

Scorpion diversity and endemism in the Rio Negro region of Brazilian Amazonia, with the description of two new species of *Tityus* C.L. KOCH (Scorpiones, Buthidae)

by

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Abstract

In recent publications, evidence based on the biodiversity and biogeographic patterns of scorpions has been proposed in support of the hypothesis that Rio Negro is one of the most important endemic regions of occidental Amazonia. In this note, two new species of buthid belonging to the genus *Tityus* C.L. KOCH are described from the areas of Barcelos and São Gabriel da Cachoeira, respectively in central and upper Rio Negro. These new descriptions provide further confirmation of the high biodiversity and important level of endemism found in the Rio Negro region.

Keywords: **Brazil, Amazonia, Rio Negro region, biodiversity, endemism, scorpion, new species.**

Resumo

Em publicações recentes, evidências fundadas em padrões biogeográficos e de biodiversidade de escorpiões foram propostas para apoiar a hipótese que a região do Rio Negro é uma das mais importantes regiões em endemismo de toda a Amazonia ocidental. No presente artigo, duas novas espécies de Buthidae pertencentes ao gênero *Tityus* C.L. KOCH são descritas das regiões de Barcelos e São Gabriel da Cachoeira, respectivamente no médio e alto Rio Negro. Essas novas descrições constituem um elemento suplementar que confirma os altos índices de biodiversidade e de endemismo encontrados na região do Rio Negro.

Introduction

The Rio Negro region includes a large area of Northwestern Brazilian Amazonia, as well as parts of Venezuelan and Colombian Amazonia (PRANCE 1973, 1982; LOURENÇO 1986). The extreme complexity of diversity and endemism in the middle and upper Rio Negro area has already been discussed by STEYERMARK (1979) and PRANCE (1982).

Of the different regions within the Amazon basin, the Rio Negro, was among the last to attract the attention of investigators because most of the pioneer work in Amazonia was carried out along the Amazon and Solimões rivers, in some cases up to Peru (PAPAVERO 1971, 1973). In so far as scorpions are concerned, only in recent decades has more intensive collecting been made in the Rio Negro region. Nevertheless, this has resulted in several new discoveries and descriptions. A preliminary synthesis, proposed

by LOURENÇO (1994), indicated at least two families, six genera and 14 species of scorpions, with a total of 93 % of endemic species, in the upper Rio Negro region. More recently new elements were described from central Rio Negro (LOURENÇO 1997; LOURENÇO & MOLteni MACHADO 2004). Especially significant is a new species of *Opisthacanthus*, family Liochelidae (LOURENÇO & FÉ 2003).

Because of their low vagility, scorpions have frequently been used as biogeographic tools (LOURENÇO 1996). In this note, two new species of buthid belonging to the genus *Tityus* C.L. KOCH are described from the areas of Barcelos and São Gabriel da Cachoeira, respectively in central and upper Rio Negro. These new descriptions provide new evidence of the very high biodiversity and the important level of endemism of the Rio Negro region.

Description of the area

Barcelos is located nearby the margins of Rio Negro, about half way between Manaus and São Gabriel da Cachoeira. Instead, São Gabriel da Cachoeira is within the upper Rio Negro region, in the vicinity of the 'Pico da Neblina', the highest altitude in Brazil (3014 m). This forms part of the 'Sierra Imeri' which belongs to the Roraima formation. Neblina is located on the border of Brazilian and Venezuelan Amazonia (from 0°S67W to 1°N66°W). According to BROWN (1982), the Neblina-São Gabriel area is characterized by two major types of vegetation: rich, dense forests on rolling terrain, and cloud or montane forests. The annual rainfall in this area ranges from 3000 to 4000 mm.

Taxonomic treatment

Descriptions

Tityus sylviae n.sp. (Figs. 1-8, Map)

Type material: Female holotype. Brazil, State of Amazonas, Barcelos, Rio Negro, 'Comunidade de Floresta', 2/VII/2002 (D.S.R. PINHEIRO), 'dentro de tronco caído' (rotten log) (INPA).

Paratypes: 1 female, same data as for holotype (INPA). 1 female, Barcelos, Estrada do Santo Antonio, 20/II/2003 (N.O. AGUIAR et al.), 'em tronco caído' (rotten log) (INPA). 1 female, Parna Jau, Seringalzinho, 01°52'34"S - 61°35'15"W (pitfall), 1-8/VIII/2001 (I. GHIZONI JR.); together with *Tityus dinizi* and *Tityus silvestris* (MNHN).

INPA = Instituto Nacional de Pesquisas da Amazônia, Manaus.

MNHN = Muséum national d'Histoire naturelle, Paris.

Etymology: Patronym is in honour of Sylvia Marlene LUCAS, Instituto Butantan, São Paulo, for her long involvement in the study of Brazilian Arachnida.

Diagnosis: Medium sized scorpions, measuring 45 to 50 mm in total length. Coloration yellowish to reddish yellow, with confluent dark spots over the carapace and tergites. Granulation moderate to strong over all the carapace and the tergites. Genital operculum covered by two large semi-oval plates. Fixed and movable fingers of pedipalps with 15/16 rows of granules. All carinae on body and appendages complete or almost complete, and generally strongly marked. Pectinal tooth count 19-20 in females.

Description: Based on female holotype and female paratypes.

Coloration. Basically yellowish to reddish yellow. Prosoma: Carapace reddish yellow, with the lateral regions darker; anterior edge lighter; regions behind the ocular tubercle and lateral eyes reddish yellow; eyes strongly marked with black pigment. Mesosoma: tergites I-VI reddish yellow with confluent dark spots. Metasoma: segments I to III yellowish; segment IV reddish yellow; segment V reddish. Vesicle: reddish yellow like segment IV; extremity of aculeus dark reddish. Venter yellowish to reddish yellow; pectines pale yellow. Chelicerae yellowish with variegated dark pigmentation on the anterior half; fingers reddish with blackish teeth. Pedipalps reddish yellow; chela hand yellowish; without spots on either.

Morphology. Carapace moderately to strongly granular; anterior margin with a weak concavity.

Anterior median carinae weak; posterior median carinae well developed, strong; central lateral and central median carinae vestigial. All furrows moderately deep. Median ocular tubercle anterior to the centre of the carapace; median eyes separated by a little more than one ocular diameter. Three pairs of lateral eyes. Sternum triangular. Mesosoma: tergites moderately to strongly granular. Median carina moderate to strong on all tergites. Tergite VII pentacarinata. Venter: genital operculum wider than long, and formed by two large semi-oval plates. Pectines: pectinal teeth count 19-19 (variation 19-20); basal middle lamellae of the pectines not dilated. Sternites with thin granulation and with elongate spiracles; VI with vestigial carinae; VII with four moderately developed carinae. Metasoma: segment I with 10 carinae; segments II-IV with 8 carinae; segment V with 5 carinae. Intercarinal spaces weakly to moderately granular. Telson with vestigial granulation on ventral and lateral surfaces and with a moderately long and strongly curved aculeus; shorter than vesicle; subaculear tooth strong and spinoid, with two, almost fused, dorsal teeth. Cheliceral dentition characteristic of the family Buthidae; ventral teeth on movable finger reduced (VACHON 1963); ventral aspect of both fingers and of manus densely covered with long setae. Pedipalps: femur pentacarinata; patella with 7 carinae; all carinae strongly developed; chela with 9 carinae; internal carinae on patella and chela with spinoid granules; femur, patella and chela weakly to moderately granular. Fixed finger with 15 and movable finger with 16 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A- α -alpha (VACHON 1974, 1975). Legs: tarsus with numerous short fine setae ventrally.

Relationships

The new species *Tityus sylviae* n.sp. belongs to the *Tityus bahiensis* species group. In its general pattern of coloration, the new species shows similarities with *Tityus confluens* BORELLI which is, however, distributed only in Chaco and Savannah formations in Argentina, Paraguay and south-western of Mato Grosso do Sul State in Brazil. In addition to this totally different range of distribution, the two species can be distinguished by: (i) different morphometric values, (ii) a darker pigmentation in the new species, (iii) carapace and tergite granulation is stronger in *T. sylviae* n.sp.

Tityus nelsoni n.sp. (Figs. 9-19, Map)

Type material: Male holotype. Brazil, State of Amazonas, São Gabriel da Cachoeira, 5-30/III/1992 (E. SOARES) (N° R. 235).

Paratypes: same data as holotype, 1 male; S.G. da Cachoeira, 'fronteira Brasil/Colombia', São Joaquim, Alto Rio Içaro (E. SOARES), 4 male juveniles, 1 female.

INPA = Instituto Nacional de Pesquisas da Amazônia.

MNHN = Muséum national d'Histoire naturelle, Paris.

Etymology: Patronym is in honor of Mr. Nelson F. Fé, in recognition of his continuous interest in the study of scorpions.

Diagnosis: Medium to large scorpions, measuring 55 to 60 mm in total length. Coloration yellowish to reddish yellow, without any marked spots over the carapace, tergites, legs and pedipalps. Granulation moderate to weak over all the body and pedipalps. Male pedipalps slightly more globular when compared with female pedipalps. Fixed and movable fingers of pedipalps with 14/14 rows of granules in males and 13-15 in females. Carinae on carapace and tergites vestigial to obsolete; those on metasoma and appendages complete or almost complete. Pectinal tooth count 16 to 18 in males and 17/19 in females.

Description: Based on male holotype and one female paratype.

Coloration. Basically yellowish to reddish yellow. Prosoma: carapace yellowish with some vestigial spots on the anterior edge; eyes strongly marked with black pigment. Mesosoma: tergites I-VII yellowish with pale reddish confluent zones. Metasoma: segments I to IV yellowish; segment V reddish without any spots. Vesicle: reddish yellow; extremity of aculeus darker than the base. Venter yellowish; pectines pale yellow. Chelicerae yellowish without any variegated dark pigmentation; fingers yellow with reddish teeth. Pedipalps pale yellow with chela fingers reddish; legs pale yellow; without any spots.

Morphology. Carapace weakly granular; anterior margin with a moderate concavity. Anterior median

and posterior median carinae weakly developed; other carinae obsolete. All furrows moderately deep. Median ocular tubercle anterior to the centre of the carapace; median eyes separated by more than one ocular diameter. Three pairs of lateral eyes. Sternum triangular. Mesosoma: tergites moderately to weakly granular. Median carina moderate on all tergites. Tergite VII pentacarinata. Venter: genital operculum wider than long. Pectines: pectinal teeth count 18-18 (male), 17-19 (female); basal middle lamellae of the pectines not dilated in either males or females. Sternites with very thin granulation and with elongate stigmata; VII with four vestigial carinae. Metasoma: segment I with 10 carinae; segments II-IV with 8 carinae; segment V with 5 carinae. Intercarinal spaces weakly to moderately granular. Telson with vestigial granulation on ventral and lateral surfaces in males and a strong granulation in females; aculeus moderately long but strongly curved; subaculear tooth strong and spinoid, with two dorsal teeth. Cheliceral dentition characteristic of the family Buthidae; ventral teeth on movable finger strongly reduced (Vachon, 1963); ventral aspect of both fingers and of manus densely covered with long setae. Pedipalps: femur pentacarinata; patella with seven carinae; all carinae moderately to strongly developed; chela with nine carinae; internal carinae on femur and patella with spinoid granules; femur, patella and chela weakly granular. Male fixed finger and movable fingers with 14 oblique rows of granules; that of female with 13 and 15 rows of granules. Trichobothriotaxy; orthobothriotaxy A- α -alpha (VACHON 1974, 1975). Legs: tarsus with numerous short fine setae ventrally.

Relationships

The new species, *Tityus nelsoni* n.sp., belongs to the *Tityus bahiensis* species group. In its general pattern of coloration, the new species shows affinities with *Tityus strandi* WERNER and with *Tityus raquelae* LOURENÇO both distributed in the States of Amazonas and Pará in Brazilian Amazonia. The new species can, however, be distinguished from these last two by: (i) a different pattern of pigmentation; *T. strandi* being darker with black zones on metasomal segments, telson and chelicerae (ii) a globular shape of the vesicle; in both *T. strandi* and *T. raquelae* the vesicle has a pearlike shape (iii) the basal middle lamellae of female pectines is not dilated in the new species, whereas it is in *T. raquelae* (iv) morphometric values are different in the three species (see Table 1).

Discussion

Although several endemic centres of scorpions have been established within Amazonia, only a few can be considered to be well known. The best known centre is unquestionably Manaus in Brazil, but even in this area new species are continuously being discovered and described (LOURENÇO & PÉZIER 2002; LOURENÇO & ARAUJO 2004; LOURENÇO et al.(2005); MONOD & LOURENÇO 2001; PINTO DA ROCHA et al. 2002).

Since the region of the Rio Negro is much more vast than that of Manaus, many new taxonomic elements, mainly at the level of species, but also even of genera, may be expected to be discovered and described in coming years. Any final conclusions regarding the actual composition of the scorpion faunas of both Manaus and specifically of the Rio Negro region should be interpreted with caution because the results obtained may well be biased in consequence of insufficient collecting and field work. The inventory of scorpions may present difficulties because these animals are often extremely cryptic. Some species remain known only from a single locality until better methods of sampling are used. Precautions must be taken into consideration in the interpretation of results in all biogeographical work (PRANCE 1982; LOURENÇO 1996).

The new evidence presented in this paper, based on scorpion studies, supports the conclusion that the upper Rio Negro (Imeri), and especially the Neblina-São Gabriel area, are important endemic centres.

Scorpions of the Rio Negro region of Brazilian Amazonia

The scorpions of Rio Negro belong to three families, two of which are the most common in the Amazon basin, Buthidae and Chactidae. Buthidae are slightly better represented than Chactidae. Only one species of Liochelidae is known from the region.

Buthidae

Microtityus vanzolinii LOURENÇO & EICKSTEDT, 1983

Tityus clathratus C.L. KOCH, 1845

Tityus dinizi LOURENÇO, 1997

Tityus nelsoni n.sp.

Tityus silvestris POCKOCK, 1897

Tityus sylviae n.sp.

Chactidae

Brotheas henriquesi LOURENÇO & MOLTENI MACHADO, 2004

Brotheas jourdani LOURENÇO, 1997

Chactopsis anduzei GONZALEZ-SPONGA, 1984*

Teuthraustes lisei LOURENÇO, 1994

Vachoniochactas ashleeae LOURENÇO, 1994

Liochelidae**

Opisthacanthus borboremai LOURENÇO & FÉ, 2003

Total species: 12. Endemic species: 9

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*Note: SOLEGLAD & SISSOM (2001) transferred the genus *Chactopsis* to the family Euscorpidae. More recently, LOURENÇO (2003) studied the male genitalia of *Chactopsis amazonica* LOURENÇO & FRANCKE (1986), and suggested that this decision should be further investigated.

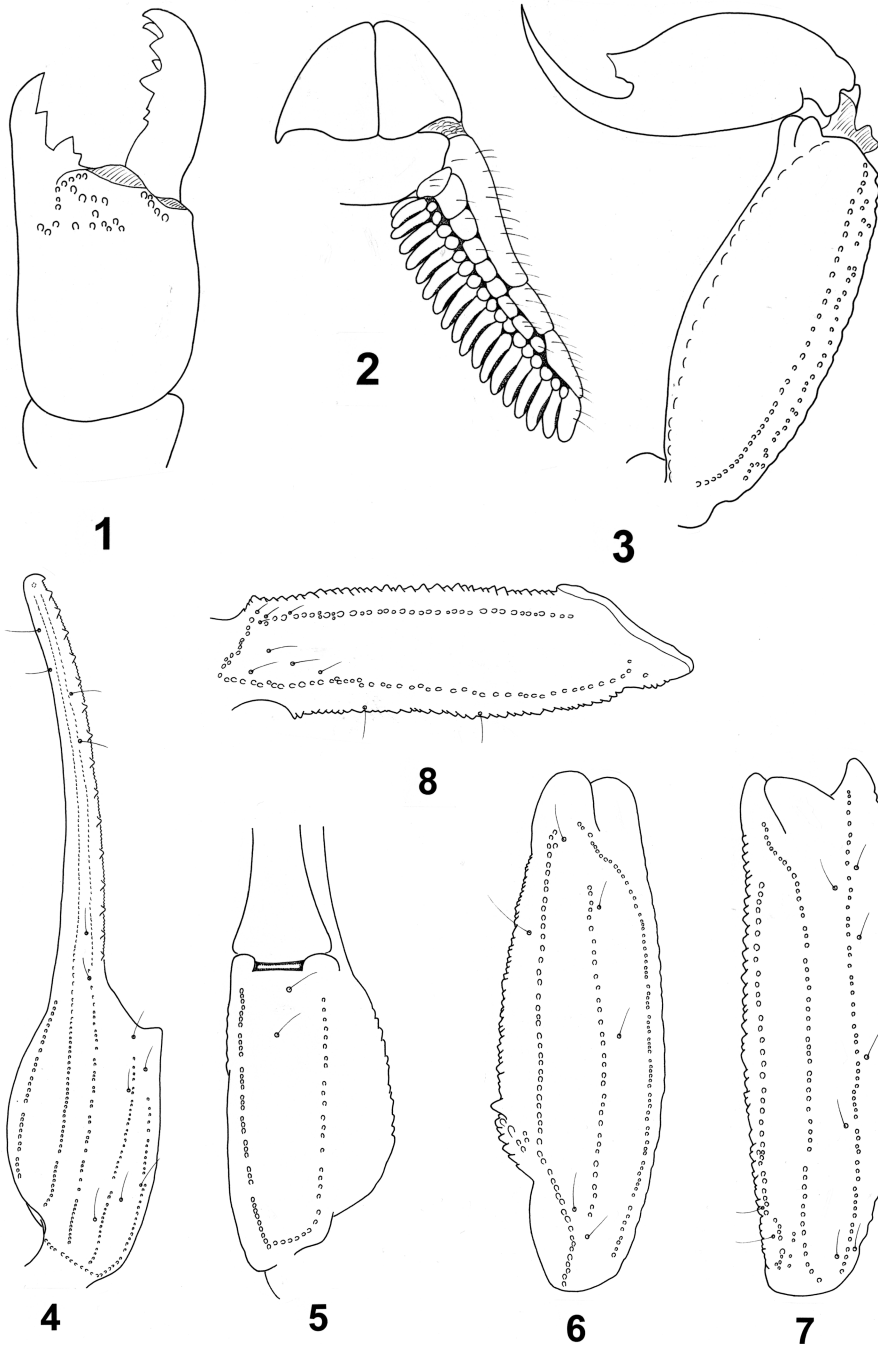
**Note: Now Hemiscorpiidae see SOLEGLAD et al. 2005.

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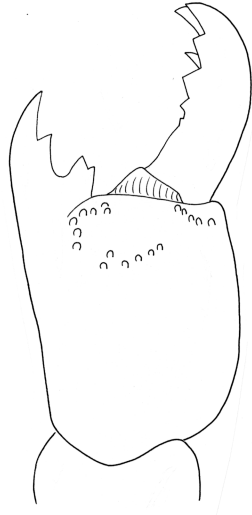
Table 1: Morphometric values (in mm) of the species considered in this study.

	<i>Tityus sylviae</i> n.sp. Holotype(F)	<i>Tityus nelsoni</i> n.sp. Holotype(M) Paratype(F)	<i>Tityus strandii</i> Male Female	<i>Tityus raquelae</i> Female(type)	
Total length	50.1	60.9	55.9	68.2 64.0	56.4
Carapace:					
- length	6.1	6.3	6.4	5.7 5.9	5.6
- anterior width	4.1	4.8	4.8	4.5 4.7	3.7
- posterior width	6.8	6.9	7.4	6.5 6.7	6.3
Metasomal segment I:					
- length	3.8	5.8	5.1	6.1 5.4	4.9
- width	3.1	3.4	3.3	3.1 3.5	3.1
Metasomal segment V:					
- length	6.8	8.8	7.9	8.5 7.5	6.3
- width	2.8	3.4	3.2	3.4 3.4	2.9
- depth	2.7	3.6	3.6	3.6 3.5	3.0
Vesicle:					
- width	2.2	2.6	2.4	3.1 2.6	2.5
- depth	2.2	2.7	2.6	2.9 2.6	2.4
Pedipalp:					
- Femur length	6.2	6.6	6.2	6.5 6.4	5.5
- Femur width	1.7	1.9	2.1	1.9 2.0	1.8
- Patella length	6.6	7.4	7.2	7.1 7.1	6.2
- Patella width	2.1	2.5	2.8	2.5 2.6	2.5
- Chela length	11.1	12.7	12.4	12.6 12.0	11.0
- Chela width	2.2	2.3	2.3	3.4 2.6	2.4
- Chela depth	2.0	2.1	2.0	3.0 2.4	2.3
Movable finger:					
- length	7.4	8.9	8.8	7.6 7.9	7.6



Figs. 1-8:

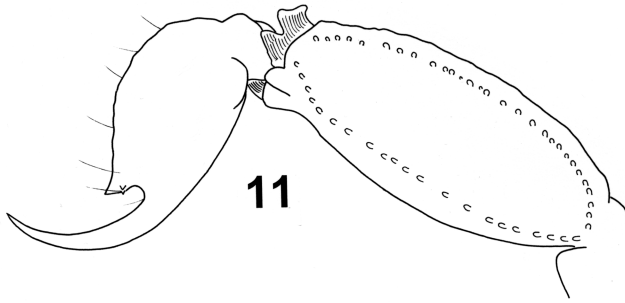
Tityus sylviae n.sp., female holotype. **1:** Chelicera. **2:** Genital operculum and pecten. **3:** Metasomal segment V and telson, lateral aspect. **4-8:** Trichobothrial pattern. **4-5:** Chela dorso-external and ventral aspects. **6-7:** Patella, dorsal and external aspects. **8:** Femur, dorsal aspect.



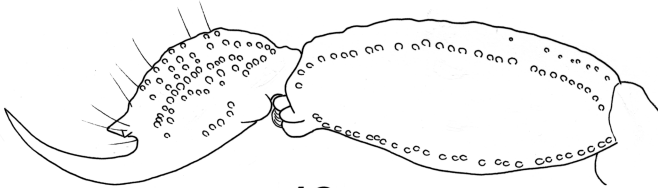
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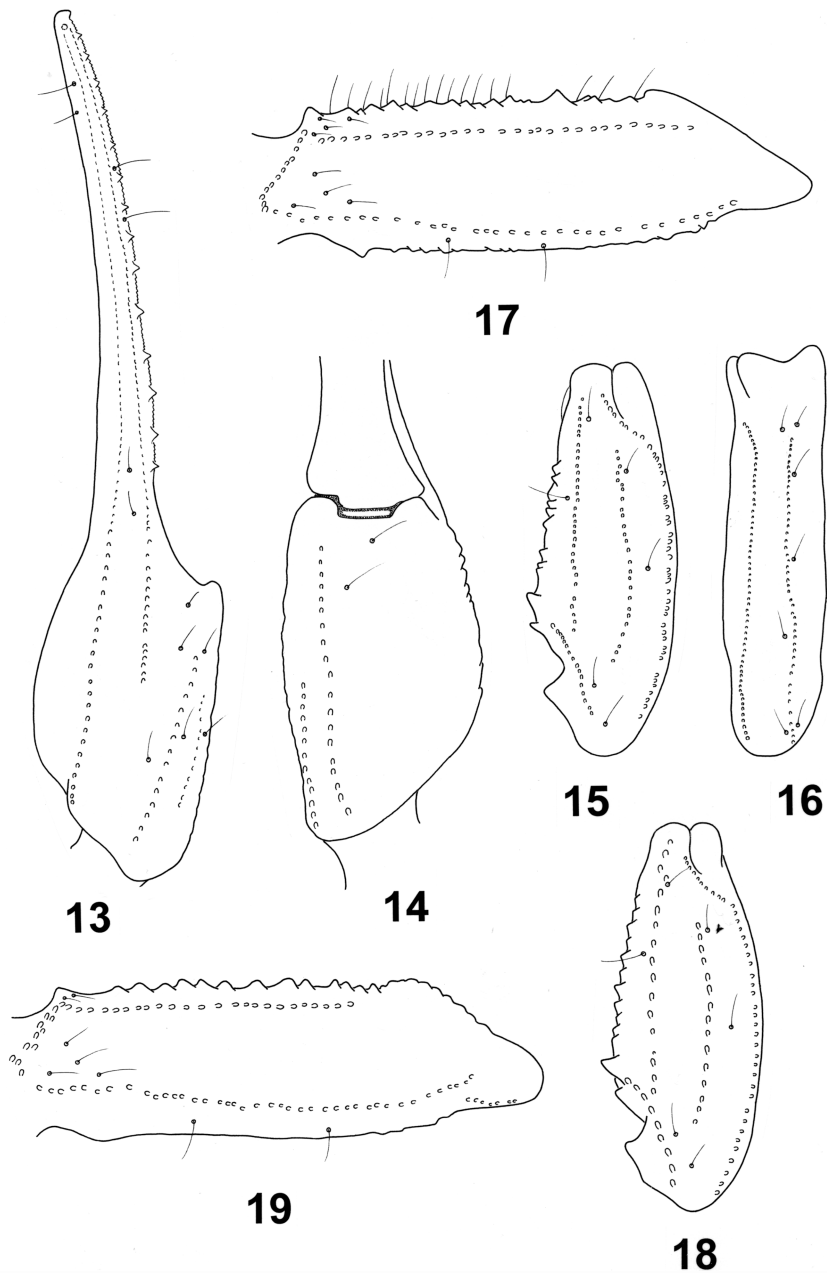
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Figs. 9-12:

Tityus nelsoni n.sp., male holotype and female paratype. **9-10:** Chelicera, male and female. **11-12:** Metasomal segment V and telson, male and female.



Figs. 13-19:

Tityus nelsoni n.sp., male holotype and female paratype. 13-19: Trichobothrial pattern. 13-17: Male holotype. 13-14: Chela dorso-external and ventral aspects. 15-16: Patella, dorsal and external aspects. 17: Femur, dorsal aspect. 18-19: Female paratype. 18: Patella, dorsal aspect. 19: Femur, dorsal aspect.

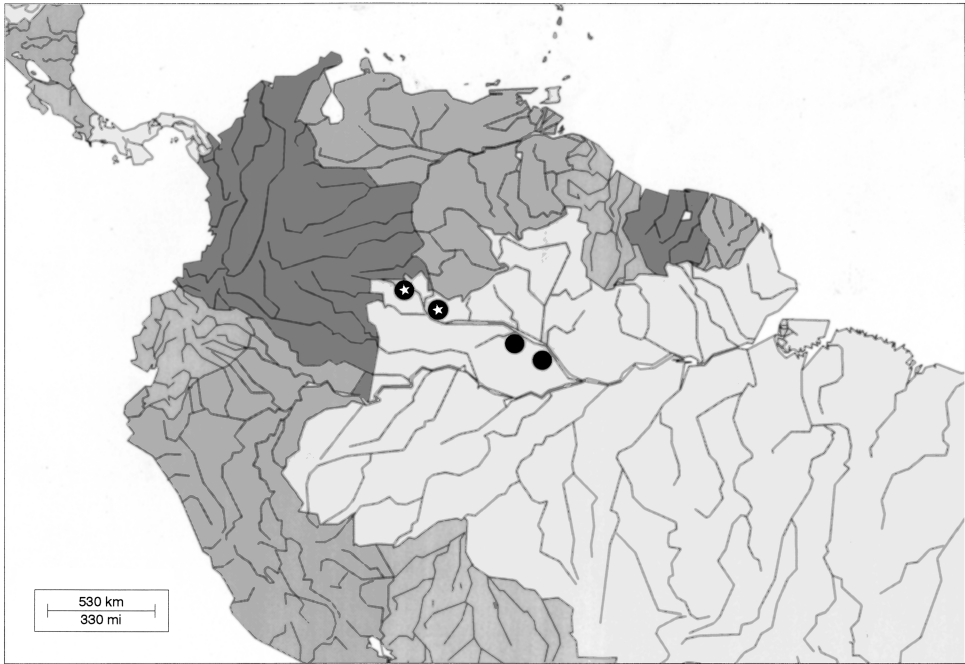


Fig. 20:
Map of the Amazon region, showing the type localities of *Tityus sylviae* n.sp. (black circle), and *Tityus nelsoni* n.sp. (black circle with white star).

