A new species of Brazilian troglobitic harvestman of the genus *Iandumoema* (Opiliones: Gonyleptidae)

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Abstract

*Iandumoema setimapocu* sp. n. is described from the cave Lapa do Zu, Coração de Jesus, Minas Gerais State, Brazil. The new species is closely related to *Iandumoema uai* Pinto-da-Rocha, 1996 in the subfamily Pachylinae, from which it differs by the following features: Male femur IV straight; the male apophysis on coxa IV directed obliquely backward; eyes depigmented; tubercles on femur IV close to each other, separated by about one diameter; male pedipalpal tibia with ectal setae IliIi; lack of median setae on ventral plate of penis. *Iandumoema* is the first exclusively troglobitic genus of Opiliones in Brazil that contains two species.

Key words: Pachylinae; cave; troglomorphic

Introduction

Animals which inhabit caves are ecologically grouped into trogloxenes (organisms which are regularly found in cave habitats but must periodically go aboveground to complete their life cycles), troglophiles (organisms which may complete their life cycles both in subterranean and surface habitats, forming self-sustained hypogean populations genetically connected with epigean ones) and troglobites (species that live exclusively in subterranean habitats) (see e.g., Holsinger & Culver 1988; Trajano 2005). Among the troglobites, arthropods stand out for having many specializations associated to an exclusively subterranean way of life. These include the reduction or loss of tegumentary pigmentation, weak sclerotization of the cuticle, reduction or loss of the eyes and increased length of appendages, amongst others (see e.g., Curtis & Machado 2007).

Cave dwelling harvestmen, including troglobites, troglophiles and trogloxenes, are quite common in Brazil (Gnaspini & Trajano 1994; Pinto-da-Rocha 1995). Almost all known troglobitic Brazilian harvestmen belong to the family Gonyleptidae (Kury 2003), most of them currently placed in monotypical genera, as is the case of *Pachylospeleus strinatii* Šilhavý, 1974 (Pachylospeleinae); *Giupponia chagasi* Pérez-González & Kury, 2002 (Pachylinae) and *Iandumoema uai* Pinto-da-Rocha, 1996 (Pachylinae). Moreover, there is an undescribed Pachylinae from the State of Santa Catarina (Pinto-da-Rocha et al. 2001) and a Tricommatinae, from the State of Minas Gerais (description in progress by A. Kury and A. Pérez-González, E. Trajano pers. comm.). The only troglobitic non-gonyleptid harvestman in Brazil is *Spaeleoleptes spaeleus* H. Soares, 1966 (Escadibiidae), which is also in a monotypic genus.

Intensive collections have recently been made in Brazilian caves as well as other sites that had rarely or never been studied before, because of government concern over the biodiversity of these habitats. An expedition undertaken by Eleonora Trajano and Maria Elina Bichuette, funded by the Brazilian government, yielded
totally depigmented harvestmen with reduced eyes and slender, long legs from a cave in the State of Minas Gerais. This species, described below, belongs to the genus *Iandumoema* and makes it the first exclusively troglobitic Brazilian harvestmen genus with two species.

**Material and methods**

Methods and terminology follow Acosta *et al.* (2007). The male genitalia were cleared with creosote for observation. Coloration is based on specimens immersed in ethylic alcohol. Abbreviations used in tables are: TR=trochanter; FE=femur; PT=patella; TI=tibia; MT=metatarsus; TA=tarsus. All measurements are in mm. The types are deposited in the Museu de Zoologia, USP, São Paulo (MZSP).

**Results**

*Iandumoema setimapocu* sp. n.
Figs 1–3

**Type material:** Brazil, Minas Gerais, Coração de Jesus, Lapa do Zu, 3.IX.2004, M.E. Bichuette & E. Trajano leg., male holotype, one female and one male paratypes (MZSP-28536).

**Etymology:** The name (from “sëtymã” = animal leg, and “poku”= long; a noun in apposition) is taken from the language of the indigenous Tupi people and refers to the characteristic legs of this species.

**Diagnosis:** The new species differs from *I. uai* by the male femur IV being straight (curved laterally and dorsally in the basal part in *I. uai*), the male apophysis on coxa IV directed obliquely backwards (basal-half laterad), eyes depigmented (reduced black pigmentation); tubercles on femur IV close to each other, separated by about one diameter (tubercles much more widely spaced); pedipalpal tibia with ectal setae Iiii (ectal and mesal setae Iiili). See also Table 2.

**Description:** *Male* (holotype): Dorsum (Fig. 1A): Measurements: Dorsal scute length 3.7; prosoma length 1.4; opisthosoma maximum width 3.3; prosoma width 2.2. Measurements of legs: Table 1. Frontal hump with 4 tubercles, anterior margin with 4 tubercles on each side. Ocularium with reduced and depigmented eyes; with high upwardly directed spine, apex curved backwards (Fig. 1C). Each side of ocularium with 7–8 tubercles; 6 tubercles posterior to ocularium. Area I divided, with 5 tubercles on each side; II with two transversal rows of 5–7 tubercles each; III with 9 tubercles; IV with 8 tubercles. Lateral margin with two rows of tubercles from sulci I to III. Posterior margin of dorsal scute with 9 tubercles. Free tergite I with 13 tubercles; II with 10; III with 10. Anal opercle irregularly tuberculate.

| TABLE 1. *Iandumoema setimapocu* sp. n., measurements of appendages of male holotype and female paratype (in parenthesises). |
|---------------|-------|-------|-------|-------|-------|-------|-------|
|               | TR    | FE    | PT    | TI    | MT    | TA    | Total |
| Leg I         | 0.3 (0.4) | 3.8 (3.2) | 1.2 (1.0) | 3.4 (2.4) | 5.5 (4.3) | 3.1 (2.4) | 17.3 (13.7) |
| Leg II        | 0.6 (0.6) | 8.4 (5.7) | 1.6 (0.9) | 7.4 (5.0) | 10.1 (6.8) | 7.5 (6.1) | 35.6 (25.1) |
| Leg III       | 0.7 (0.6) | 5.9 (4.5) | 1.4 (1.1) | 3.6 (2.9) | 6.8 (4.7) | 2.6 (2.3) | 21.0 (16.1) |
| Leg IV        | 1.1 (0.7) | 8.5 (6.1) | 1.9 (1.4) | 6.2 (4.2) | 9.3 (6.6) | 2.8 (2.5) | 29.8 (21.5) |
| Pedipalp      | 0.6 (0.6) | 1.9 (1.7) | 1.0 (0.8) | 1.4 (1.2) | ---     | 1.1 (1.0) | 6.0 (5.3) |

Venter (Fig. 1B): Coxa I with 17 tubercles; II with 22; III with 12 tubercles; IV and stigmatic area irregularly tuberculate. Posterior margin and free sternites with a row of low tubercles.

NEW BRAZILIAN TROGLOBITIC HARVESTMAN  
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FIGURE 1. *Iandumoema setimapocu* sp. n. Male (holotype): A, habitus, dorsal view; B, idem, ventral view; C: idem, right lateral view; D, right trochanter IV, dorsal view; E, right pedipalp, ventral view. Female (paratype): F, habitus, dorsal view; G, right trochanter IV, dorsal view. A and F at same scale, D and G at same scale. Scale bars: 1 mm.

Chelicera: Segment I elongated, bulla with 5 tubercles. Fixed finger with 5 equal-sized teeth on the edge; movable finger with 3 teeth.

Pedipalps (Fig. 1A,E): Slightly elongated. Coxa with 1 dorsal tubercle. Trochanter with 2 dorsal and 2 ventral (ventral mesal largest) tubercles. Femur with 1 ventro-basal followed by 3 small and 1 mesal subapical tubercles. Patella smooth; tibial spination: Ectal IiIi, mesal IiIi; tarsal spination: Ectal and mesal IiIi.

Legs (Figs 1C–D, 2A–C): Coxa I with 2 stout tubercles; II with 1 stout anterior tubercle and 1 posterior, the latter largely fused with anterior tubercle of III; IV with scattered tubercles and with dorso-apical, slightly sigmoid, backwards-directed apophysis. Trochanter I with 4 dorsal, 1 prolateral, 1 retrolateral and 3 ventral tubercles.
tubercles; II with 3 dorsal, 1 prolateral, 1 retrolateral and 3 ventral tubercles; III with 4 dorsal and 3 ventral tubercles; IV with large basal prolateral apophysis, wide and low median apophysis, and with 4 retrolateral (apical one largest), 2 dorsal and 9 ventral tubercles. Femur–tibia III with small tubercles. Femur IV straight, with 2 irregular rows of dorsal tubercles, 2 ventral rows of higher (twice as long as wide) tubercles on apex, 1 retrolateral row of irregular-sized tubercles, 1 prolateral row of small tubercles, 3 larger (median one largest) dorso-apical tubercles. Tibia IV with 2 rows of ventral tubercles (one higher than the other) in distal 1/3. Basi-tarsus I slightly swollen. Tarsal segmentation: 6(3), 11(3), 6, 6.

Penis (Fig. 3A–B): Ventral plate subrectangular, with concave base, distal margin straight; apex with an apical and a basal group of 4 long and straight setae on each side, without small intermediary setae. Glans enlarged in basal half, stylus short and thick; ventral process of stylus with serrate distal margin, not reaching apex of stylus.

TABLE 2. Detailed morphological comparison between Iandumoema uai and I. setimapocu sp. n.

<table>
<thead>
<tr>
<th>Characters</th>
<th>I. uai</th>
<th>I. setimapocu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of eyes</td>
<td>At least twice the diameter of tubercles on prosoma</td>
<td>Same or similar size of diameter of tubercles on prosoma</td>
</tr>
<tr>
<td>Setae on male pedipalpal tibia</td>
<td>Ectally and mesally with IiiIi</td>
<td>Ectally with liiiIi and mesally with liiIi</td>
</tr>
<tr>
<td>Direction of dorso-apical apophysis on male coxa IV</td>
<td>Backwards and laterad</td>
<td>Obliquely backwards, close to body</td>
</tr>
<tr>
<td>Median prolateral apophysis on male trochanter IV</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Retrolateral row of high tubercles on male femur IV</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Larger tubercles on male femur apex</td>
<td>Two (one prolaterally, the other retrolaterally)</td>
<td>Three (two as in I. uai, plus a large median one)</td>
</tr>
<tr>
<td>Median setae on ventral plate of penis</td>
<td>Present (one pair)</td>
<td>Absent</td>
</tr>
<tr>
<td>Size of dorso-apical apophysis on female coxa IV</td>
<td>Short (half of trochanter IV length)</td>
<td>Long (3/4 of or almost equal to trochanter IV length)</td>
</tr>
<tr>
<td>Prolateral apophyses on female trochanter IV</td>
<td>Absent</td>
<td>Present, half or less than half as long as those in male</td>
</tr>
</tbody>
</table>


Female (paratype; Figs 1F–G, 2D–E): Measurements: Dorsal scute length 3.2; prosoma length 1.8; opisthosoma maximum width 2.6; prosoma width 1.9. Only characteristics different from those of males are mentioned. Anterior margin of dorsal scute with 1–3 tubercles on each side. Area I with 3–7 tubercles on each side; II with 17; III with 11; IV with 10 tubercles. Posterior margin with 12 tubercles. Free tergite I with 12; II with 11; III with 12 tubercles. Pedipalpal tibia spination: Ectal and mesal IiiIi. Coxa IV with a shorter dorsal apophysis (half as long) than in male; trochanter IV with basal and median apophyses half as long or less than in male; tubercles on legs smaller than in male; femur IV with 2 larger dorso-apical tubercles.

Detailed comparison between Iandumoema uai and I. setimapocu sp. n.: A brief summary of the morphological comparison is presented in table 2. In general I. uai has proportionally longer appendages, whereas I. setimapocu has proportionally smaller eyes. It is noteworthy to mention that the female of I. setimapocu possesses a dorso-apical apophysis on coxa IV which is proportionally larger than in females of other genera of Pachylinae (usually with a larger, pointed tubercle dorso- api cally on coxa IV). Other relatively similar conditions, i.e. females which have legs with spines and apophyses as long as those of males, are exhibited in
some species of Caelopyginae (see illustrations in Pinto-da-Rocha 2002) and Progonyleptoidellinae (Kury & Pinto-da-Rocha 1997). The presence of spines and apophyses on coxa IV of females that are as long as in males indicates paternal care (Machado & Macías-Ordóñez 2007). However, there is no reported case of paternal care in Pachylinae and the reproductive biology of *I. setimapocu* is unknown. Nonetheless, it is worth investigating their reproductive biology to test the hypothesis that paternal care is connected to coxa IV armature in females and to provide additional data for conservation management of the cave and its surroundings.

**FIGURE 2.** *Iandumoema setimapocu* sp. n. Male (holotype): A, right leg IV, dorsal view; B, idem, prolateral view; C, idem, ventral view. Female (paratype): D, right leg IV, dorsal view; E, idem, ventral view. A–C at same scale, D–E at same scale. Scale bars: 1 mm.
**Distribution:** Known only from the type locality.

**Biological notes:** The Lapa do Zu Cave is 3 km long, traversed by a stream which carries considerable amounts of leaves, tree branches and trunks into the aphotic zone. The air temperature was around 24°C during collecting. The animals were captured 200–300 m from the main cave entrance, on plant debris close to the stream and on the cave walls, in a very humid place. *Iandumoema setimapocu* sp. n. shows the following troglomorphism: Body depigmented, appendages elongated, eyes reduced and depigmented.

**Biogeographical remarks:** The genus *Iandumoema* encompasses only two species, *I. uai* and *I. setimapocu* sp. n., each restricted to a single cave in the State of Minas Gerais. These caves are about 170 km apart in a straight line, with the São Francisco river between them. Dispersion across the subterranean habitat by a common ancestor, now extinct, seems to be unlikely, since these caves are located at different margins of the large São Francisco river. Even if there is a lithographic continuity beneath the river, the limestone spaces would be filled with water (A. Auler pers. comm.), thus precluding the dispersion of terrestrial cave animals. An independent colonization of both caves by an epigeeic ancestor, which then was widely distributed in northwestern Minas Gerais, followed by isolation and speciation, seems to be more reasonable. Terrestrial subterranean animal species in Brazil are believed to be of recent origin (Trajano 1995). The isolation may have occurred in one of the nine Pleistocene dry phases during the last 210,000 years that were intercalated by short wet phases lasting from several hundred to a few thousand years each, as found for the northern Bahia region (Trajano 2007). The absence of detailed paleoclimatic records from the study site led us to assume a scenario similar to that suggested for northeastern and southeastern Brazil, which showed wet periods with a certain synchronism (Wang *et al.* 2004; Cruz *et al.* 2005; Wang *et al.* 2007). Unfortunately, studies on phylogenetic relationships among Pachylinae species and even Laniatores families are just beginning. Phylogenetic molecular analyses focusing on species closely related to *Iandumoema* are also not available, thus making it impossible to correlate isolation and speciation to a dated geological or paleoclimatic event.
Notes on the distribution of Brazilian cave species: About 800 harvestmen species in 13 families occur in Brazil (Kury 2003). Among them, 30 species in five families (Sclerosomatidae; Escadabiidae; Cosmetidae; Gonyleptidae; and Stygnidae) are associated to a subterranean environment. Some are found close to cave
entrances and use caves only as oviposition sites and/or as diurnal shelters. These species belong to the gagrelines (Sclerosomatidae), cosmetines (Cosmetidae), goniosomatines and mitobatines (Gonyleptidae); they are considered to be trogloxenes (Pinto-da-Rocha 1995). Others maintain considerable populations in the interior of caves, but also occur outside. These are *Verrucastynus caliginosus* (Pinto-da-Rocha, 1990) (Stygnidae), “Daguerreia” inermis Soares & Soares, 1947 (the only species that cannot be placed in the genus *Daguerreia* after it was synonymized with *Pachyloides* Holmberg by Acosta (1996); it is currently considered as a species of uncertain taxonomic position), and a few *Eusarcus* species (both Gonyleptidae). Eleven truly troglobitic harvestmen species belonging to the families Escadabiidae (*Spaeleoleptes spaeleus* H.Soares, 1966) and Gonyleptidae (remaining species) have been recorded from Brazilian caves. Most troglobitic gonyleptids belong to the Pachylinae (*Discocyrtus* sp., *Eusarcus* spp., *Giupponia chagasi*, *Iandumoema uai* and two undescribed Pachylinae), others to the Tricommatinae (*Spinopilar* sp.) and the Pachylospeleinae (*Pachylospeleus strinatii*). Almost all species live in limestone regions, except for an undescribed *Discocyrtus* sp. (Kury in press) in a sandstone cave (see Fig. 4). Although most of the diversity of Gonyleptidae (more than one third of the known 800 spp.; see Kury 2003) was recorded from the coastal Atlantic Rain Forest, an area with some isolated limestone lenses (in southern Bahia, from São Paulo to Santa Catarina States), most of the troglobitic species occur in Central Brazil (Bambuí region, Goiás, Minas Gerais and Bahia States; see Fig. 4). There limestone caves are very abundant and covered by the relatively hotter and drier cerrado (Brazilian savanna). Other areas with this kind of rock that is very susceptible to dissolution (and thus to form caves) are Mato Grosso (West of Cuiabá) and the northeastern Brazilian States (approximately at 6°S). The few surveys conducted there yielded no troglobitic harvestmen up to now. Brazilian troglobitic species are considered by the government as threatened and are listed in a “Red list of threatened species” (Ministério do Meio Ambiente 2003) due to their very restricted distribution (normally only one cave), low population densities and threat by limestone quarrying.

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