

***Tuberculobasis cornu* sp. nov., a new damselfly from Suriname and notes on its genus (Odonata: Coenagrionidae)**

Wouter W.T. van der Voort & Marcel Th. Wasscher

Naturalis Biodiversity Center, P.O. Box 9517, 2300 RA Leiden, The Netherlands;
woutervandervoort@protonmail.com

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Abstract. *Tuberculobasis cornu* sp. nov. (holotype ♂: Tapatosso, Suriname, 04°04'28.844"N, 54°47'37.406"W, 06.iv.1963, leg. J. Belle; RMNH.INS.514704) is described. The diagnostic characteristics of the genus *Tuberculobasis* are slightly adapted, summarized, applied on the new species and compared to those of *Denticulobasis*. Several notes on the genus *Tuberculobasis* are presented and a new intrageneric classification is proposed.

Further key words. Dragonfly, Zygoptera, Neotropics, taxonomy

Introduction

The genus *Tuberculobasis* Machado, 2009, was established alongside *Denticulobasis* Machado, 2009, to accommodate several damselfly species formerly placed in *Leptobasis* Selys, 1877 (MACHADO 2009a). At present, ten species are classified under *Leptobasis*, three under *Denticulobasis*, and 13 under *Tuberculobasis*, including *T. croceum* (Burmeister, 1839), which is suspected to be a senior synonym of *T. mammilaris* (Calvert, 1909) or *T. yanomami* (De Marmels, 1992) (GARRISON & VON ELLENRIEDER 2019, 2024: 36). All three genera are distributed throughout the Neotropics, with a notable concentration in the Amazon rainforest. Males of *Tuberculobasis* are distinguished by the presence of mesepisternal processes – referred to as ‘tubercles’ – located on the anterior part of the synthorax, as well as a prominent ventral process on the cercus. These structures vary in position, shape, and size, often serving as key diagnostic features. In this publication, a new species of *Tuberculobasis* is described based on two male specimens collected in 1963 in Suriname by Jean Belle. These specimens had long been part of the collection at the Naturalis Biodiver-

sity Center, labeled as *Leptobasis* sp., before being recognized in 2011 as a potential new species within *Denticulobasis* or *Tuberculobasis* by Rosser Garrison and Natalia von Ellenrieder. It represents the fourth *Tuberculobasis* species currently known from Suriname. Additional notes on the taxonomy and morphology of the damselflies in the genus *Tuberculobasis* are provided.

Material and methods

During an entomological trip conducted in 1963 by Jean Belle in Suriname, he travelled by boat from Albina over the Marowijne and Tapanahoni rivers, with Tapatosso as furthest point. At this last location, he collected two males of the hereby described species.

In 2013 the paratype was softened and extraction of the genital ligula was attempted. Unfortunately, it broke after the flexus and only the proximal segment was left.

The photographs of details of the type specimens were produced using a Zeiss Axiocam 305 color camera mounted on a Zeiss SteREO Discovery stereo 2.0 microscope using Auto-Montage stacking software, in 2013 and in 2026. Photos were slightly processed (cropped and contrast modified) in Adobe Photoshop. Figures 3b, d and 6e, f, h are drawn by us based on illustrations from MACHADO (2009a).

Terminology for external characters and genitalia structures follows GARRISON *et al.* (2010).

Abbreviations: Fw – fore wing(s); Hw – hind wing(s); Px – postnodal cross-vein(s); S1–10 – abdominal segment(s) 1–10.

Tuberculobasis cornu sp. nov.

(Figs 1a, 2, 3a, c, 4, 5, 6c, g)

Material examined

Holotype ♂. Suriname, Tapatosso (04°04'28.844"N, 54°47'37.406"W, 95 m a.s.l.), 06.iv.1963, leg. J. Belle; in coll. Naturalis Biodiversity Center, Leiden, The Netherlands (RMNH.INS.514704).

Paratype. 1♂, same date and locality as holotype, RMNH.

Etymology

From Latin *cornu* (neuter noun of the 4th declension), meaning horn, after the horn-like morphology of the tubercle process on the thorax of this species.

Male (Holotype, dried specimen)

Head – Labium and mandibles yellowish. Labrum and clypeus dark, frons and vertex black. Blue postocular spots, slightly triangularly shaped with blunt corners, and of approximately similar size as vertex (Fig. 1a). Rear of head brownish. Eyes brown.

Thorax – Median projection of posterior lobe of prothorax large and relatively dark with a central yellow line. Lateral lobes of prothorax present but very small. Middle lobe of the prothorax at the base with a greenish triangle (Fig. 2). Mesepisternal tubercles separated from mid-dorsal carina, approximately 1.5 times as long as wide, pointed cranially (Figs 3a, c, 6g). Mesepisternum brown, with light blue ante-humeral band over humeral suture, mesepimeron yellowish with dorsal brown humeral band and light blue band over first lateral suture (Fig. 6c). Metepisternum yellow, metepimeron with light blue band. Base colour of legs yellow with black spines. First and middle leg coxae dark posteriorly. Femora with lateral dark stripe. Tarsi and claws dark distally.

Wings – Hyaline, venation dark yellow and pterostigma orange with yellow border. Fw with 11 Px, Hw with 9 Px. Petiolation of anal vein distal to Ac by



Figure 1. The male thorax with horns and head. a – *Tuberculobasis cornu* sp. nov., holotype; b – *Denticulobasis* cf. *garrisoni* Machado, 2009 (RMNH.INS.747107, in the collection of the Naturalis Biodiversity Center); c – *Denticulobasis dunklei* Machado, 2009. Photo (27.vii.2009): Tim Faasen, Tamshiyacu-Tahuayo Reserve, Peru.

a distance equal to its length in Fw and half its length in Hw. R3 originating at level of fifth Px in Fw and fourth Px in Hw. IR2 originating at level of ninth Px in Fw and eighth Px in Hw.

Abdomen – Ventral color yellow. S1 blue with anterior $\frac{3}{4}$ brown dorsally. S2 blue with anterior $\frac{1}{6}$ brown dorsally. S3–6 yellow (S3 blue fading to yellow), brown dorsally, narrowing at anterior suture and broadening at posterior suture. S7–9 reddish brown, dorsally darker and with a dark ventro-lateral stripe. S10 reddish brown with slightly extending mid-ventral crest at posterior end. Cercus brownish, ventral process pointed inwards, distal patches present, with a slightly oval shape and about the same height as the ventral process in posterior view (Fig. 4c). Paraproct brown but basally yellow, tip blackish, four times as long as cercus and longer than S10, with tip slightly pointing inwards; cuticle surface except the base warty (Fig. 4). Ligula with a short (0.1 mm) inner fold flagellum (Fig. 5), rest of ligula not present.

Measurements (mm, paratype in brackets) – Hw 15.0 (15.0); total length 33.5 (33.0).

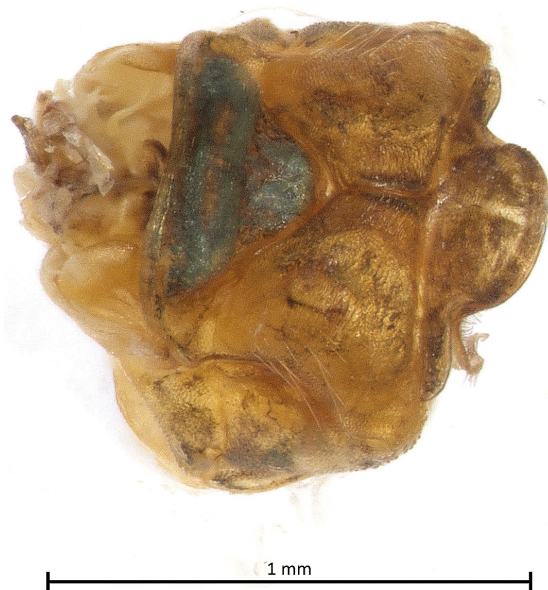


Figure 2. *Tuberculobasis cornu* sp. nov.; male prothorax of paratype of in dorsal view.

Female and larva

Unknown.

Differential diagnosis

Can be easily distinguished from males of other *Tuberculobasis* species by tubercles being approximately 1.5 times as long as wide. In the key by MACHADO (2009a), it would split from *T. macuxi* in step 6 by this characteristic. Additionally, it can be separated from the species of this genus occurring in Suriname (*T. geijskesi* Machado, 2009; *T. macuxi* Machado, 2009;

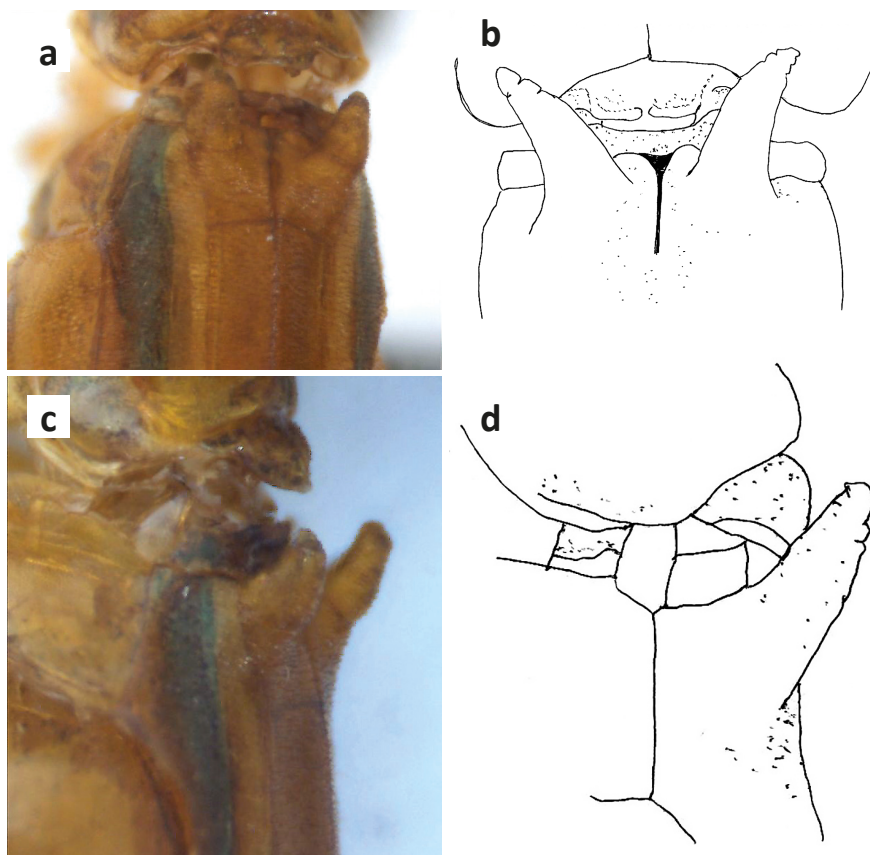


Figure 3. Thorax and horns of *Tuberculobasis cornu* sp. nov. (a, c) and *Denticulobasis dunklei* (b, d) in dorsal view (a, b) and lateral view (c, d).

T. mammilaris; and *T. yanomami*) by the paraproct being longer than S10 and extending three times as far as cercus.

***Tuberculobasis* or *Denticulobasis*?**

The two specimens in the Naturalis collection were identified by R. Garrison and N. von Ellenrieder as »a new species of *Denticulobasis* or *Tuberculobasis*« because they have characteristics of both genera as defined by MACHADO (2009a), who based the distinction of these two genera primarily on the mesepisternal processes: »At the antero-medial part of mesepisternum of *Denticulobasis* and *Tuberculobasis* two types of processes occur: tubercles and horns. Tubercles, as defined here, are short processes never higher than wide, whereas horns are slender processes longer than wide,

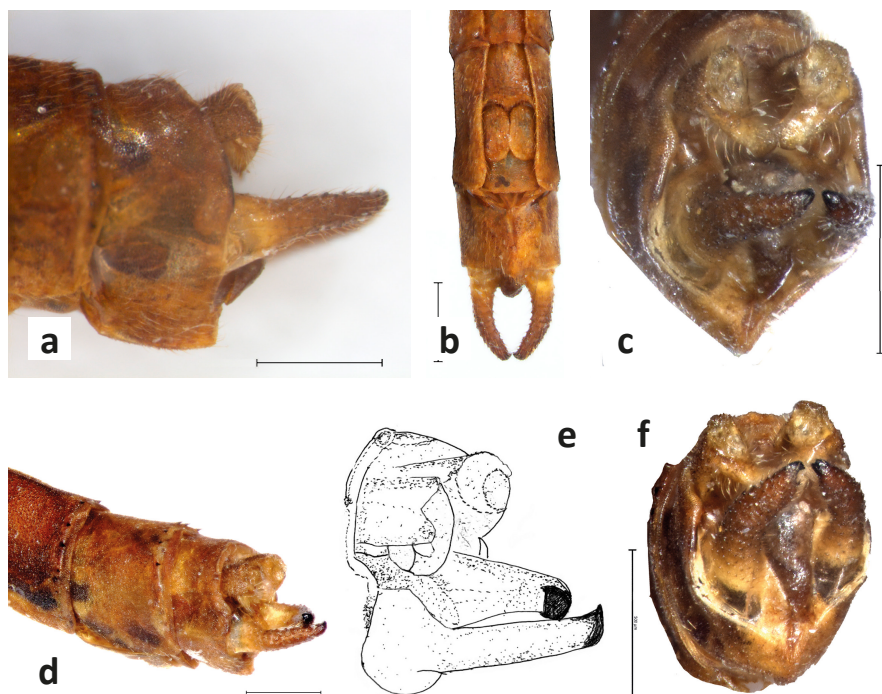


Figure 4. The male appendages of *Tuberculobasis cornu* sp. nov.; a – lateral view; b – ventral view; c – posterior view; d – dorso-lateral view; e – dorso-lateral view drawing of d; f – ventro-dorsal view. All illustrations of the paratype except Figure 4d and 4e. Scale bar is 0.5 mm.

typified by the processes found in most species of *Metaleptobasis*. Horns occur only in males of *Denticulobasis* whereas tubercles occur in all males and most females of *Tuberculobasis* and in females of *Denticulobasis*«. Additionally, MACHADO (2009a) noted that a defining feature of some *Tuberculobasis* males is the presence of a ventral process on the cerci. In their overview of the genera of the Zygoptera of the New World, GARRISON *et al.* (2010) used the presence of horns as the key factor in the genus *Denticulobasis*. We decided to put the new species in *Tuberculobasis* based on the cercus having a significant ventral process. However, its tubercles are longer than wide, making it the first known *Tuberculobasis* species to exhibit this morphology. This finding demonstrates that the tubercle proportions, as proposed by MACHADO (2009a), are not a reliable diagnostic character to separate the genus from *Denticulobasis*. Instead, we redefine the tubercles in *Tuberculobasis* as being short processes at most 1.5 times as long as wide, whereas horns in *Denticulobasis* are slender processes at least twice as long as wide. The denticulated vulvar plate of females of *Denticulobasis* is still the most accurate diagnostic feature for that genus, but it cannot be confirmed to be absent in *T. cornu* sp. nov. until females of this species are found.



Figure 5. Abdominal segment 1 and a part of segment 2 of the paratype, and the proximal segment of the ligula.

Ecology

Jean Belle visited Tapatosso on two dates, as can be reconstructed from his collected Odonata present in the collection of the Naturalis Biodiversity Center. Besides *Tuberculobasis cornu* sp. nov., on the second day (06. iv.1963) he found the following Zygoptera: *Acanthagrion chacoense* Calvert, 1909, *Epipleoneura pereirai* Machado, 1964, *Neoneura joana* Williamson, 1917, *N. myrthea* Williamson, 1917, and *Tuberculobasis yanomami*; and the following Anisoptera: *Macrothemis flavescens* (Kirby, 1897), *Perithemis lais* (Perty, 1834), *P. thais* Kirby, 1889, and *Uracis fastigiata* (Burmeister, 1839). Except for *T. yanomami*, *P. lais*, *P. thais*, and *U. fastigiata* all species are characteristic for running waters of the Tapanahony river and the Tosso creek. Although these species might have been collected in several habitats at that locality, both *T. cornu* sp. nov. and *T. yanomami* have been recorded at Tapatosso on the same date and therefore might have co-occurred.

Note on the type locality

The location 'Tapatosso' cannot be found on any map of Suriname. However, the name is mentioned in literature of Suriname: this is what HELMAN (1980) called their camp in 1955 at the confluence of the »Tapamatorie« and Tosso creek (with »Tapamatorie« being a wrong spelling of Tapanahony). In 2011, almost 50 years later, while the second author was staying with Johan van 't Bosch, Wouter Wakkie and Ruth Langemeijer at Drietabbetje, an island in the Tapanahony river, he asked a boat owner living there if he knew the locality 'Tapatosso'. The man said he did, and so we went on 25.vii.2011 to a locality about 50 km upstream. We hoped to find clues about the habitat of the new species described here or maybe find it, even though it was nearly four months later in the season. The locality was an open space at the riverside with one house, more or less opposite to Godo Olo at the Tapanahony river. When we were walking on a path in the woods it started to rain within one hour and we had to return to the boat without any clue on the habitat, and we did not find *Tuberculobasis cornu* sp. nov. On a trail in the woods, we found *Inpabasis rosea* (Selys, 1877), *Acanthagrion rubrifrons* Leonard, 1977, and two species from Jean Belle's list (*Perithemis lais* and *P. thais*).

Discussion

Based on the characteristics described above, *Tuberculobasis cornu* sp. nov. can be distinguished from all other currently known *Tuberculobasis* species. However, two previously described species require further clarification. First, *T. cardinalis* Fraser, 1946, was described from a single female specimen, and the male morphology remains unknown. Given the markedly different morphology of the tubercles and a different wing venation in *T. cornu* sp. nov. with respect to *T. cardinalis* – in the redescription by DE MARMELS (1984) as *Oxyagrion cardinalis* – it is assumed that these are distinct species. This is supported by the considerable geographic distance of 3 000 km, and even more by the difference in elevation, between Mashuyacu, Peru (as we interpret the original type locality ‘Mishuyacu, Peru’ for *T. cardinalis*, approximately 1 670 m a.s.l.) and Tapatosso, Suriname (95 m a.s.l.). However, this significant difference in specimen locality cannot be conclusive as it has previously been shown that *Tuberculobasis* species can be found over large geographical distances and habitat differences (DE ALMEIDA *et al.* 2010). Morphology of the thorax also seems to vary between males and females throughout the *Tuberculobasis* genus, so more research is needed to investigate the differences between these two species. Secondly, the type locality of the male holotype – and thus far only known specimen – of *T. karitiana* Machado, 2009, is Porto Velho Rondônia State, in western Brazil, at a distance of 1 600 km, but at a rather comparable elevation of 110 m a.s.l. This male unfortunately lacks the abdomen and appendages, but the species can be distinguished from *T. cornu* sp. nov. based on its tubercle and dorsal thoracic morphology.

Within *Tuberculobasis*, MACHADO (2009a) previously proposed two species groups based on the relative length of the cerci and paraprocts. One group has cerci and paraprocts of similar lengths, while the other group has significantly longer paraprocts as also presented in several other genera: *Denticulobasis*, *Mesoleptobasis* Sjöstedt, 1918, and *Tukanobasis* Machado, 2009. The groups were defined as follows:

- The *mammilaris* group, comprising species in which the cerci and paraprocts are typically of similar length: *Tuberculobasis geijskesi*, *T. mammilaris*, *T. tirio* Machado, 2009, and *T. yanomami*.

Table 1. Proposed organization of the genus *Tuberculobasis*. Species names in each column arranged according to year of description, earliest first. Both *T. cardinalis* (only known from one ♀) and *T. karitiana* (only known from one ♂ with abdomen missing) could not be classified. To facilitate comparison, a male *Tuberculobasis* from each group and its appendages are illustrated in Figure 6.

Group	<i>mammilaris</i> group	<i>inversa</i> group	<i>arara</i> group
Length paraproct ♂	Short	Long	Long
Distal patch ♂	Absent	Absent	Present
Tubercles ♀	Absent	Present	Present
Median lobe ♀	Well-defined	Poorly defined	Well-defined
Species	<i>T. mammilaris</i>	<i>T. inversa</i>	<i>T. costalimai</i>
	<i>T. yanomami</i>	<i>T. guarani</i>	<i>T. arara</i>
	<i>T. geijskesi</i>	<i>T. macuxi</i>	<i>T. cornu</i> sp. nov.
	<i>T. tirio</i>	<i>T. williamsoni</i>	

- The *costalimai* group, comprising species in which the cerci are typically 1/3 to 2/3 the length of the paraprocts: *Tuberculobasis arara* Machado, 2009, *T. cardinalis*, *T. costalimai* (Santos, 1957), *T. guarani* Machado, 2009, *T. inversa* (Selys, 1876), *T. karitiana*, *T. macuxi*, and *T. williamsoni* Machado, 2009.

Based on the unique morphology of *T. cornu* sp. nov., we propose a revised classification of the genus, introducing a third group: the *arara* group. This group comprises species with a distinguishable ‘distal patch’ on the male cerci. The distal patch is a structural feature analogous to the ‘distal lobe’ described in *Denticulobasis* but is distinguishable by its flatter and rougher appearance. The distal patch is present on the cerci of *T. arara*, *T. costalimai*, and *T. cornu* sp. nov.

With the reassignment of *T. costalimai* to the *arara* group, the former *costalimai* group has been renamed as the *inversa* group. Furthermore, *T. karitiana* and *T. cardinalis* have been excluded from group placement due to missing or unavailable information on cerci length, resulting from damaged holotype and the absence of male description, respectively. This reorganization is supported by diagnostic characteristics of known females as well: females from the *mammilaris* group (*T. mammilaris*, *T. yanomami*, and

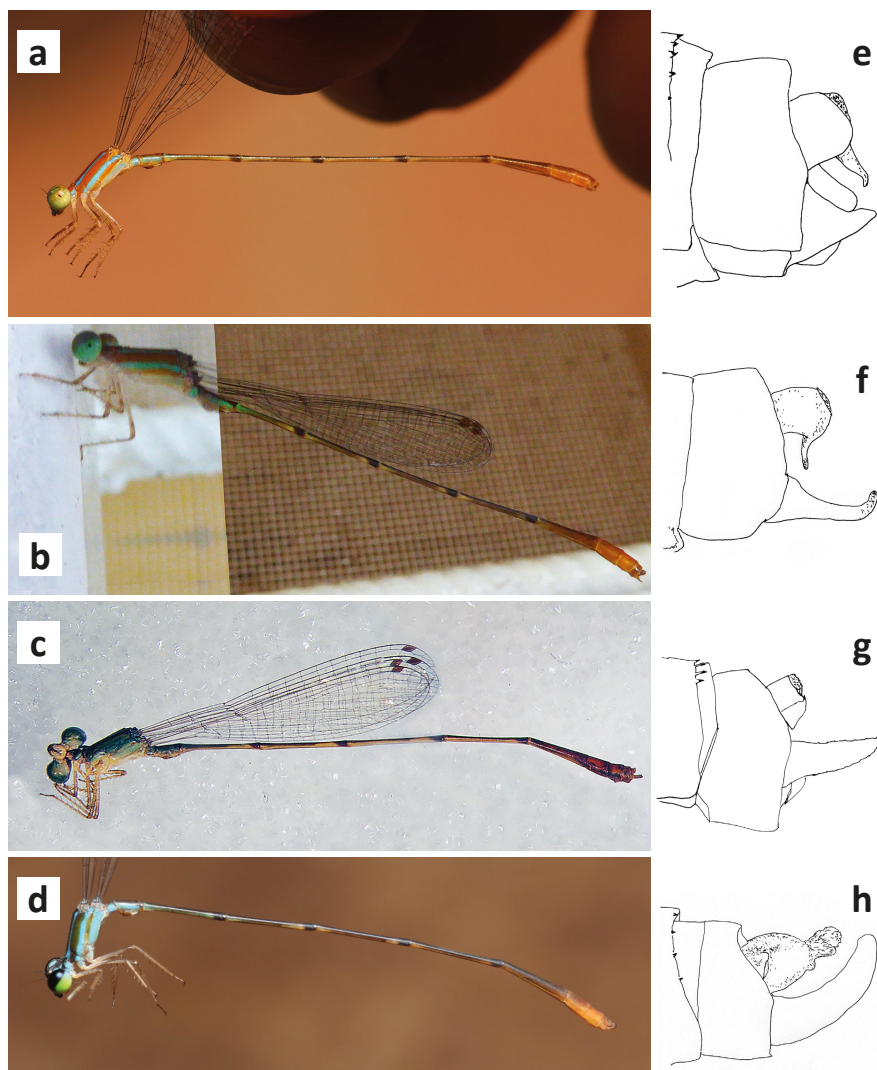


Figure 6. Photos of males and drawings of the appendages of the three groups. a, e – *Tuberculobasis geijskesi* (mammilaris group); b, f – *T. macuxi* (inversa group); c, g – *T. cornu* sp. nov. (arara group); d, h – *Denticulobasis garrisoni*. Photos: a – Jos Hoogveld (07.x.2017), Coropinakreek near J.F. Kennedyweg, Para, Suriname; b – Cees Witkamp, (24.iii.2018), Bersaba, Para, Suriname; c – holotype, d – Tim Faasen (30.i.2015), Tamshiyacu-Tahuayo Reserve, Peru. Figures b and c are both composites of two photos.

T. tirio) do not have well-developed mesepisternal tubercles, and females from the *inversa* group (*T. inversa* and *T. williamsoni*) have a poorly defined median lobe of the hind prothoracic lobe, which is well-defined in females from the *arara* group (*T. costalimai*). These characteristics would place the female of *T. cardinalis* in either the *mammilaris* group or the *arara* group, as the female has a well-defined median lobe but only has rudimentary tubercles. The revised organization of the genus is summarized in Table 1 and partly visualized in Figure 6.

Lastly, there are three female *Tuberculobasis* specimens known that are currently not assigned to a species and could represent a new species (MACHADO 2009a). Until a certain female specimen is found for *T. cornu* sp. nov., it cannot be ruled out that one of these females is *T. cornu* sp. nov.

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