A new species of *Seira* Lubbock (Collembola, Entomobryidae), with a key to the species of Paraíba, Brazil

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ABSTRACT. A new species of *Seira* Lubbock (Collembola, Entomobryidae), with a key to the species of Paraíba, Brazil. A new species of Entomobryidae of the genus *Seira* Lubbock, *S. paraibensis* **sp. nov**. is described and illustrated. The type locality of the species is the municipality of Areia, state of Paraíba, Brazil. The species was found inhabiting the Atlantic forest litter and top soil environment. *S. paraibensis* **sp. nov.** resembles *S. pseudoannulata* in many morphological features. This is the sixth species of the genus found and described in Paraiba so far. A key with the 11 species of *Seira* registered so far in Paraíba is provided. Also a list with all species of the genus from Brazil is presented.

KEYWORDS. Brazilian collembolan diversity; chaetotaxy patterns; Entomobryomorpha; list of species; Seirinae.

RESUMO. Uma nova espécie de *Seira* Lubbock (Collembola, Entomobryidae), com chave para as espécies da Paraíba, Brasil. Uma nova espécie de Entomobryidae do gênero *Seira*, *S. paraibensis* **sp. nov.** é descrita e ilustrada. A localidade tipo da espécie é o município de Areia, no Estado da Paraíba, Brasil. A espécie foi encontrada habitando o folhiço e solo superficial de um remanescente de Mata Atlântica. *S. paraibensis* sp nov. possui muitas similaridades em sua morfologia com *S. pseudoannulata*. Esta é a sexta espécie do gênero encontrada e descrita na Paraíba até o momento. Uma chave com as 11 espécies de *Seira* registradas até o momento na Paraíba é apresentada, juntamente com uma lista com todas as espécies do gênero encontradas no Brasil.

PALAVRAS-CHAVE. Diversidade brasileira de Collembola; Entomobryomorpha; lista de espécies; padrões de quetotaxia; Seirinae.

Entomobryidae is the most diverse family of Collembola (Bellinger *et al*. 1996–2008; Soto-Adames 2008). The species of this family usually have long appendages such as antennae, legs and furca, like other Entomobryomorpha (Bellinger *et al*. 1996–2008; Christiansen & Bellinger 1998). Entomobryidae distinguishes itself from other families by the presence of multiciliated setae on body, an abdominal segment IV longer than III, crenulate dens and a small mucro with one or two well developed teeth (Zeppelini & Bellini 2006; Soto-Adames *et al.* 2008).

Seira Lubbock is one of the most assorted genera in Entomobryidae with 178 described species so far (Bellini & Zeppelini 2008). The genus is formed by epiedaphic species which are distributed predominantly in tropical areas (Bellinger *et al.* 1996-2008, Christiansen & Bellinger 2000, Barra 2004). Many species of *Seira* were found in high temperature forested areas or even in open hot semi-arid regions, which points to the natural resistance of the group to the heat and water shortage. There are 48 species of *Seira* in the Americas, 20 of them occurring in Brazil (Mari Mutt & Bellinger 1990, 1996; Mari Mutt *et al.* 1998–2008; Christiansen & Bellinger 1998; Culik & Zeppelini 2003; Bellini & Zeppelini 2005, 2008; Zeppelini & Bellini 2006).

The morphology of *Seira* is very similar to *Entomobrya* Rondani and *Lepidocyrtus* Bourlet. *Seira* can be distinguished from other genera in Entomobryidae by the following features: the presence of yellowish or brownish rounded scales covering almost all the head body and at least the first segments of the appendages; the presence of seven or eight well developed lenses on each eye spot; and a falcate mucro (Jacquemart 1974; Mari Mutt 1986; Christiansen & Bellinger 2000).

The newly described species of *Seira* was collected in forest litter and top soil of a transition vegetation called *Brejo de altitude*, a sort of remnant of Atlantic forest in the semi-arid region with predomination of the xeromorphic Brazilian *caatinga*. This species was found in Areia, a small municipality in the state of Paraíba, northeastern Brazil. The chaetotaxy scheme follows the system of Christiansen & Bellinger (2000) modified from Jacquemart (1974).

MATERIAL AND METHODS

The specimens were collected during the dry season with entomological aspirators, directly from litter and soil samples transferred to white trays. The specimens were fixed in ethanol at 70%.

The specimens were mounted on glass slides with Hoyer liquid following the procedures described by Christiansen &

Bellinger (1998). The type material is deposited at the Museu Nacional, Universidade Federal do Rio de Janeiro (CM/MNRJ/UFRJ).

The key to the species of *Seira* from Paraíba was made with the most common characters used in descriptions of species of Entomobryidae, like color patterns, dorsal chaetotaxy features, shape of antennae and feet complexes (Bellinger *et al.* 1996–2008; Christiansen & Bellinger 2000).

The list with 21 species of *Seira* recorded in Brazil was obtained by the revision of Culik & Zeppelini (2003), Zeppelini & Bellini (2006) and Bellini & Zeppelini (2005, 2008).

***Seira paraibensis* sp. nov.**

(Figs. 1–3)

Etymology. The species was named after its type location.

Description. Total length of the holotype 2,05 mm, other measures are listed in Table I. *Habitus* typically entomobryid (Figs. 1, 2A). Color of specimens in alcohol pale yellow with light blue pigment covering the antennae and legs and dark blue pigment covering eyepatches, lateral borders of mesothorax and lateral borders of abdominal segments III and IV and distal femurs (Fig. 1). Color of specimens mounted in Hoyer, pale white, with light blue pigment covering antennal segments I and II, posterior half of the head, lateral borders of mesothorax and lateral borders of abdominal segments III and IV and legs. Dark blue pigment covering antennal segments III and IV, eye patches and anterior half of the head. Brownish rounded scales covering all antennal segments, head, thorax, abdomen, coxae, trochanters, femurs, tibiotarsi, manubrium and dens. Antennal segment IV weakly annulated, with a bilobed apical bulb and no pin setae (Fig. 2B). Eye patches

Fig. 1. *S. paraibensis* **sp. nov**. *Habitus* of a fixed specimen.

oval, with the largest lens being A and the smallest lens being G, with three interocular feathered setae (Fig. 2C). Pre-labral and labral setae smooth. Labial triangle seta r reduced, M1, M2 and E feathered (Fig. 2D). Trochanteral organ in V- shape with 32 spine-like setae (Fig. 2E). Pro, meso and meta ungues with four inner teeth, one pair at the basis and two unpaired teeth at the apex (Figs. 2F-H). Unguiculi truncate (Figs. 2F-H),

Table I. Comparative lengths of segments of the body of *S. paraibensis* **sp nov.** Ant. = Antennal Segment; Abd. = Abdominal Segment; C. D. = Cephalic Diagonal Measurements were taken from holotype. * conversion rate to μm = x10

Segments	*S. paraibensis*
Ant. IV	64
Ant. III	36
Ant. II	31
Ant. I	20
Head length	35
Head (C. D.)	37
Mesothorax	27
Metathorax	16
Abd. I	11
Abd. II	12
Abd. III	16
Abd. IV	60
Abd. V	15
Abd. VI	6
Manubrium	40
Dens	54
Mucro	2

Table II. Comparison of characters of *Seira* species.

Species	Lobes on antennal apical bulb	Annulations on 4th antennal segment	Ratio antenna / cephalic diagonal	Unguiculus shape
*paraibensis**	2	+-	4.1	TR
pseudoannulata	1	+	2.3	TR
annulata	2	+-	2.25 - 2.65	TR

Species	Number of inner ungual teeth	Distinctly larger inner ungual tooth	Spine-like setae at base of dens	Number of ventral manubrial subapical setae
*paraibensis**	4	M+, A-	-	8
pseudoannulata	4	-	-	6
annulata	3	-	-	4?

TR = truncate; A- = minor apical; M+ = larger medial; + = present; - = absent; +- = present but weak; ? = uncertain. *Measurements were taken from the holotype.

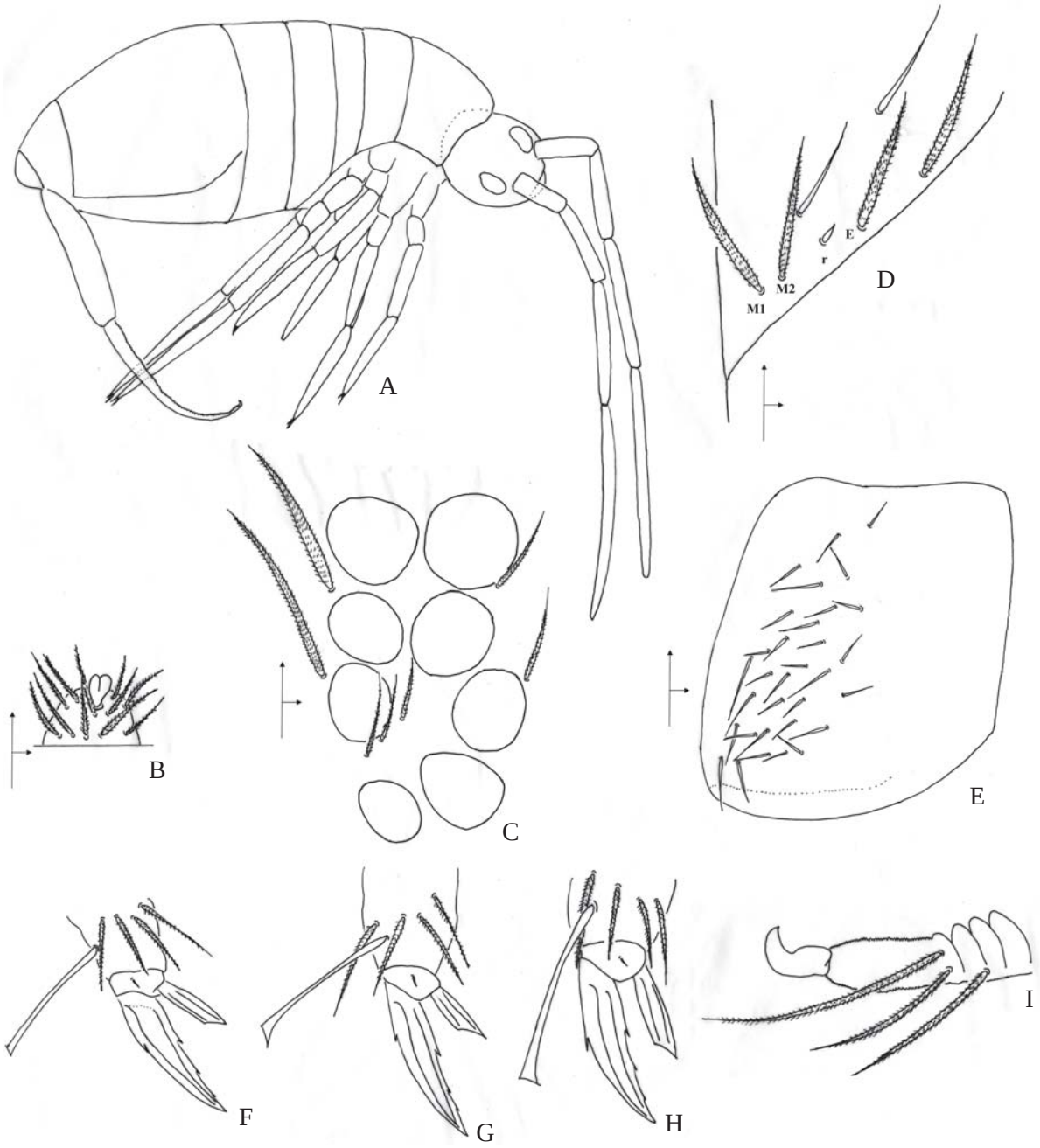

Fig. 2. *S. paraibensis* **sp. nov**. A, *habitus*; B, labial quaetotaxy; C, apical bulb of 4th antennal segment; D, right eye patch; E, metatrochanteral organ; F, first foot complex; G, second foot complex; H, third foot complex; I, distal dens and mucro.

with slightly serrated edges. Tenent hair capitate (Figs. 2F-H) with smooth edges. Venter of manubrium with eight subapical setae. No spine-like setae present on the manubrium. Mucro typically falcated (Fig. 2I). Dorsal macrochaetae distribution of head and body as in fig. 3. Other characteristics are listed in Table II.

Taxonomic Summary

Holotype. BRAZIL, Paraíba: Areia, female, 11-XI-2008. Bellini & Zeppelini leg. Paratypes. 4 males, 4 females. BRAZIL, Paraíba: Areia, 11/12-XI-2008. Bellini & Zeppelini leg.

Habitat. The climate of the type locality is 'As' following Koeppen's system (Kottek *et al.* 2006) which means the main climate of the area is equatorial and the precipitation levels indicate a dry summer. Areia is located at 620 meters over the sea level and at approximately 93km far away of the coast of Paraíba. The Good's biogeographic zone is 27 (Good 1974).

Remarks. The closest species to *S. paraibensis* **sp. nov.** is *S. pseudoannulata* Bellini & Zeppelini, 2008. The cephalic regions 1, 2, and 4 have a similar number and pattern of distribution of macrochaetae. The cephalic region 5 has only

one macrochaetae and there are no macrochaetae on cephalic region 6 on both species. On mesothorax, the superior half of region 2 and region 3A have five macrochaetae each, in a similar distribution on the two species. Metathorax and abdominal segments I and II have the same dorsal chaetotaxy pattern, and the number of macrochaetae on region B of the abdominal segment III is the same in *S. paraibensis* **sp. nov.** and *S. pseudoannulata*. Both species also shares annulations on the antennae IV, truncate unguiculi, same teeth formulae on the claws, furthermore they are distributed in relatively adjacent areas, since the type locality of *S. pseudoannulata* is Mataraca, a municipality on the north coast of Paraíba State (Bellini & Zeppelini 2008). Despite all these similarities both species can clearly be distinguished from each other by the presence of two macrochaetae on the cephalic region 3 of *S. paraibensis* **sp. nov.** and none on *S. pseudoannulata*, many differences on the dorsal chaetotaxy in fields 1, 3B, 3C of metathorax, the presence of one macrochaetae on region A of abdominal segment III in *S. paraibensis* **sp. nov.** and none in *S. pseudoannulata*, and a completely distinct chaetotaxy on abdominal segment IV on both species.

It's very likely that *S. paraibensis* **sp. nov.** and *S. pseudoannulata* are closely related. Another somewhat similar species is *S. annulata* (Handschin), 1927, which was also recorded in Brazil (Table III) (Culik & Zeppelini 2003, Christiansen & Bellinger 2000). The three species share annulations on antennae IV, truncate unguiculi, absence of macrochaetae on cephalic region 6 and they have similarities on the number and disposition of macrochaetae on regions 2 and 3A of mesothorax, metathorax, and abdominal segments I, II and III (Christiansen & Bellinger 2000, Bellini & Zeppelini

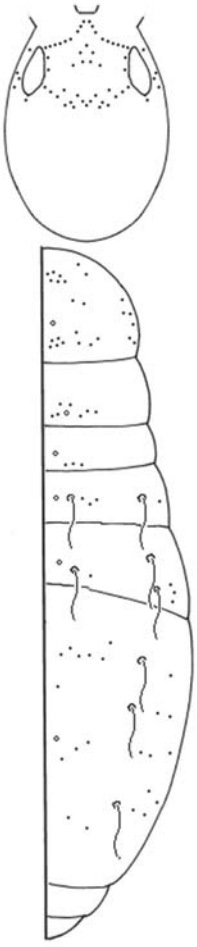

Fig. 3. *S. paraibensis* **sp. nov**. Dorsal macrochaetae distribution.

Table III. List of the Brazilian *Seira* species.

Species	Brazilian distribution	Habitat
S. annulata (Handschin, 1927)	SP	Close to a lagoon
S. arenicola Bellini & Zeppelini, 2008	PB	Dune land, forest litter
S. atrolutea (Arlé, 1939)	MS, SP	Unknown
S. brasiliana (Arlé, 1939)	MS, PB, RJ, SP	Unknown
S. eidmanni (Stach, 1935)	RJ, SP	Ant nests, tree barks
S. mataraquensis Bellini & Zeppelini, 2008	PB	Forest litter
S. melloi (Arlé, 1939)	ES, RJ	Lichen, moss
S. mendoncea Bellini & Zeppelini, 2008	PB	Top soil, litter
S. mirianae Arlé & Guimarães, 1981	PB, RJ	Dune land, forest litter
S. musarum Ridley, 1890	PE (F. de Noronha)	On plants
S. nigrans (Arlé, 1959)	MT, PB	Scrubland, litter
S. nunezae Christiansen and Bellinger, 2000	MS, SP	Litter, top soil
S. paraibensis **sp. nov.**	PB	Forest litter
S. paranensis (Stach, 1935)	PR	Unknown
S. prodiga (Arlé, 1959)	MT, PB, PE, RJ	Forest litter
S. pseudoannulata Bellini & Zeppelini, 2008	PB	Forest litter
S. pulcher (Handschin, 1924)	SC	Unknown
S. raptora Zeppelini & Bellini, 2006	PB	Top soil, litter
S. reichenspergeri (Handschin, 1924)	SC	Unknown
S. subannulata (Denis, 1933)	ES, RJ	Lichen, moss
S. xinguensis (Arlé, 1959)*	MT, PB	Litter, top soil

* *S. xinguensis* was considered here a full species taxon and not a subspecies of *S. prodiga*

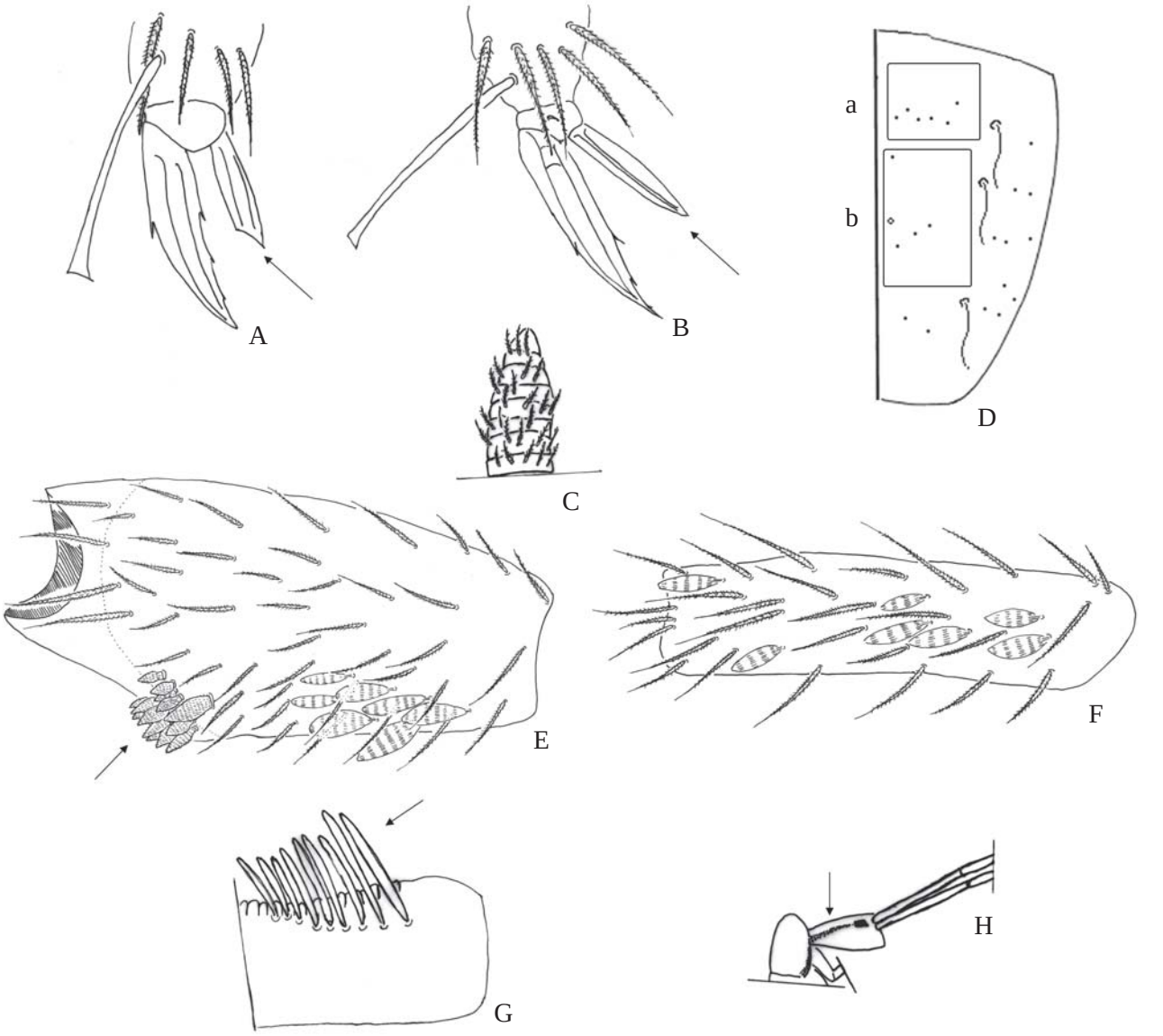

Fig. 4. A, Foot complex with a truncate unguiculus; B, foot complex with a acuminate unguiculus; C, apex of an annulate antenna; D, fourth abdominal segment showing regions a and b; E, enlarged femur with spines of males of *S. raptora*; F, regular femur of a *Seira* species; G, row of large blunt smooth setae on dens; H, Head of *S. xinguensis* showing a dark lateral line of pigment.

2008). Other characters are listed on Table II. However, only a complete phylogenetic revision of the genus will clarify the real relationships among the species.

In Paraíba we found until present, including *S. paraibensis* **sp. nov.**, 11 species of *Seira* (Bellini & Zeppelini 2005, 2008; Zeppelini & Bellini 2006), with six new species identified and described to the state. In Brazil there are now 21 described species of *Seira*, as shown in Table III.

A key to the species from Paraíba is presented below. *S. prodiga* Arlé, 1959, *S. xinguensis* Arlé, 1959 and *S. nigrans* Arlé, 1959 can only be distinguished from each other by distinct color patterns (Arlé 1959) and the ratio of some segments (Christiansen & Bellinger 2000). It is possible that *S. prodiga* and *S. xinguensis* are the same species (Arlé 1959), and the dorsal chaetotaxy of *S. nigrans* was not presented in any literature. A revision of the three taxa is important to indicate the true status of them.

Key to the species of *Seira* from Paraíba, Brazil

1. Unguiculi truncate (Fig. 4A), fourth antennal segment annulate (Fig. 4C) 2
   Unguiculi acuminate (Fig. 4B), fourth antennal segment not annulate 3

2. Regions a and b of the fourth abdominal segment with 6+6 and 4+4 macrochaetae respectively (Fig. 4D) .... *S. paraibensis* **sp. nov.**
   Region a of the fourth abdominal segment with 4+4 macrochaetae and region b without macrochaetae .... *S. pseudoannulata*

3. First abdominal segment without macrochaetae 4
   First abdominal segment with at least 2+2 macrochaetae . 5

4. Metathorax with 10+10 macrochaetae or more; femurs of the first pair of legs of males greatly enlarged, bearing spines in a ventral projection (Fig. 4E) ..... *S. raptora*
   Metathorax with 6+6 macrochaetae; first pair of legs of males similar to the females (Fig. 4F) ..... *S. mirianae*

5. Dens with a row of large blunt smooth setae (Fig. 4G) 6
   Dens normal, without large blunt setae 8

6. Head dark ..... *S. nigrans*
   Head pale 7

7. Head with a dark lateral line of pigment starting behind the eye patches (Fig. 4H) ..... *S. xinguensis*
   Head without a lateral line of pigment ..... *S. prodiga*

8. First abdominal segment with 4+4 or less macrochaetae .. 9
   First abdominal segment with 5+5 macrochaetae 10

9. First abdominal segment with 2+2 macrochaetae; dorsal vertex of the head with 4+4 macrochaetae .. *S. brasiliana*
   First abdominal segment with 4+4 macrochaetae; dorsal vertex of the head without macrochaetae .... *S. mataraquensis*

10. Regions a and b of the fourth abdominal segment with 2+2 and 4+4 macrochaetae respectively ..... *S. mendoncea*
    Region a of the fourth abdominal segment with 2+2 macrochaetae and region b without macrochaetae .... *S. arenicola*

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