. Small abdomen (n= 6) (Fig. 17). Ab. V with **Tri D** in row **a,** and **Tri E** very short in row **p**. Ab.VI chaetotaxy: row **a** with 7 setae; row **m** with 9 setae and **mi6** short; row **p** with 5 setae and **pi3** short. Genital plate with 3+3 short setae. Seta circa Tri-E (n= 6) 21 (range 14-28).

Female. Head length (n = 13) 323 (range 280-350) antenna (n = 17) 491 (range 350-600); ratio head antenna: 1: 1.5. Abdomen length (n = 16) 491 (range 350-600). Antennae not elbowed between Ant. II and III (Fig. 23). Ant. I with 7 setae. Ant. II with 11 setae. Ant. III with 21, Ant organ III a pair of oval sensilla and one microsensillum (Fig. 23). Ant. IV subdivided into 9 subsegments, with about 55 setae and 6 sensilla (Fig. 24). Ratio Ant. I:II; III; IV: 1:1.3; 3.2; 6.2. 8+8 eyes **D** small, **C** absent with interspecies variation 8+8 **C** and **D** small and two pairs of interocular setae. Head chaetotaxy (Fig. 25) like male (Fig. 16) but longer. Cephalic seta A (n= 17) 21 (ratio 15-27); Pl seta = 28 (range 25-50). Labral setae thick, spiniform (Fig. 33). Venter of head with 3 rows of postlabial setae, A1, A2, A3, A4, M1, P1, P2, P3 (Fig. 35).



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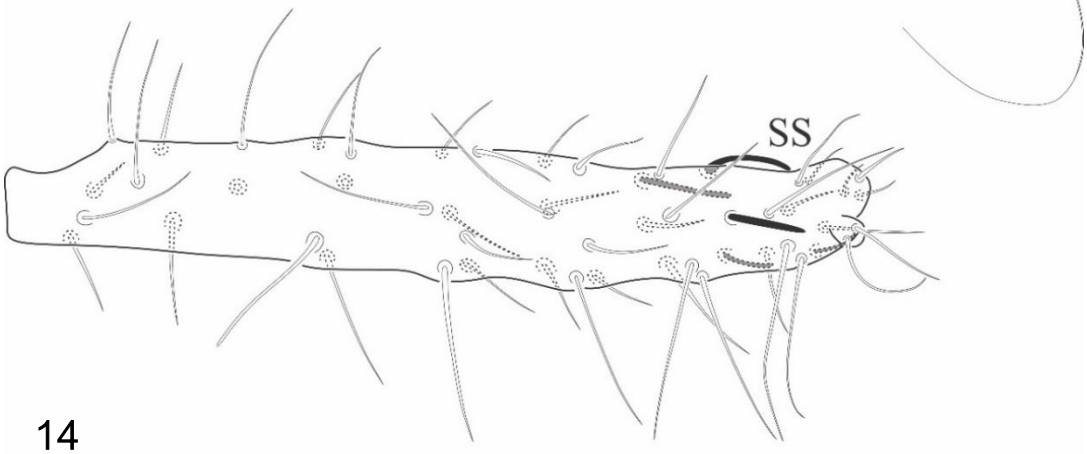

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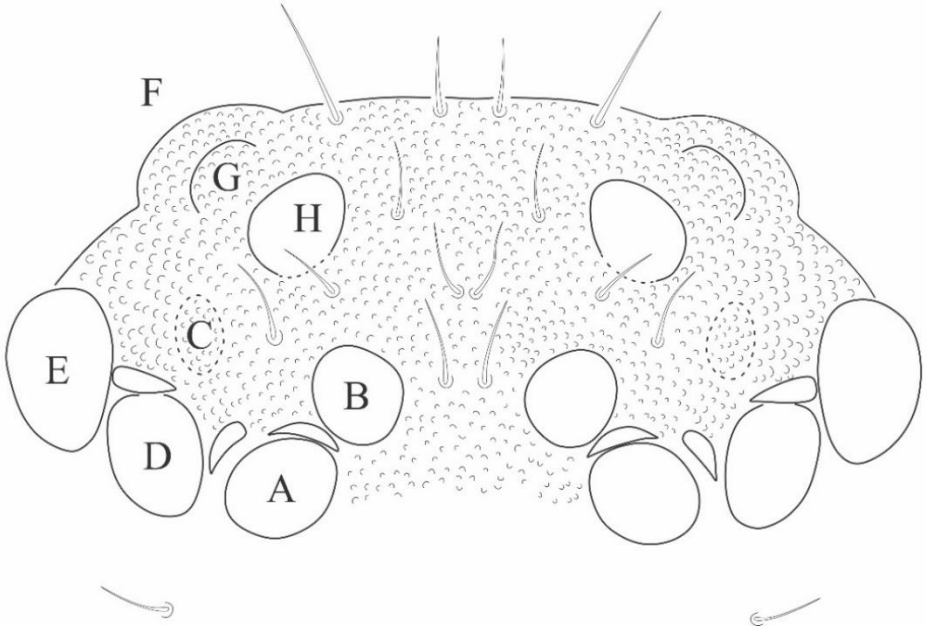

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Figures 13-15. Male of *Sminthurides pejelargarto* sp. nov. 13. Ant. II-III. 14. Ant. IV with sensilla;15. eyes distribution.

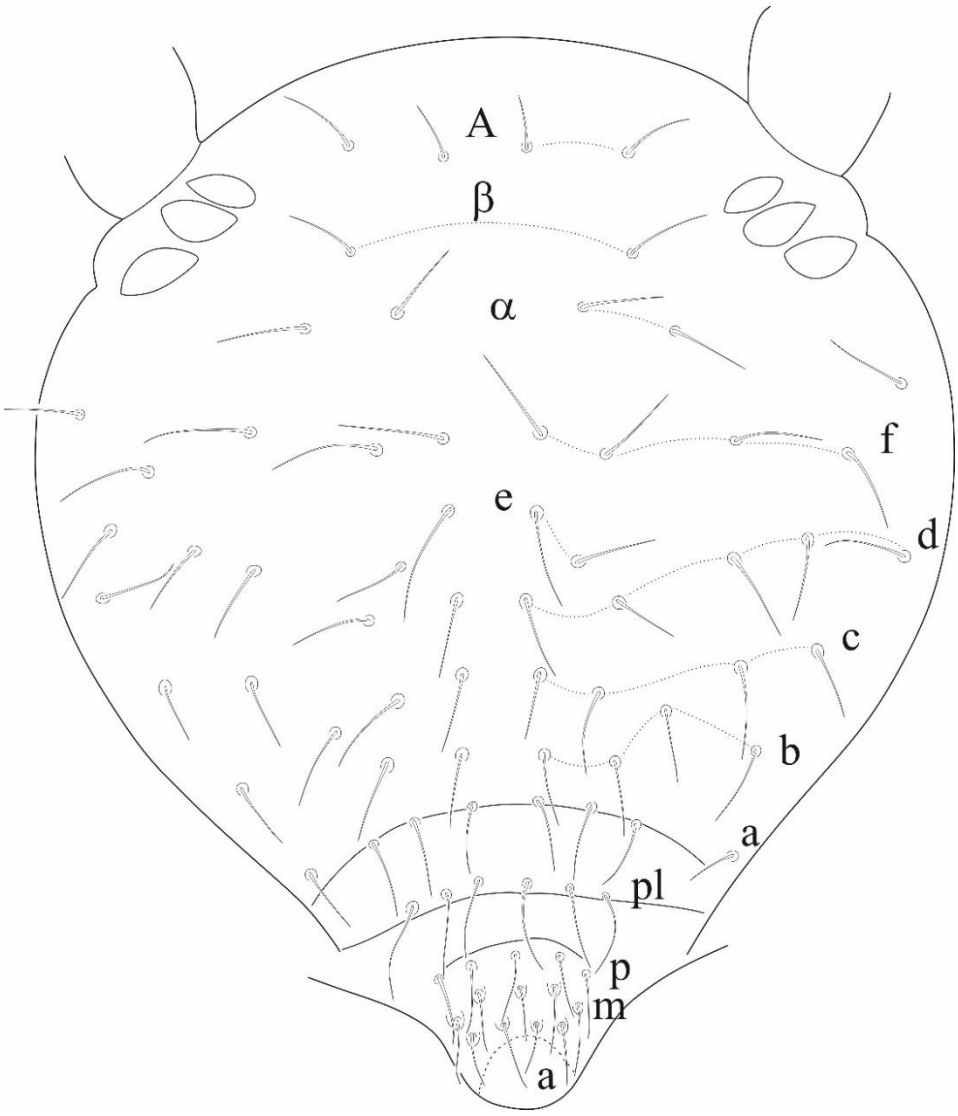


Figure 16. Male of *Sminthurides pejelagarto* sp. nov., head and labral chaetotaxy.

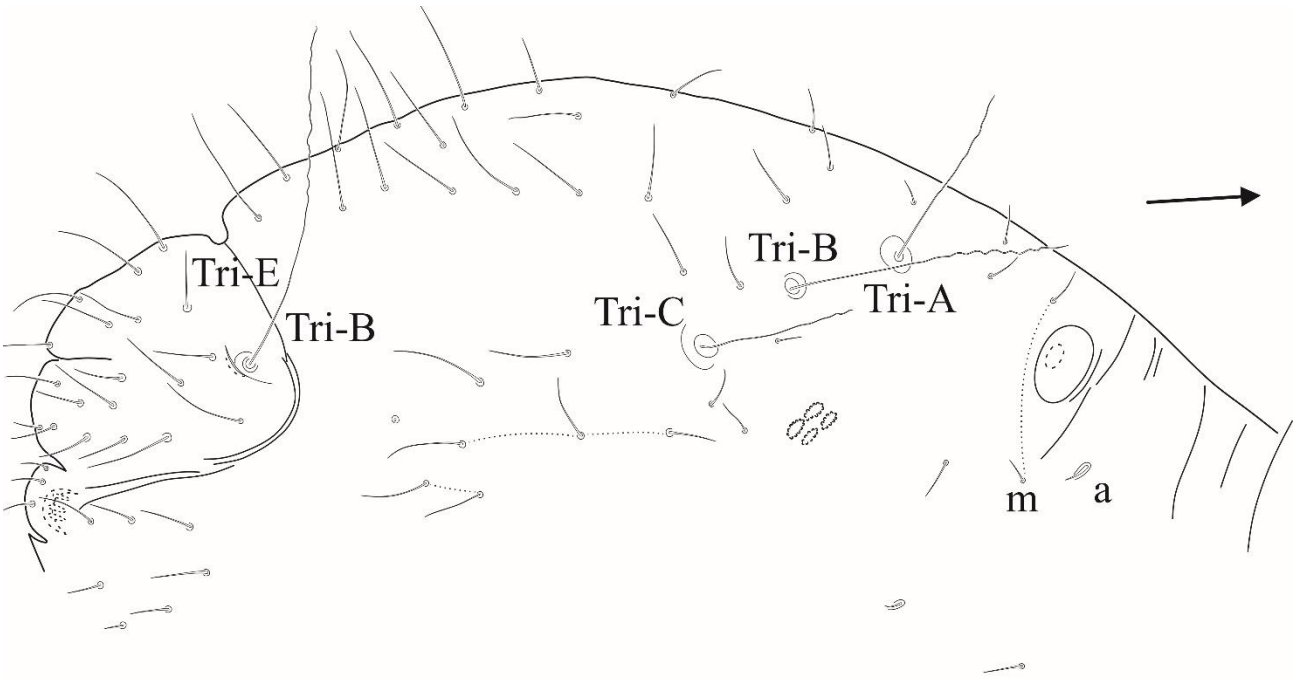
Leg I. (Fig. 26). Coxa with one seta; trochanter with three setae; femur with 11 setae and one is thick, curved turned perpendicularly to longitudinal axis; tibiotarsus with 35 setae: Ja is slightly curved in whorl I and two oval organ 3ae and 3pe in whorl III. Tita length (n = 17): 143 (110-190).

Leg II. Coxa with one seta; trochanter with three setae; femur with 11 setae; tibiotarsus with 36 setae: Ja is slightly curved in whorl I and two oval organ 3ae and 3pe in whorl III. Tita length (n = 17) 143 (110-190).

Leg III (Fig. 28), coxa with 5 setae, one short and thin; trochanter with four setae; femur with 12 setae; tibiotarsus with 32 setae: Ja is slightly curved, tibiotarsal organ III like male and two oval organ 3ae and 3pe in whorl III. Chaetotaxy of whorl of tibiotarsus is similar to male. Tita length (n = 17) 170 (140-200).

Unguis without tunica and pseudonychia; unguis I and II with one inner tooth, unguis III without inner tooth; unguiculus I, II and III lanceolate filament surpassing unguis (Fig. 27, 28) Pretarsus with one anterior and one posterior seta on each leg.

Abdominal setae from 2.5 to 4 times longer than males (Fig. 29), seta circa Tri-B (n=17) 50 (range 20-85) (Fig. 36). Seta circa E (n= 16) 44 (20-85). Ventral tube 1+1 seta. Corpus of tenaculum with 3 setae and each ramus with three teeth and basal appendix.



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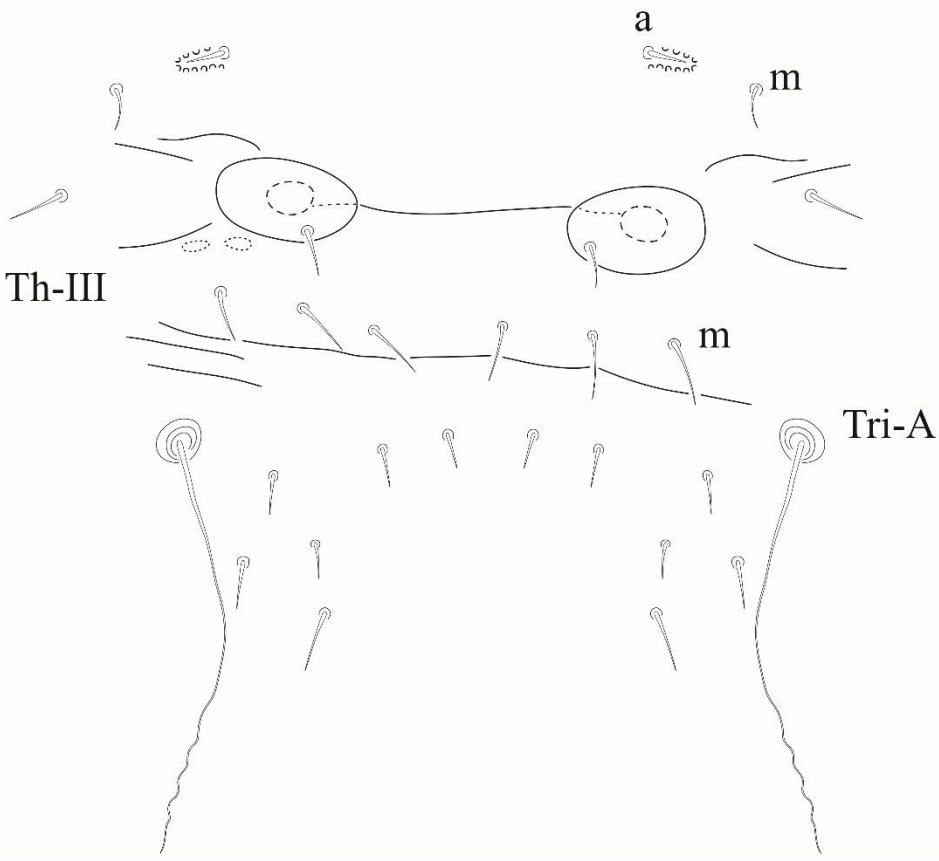

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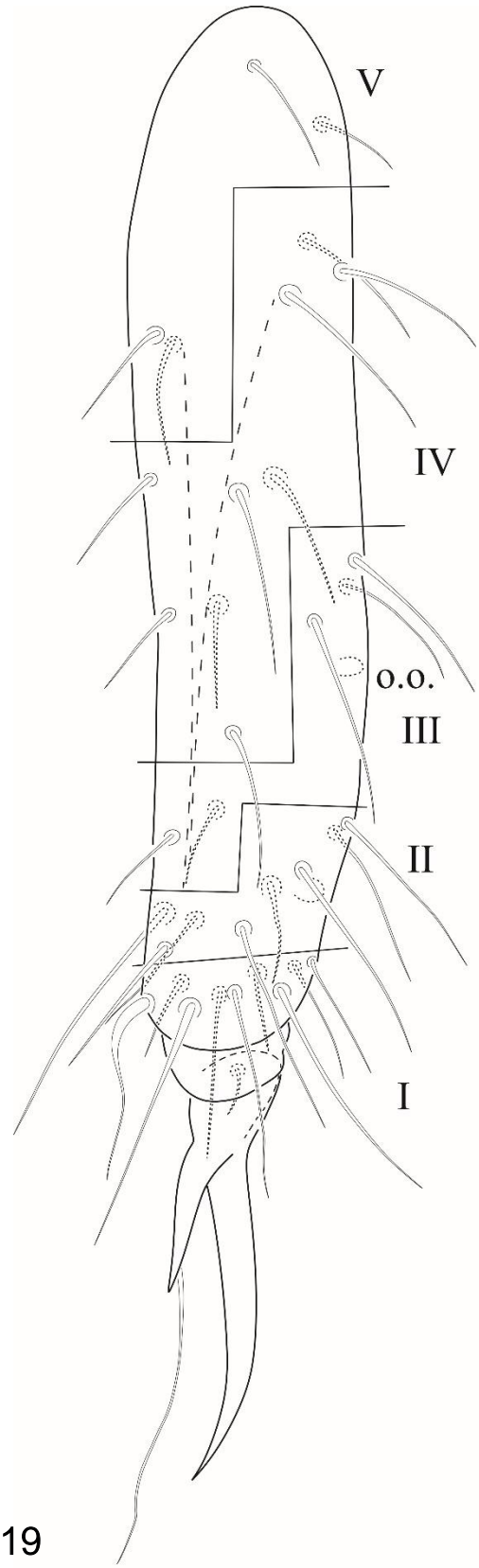
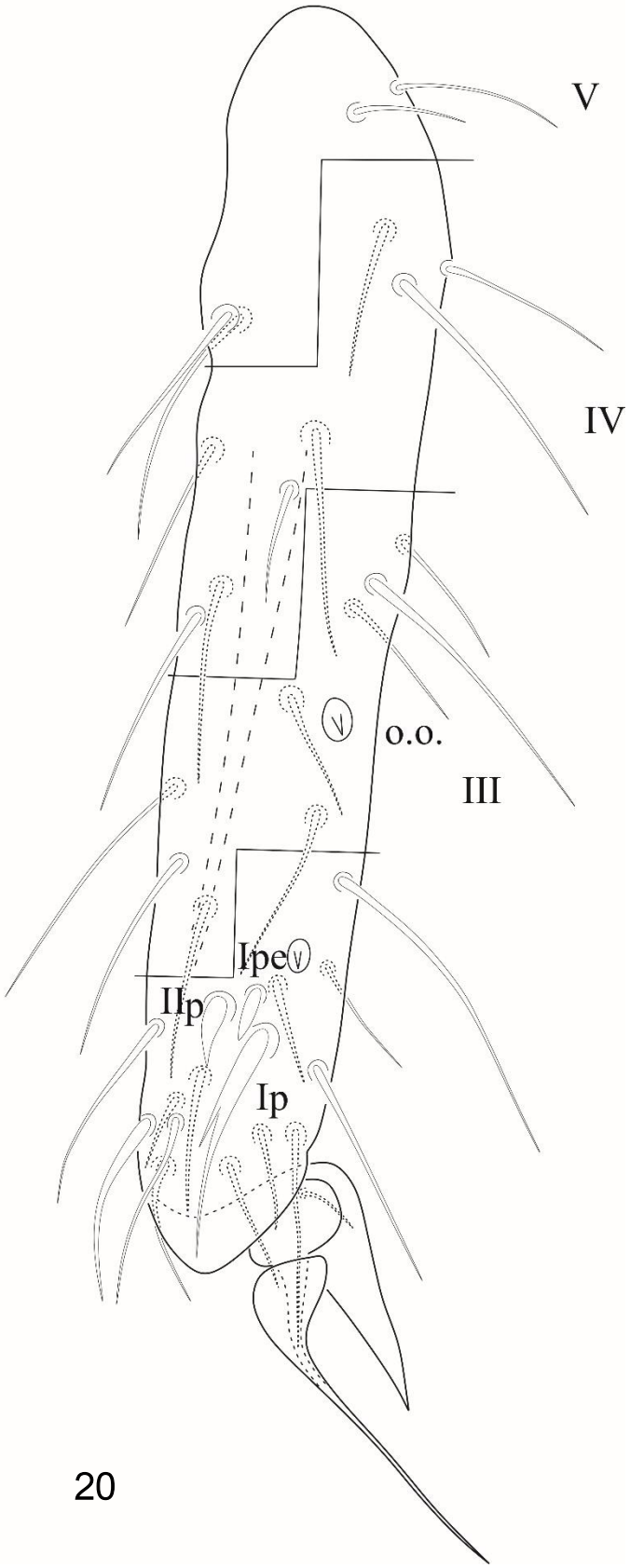
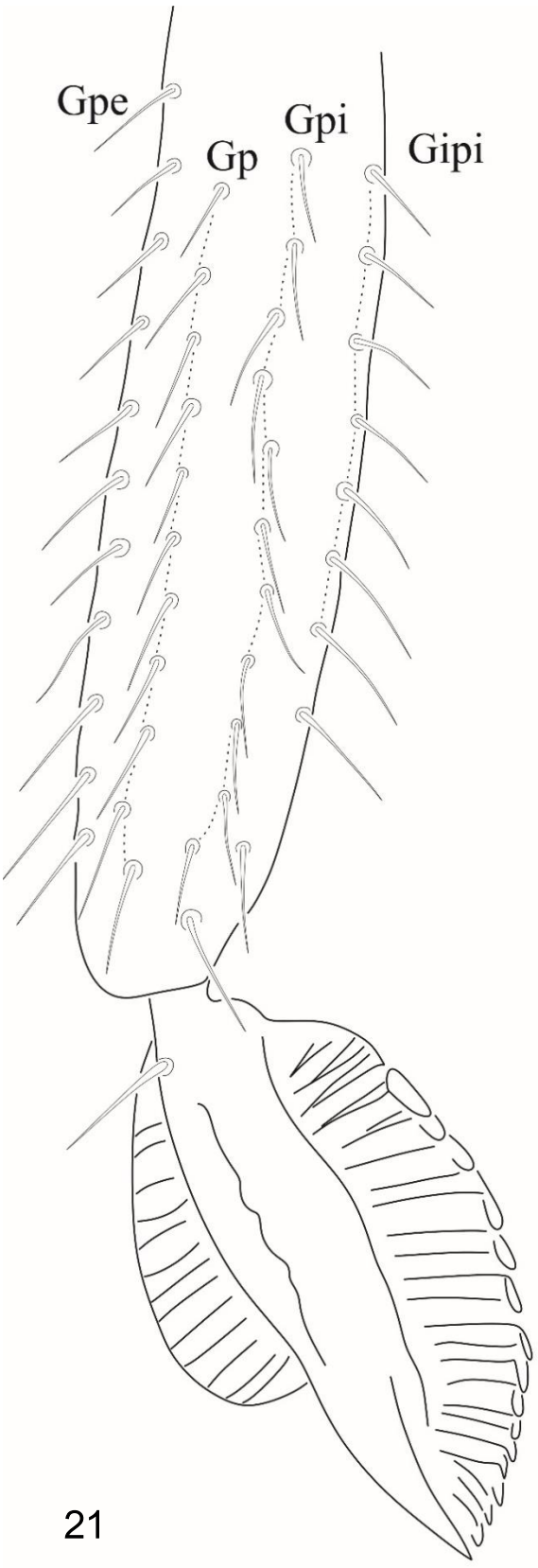
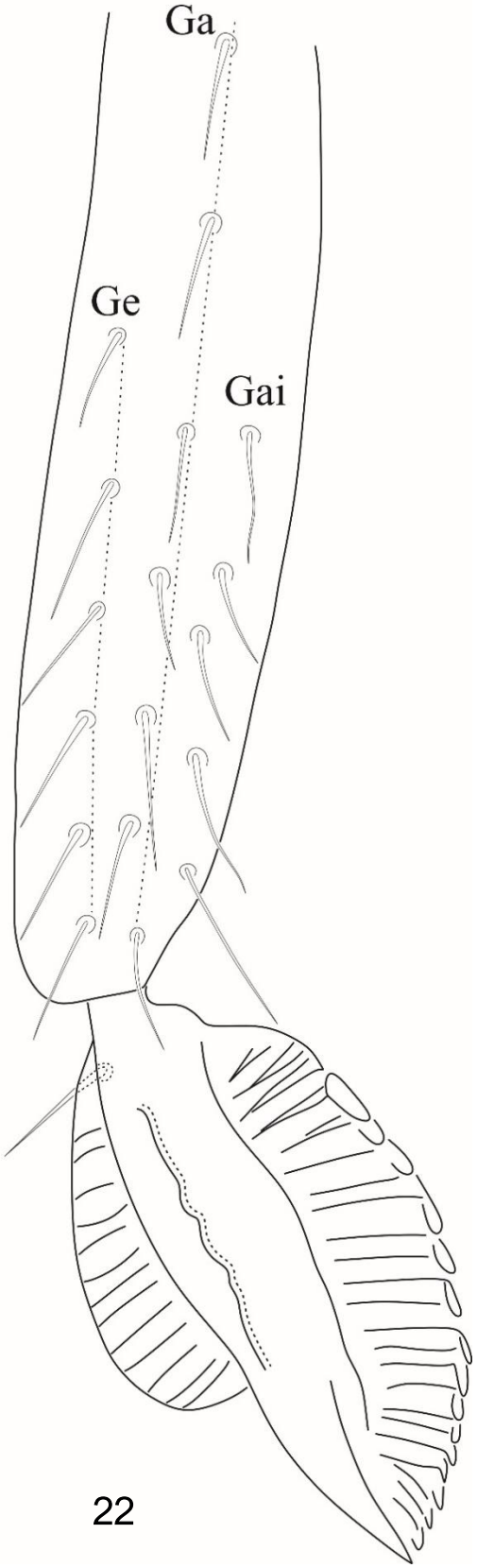
Figures 17-18. *Sminthurides pejelagarto* sp. nov. 17. Male great and minor abdomen in lateral view; 18. Male Th II-III and Abd. I dorsal view.



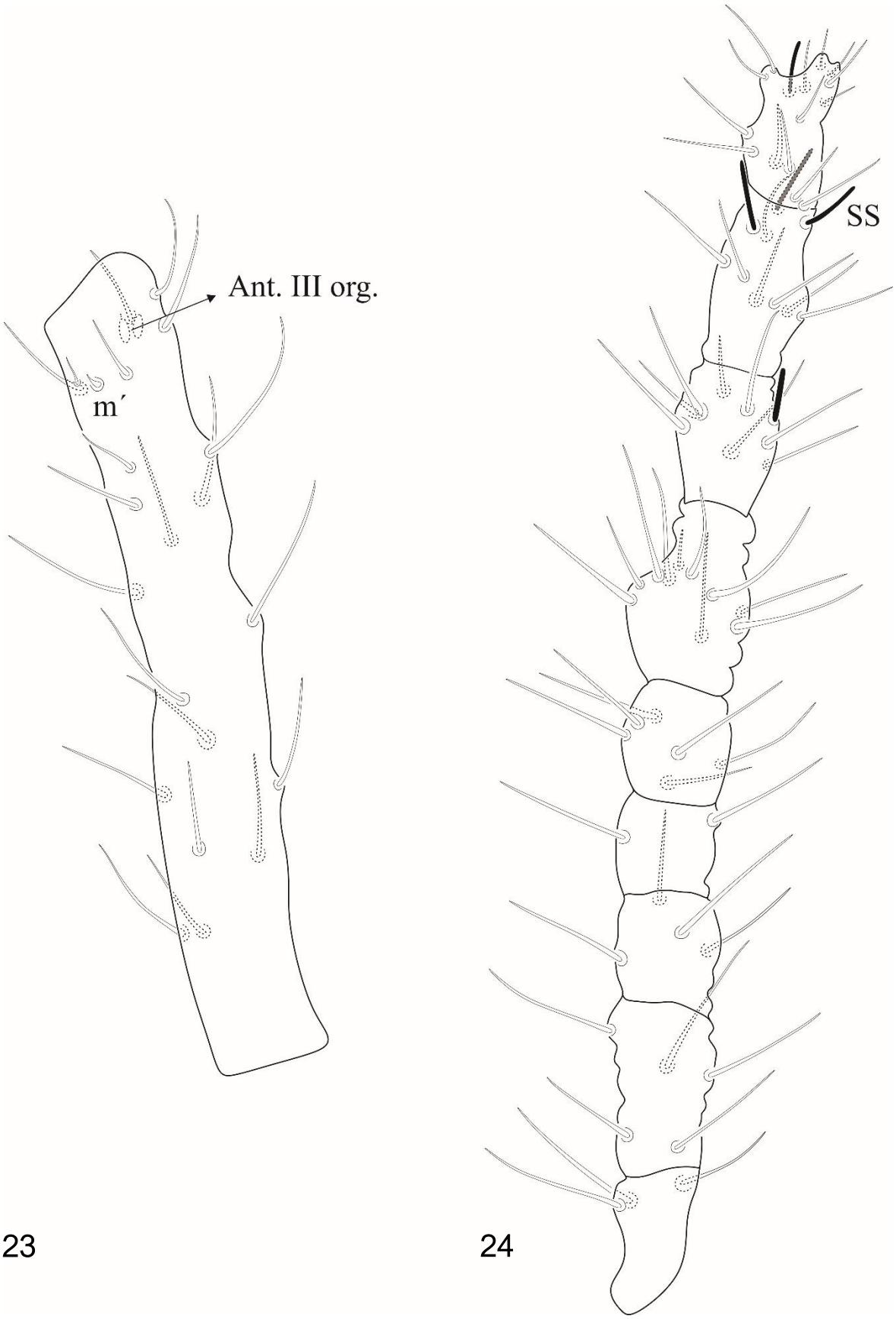


Figures 19-20. Male *Sminthurides pejelagarto* sp. nov. 19. Tibiotarsus I; 20. Tibiotarsus and tibiotarsal organ III.





Figures 21-22. Male of *Sminthurides pejelargarto* sp. nov. 21. Apex of dens an mucro posterior side; 22. Apex of dens anterior side.



Figures 23-24. Female *Sminthurides pejelargarto* sp. nov. 23. Ant III chaetotaxy; 24. Ant IV chaetotaxy and sensilla.

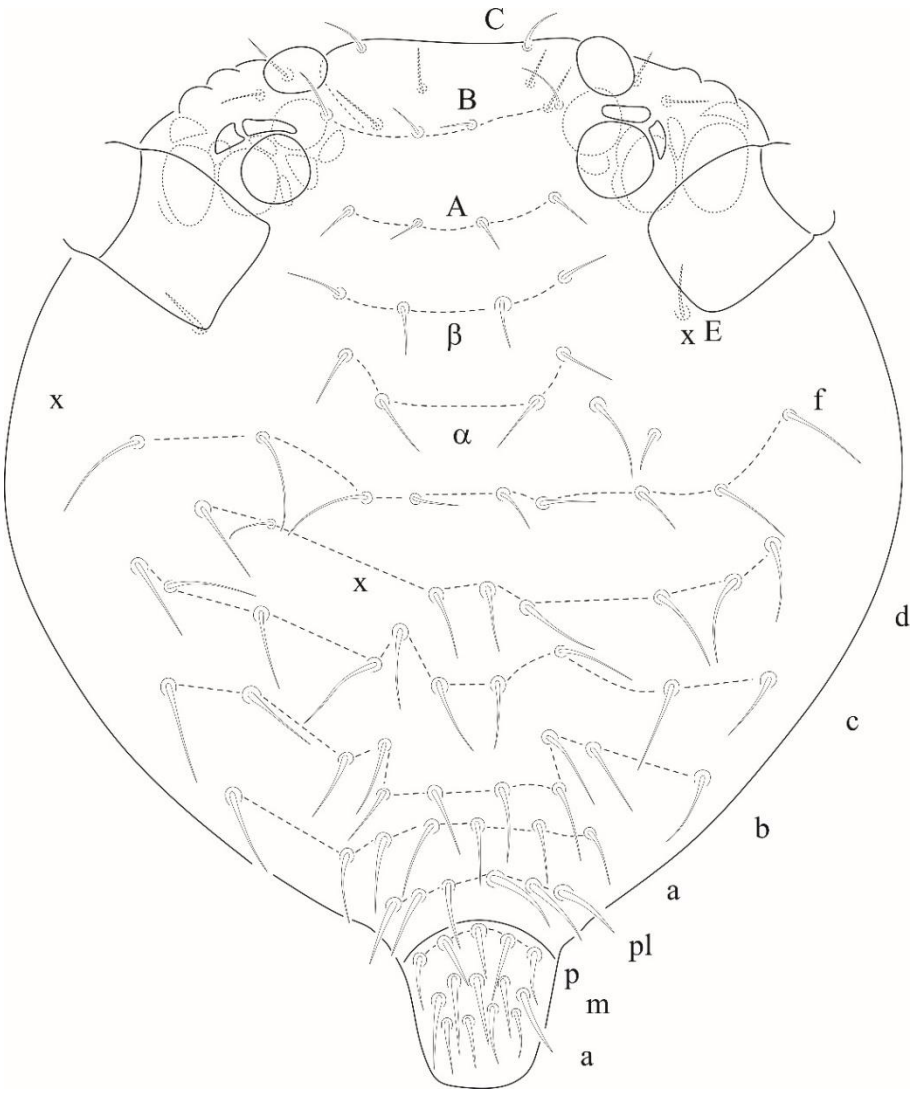


Figure 25. Female *Sminthurides pejelagarto* sp. nov., head and labral chaetotaxy.

Furcula. Manubrium with 7+7 setae (Fig. 39); length of dens (n = 17) 298 (270-300) and mucro (n = 17) 108 (100-120), mucronal lamellae reaching the apex, posterior internal side with 7 long setae, distal longer and proximal small. Ratio dens: mucro as: 3. Posterior surface of dens with about 60 setae (Fig. 30), anterior surface with 26 (Fig. 31). Chaetotaxy of great and small abdomen is similar to the male but with longer setae (Fig. 36) Genital setae thick, 2 + 2 (Fig. 37).

Etymology. *Sminthurides pejelagarto* **sp. nov**. is named after the fish *Lepisosteus* Lepisosteidae) known as "pejelagarto", typical food of Tabasco state which can live in fresh or marine water.

Distribution and habitat. The specimens in small ponds close to Emiliano Zapata (17° 44' 35.8" N, 91° 46' 30.4" W), in the area of Usumasinta, State of Tabasco, 30 masl. The city of Emiliano Zapata is in the municipality of the same name, in the state of Tabasco, Mexico.

The climate is warm and humid with rains in summer (Am, according to the Köppen classification of 1936). The average annual temperature is 27.5 °C, with an average annual rainfall of 1,829 mm, with rainy season spanning from June to November, while the dry season is from December to May (Servicio Meteorológico Nacional, 2020).

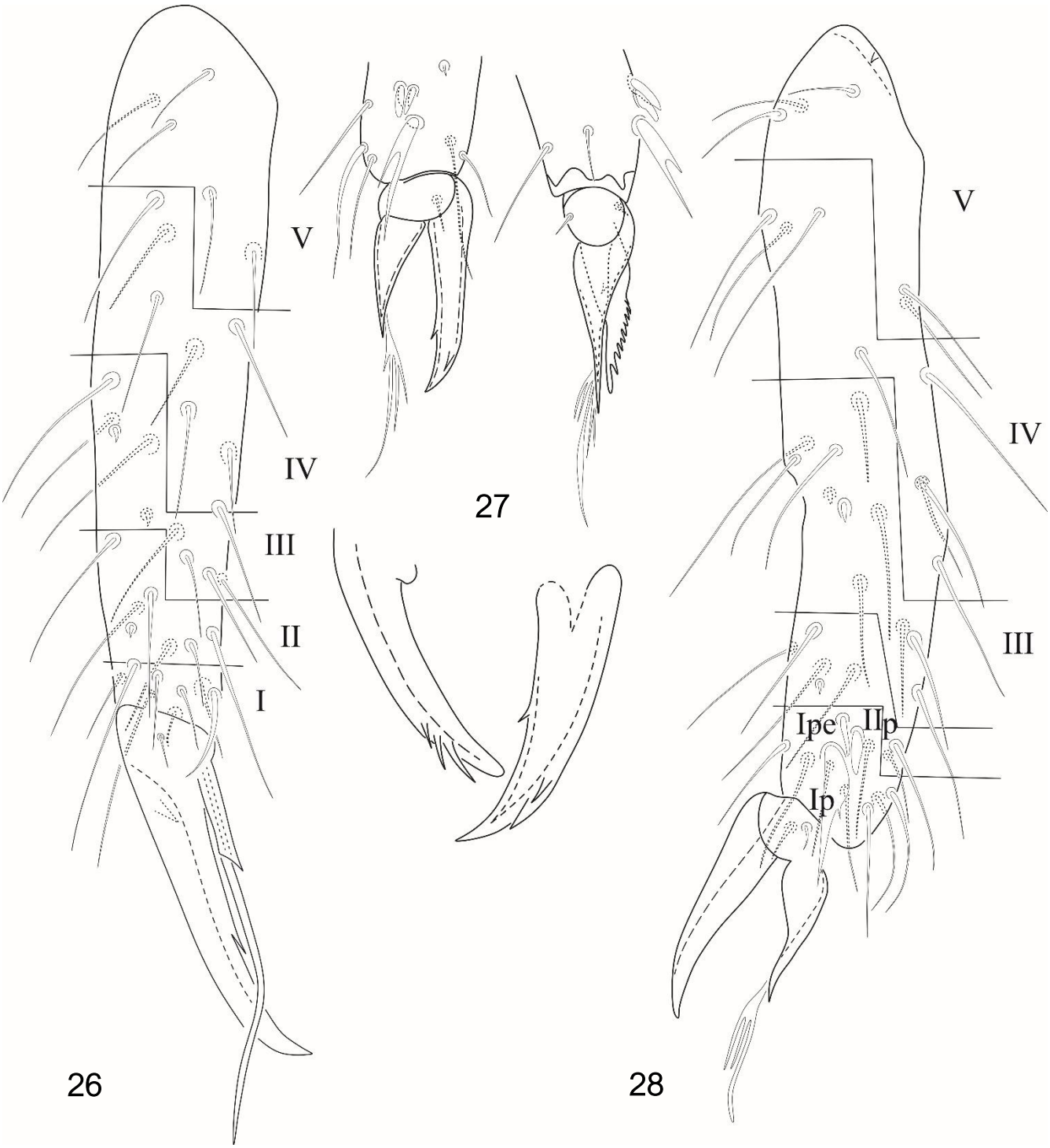


Figure 26-28. Female *Sminthurides pejelagarto* sp. nov. 26. Tibiotarsus and foot complex I; 27. Variation of filament of empodial appendix and ungual teeth III; 28. Tibiotarsus III, tibiotarsal organ and foot complex.

The area has a complex hydrological network, formed mainly by the Usumacinta River and its tributaries, the Chacamax rivers and the Hondo, Jobo and Pochote streams, which cause overflows and floods during the rainy season. The new species is distributed also at Agua Blanca (Macuspana) and Tlacotalpan (Veracruz State).

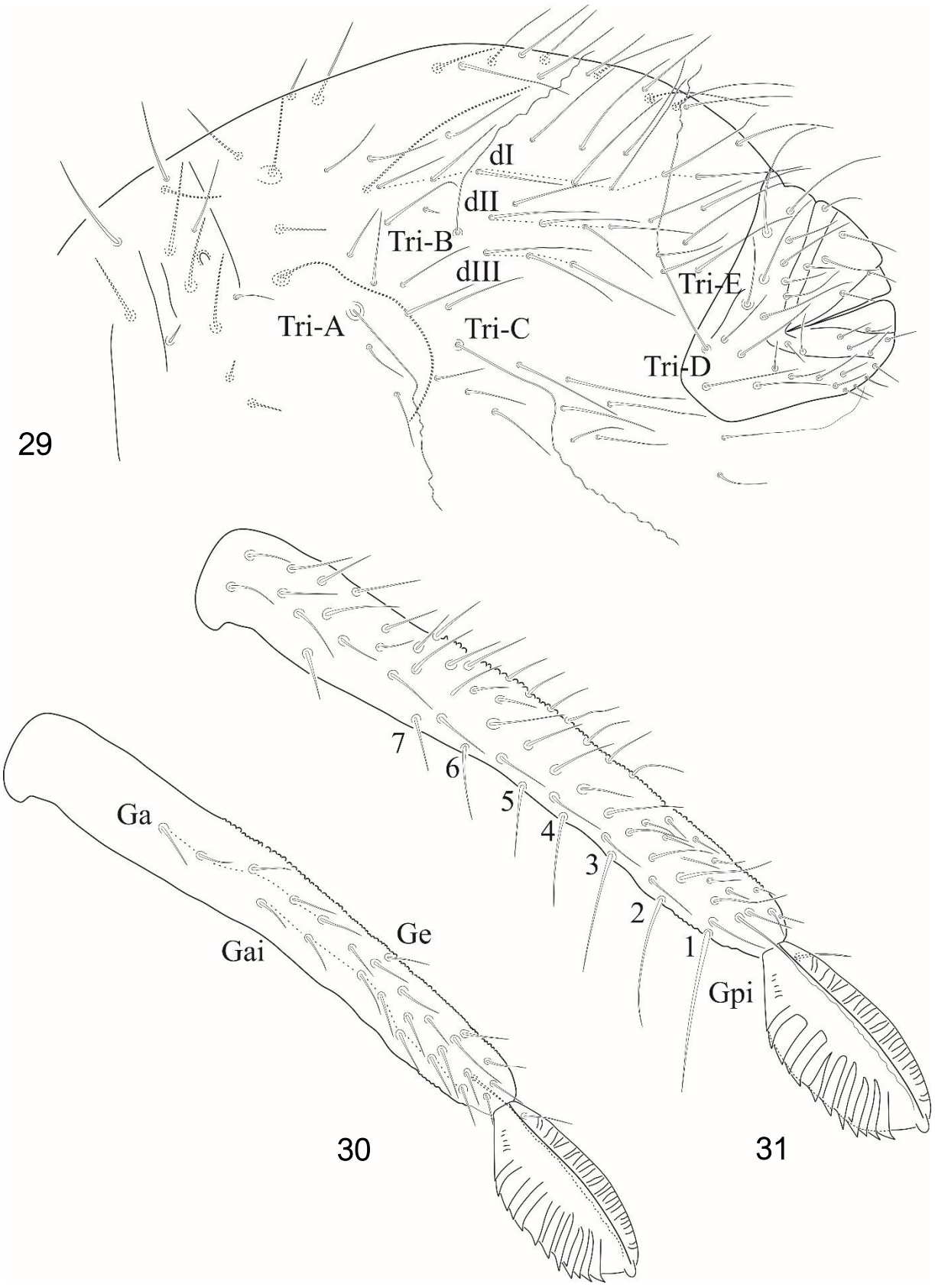


Figure 29-31. Female of *Sminthurides pejelagarto* sp. nov. 29. Great and minor abdomen chaetotaxy; 30. Dens and mucro posterior view; 31. Dens an mucro anterior view.

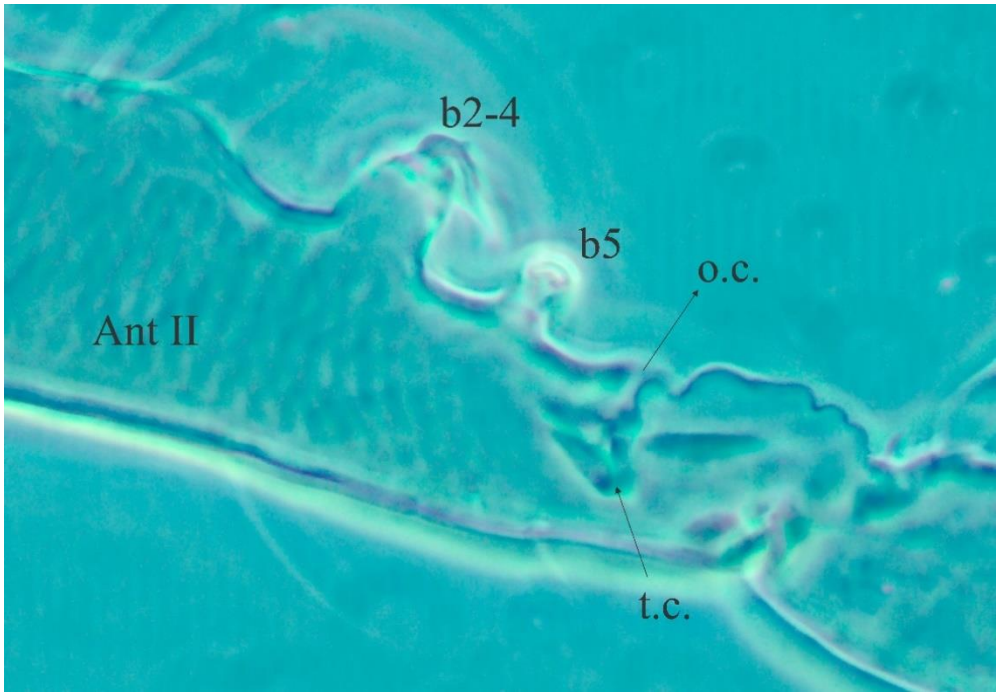


Figure 32. Male *Sminthurides pejelagarto* sp. nov., showing the triangular and opening cavity.

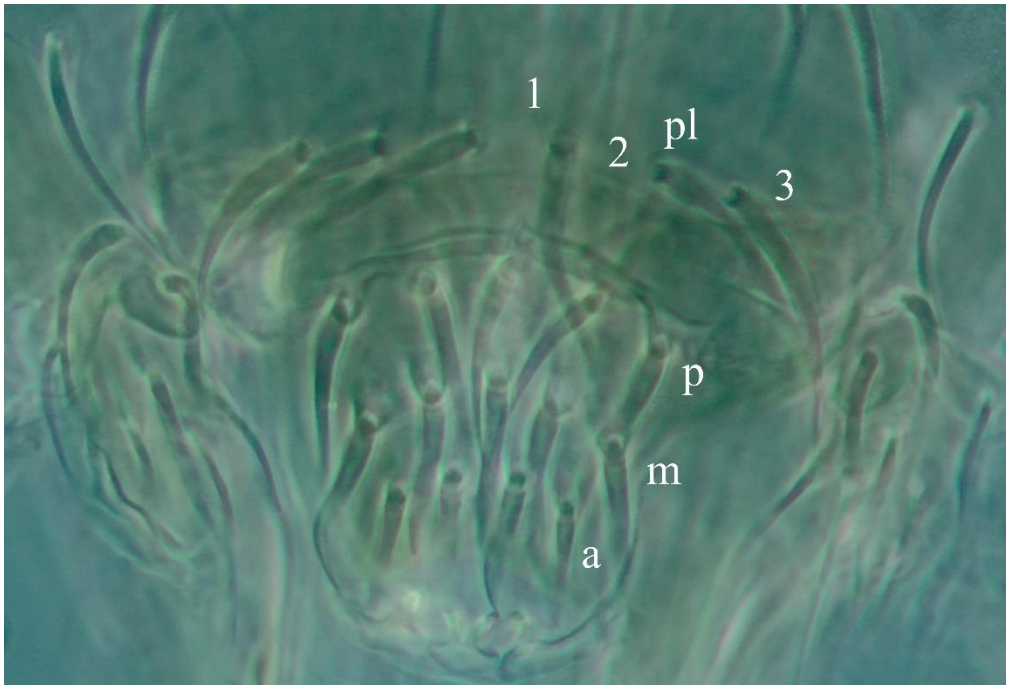


Figure 33. Female *Sminthurides pejelagarto* sp. nov., labral chaetotaxy.

Remarks. *Sminthurides pejelagarto* sp. nov. belongs to the *penicillifer*-group (Massoud & Betsch 1972) because it has two trichobotria (**Tra 1** and **Tra 2)** on Ant II. It has a mucro broad, trilamellate and dens with plurichaetosis as *S. bifidus* Mills, *S. condei* Delamare Deboutteville & Massoud and *S. spegazzinii* Borner. The new species differs from *S. bifidus* in the absence of inner tooth on unguis III and females have unguiculus III with filament splitting into branches (from 1 to 7 in the new species).

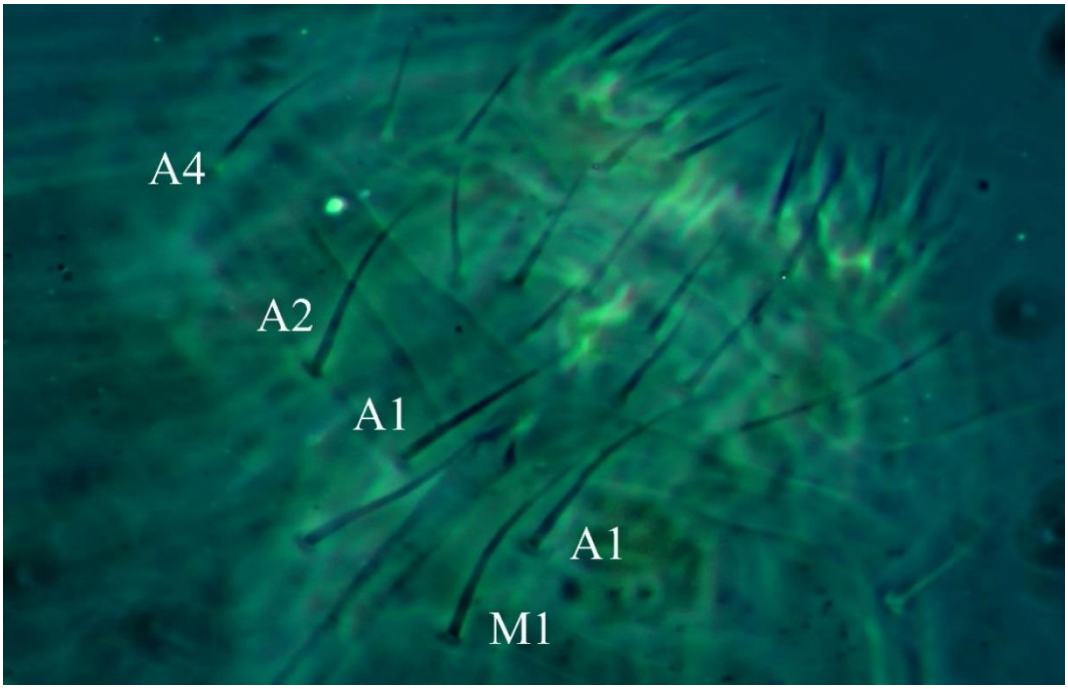


Figure 34. Male *Sminthurides pejelagarto* sp. nov., labial chaetotaxy.

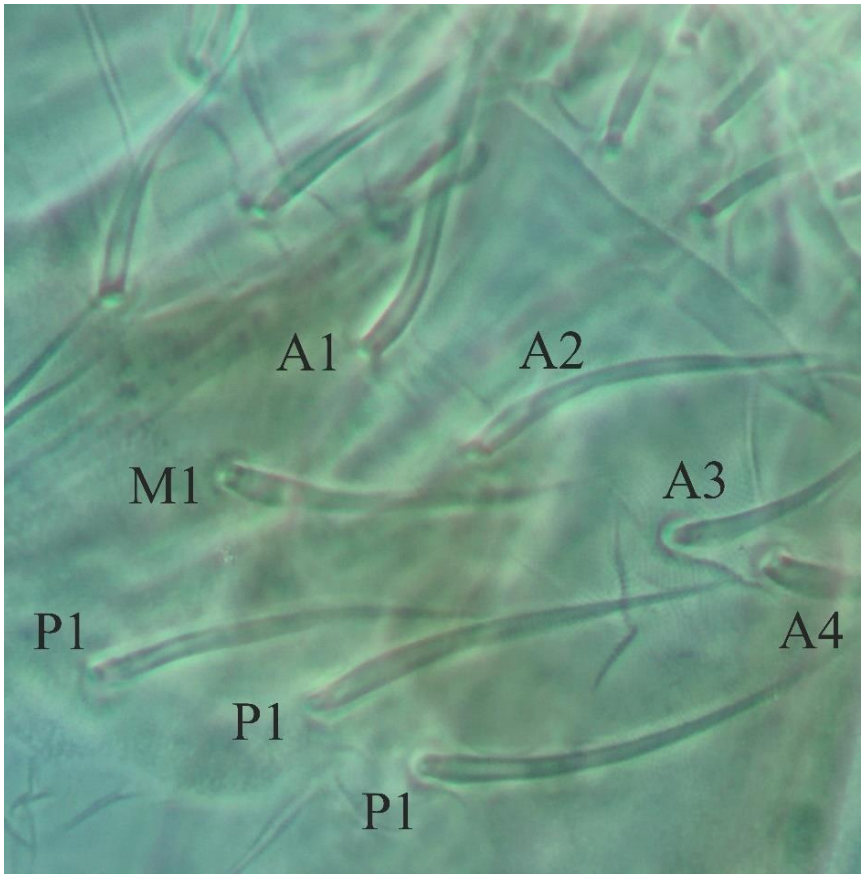


Figure 35. Female *Sminthurides pejelagarto* sp. nov., labial chaetotaxy.

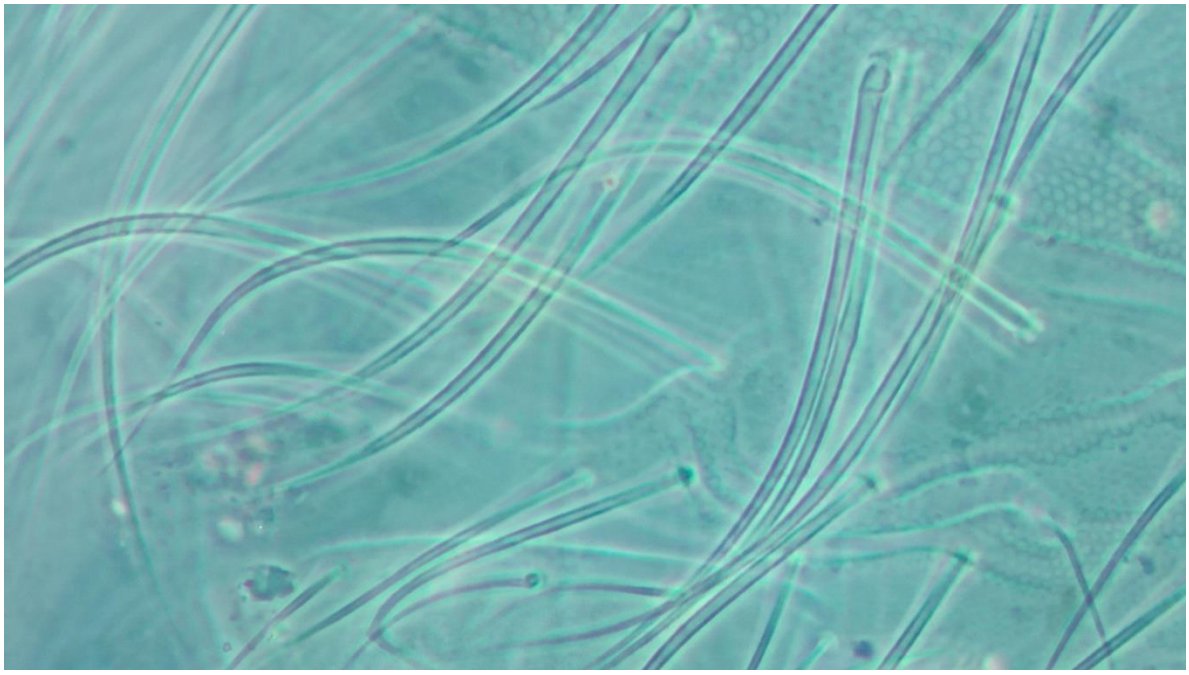


Figure 36. Female *Sminthurides pejelagarto* sp. nov., great abdominal setae.

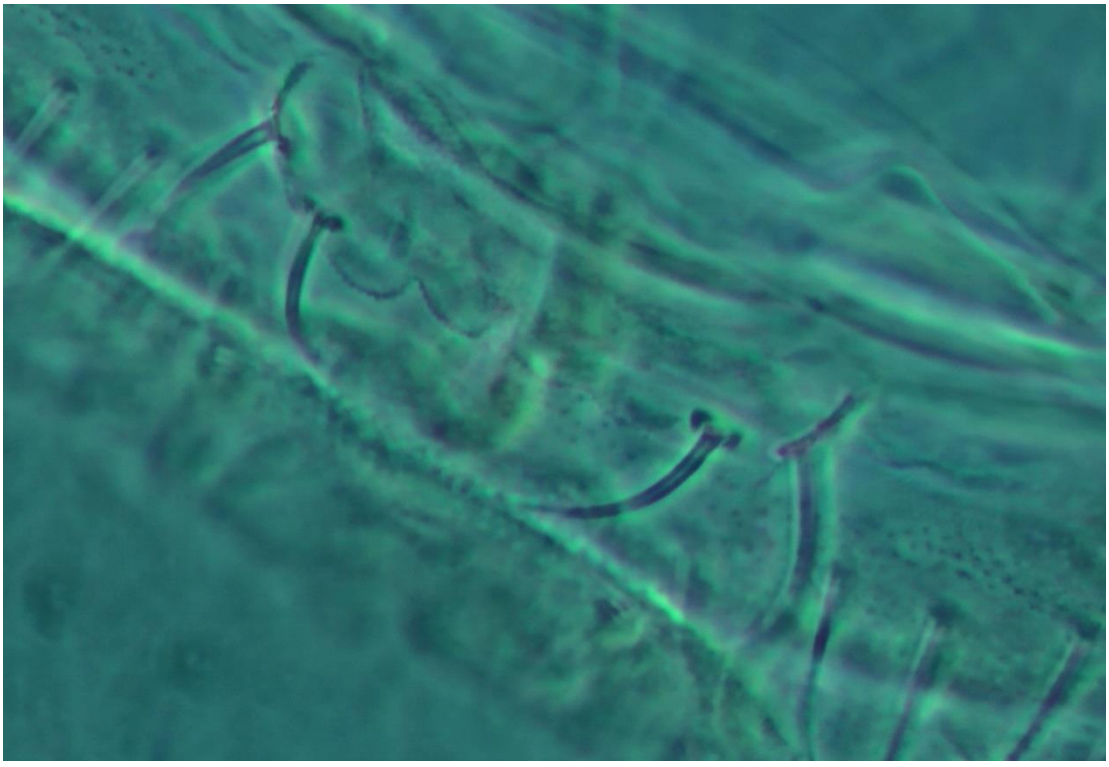


Figure 37. Female *Sminthurides pejelagarto* sp. nov., genital plate.

Female Ant. IV in *S. bifidus* subdivided into 5 subsegments while in *S. pejelagarto* sp. nov. it has 9 subarticles. *S. condei* has Ant. II b5 spherical and two head macrosetae in row f not seen in any other member of the genus and most dental setae similar in size. *S. spegazzinii* female has only 5 subsegments on Ant IV and a stronger setation on dens. Ventral Abd. IV of males differs from *S. fridakahloae* in having 6 setae (versus 3).

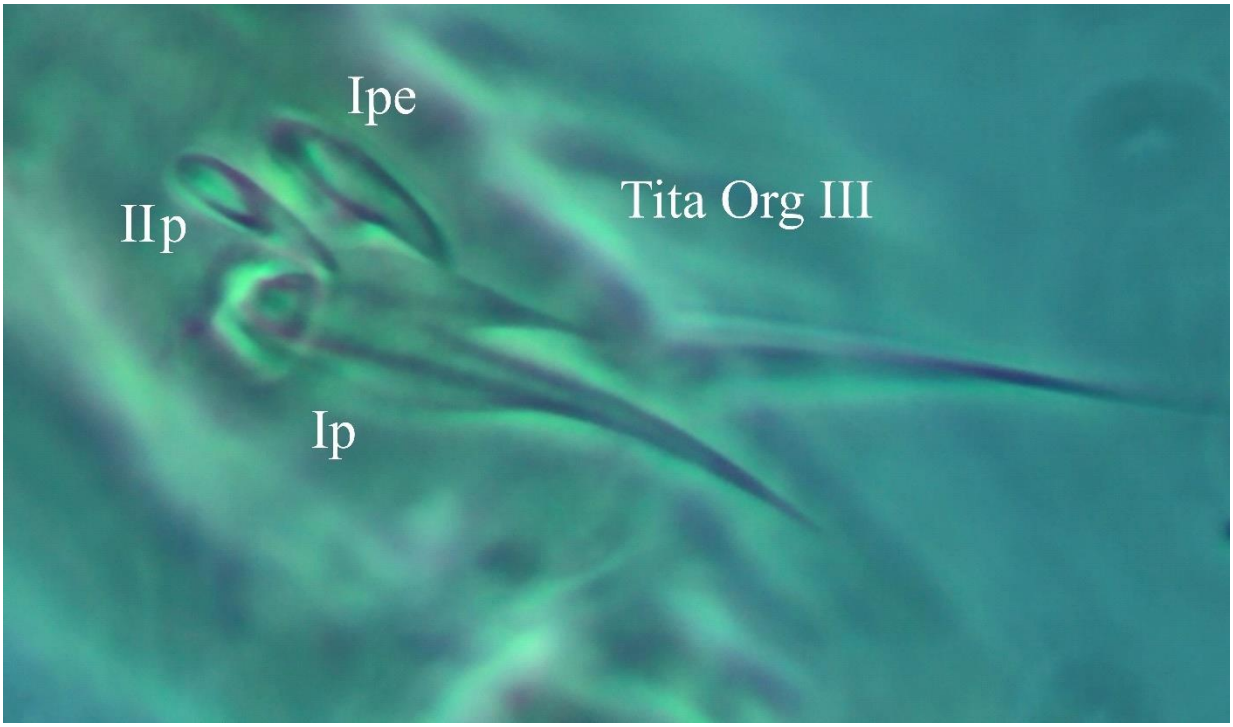


Figure 38. Female *Sminthurides pejelagarto* sp. nov. tita organ III.

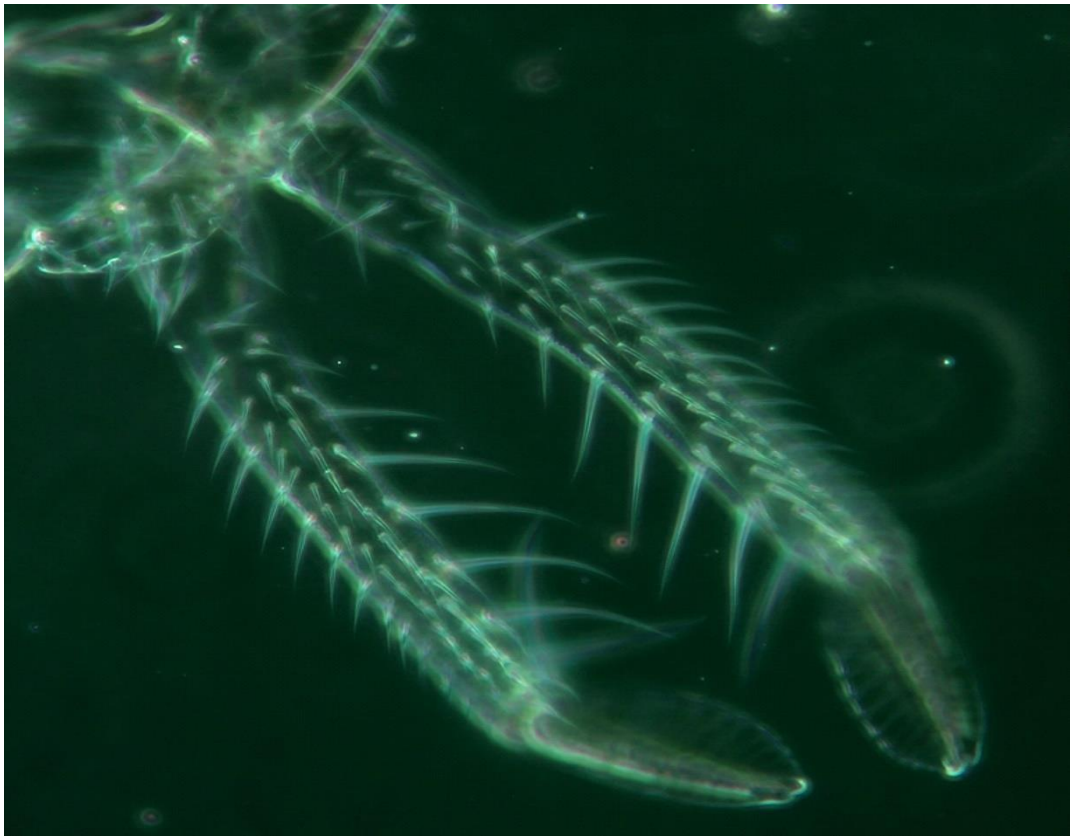


Figure 39. Female *Sminthurides pejelagarto* sp. nov. furcula in black champ.

Males with 4 pairs of postlabial setae in two rows and females with 8 pairs in three rows on *S. pejelagarto* sp. nov. Females are also more sclerotized than males and the labral and postlabial setae are thicker than those of males (Setae A and PI twice the size of males). Abdominal setae of female are very long, from 2.5 to 4 times those of male. In some keys males and females match with *S. penicillifer* (Schäffer), but they differ in the shape of mucro and dental setae. Postlabial setae were study and compared with several specimens from other countries and seta M1 can be a small spine as one undescribed species from Colombia (Cundinamarca: Sopo, 12-VII-2016, J. G. Palacios-Vargas and O. Pinzón col.).

Morphological Variation: Number of teeth in unguis varies from 1 to 7, and there is a variation of the number of branches of the empodial appendix of ungues III, as well as number of branches of the filament. The variation in the length of the morphological structures is given in the range.

Acknowledgments

Material from Tabasco was collected with the help of Mr. Aurelio Hernández, from Emiliano Zapata city and mounted under slides by Blanca E. Mejía (LESM). Dr. Silvia Espinosa (Facultad de Ciencias, UNAM) processed the specimens and took the scanning electron microphotos. Aila Ferreira (pos-doc at UNAM) participated in the selection of material for electron microscope study and taking the photos. Prof. Patricia Pinzón, Universidad Distrital "Francisco José de Caldas" of Colombia took the author to field work at Sopo, Cundinamarca. Drawings were inked by Jair Páez who also prepared the final plates. Erick García, which oversees the Science Faculty collections, assigned the catalogue numbers for the slides and he is the link with the CONABIO, who has supported the curation of the collection. Two reviewers gave criticism and suggestions for improving the manuscript.

Literature Cited

Bellinger, P. F., Christiansen K. A. and Janssens, F. (December 3rd, 2020). Checklist of the Collembola of the world. Available in: http://www.collembola.org

Betsch, J. M. (1980). Éléments pour une monographie des Collemboles Symphypleonés (Hexapodes, Aptérygotes). *Mémoires du Muséum national d'histoire naturelle. Série A Zoologie*, 116, 1–227.

Betsch, J. M. (1997). An ontogenetically focused chaetotaxical scheme in Symphypleona (Collembola): the 6th abdominal segment. *Pedobiologia*, 41, 13–18.

Betsch, J. M. and Waller, A. (1994). Chaetotaxic nomenclature of the head, thorax and abdomen in Symphypleona (Insecta, Collembola). *Acta Zoologica Fennic*a, 195, 5–12.

Börner, C. (1900). Vorlaufige Mittheilung zur systematik der Sminthuridae Tullb. inbesondere der genus *Sminthurinus*, *Latr. Zoologischer Anzeiger*, 23(630), 609–618.

Börner, C. (1901). Zur Kenntnis der Apterygoten-Fauna von Bremen und der Nachbardistrikte. Beitrag zu einer Apterygoten–Fauna Mitteleuropas. *Abhandlungen Naturwissenschaftliche Verein zu Bremen*, 17(1), 1–140. https://doi.org/10.5962/bhl.part.18332

Börner, C. (1906). Das system der Collembolen nebst Beschreibung neuer Collembolen des Hamburg-er. *Naturhistorischen Museums. Mitteilungen aus dem Zoologischen Museum in Hamburg*, 23, 147–188.

Börner, C. (1907). *Collembolen aus Ostafrika, Madagascar und Südamerika*. En: Voetzkow (Ed), Teise in Ostafrika in dem Jahren 1903-1905 Stuttgart 2 (pp. 147–178).

Ferreira, A.S., Arango, A. and Palacios-Vargas, J. G. (2021). Two new species of *Sminthurides* Börner, 1900 (Collembola: Sminthurididae) from Mexico with comments on the genus and a key to the members from the Americas. *Neotropical Entomology*, 50, 408-429. https://doi.org/10.1007/s13744-020-00831-5

Fjellberg, A. (1989). *Redescription of Mackenziella psocoides Hammer, 1953 and discussion of its systematic position (Collembola, Mackenziellidae).* En: Dallai, R. (Ed.), Third International Seminar on Apterygota. Siena, Italy, (pp. 93–105).

Folsom, J. W. and Mills, H. B. (1938). Contribution to the knowledge of the genus *Sminthurides* Börner. *Bulletin of the Museum of Comparative Zoology*, 82, 231–274.

Köppen, W. (1936). *Das Geographische Systemder Klimate*. In: Köppen, W. and Geiger, R. (Eds.), Handbuch der Klimatologie, Vol. I, Part C (pp. 1–44). Verlag von Gebrüder Borntraeger.

Linnaniemi, W. M. (1912). Die apterygotenfauna Finlands. II. Spezieller Teil. *Acta societatis scientiarum fênica*, 40,1–359.

Magaña-Martínez, C. S., Palacios-Vargas, J. G. and Navarrete-Heredia, J. L. (2019). Synthesis of Mexican Symphypleona (Hexapoda: Collembola) updated checklist with ecological and geographical distribution. *Zootaxa*, 4647, 55–66. https://doi.org.10.11646/zootaxa.4671.1.4

Massoud, Z. and Betsch, J. M. (1972). Étude sur les Insectes Collemboles II.-Les caractères sexuels secondaires des antennes des Symphypléones. *Revue d'Ecologie et de Biologie du Sol*, 9(1), 55–97.

Maynard, E. A. (1951). A Monograph of the Collembola or Springtail Insects of New York State., *Comstock Publishing Company Inc. Ithaca*. *New York*. (pp. 1–339).

Mills, H. B. (1934). A Monograph of the Collembola of Iowa. *Collegiate Press, Inc. Ames. Iowa*. (pp. 1–143).

Nayrolles, P. (1988). Chétotaxie tibiotarsale des collemboles Symphyplèones. *Travaux du Laboratoire d'Écobiologie des Arthropodes Édaphiques*, 5(4),1-19.

Nayrolles, P. (1990). Chétotaxie furcale des Collemboles Symphypléones. *Travaux du Laboratoire d'Écobiologie des Arthropodes Édaphiques*, 6(2), 27–50.

Palacios-Vargas, J. G. (1990). El uso de trampas epineústicas para la colecta de microartrópodos. *Folia Entomológica Mexicana*, 78, 275–277.

Palacios-Vargas, J. G. (1995). A new species of *Denisiella* (Collembola: Sminthurididae) from Nicaragua. *Revista Nicaragüense de Entomología*, 32, 25–33.

Palacios-Vargas, J. G. (1997). *Catálogo de los Collembola de México*. Universidad Nacional Autónoma de México. 280 p.

Palacios-Vargas, J. G. (2000). *La cutícula de los colémbolos acuáticos bajo el microscopio electrónico de barrido*. XXXV Congreso Nacional de Entomología. Acapulco, Guerrero, México.

Palacios-Vargas, J. G., Ferreira, A. S. y Zeppelini, D. (2018). Redefinition of *Denisiella* Folsom & Mills, 1938 (Collembola: Sminthurididae) with description of three new species from Brazil. *Zootaxa*, 4434, 111–129. https://doi.org/10.1164/zootaxa.4434.1.7

Palacios-Vargas, J. G. and Castaño-Meneses, G. (2009). Importance and evolution of sexual dimorphism in different families of Collembola (Hexapoda). *Pesquisa Agropecuaria Brasileira*, 44 (8), 959–963. https://doi.org/10.1590/s0100204x2009000800024

Palacios-Vargas, J. G., Cortés-Guzmán, D. and Alcocer, J. (2018). Springtails (Collembola, Hexapoda) from Montebello Lakes, Chiapas, Mexico. *Inland Waters*, 8(3), 264–272. https://doi.org/10.1080/20442041.2018.1439863

Pedigo, L. P. (1966). A new Sminthurid from northwestern Indiana with a redescription of *Sminthurus trilineatus* Banks (Collembola: Sminthuridae). *Journal of the Kansas Entomological Society*, 39 (1), 90–98.

Servicio Meteorológico Nacional. (2020). Datos de estación meteorológica Emiliano Zapata. Available in: https://smn.conagua.gob.mx/tools/RESOURCE/Estadistica/27012.pdf

Vargovitsh, R. S. (2009). New cave Arrhopalitidae (Collembola: Symphypleona) from the Crimea (Ukraine). *Zootaxa*, 2047(1), 1–47. https://doi.org/10.11646/zootaxa.2047.1.1