Description of Tityus (Atreus) cisandinus sp. n. from Ecuadorian Amazonia, with comments on some related species (Scorpiones: Buthidae)

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Descrizione di *Tityus* (*Atreus*) *cisandinus* sp. n. dall'Amazzonia ecuadoriana, con commenti su alcune specie correlate (Scorpiones: Buthidae)

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Abstract

The status of the enigmatic buthid scorpion *Tityus asthenes* Pocock, 1893 is once more discussed. Described from Poruru in Peru, the species remains known by the female holotype only. A reanalysis of the several characteristics of the holotype demonstrates that the species is valid, but not a member of the subgenus *Atreus* (group *Tityus americanus* as suggested by Pocock) but rather belongs to the subgenus *Tityus* and to the group of *Tityus bolivianus*, consequently distinct from all other populations of *Tityus* (*Atreus*) distributed from Ecuador to Costa Rica. Previous suggestions that *T. asthenes* could represent a senior synonym of several other *Tityus* (*Atreus*) species were due to inadequate interpretations of their biogeographic pattern of distribution. Although the validity of *Tityus asthenes* is unquestionable, its precise range of distribution remains enigmatic since its type locality Poruru is not known from Peru and no further details are available about the collection of this species. A new species of *Tityus* (*Atreus*) is described from the cis-Andean rainforests of Ecuador and some taxonomic considerations are proposed for some related species within the subgenus *Atreus*.

Key-words: Scorpion, *Tityus*, *Atreus*, *Tityus asthenes*, new species, Ecuador.

Riassunto

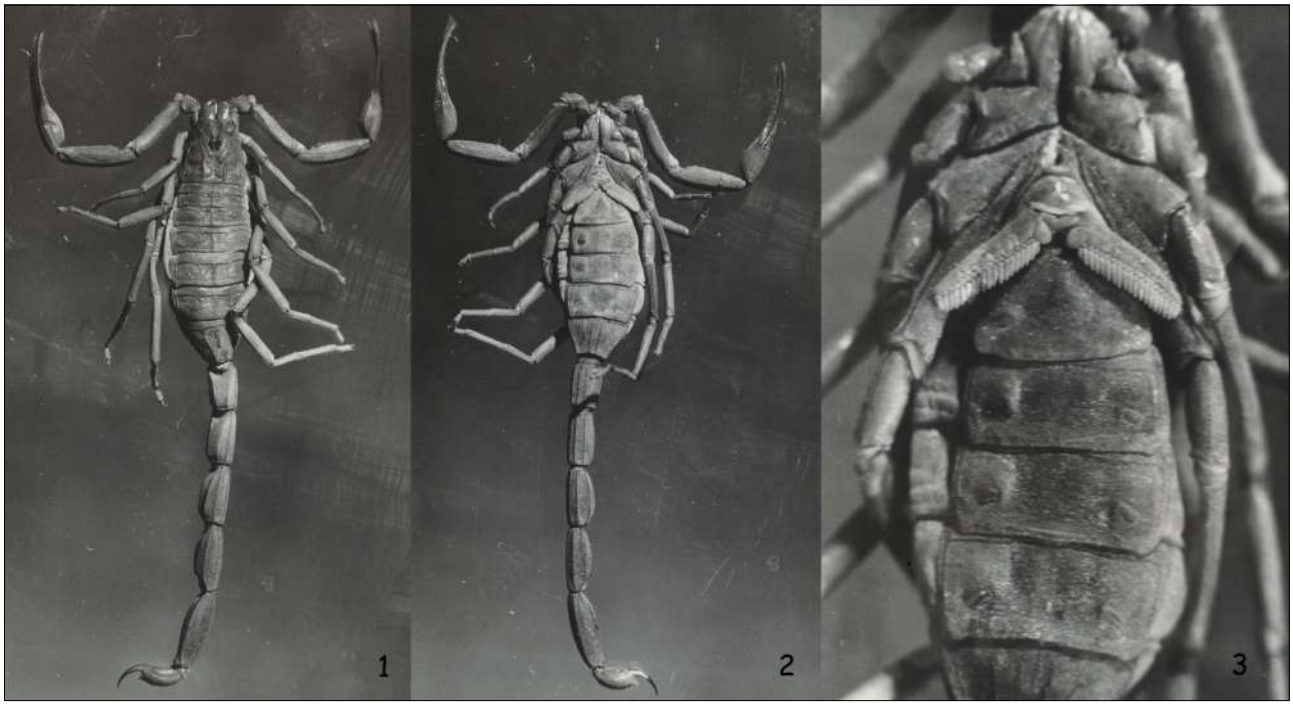
Lo stato dell'enigmatico scorpione Buthidae *Tityus asthenes* Pocock, 1893 viene ancora una volta discusso. Descritta da Poruru in Perù, la specie rimane conosciuta soltanto per la femmina olotipo. Una rianalisi di alcune caratteristiche dell'olotipo dimostra che la specie è valida, ma non un membro del sottogenere *Atreus* (gruppo *Tityus americanus* come suggerito da Pocock) ma piuttosto appartiene al sottogenere *Tityus* ed al gruppo di *Tityus bolivianus*, conseguentemente diverso da tutte le altre popolazioni di *Tityus* (*Atreus*) distribuite dall'Ecuador al Costa Rica. Precedenti proposte che *T. asthenes* potesse rappresentare un sinonimo senior di alcune altre specie di *Tityus* (*Atreus*) erano dovute ad interpretazioni inadeguate del loro disegno di distribuzione biogeografico. Sebbene la validità di *Tityus asthenes* sia indiscutibile, la sua precisa area di distribuzione rimane enigmatica dal momento che la sua località tipica Poruru non è conosciuta in Peru e nessun ulteriore dettaglio è disponibile riguardo alla raccolta di questa specie. Una nuova specie di *Tityus* (*Atreus*) viene descritta dalle foreste pluviali cisandine dell'Ecuador ed alcune considerazioni tassonomiche vengono proposte per alcune specie correlate all'interno del sottogenere *Atreus*.

Parole chiave: Scorpione, *Tityus*, *Atreus*, *Tityus asthenes*, nuova specie, Ecuador.

Introduction

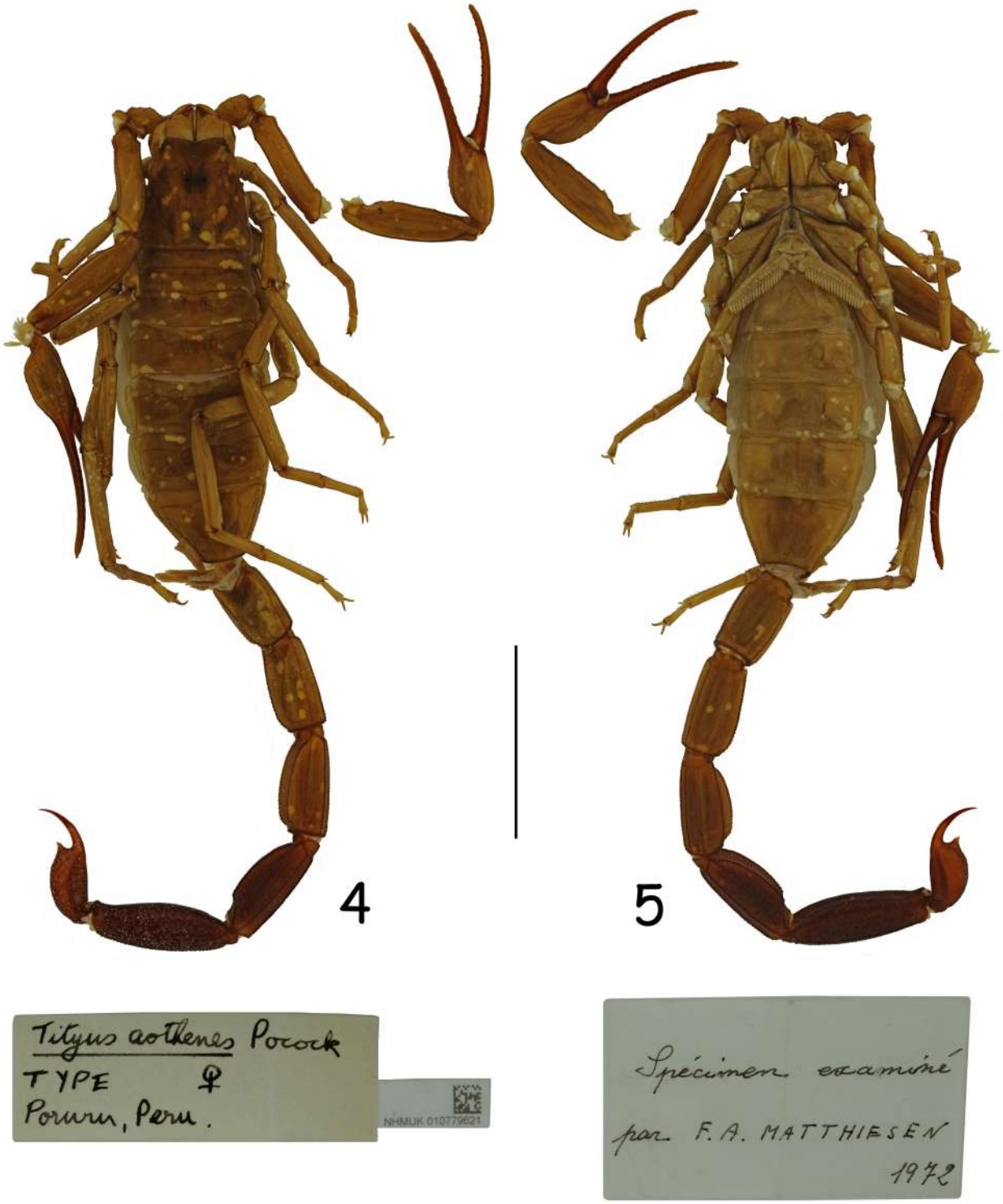
The buthid scorpion *Tityus asthenes* was originally described by Pocock (1893) from Poruru in Peru, in a paper devoted to the classification of scorpions in general and including description of several new genera and species. No precision, however, about the collector of the studied specimen was supplied, situation not uncommon in the publications of Pocock (Lourenço & Ramos, 2004). The description of *T. asthenes* was brief, based on a single female specimen and not followed by any illustrations. The type locality of *Tityus asthenes*, supposedly in Peru, remains unclear since no present locality with this name, including in river systems, exist in this country. Francke (1977) suggested that the correct locality is Paruro in southern Peru, however this corresponds to an arid region not compatible with many species of *Tityus* placed in the subgenus *Atreus*. Consequently, the specimen described by Pocock could have been collected in quite different regions in tropical America. Probably in relation to its general morphology, *Tityus asthenes* was associated to the group of *Tityus americanus* (= *Scorpio americanus* Linné, 1754) by Pocock (1893). In fact, this group corresponds to scorpions defined by a large size, 80 to 110 mm in total length, presenting long and slender pedipalps, in particular in males and with an overall dark coloration. This group corresponded well to the *Tityus asthenes* group of species as defined by Lourenço (2002a), this until the more precise definition of subgenera within *Tityus* (Lourenço, 2006), which placed these large scorpions in the subgenus *Atreus* Gervais 1843.

Figs. 1-3. *Tityus asthenes*, female holotype. **1-2**. Habitus, dorsal and ventral aspects. **3**. Detail of ventral aspect, showing coxapophysis, sternum, genital operculum and pectines. Black & white photos taken in 1972.



After the description of *T. asthenes*, several other species were described and associated to this group, namely *Tityus cambridgei* Pocock, 1897 (now *Tityus obscurus* Gervais, 1843), *Tityus championi* Pocock, 1898, *Tityus timendus* Pocock, 1898, *Tityus rosenbergi* Pocock, 1898 and *Tityus nematochirus* Mello-Leitão, 1940. The taxonomic position of these species knew a considerable variation according to different authors (see Lourenço, 1988 for details) and finally, Lourenço (1988) placed a number of these in synonymy of *Tityus asthenes*, mainly based on inaccurate biogeographic patterns. Some of these were revalidated such as *Tityus championi* by Teruel (2011) or *Tityus timendus* by Lourenço (2012). The subsequent discovery and description of several new species belonging to this group of scorpions in the last 30 years changed the past opinion about their models of distribution and showed that most species could have less extended and much more localised ranges of distribution (Lourenço, 1997, 2002b, 2011, 2017).

A recent study on some scorpions from Ecuador (Ythier & Lourenço, 2017) re-opened the question about the true identity of some *Tityus* from this country, and in particular that of *Tityus asthenes*. In an old paper on scorpion fauna of Ecuador, Lourenço (1988) suggested that *Tityus asthenes* was the most common species of the subgenus *Atreus*, being present in both the cis-Andean and trans-Andean regions of the country. The type specimen of *Tityus asthenes* was examined by the senior author early in the 1970s, while yet a student, without any final resolution about its true identity (Figs. 1-3). The recent reanalysis of the female holotype of *T. asthenes* clearly demonstrates that this species does not belongs to the subgenus *Atreus* but rather to the subgenus *Tityus* and to the group of species *Tityus bolivianus* (Lourenço & Maury, 1985; see taxonomic section; Figs 4-5). Moreover, the study



Figs. 4-5. *Tityus asthenes*, female holotype. Habitus, dorsal and ventral aspects. Recent colour photos taken in 2017. Labels attest that the type was examined by F. Matthiesen, while in the Muséum in Paris during 1972. (Scale bar = 1 cm).

of two new specimens collected in the Amazon region of Ecuador, close to the Peru border and associated to *T. asthenes* in Lourenço & Ythier, 2013, led us to consider this *Tityus* population as a new species. Until now the cis-Andean and trans-Andean populations of

Tityus (*Atreus*) found in Ecuador were considered as a single one (Lourenço, 1988; Brito & Borges, 2015), however we now consider these as possibly different and separated by the Andean mountain system. The material cited by Lourenço (1988) from the Napo province was not re-studied, but most certainly corresponds to the new species described here. The trans-Andean populations of *Tityus* subgenus *Atreus* in Ecuador, in particular those from the Province of Esmeraldas, will require some further studies to have their status clearly redefined, since it may correspond to a not described species.

The Amazon region of Ecuador, known as the Oriente, is exceptionally rich in biodiversity of both flora and fauna. Much of the Oriente is tropical rainforest (Fig. 6.), starting from the east slopes of the Andean mountains (upland rainforest) and descending into the Amazon basin (lowland rainforest). It is crossed by many rivers rising in the Andean mountains and flowing east towards the Amazon River. The lowlands in the Oriente, where the new species was found (type localities going from 250 m (Kapawi) to 310 m (Yaupi) above sea level), have a warm and humid climate year round, and typically receives more than 2000 mm (average 3500 mm) of rain each year, April through June being the wettest period. Temperatures vary little throughout the year and averages 25° C, with variation between day-time (up to 28° C) and night-time (about 22° C). Lowland rainforests contain the tallest trees of all types of rainforest, with the largest variety of species. The tree canopy typically sits 20-40 m above the ground where vegetation is sparse and comprises mainly small trees and herbs that can experience periodical flooding during heavy rains. For several sections of the lowland rainforest such as the canopy, knowledge of the scorpion fauna is still almost non-existent (Lourenço & Pézier 2002). Consequently, the effective number of species in the Amazon region of Ecuador may be much greater than what is presently estimated.

Material and Methods

Illustrations and measurements were produced using a Wild M5 stereo-microscope with a drawing tube and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974), while morphological terminology mostly follows Vachon (1952) and Hjelle (1990).

Comparative material:

- *Tityus obscurus* (Gervais, 1843): French Guiana, Réserve de la Trinité, XII/2010 (C. Courtial), 2 males, 1 female.
- *Tityus apiacas* Lourenço, 2002: Brazil, Pará, Itaiatuba, Bacia do Rio Jamanxim, 5/XII/2007 (J. Zuanon, 1 male; Amazonas, BR-319, km 350, trilha 1, ponto 500 (5°16'11.28" S - 61°55'46.8" W), 25/VII:2001, pitfall (H. Guariento & L. Pierrot), 1 male.
- *Tityus dinizi* Lourenço, 1997: Brazil, Amazonas, Anavilhanas, X/1999 (J. Adis), 2 males.

All specimens are now deposited in the collections of the Muséum national d'Histoire naturelle, Paris, France.

Fig. 6. The natural habitat of *Tityus cisandinus* sp. n. (rio Capahuari, Pastaza province), covered by rainforest.

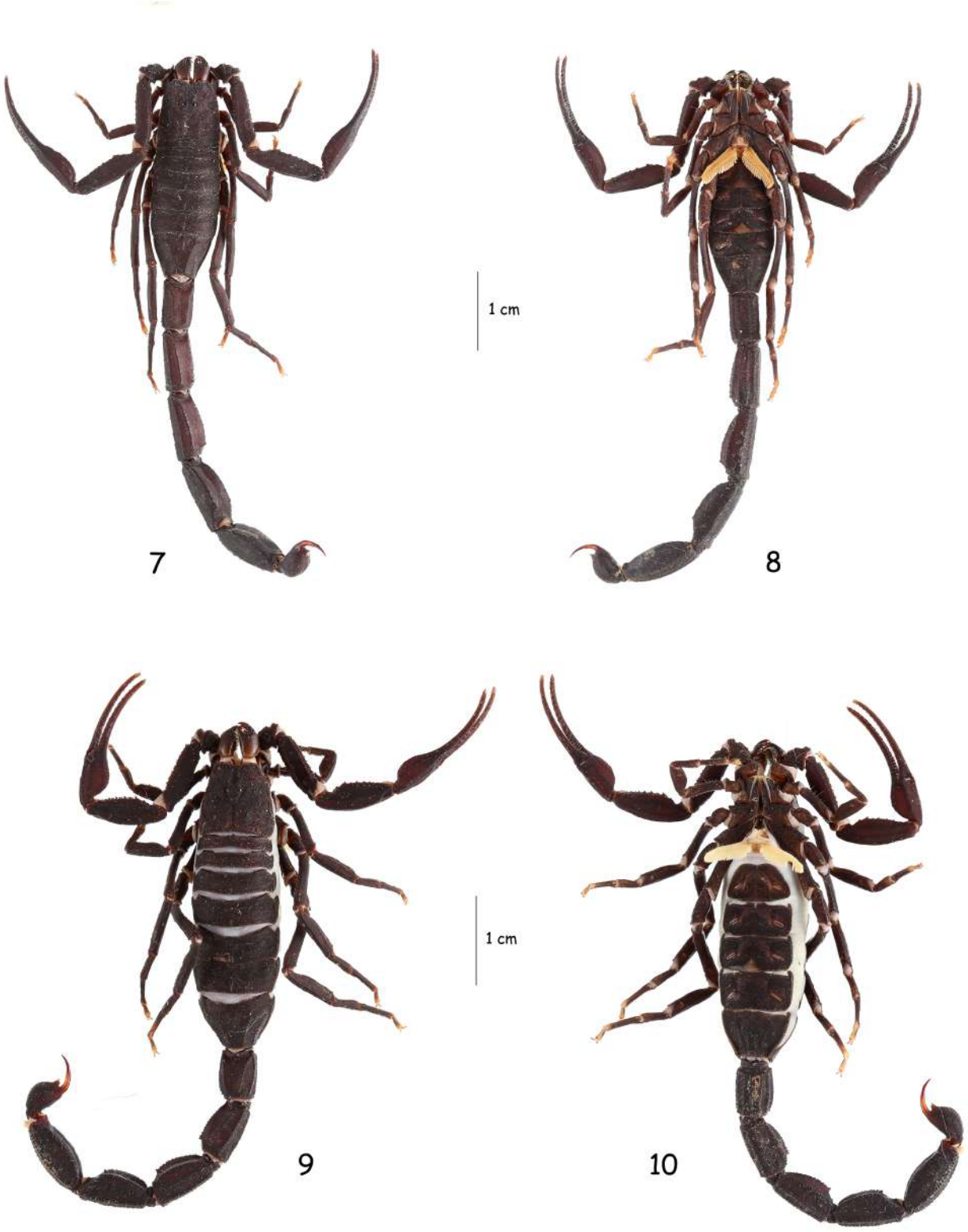
Taxonomy

Family **Buthidae** C. L. Koch, 1837
Genus ***Tityus*** C. L. Koch, 1836

***Tityus* (*Atreus*) *cisandinus* sp. n.** (Figs. 7-20)

Type material. Ecuador, Morona-Santiago Province, Yaupi (border with Peru), rain forest, under log, V/1976 (British-Expedition): male holotype. Ecuador, Pastaza Province, Rio Capahuari, near Kapawi (close to Peru Border), found in a canoe on the river bank (E. Ythier & C. Benros-Ythier), 17/VIII/2017: female paratype (Fig. 21. Fig. 22. Map). Holotype and paratype deposited in the Muséum national d'Histoire naturelle, Paris, France.

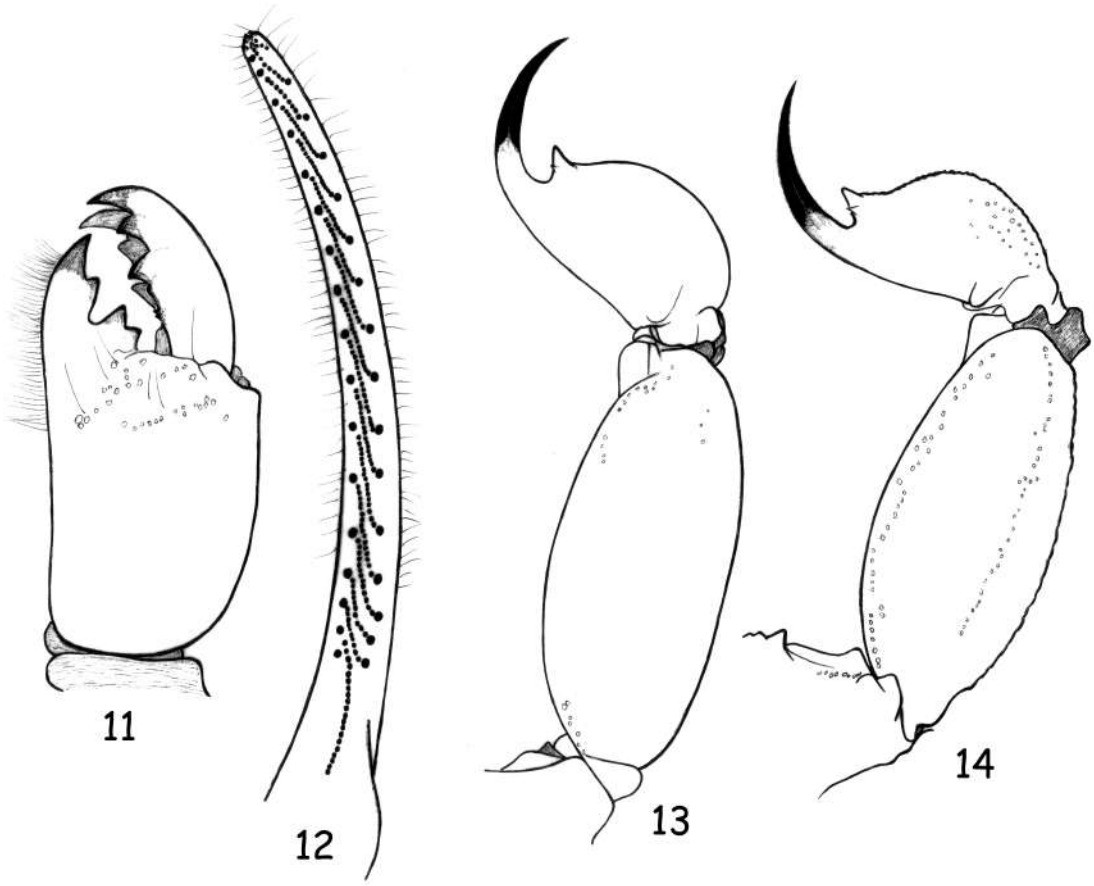
Etymology. The specific name refers to the geography of the region where the new species was found, between Amazon and Oriental Andes in Ecuador.



Figs. 7-10. *Tityus cisandinus* sp. n., male holotype and female paratype. Habitus, dorsal and ventral aspects.

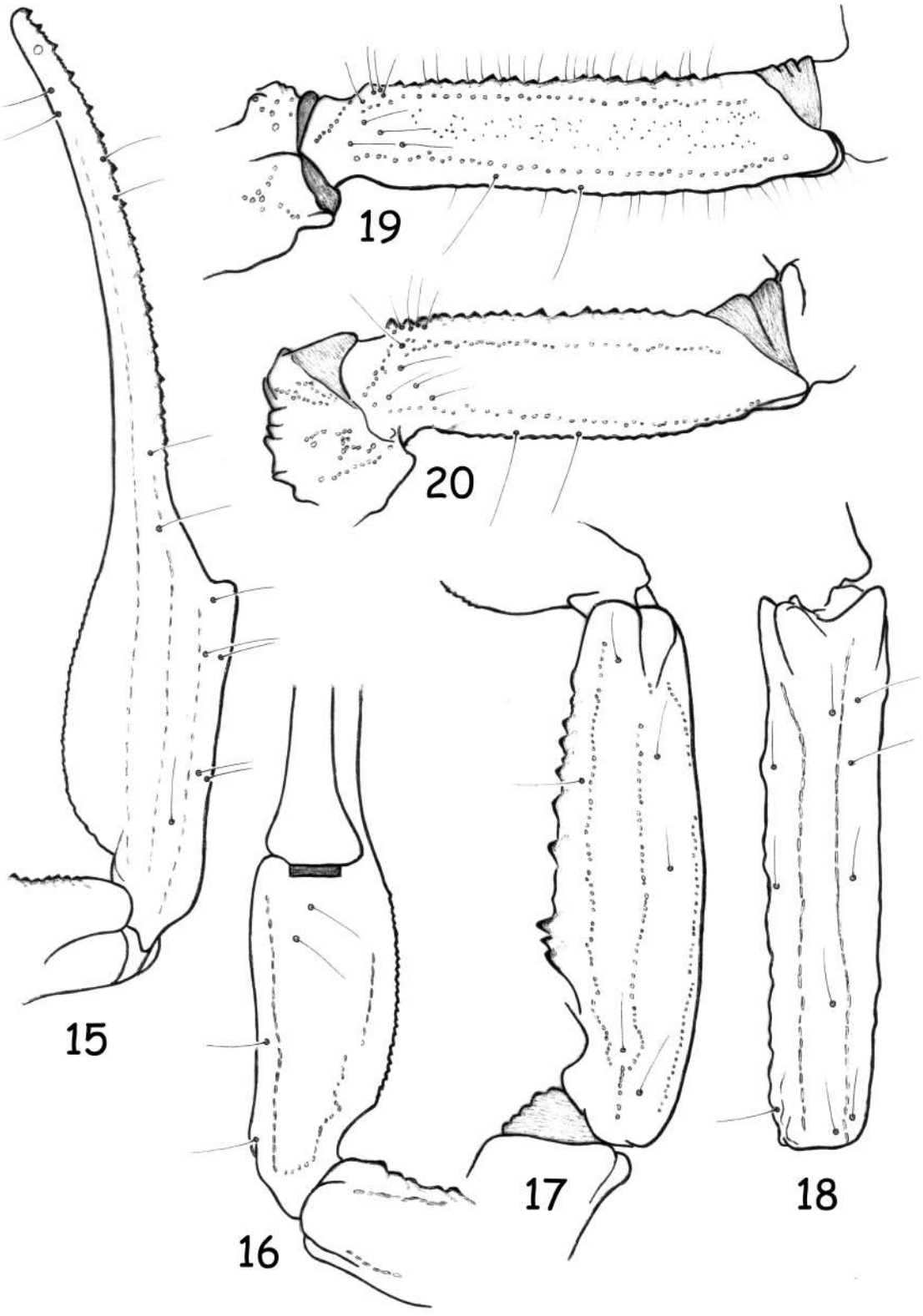
Diagnosis. A moderate species when compared with the average size of other species in the subgenus *Atreus*: male 72.8 mm and female 70.1 mm in total length (see Table I). General pattern of pigmentation reddish-brown to brown overall. Basal middle lamella of

female pectines dilated, but less conspicuous when compared with that of several other species of the subgenus *Atreus*. Subaculear tooth moderately long and spinoid. Pectinal tooth count 19-19 in male and 21-20 in female. Fixed and movable fingers of the pedipalp with 15-16 oblique rows of granules. Ventral carinae of metasomal segments II to IV parallel in configuration. Pedipalps and in particular chela fingers with a strong chetotaxy. Trichobothriotaxy A-α orthobothriotaxic. The new species may be an endemic element to the occidental region of Amazon.



Figs. 11-14. *Tityus cisandinus* sp. n. Male holotype (**11-13**) and female paratype (**14**). **11**. Chelicera, dorsal aspect. **12**. Cutting edge of movable finger showing rows of granules. **13-14**. Metasomal segment V and telson, lateral aspect.

Description based on male holotype and female paratype. Measurements in Table I.
Coloration. Basically reddish-brown to brown overall. Prosoma: carapace reddish-brown with some dark pigment on the carinae. Mesosomal tergites reddish-brown with one darker transverse stripe on the posterior edge of tergites I-VI. Metasoma: segments I to V reddish-brown; IV and V darker than the others and with some blackish regions over carinae. Vesicle: dark reddish-brown; aculeus reddish at the base and dark reddish at the tip. Venter reddish-yellow; sternites with dark zones on lateral and posterior edges; sternite V with a white triangular zone on posterior edge, better marked on male; pectines



Figs. 15-20. *Tityus cisandinus* sp. n. Male holotype (**15-19**) and female paratype (**20**). Trichobothrial pattern. **15-16**. Chela, dorso-external and ventral aspects. **17-18**. Patella, dorsal and ventral aspects. **19-20**. Femur, dorsal aspect.

pale yellow to white. Chelicerae reddish-yellow with a dark thread; fingers blackish with dark reddish teeth. Pedipalps: reddish-brown; fingers dark, almost blackish with the extremities yellow. Legs reddish-brown to brown.

Morphology. Carapace moderately to strongly granular; anterior margin with a moderate to strong concavity. Anterior median superciliary and posterior median carinae moderate to strong. All furrows moderately to strongly deep. Median ocular tubercle distinctly anterior to the centre of carapace. Eyes separated by more than one ocular diameter. Three pairs of lateral eyes. Sternum subtriangular. Mesosoma: tergites moderately to strongly granular. Median carina moderate in all tergites. Tergite VII pentacarinate. Venter: genital operculum divided longitudinally; each half with a semi-oval to semi-triangular shape. Pectines: pectinal tooth count 19-19 in male holotype and 21-20 in female paratype; basal middle lamellae of the pectines dilated in the female and inconspicuously dilated in male. Sternites with a thin granulation and elongate spiracles; VII with four carinae better marked on female. Metasomal segments with 10-8-8-8-5 carinae, crenulated, better marked on female. Dorsal carinae on segments I to IV with one to three spinoid granules, better marked on female. Lateral inframedian carinae on segment I complete, crenulate; represented by 1-3 granules on II; absent from III and IV. Ventrolateral carinae moderate to strong, crenulated on female, smooth on male. Ventral submedian carinae crenulate. Intercarinal spaces weakly granular. Segment V with dorsolateral, ventrolateral and ventromedian carinae crenulated on female, inconspicuous in male. Lateral intercarinal spaces moderately granular on female, smooth on male. Telson granular on female, smooth on male, with a long and strongly curved aculeus on both sexes. Dorsal surface smooth in both sexes; ventral surface weakly granular in females; subaculear tooth spinoid, shorter in male. Cheliceral dentition characteristic of the family Buthidae (Vachon, 1963); movable finger with two well formed, but reduced, basal teeth; ventral aspect of both fingers and manus with long dense setae. Pedipalps: femur pentacarinate; patella with seven carinae; internal face of patella with several spinoid granules; chela with nine carinae and the internal face with an intense granulation; other faces weakly granular. Femur, patella and chela fingers with a strong chetotaxy. Fixed and movable fingers with 15-16 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A-α (Vachon, 1974, 1975). Legs: tarsus with numerous short fine setae ventrally.

Relationships. Taking into account the fact that previous populations of *Tityus* (*Atreus*) from Ecuador and, in particular, those from the Amazon region were associated to *Tityus asthenes* (Lourenço, 1988, Lourenço & Ythier, 2013), it would be logical to associate the new species to this one. However, the type locality of *Tityus asthenes*, supposedly in Peru, remains unclear, and the specimen described by Pocock could have been collected in quite different regions in tropical America. Moreover, the re-analysis of the general morphology of the female holotype brings confirmation that *T. asthenes* does not belongs to the

subgenus *Atreus*, but rather to the subgenus *Tityus* and to the *Tityus bolivianus* group of species. It has a rather small size with only 53 mm in total length and a tegument strongly smooth with weakly marked carinae and granulations; the subaculear tubercule is small and very sharp (see Lourenço & Maury, 1985). These considerations led us to rather associate the new species to other *Tityus* (*Atreus*) distributed in the Amazon basin such as *Tityus obscurus*, *Tityus dinizi*, *Tityus apiacas* and *Tityus tucurui* Lourenço 1988 (Figs. 23-28). *Tityus cisandinus* sp. n. can however be distinguished from these cited species by: I) a rather smaller global size (see Table 1) with marked different morphometric values; II) better marked carinae and granulations; III) stronger chetotaxie on pedipalps. Moreover the geographical range of distribution appears as quite different (see Lourenço, 2011, 2017). The new species is a possible endemic element to the Andean/Amazon region of Ecuador and Peru. In our opinion, the material listed by Teruel (2011) from Loreto in Peru and associated to *Tityus asthenes*, corresponds in fact to the new species described here. No confirmation is however possible since the cited material is deposited in the private collection of this author and not accessible.

Fig. 21. *Tityus cisandinus* sp. n. Female paratype alive.

List of the Ecuadorian species of *Tityus*

Genus ***Tityus*** C. L. Koch, 1836

1. Species belonging to the subgenus *Archaeotityus* Lourenço, 2006

Tityus bastosi Lourenço, 1984

Tityus silvestris Pocock, 1897

Tityus julianae Lourenço, 2005 (*)

2. Species belonging to the subgenus *Tityus* C. L. Koch, 1836

Tityus demangei Lourenço, 1981 (*)

Tityus ecuadorensis Kraepelin, 1896

Tityus gasci Lourenço, 1981

Tityus intermedius Borelli, 1899 (*)

Tityus jussarae Lourenço, 1988 (*)

Tityus pugilator Pocock, 1898 (*)

Tityus roigi Maury *et* Lourenço, 1987 (*)

Tityus simonsi Pocock, 1900

3. Species belonging to the subgenus *Atreus* Gervais, 1843

Tityus cisandinus sp. n. (*)

Tityus crassicauda Lourenço *et* Ythier, 2013 (*)

Tityus forcipula (Gervais, 1844)

Tityus spinatus Pocock, 1898 (*)

Tityus timendus Pocock, 1898 (*)

Tityus ythieri Lourenço, 2007 (*)

Total 17 species. 11 (*) are possibly endemic elements to Ecuador.

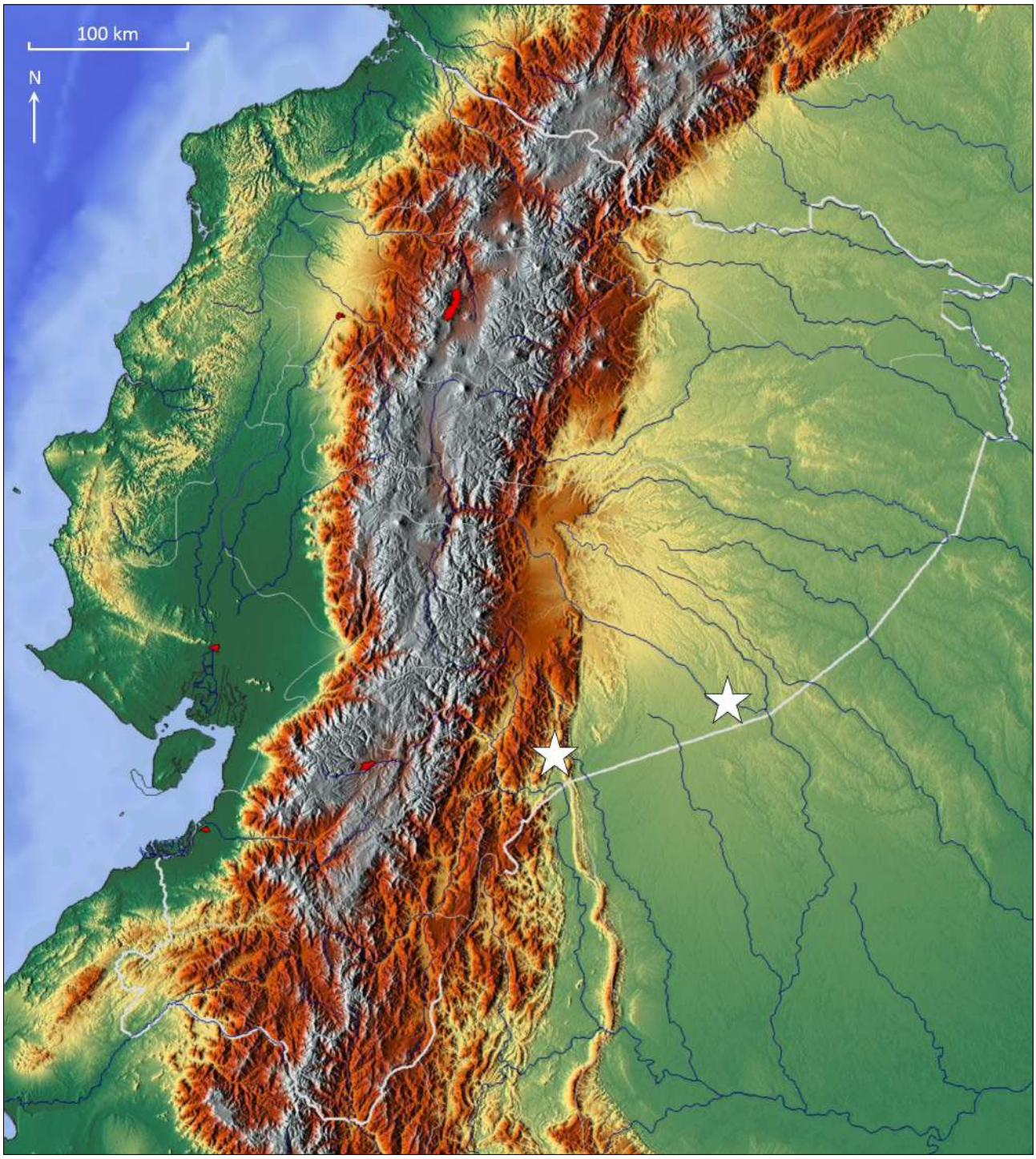


Fig. 22. Map of Ecuador showing the type localities of *Tityus cisandinus* sp. n.

Acknowledgements

We are most grateful to Janet Beccaloni (NHM, London) for useful information on the type specimen of *Tityus asthenes* and for providing the colour photos of the type. We are also grateful to Elise-Anne Leguin (MNHN, Paris) for the preparation of several photos and plates.

Fig. 23-24. *Tityus obscurus* from French Guiana. Habitus of male, dorsal and ventral aspects.

Fig. 25-26. *Tityus dinizi* from Brazil. Habitus of male, dorsal and ventral aspects.

Table I. Measurements (in mm) of the male holotype and female paratype of *Tityus cisandinus* sp. n. and males of *Tityus dinizi* (Brazil), *Tityus apiacas* (Brazil) and *Tityus obscurus* (French Guiana).

	Tityus cisandinus sp. n.		*Tityus dinizi*	*T. apiacas*	*T. obscurus*
	♂	♀	♂	♂	♂
Total length:	72.8	70.1	96.1	81.8	90.5
Carapace:					
Length	7.6	8.1	9.1	8.4	8.1
Anterior width	5.7	5.6	6.7	6.2	6.3
Posterior width	7.9	9.0	9.5	9.1	8.7
Mesosoma length	16.9	19.2	19.8	20.2	24.4
Metasomal segment I.					
length	5.8	5.2	8.7	6.6	7.6
width	3.8	4.2	4.1	4.2	4.2
Metasomal segment II.					
Length	7.8	6.3	10.8	8.5	9.2
Width	3.6	4.1	3.8	4.3	4.0
Metasomal segment III.					
Length	8.7	7.1	12.2	9.6	10.1
Width	3.6	4.2	3.9	4.4	4.1
Metasomal segment IV					
Length	9.4	8.2	13.6	10.5	10.6
Width	3.8	4.1	4.0	4.7	4.4
Metasoma, segment V.					
length	9.9	8.8	13.5	10.7	10.9
width	4.0	4.1	4.1	4.8	4.6
depth	3.8	3.9	4.1	4.4	3.9
Telson length	6.7	7.2	8.4	7.3	9.6
Vesicle:					
width	3.2	2.9	3.3	3.2	3.2
depth	3.0	2.9	3.2	3.2	3.1
Femur:					
length	9.8	8.4	13.3	13.2	13.3
width	2.2	2.4	2.4	2.2	2.3
Patella:					
length	10.1	9.1	13.8	13.8	14.0
width	2.6	3.0	3.1	2.8	2.8
Chela:					
length	17.4	15.7	21.5	21.8	23.1
width	2.5	2.9	2.8	2.6	2.5
depth	2.3	2.8	2.6	2.5	2.3
Movable finger:					
length	11.3	10.8	13.2	13.4	13.5

Fig. 27-28. *Tityus apiacas* from Brazil. Habitus of male, dorsal and ventral aspects.

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