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A new species of the stingless bee *Trichotrigona* (Hymenoptera: Apidae, Meliponini)

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Abstract

Trichotrigona camargoiana **sp. nov.** from Candeias do Jamari, Rondônia, Brazil is described and illustrated, along with nesting and behavior, as the second species of the rare and unusual genus *Trichotrigona* Camargo & Moure, 1983. The new species differs from *T. extranea* Camargo & Moure, 1983 by having plumose setae on the face and mesepisterna, wing setae predominantly yellow and black metatibia. The diagnosis for *Trichotrigona* is updated. As believed for *T. extranea*, *T. camargoiana* **sp. nov.** apparently does not store food and is a cleptobiotic social bee associated with *Frieseomelitta*.

Key words: cleptobiosis, male, nest, pollen, resin, Apoidea, taxonomy

Resumo

Trichotrigona camargoiana **sp. nov.**, de Candeias do Jamari, Rondônia, Brazil é descrita e ilustrada, incluindo nidificação e comportamento, sendo a segunda espécie do gênero raro e incomum *Trichotrigona* Camargo & Moure, 1983. A nova espécie difere de *T. extranea* Camargo & Moure, 1983 por apresentar pêlos plumosos na face e mesepisternos, pêlos das asas predominantemente amarelos e tíbia posterior preta. A diagnose de *Trichotrigona* é atualizada. Como suposto para *T. extranea*, *T. camargoiana* **sp. nov.** aparentemente não estoca alimento e trata-se de uma abelha social cleptobiótica, associada com *Frieseomelitta*.

Palavras-chave: cleptobiose, macho, ninho, pólen, resina, Apoidea, taxonomia

Introduction

Discovery of this enigmatic stingless bee genus occurred in 1980, when J.M.F. Camargo and M. Mazucato found what appeared to be fragments of a nest, or perhaps an incipient nest, inside a small dried tree trunk shared with another stingless bee, *Frieseomelitta paranigra* (Schwarz, 1940). The material was composed of a few workers, cells and cocoons, besides a young physogastric queen (forewings unworn, without damage; Camargo & Moure 1983; Camargo & Pedro 2007a). The new genus and species were named *Trichotrigona extranea* Camargo & Moure, 1983. On that occasion it was supposed (Roubik 1989; Michener 1990, 2000) that *T. extranea* could be a social parasite as the workers had a reduced penicillum and slender, tapering setae, instead of the stiff rastellar bristles on the metatibia (tibia III), and few plumose setae. Furthermore, the nest was attached to a nest of *F. paranigra* in the same tree cavity.

In terms of morphology, other peculiarities of the genus, compared to other stingless bees, are the hairy compound eye, the spatulate setae on the external surface of worker protibia, the shape of the metasoma, which is wide at its base, acuminate at the apex and with sides slightly curved, and body and wings covered with abundant long, simple, bristle-like setae, with few plumose setae (Camargo & Pedro 2007a).

Three further nests of *T. extranea* were found 19 years later in hollows of dead, dried branches of "Tanimbuca", *Buchenavia suaveolens* Eichler (Combretaceae), in periodically flooded forests ("igapó" forest), near the mouth of

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the Daraá River, a tributary of the Negro River, ca. 30 km E of Santa Isabel do Rio Negro (Tapurucuara), Amazonas, Brazil. This was precisely the same place where the first nest had been discovered earlier (Camargo & Pedro 2007a). As with the first nest there were no storage food pots and two of the colonies were sharing the same hollow with another stingless bee, this time with an undescribed species of *Frieseomelitta* Ihering, 1912. New data about the biology of *T. extranea* were obtained and males were described. However, no additional information was given to clarify the nature of its food gathering behavior (Camargo & Pedro 2007a). Considering the robust body shape (compared with *Frieseomelitta*, a closely related taxon; Camargo & Pedro, 2003; Rasmussen & Cameron, 2010), the polished integument covered mainly with simple setae, and the brood cells provisioned with a large diversity of pollen types (but no pollen storage pots within the nest), besides the other characteristics already mentioned, it was supposed by Camargo & Pedro (2007a) that *T. extranea* could have a very peculiar form of cleptobiotic behavior. In contrast to *Lestrimelitta* Friese, 1903 species, which have densely populated nests and perform massive attacks on host nests, then transporting brood provisions removed from larval cells in their 'stomach' (crop) to their nests (Sakagami et al. 1993), *T. extranea* has a small population between 43 and 163 individuals. If *Trichotrigona* is really cleptobiotic, then these bees probably act individually and have free and continuous access to the nests of their 'hosts', probably species of *Frieseomelitta,* which occupy the same nest substrate and are always nearby (Camargo & Pedro, 2007a).

In addition, phylogenetic hypotheses based on morphology, biology (Camargo & Pedro 2003) as well as molecular data (Rasmussen & Cameron 2010) places *Trichotrigona* close to *Frieseomelitta*, as the sister group of the clade *Frieseomelitta* plus *Duckeola* Moure, 1944 (Camargo & Pedro 2003) or of *Duckeola* [i.e.(*Frieseomelitta* (*Duckeola*, *Trichotrigona*))] according to the molecular hypothesis (Rasmussen & Cameron 2010).

The new species of *Trichotrigona* described here was discovered in a meliponary (a site of managed bee colonies) in the southwestern Amazon region of Brazil. The *Trichotrigona* nest was naturally established in a small and empty wooden beehive. The new species has all the peculiarities of the genus as originally described, with just a few differences mainly on integument color and pilosity. An emended diagnosis for the genus is provided, including new diagnostic characters, in addition to the description of *Trichotrigona camargoiana* **sp. nov.**, and its nest.

Methods

The specimens of *Trichotrigona camargoiana* **sp. nov.** were collected from a nest established within a small wooden beehive in a meliponary in the neighborhoods of Candeias do Jamari, Rondônia State, western Amazonian region of Brazil, 08°47'30,6"S, 63°44'18,1"W (Fig. 47), on two different occasions, September 9th, 2011 by GDC, and April 17–21, 2012, by both authors, when additional data and photographs of the nest were taken.

For the taxonomic descriptions the terminology and measurements follow Camargo and Pedro (2009). Abdominal terga and sterna are indicated as TII–TVIII and SII–SVIII, respectively; the first abdominal tergum, incorporated to the thorax, is referred to as the propodeum and the 'propodeal disc' as the metapostnotum; legs and respective podomeres are followed by Roman numerals according to the segment, e.g. tibia III refers to the metatibia; flagellomeres are abbreviated and numbered from base to apex, fl.1, fl.2, etc. The alveolocellar distance is measured from the alveolus to the anterior margin of the lateral ocellus of the same side, interocellar distance is measured between the lateral ocelli, clypeocellar distance from the apex of the clypeus to the anterior margin of the median ocellus, length of the head from the apex of the clypeus to the vertex aligned on the same focal distance, and length of the forewing from the apex of the costal sclerite to the tip of the forewing, except when indicated. Measurements were taken with an ocular reticule and are given in millimeters. Microphotographs were taken with digital camera Leica DFC 420 coupled with a Leica M205C stereomicroscope and scanning electron microscopy.

The specimens are deposited in the RPSP—Camargo Collection (Departamento de Biologia, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo—USP, Ribeirão Preto—SP, Brazil), DZUP—Coleção Moure (Departamento de Zoologia, Universidade Federal do Paraná), AMNH—American Museum of Natural History (New York—NY, USA), and SEMC—Natural History Museum (Division of Entomology, University of Kansas, Lawrence, Kansas, USA).

Trichotrigona Camargo & Moure, 1983

Trichotrigona Camargo & Moure 1983: 421; Michener 1990: 128; 1997: 59; 2000: 799; 2007: 823; Camargo & Pedro 2007a: 73; 2007b: 524

Type species: *Trichotrigona extranea* Camargo & Moure, 1983: 424 (by original designation).

Diagnosis. A diagnosis of the genus *Trichotrigona* is presented following Camargo & Moure, 1983 and Camargo & Pedro, 2007a, including modifications, in order to accommodate the new species, *Trichotrigona camargoiana* **sp. nov.** The main characters are highlighted in boldface lettering. The system of Moure (1961) was slightly modified in order to include new diagnostic characters unknown prior to the discovery of *Trichotrigona*, but the sequence of the structures was maintained as far as possible. The characters mentioned here, which are invariable among the species, are not repeated in the descriptions.

a) Integument smooth and shiny; piligerous punctures small and sparse, the space between punctures 3 to 4x their diameter (Figs. 9, 10); yellow maculation pronounced on head (Figs. 5–8), standing out on supraclypeal area, clypeus and lower paraocular areas extending as a fragmentary stripe rounding the ocular orbits; on thorax, well defined on pronotum, pronotal lobes and metepisternum, variable (pronounced or vestigial, depending on the species) on sides of mesoscutum, axillae and posterior edge of scutellum (Figs. 9, 10).

b) Compound eyes with erect setae well evident (0.04–0.05 mm length, Fig. 18), almost as long as those of the paraocular areas.

c) Head slightly narrower than thorax; maximum interorbital distance longer than length of compound eye; inner orbits slightly sinuous and convergent below; superior alveolar tangent clearly above the middle of face (Figs. 5, 7); interalveolar distance ca. 2/3 of alveolorbital; frons slightly depressed medially and above, elevated between the antennal alveoli; frontal carina absent.

d) Clypeus slightly arched, twice as wide as long; covered only with short, semi-erect pilosity; epistomal sulcus slightly curved on sides.

e) Mandibles with two small acute denticles in upper third of apical margin, the space between them semicircular.

f) Vertex convex, little elevated above the superior orbital tangent, depressed medially and with two arches, one behind each lateral ocellus; preoccipital carina absent; ocelloccipital distance, 1.5x diameter of median ocellus; orbitoccipital 1.3x ocelloccipital; interocellar distance a little more than 2x ocellar diameter; ocellorbital 2/3 of interocellar (Figs. 12, 13).

g) Antennal scape 1.5x longer than alveolocellar distance (Figs. 12, 13); flagellomeres slightly longer than their diameters; fl.2 longer than fl.1 and approximately as long as fl.3.

h) Prescutal sutures and median sulcus weakly impressed; scutellum clearly projected beyond the metanotum, approximately ogive shaped (Figs. 9, 10).

i) Forewings longer than body (Figs. 1, 2), remarkably hirsute (Fig. 11); pterostigma small, parastigma shorter than width of pterostigma; marginal cell 4.5x longer than wide, narrowed at base and almost closed at apex; bifurcation between M and Cu anterior to cu-anal vein; submarginal angle between Rs and Rs+M obtuse; M strong, angled on 1st m-cu almost reaching distal edge of wing; submarginal cells absent; Cubital vein evident; hamuli 6; jugal lobe half length of anal; M and cu-anal veins absent in hind wings (Fig. 11).

j) Tibia III approximately club shaped, enlarged; posterior border slightly concave on basal third, the anterior weakly convex; postero-distal corner entirely rounded (Figs. 19, 20); setae on posterior edge simple, long and short intercalated; some plumose setae on distal border; corbicular area large, hairy, approximately 3/5 tibia length; elevated keirotrichiate area narrower than the anterior lowered zone and almost as wide as the posterior; both anterior and posterior lowered zones with longer and sparser pilosity (Fig. 20); **penicillum reduced; rastellum absent, instead, slender tapering soft setae (Fig. 20)**.

k) **Basitarsus II long and thin, about 5x as long as wide**; basitarsus III flat, 1/3 wide as long with parallel sides; distal edge obtuse angled with rounded vertex (Fig. 19); inner surface uniformly setose (Fig. 20).

l) Tibia I of worker swollen, external surface covered with long, stiff, spatulate setae (Figs. 12, 16, 17)

m) Metapostnotum well developed, convex; basal area glabrous, smooth, shiny, with some small setae on sides; abdomen robust, as wide as the thorax, approximately ogived (Figs. 9, 10); last tergum (TVII) acuminate at apex.

Trichotrigona extranea Camargo & Moure, 1983

Trichotrigona extranea Camargo & Moure 1983: 424; Michener 1990: 101, 105, 128; 1997: 59; 2000: 799; Michener & Roubik 1993: 259, 261; Camargo 1994: 50; 1996: 89; 2008: 17, 18; 2013: 24, 25; Silveira *et al*. 2002: 92; Camargo & Pedro 2003: 109–122; 2007a: 72–81; 2007b: 524–525; Urban 2003: 36; Pedro 2009: 687; Rasmussen & Cameron 2010: 211, 218, 225; Pauly *et al*. 2013: 94.

Diagnosis. **Worker (Figs. 2, 7, 13, 15; Tab. I)**. Front, mesoscutum and mesepisterna laterally with simple setae only; anterior wings pale yellowish; setae of tibia III yellowish; yellow maculation faint on thorax, lateral stripes on mesoscutum short, starting from middle of tegulae to axillae; axillae only with small stripe on anterior edge; tibiae III yellowish. **Male (Figs. 4, 8, 30–37)**. Like worker in general appearance, however with a few sparse plumose setae among simple setae on frons and mesepisterna laterally; labrum flat medially.

Trichotrigona camargoiana sp. nov.

Diagnosis. **Worker (Figs. 1, 5, 9, 11, 12, 14, 16–21; Tab. I).** Front and mesepisterna laterally with plumose setae intermingled with simple; anterior wings bright yellow; setae of tibia III predominantly black; maculation on thorax bright yellow, lateral stripes of mesoscutum from anterior corners to axillae; axillae entirely yellow; tibiae III black.

Male (Figs. 3, 6, 22–29). Darker than worker due to blackish metasoma. Face and mesepisterna with abundant plumose setae laterally; labrum slightly convex.

Description. Holotype, worker (Figs. 1, 5; Tab. I).

Dimensions. Total length, 5.34 mm; forewing length, from apex of costal sclerite to wing tip, 5.19 mm (including tegula, 5.88 mm); maximum head width, 2.12 mm; abdomen width, 2.48 mm.

Integument color. Head and thorax black, contrasting with yellowish abdomen, only TII and apical half of following terga darker yellowish. Antennal scape and mandible yellowish in basal half and ochre-ferruginous in apical half; antennal flagellum fuscous on external surface and bicolored, with basal 2/3 fuscous and apical third reddish on internal surface of each flagellomere; legs ochre-ferruginous, tibia II, femur II and tibia III wholly black except for basal 1/6 and small spot at articulation point with the basitarsus yellow; metepisterna and scutellum ochraceous, last with two brownish medial spots. Wing membrane hyaline, slightly yellowish close to basal veins; alar venation yellowish. Cream-colored maculation occupying lower paraocular area, except for narrow black stripe contiguous with epistomal sulcus, enlarged near antennal socket, with two stripes gradually narrower above, one extending along inner orbit of eye to superior occiput, interrupted at tangent of upper interorbital, other slightly surpassing antennal socket separated by U-shaped black area. Other cream-colored areas include almost whole clypeus except for light brownish irregular medial spot (partially covered by pollen—in paratypes, two bars converging above); one trapezoid in supraclypeal area; almost whole pronotum, except one brownish spot next to medial posterior margin and blackish corners; anterior 1/2 of pronotal lobes; very narrow stripe (about 1/3 of scape diameter) stripe following posterior paraocular margin; posterior 1/2 of tegulae; one stripe with 1/2 to 1/3 diameter of scape at each side of mesoscutum, next to lateral margins and axillae almost completely cream colored.

Pilosity. Well developed and predominantly ochraceous except pale whitish on face and ventrally on thorax and abdomen, and in anterior and black posterior margins of tibia III; mainly with simple setae except shortly plumose on face, sides of thorax (pronotal lobes, anterior corners of mesoscutum, mesepisternum, epimeron, metepisternum and near propodeal spiracles), and apical margin of tibia III, where setae are shortly plumose; external margin of tibia I covered with long, dense, spatulate setae; compound eyes with short pilosity (35–40 mm long) well evident; remarkably long and scattered on abdominal terga mainly TV–TVII, more concentrated laterally.

Integument. Smooth and shiny, only with very small sparse piligerous punctures, the space between punctures larger than their diameter.

Form and proportions (measurements in Table I). General shape of the body as described for genus. Head slightly wider than long (2.12 : 1.78). Eyes 3x longer than wider (1.32 : 0.42) converging slightly below and as long as lower interorbital distance; upper interorbital distance, slightly smaller than the interorbital maximum (1.36 : 1.48 : 1.32); malar area short, almost linear; clypeus 0.56x shorter than its maximum width (0.68 : 1.22) and 0.44x clypeocellar distance (1.56); mandibles as described for the genus; interalveolar distance (between antennal sockets) slightly larger than alveolar diameter (0.26 : 0.22), alveolorbital ca. 1.46x first and alveolocellar distance slightly longer than 3x (0.26 : 0.22 : 0.38 : 0.72); interocellar distance 2.8x ocellar diameter (0.50 : 0.18) and ocellorbital 1.7x (0.30 : 0.18); antennal scape long, surpassing the vertex and slightly shorter than 1/2 length of flagellum plus pedicel (0.90 : 2.08). Flagellomeres as described for genus. Tibia III club-shaped, triangular with posterior angle largely rounded, 2.5x longer than wide; basitarsus III with parallel sides and posterior angle obtuse, 2.8x longer than wide (0.90 : 0.32) and as long as the maximum width of tibia III. Abdomen approximately ogived, a little wider than thorax (2.48 : 2.36) on the base and pointed at the apex.

Male (Figs. 3, 6; Tab. I). Dimensions. Total length, 5.19 mm; forewing length, from apex of costal sclerite to wing tip, 5.27 mm (including tegula, 5.90 mm); maximum head width, 2.20 mm; abdomen width, 2.55 mm.

Integument color. Like worker except scutellum and legs darker and yellow markings on face and thorax less vivid.

Pilosity. Plumose on face and sides of mesepisterna, as in worker, only slightly longer and denser; paler on thorax, mainly scutellum. Outer surface of tibia I with simple setae, not spatulate, as in male of *T. extranea*. Alar microtrichiae shorter and less dense than in worker, anterior wings fuscous on apical half and pale yellowish on base, not as yellow as worker. On abdominal terga, finer, sparser and less abundant. Posterodistal 1/3 external surface on tibia III with simple setae, denser, longer and finer, with intermixed shorter plumose setae.

Integument. Smooth and shiny, as in worker.

Form and proportions (measurements in Table I). General shape of the body as described for worker. Head 1.28x wider than long (2.20 : 1.72) and 1.45x wider than clypeocellar distance (1.52). Eyes 2.09x longer than wide (1.38 : 0.66) converging below and 1.2x longer than lower interorbital distance (1.14); upper interorbital distance slightly smaller than interorbital maximum (1.28 : 1.34 : 1.14); malar area short, almost linear; clypeus 0.61x shorter than maximum width (0.67 : 1.10) and 0.44x clypeocellar distance (1.52); mandible long and slender, slightly longer than half clypeocellar distance (0.88 : 1.52), with small indentation near inner angle, not forming a proper denticle; labrum normal, slightly convex; interocellar distance 1.92x longer than ocellorbital and ocellus diameter (0.46 : 0.24 : 0.24); antennal scape shorter than in worker, almost as long as alveolocellar distance (0.65 : 0.68) and ca. 1/4 length flagellum plus pedicel (0.65: 2.63); first flagellomere short, 1.75x as long as wide; interocellar distance 1.92x ocellus diameter. Scutellum 1.96x wider than long. General shape of tibia III as in worker, 2.54x longer than wide, with the posterodistal quarter slightly concave (a little less than in *T. extranea*), similar to shallow corbicula, swollen in anterior 1/3; basitarsus III rectangular as in worker, slightly shorter and wider, ca. 2x longer than wide. Shape of abdomen similar to worker. Genitalia and pregenital sterna as in the figures 22–29.

Type material. Holotype, worker, from "Candeias do Jamari - RO ca. 3,5 km W, margem esquerda rio Candeias", "BRASIL 17.IV.2011 08°47'S, 63°44'W S. Pedro & G. Cordeiro leg,", "905c-006 RPSP ninho Coleção Camargo", 12 paratypes—two males (one pupa) and 10 workers (1 fixed in anhydrous alcohol)—with same labels, all in RPSP, and 9 paratypes (5 dried from alcohol, and 4 kept fixed in alcohol) from the same nest with the date "09.IX.2011" and "G.D.Cordeiro leg. (N19)", three donated to AMNH (905c-005), SEMC (905c-003), and DZUP (905c-002), the other six in RPSP.

Etymology. The species here described is named honoring the late Prof. Dr. João Maria Franco de Camargo (1941-2009), who discovered *Trichotrigona* and described the first species, in addition to two other genera, 88 new stingless bee species and one *Xylocopa* Latreille, 1802 (Apidae). His contributions to the taxonomy, biogeography and biology of the stingless bees (Pedro, 2009) have substantially advanced the knowledge of this tropical, social and honey making bee group.

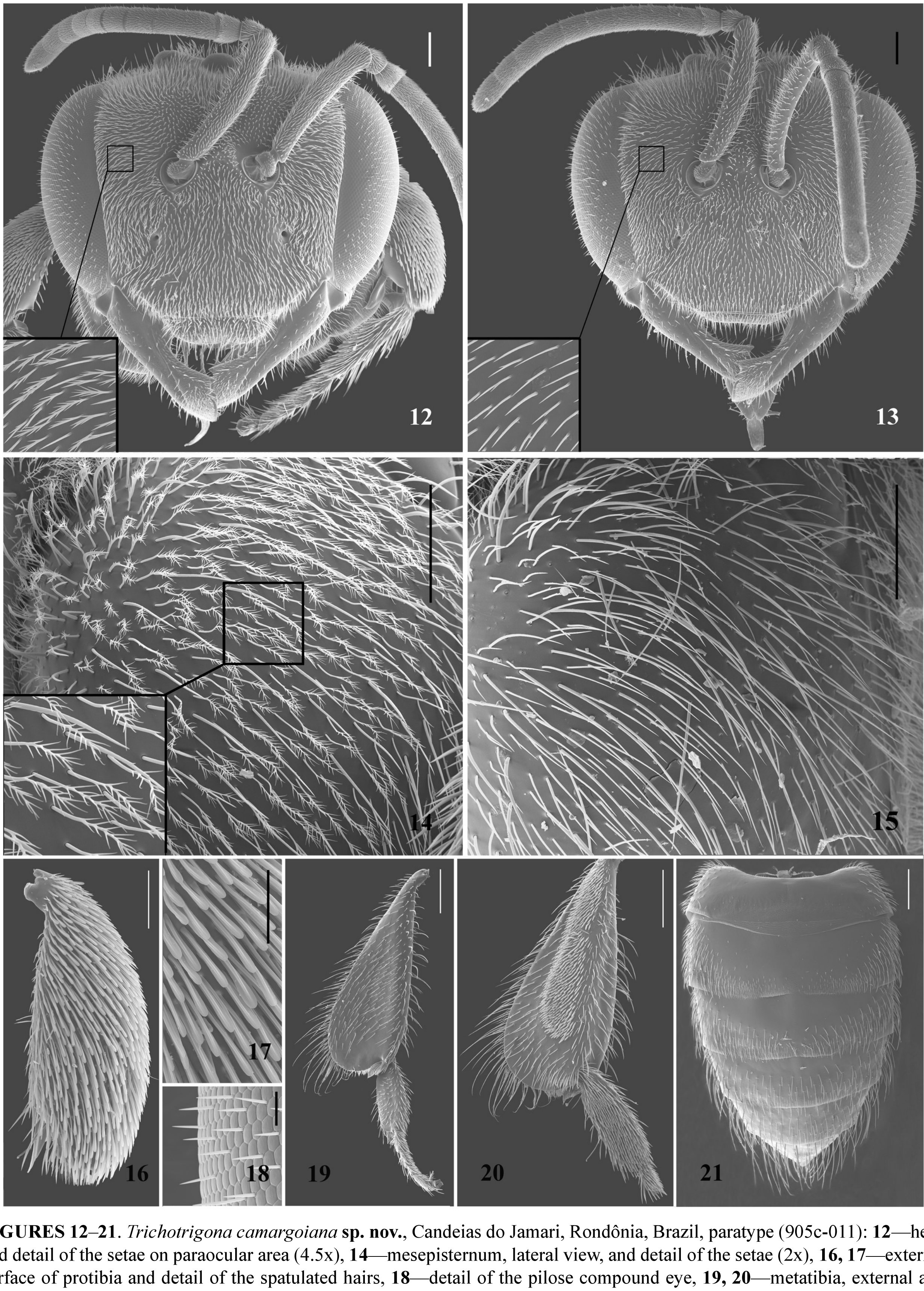
Geographic distribution and habitat. *Trichotrigona camargoiana* **sp. nov.** is known only from the type locality, Candeias do Jamari, Rondônia, Brazil (Fig. 47), between the right margin of Madeira and left margin of the Candeias River, in a region with strong anthropogenic influence (buildings, roads, crops and just 15 km E of the capital, Porto Velho), surrounded by patches of restored forest about 10 meters high. A few kilometers from the meliponary, lowland native forest still covers the banks of the Candeias (about 19 km W) and Madeira rivers (about 02 km E).

The meliponary, where the nest of *T. camargoiana* **sp. nov.** was found, was installed in a large clearing (ca. 700 m²) of upland ("terra-firme", not subject to periodical inundation) close to other clearings surrounded by regenerating forest. The closest lowlands, preserving the native vegetation and subject to periodical flooding, were about 1 km NE from the margins of a tributary of the Candeias River.

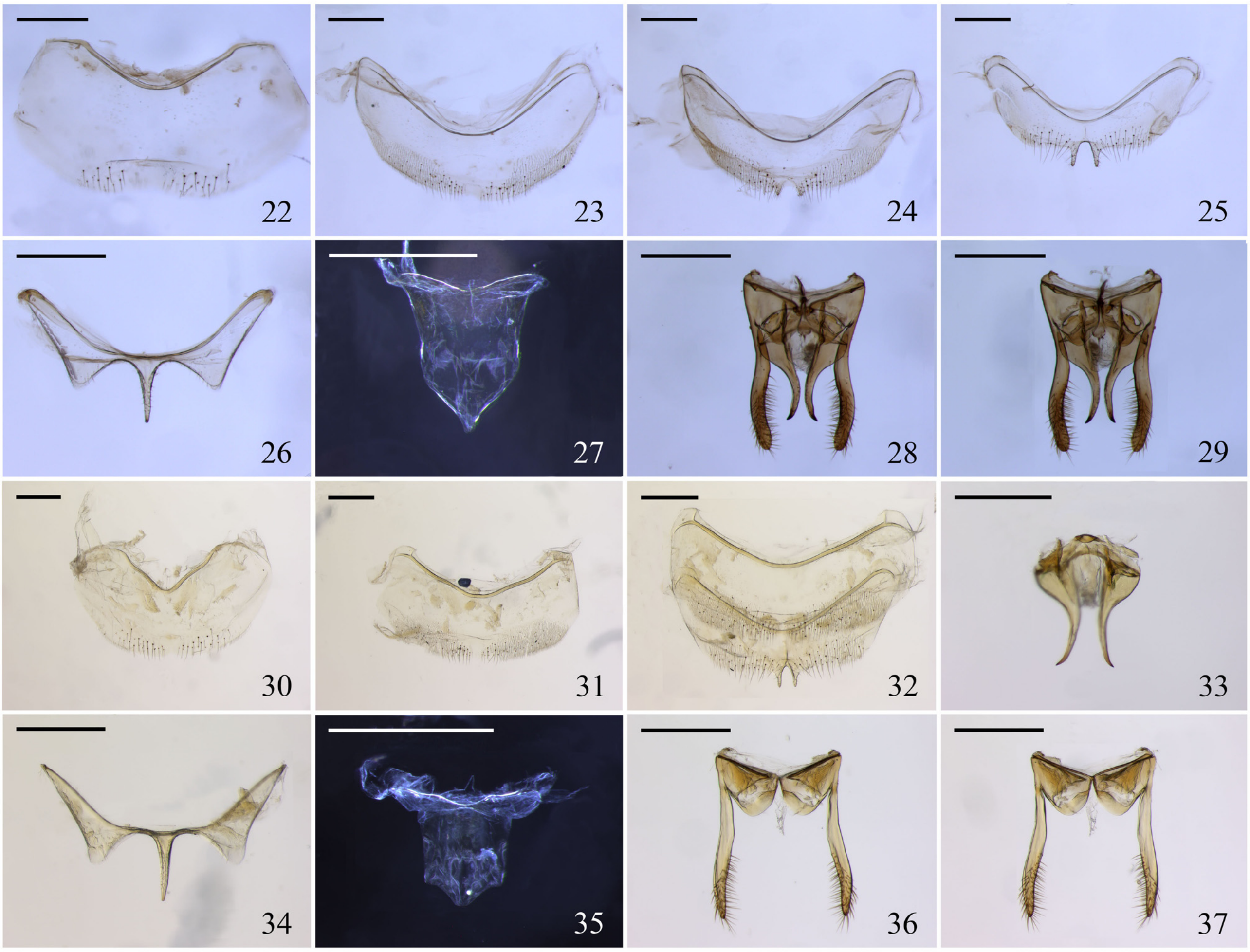
TABLE I. Measurements (mm) of *Trichotrigona extranea* (Daraá river, Amazonas, Brazil) and *T. camargoiana* **sp. nov.** (Candeias do Jamari, Rondônia, Brazil).* measurements of the holotype of *T. extranea* were retaken (using the same procedures and same stereomicroscope as used for *T. camargoiana*) in order to be directly comparable with the ones of *T. camargoiana* **sp. nov.** ** from Camargo & Pedro 2007.

Measurements	*Trichotrigona extranea*		*Trichotrigona camargoiana* **sp. nov.**	
	holotype worker *	male **	holotype worker	male
total body length	5.64	4.85	5.34	5.19
head width	2.02	1.93	2.12	2.20
head length (clypeal apex to vertex)	1.66	1.61	1.78	1.72
eye length	1.26	1.29	1.32	1.38
eye width	0.52	0.62	0.42	0.66
upper interorbital distance	1.37	1.29	1.36	1.28
maximum interorbital distance	1.44	1.35	1.48	1.34
lower interorbital distance	1.26	1.08	1.32	1.14
median ocellus diameter	0.20	0.23	0.18	0.24
interocellar distance	0.46	0.49	0.50	0.46
ocellorbital distance	0.32	0.24	0.30	0.24
interalveolar distance	0.22	0.26	0.26	0.32
alveolorbital distance	0.40	0.28	0.38	0.22
alveolocellar distance	0.66	0.63	0.72	0.68
antennal alveolus diameter	0.22	0.22	0.22	0.20
clypeus length	0.64	0.61	0.68	0.67
clypeus maximum width	1.22	0.99	1.22	1.10
intertentorial distance, clypeus width	0.68	-	0.72	0.70
clypeocellar distance	1.50	0.77	1.56	1.52
malar space length	0.04	0.02	0.02	0.02
antennal scape length	0.90	0.72	0.90	0.65
antennal scape diameter	0.14	0.18	0.14	0.18
pedicel + flagellus length	1.88	2.41	2.08	2.63
first flagellomere length	0.11 / 0.16	0.10	0.12 / 0.18	0.08 / 0.12
second flagellomere length	0.17	0.25	0.22	0.24
third flagellomere length	0.18	0.23	0.18	0.22
third flagellomere diameter	0.15	0.15	0.16	0.16
mandible length	0.98	0.78	1.06	0.88
forewing length (to apex of costal sclerite)	5.05	5.08	5.19	5.27
forewing length (including tegula)	5.64	5.66	5.88	5.90
forewing width	1.91	1.92	2.06	2.06
hamuli	6 / 6	-	6 / 6	6 / 6
mesoscutum length	1.32	1.29	1.36	1.38
mesoscutum width	1.58	1.48	1.62	1.52
scutellum width	1.02	0.95	1.00	1.02
scutellum length	0.50	0.51	0.50	0.52
tibia III length	2.28	2.34	2.38	2.34
tibia III width	0.83	0.80	0.94	0.92
basitarsus III length	0.84	0.70	0.90	0.76
basitarsus III width	0.32	0.30	0.32	0.32
tergum II (metasomal) width	2.30	-	2.48	2.55

FIGURES 1–11. *Trichotrigona camargoiana* **sp. nov.**, nest 905c from Candeias do Jamari, Rondônia, Brazil, holotype, worker, 905-006 (**1**—side view, **5**—face), paratype, male 905c-017 (**3**—side view, **6**—face) and paratypes, worker 905c-008 (**9**—thorax, dorsal view) and worker 905c-s/n (**11**—wings); *Trichotrigona extranea* Camargo & Moure from the margins of the Daraá river, near its mouth, Amazonas, Brazil, holotype, worker (**2**—side view, **7**—face), nest 262c, and males 806c-010, 806c-01 (**4**—side view, **8**—face) and worker 806c-069 (**10**—thorax, dorsal view). Scale bars: Figs 1–4, 11 = 1 mm; Figs. 5–10 = 0.5 mm.



FIGURES 12–21. *Trichotrigona camargoiana* **sp. nov.**, Candeias do Jamari, Rondônia, Brazil, paratype (905c-011): **12**—head and detail of the setae on paraocular area (4.5x), **14**—mesepisternum, lateral view, and detail of the setae (2x), **16, 17**—external surface of protibia and detail of the spatulated hairs, **18**—detail of the pilose compound eye, **19, 20**—metatibia, external and internal surfaces respectively, **21**—dorsal view of the abdomen; *Trichotrigona extranea* Camargo & Moure, Samaúma, rio Daraá, Amazonas, Brazil, (807c-085): **13**—head and detail of the setae on paraocular area (4.5x), **15**—mesepisternum, lateral view. Scale bars: Figs. 12–16 = 0.2 mm; Fig. 17 = 0.08 mm; Fig. 18 = 0.04 mm; Figs. 19–21 = 0.5 mm.



FIGURES 22–37. *Trichotrigona,* male, pre-genital sterna and genitalia*. T. camargoiana* **sp. nov.**, Candeias do Jamari, Rondônia, Brazil, paratype 905c-018, **22–29**: abdominal sterna III–VIII and genital capsule, dorsal and ventral views, respectively; *T. extranea* Camargo & Moure, Samaúma, rio Daraá, Amazonas, Brazil, 806c-011, **30**–**37**: metasomal sterna III–VIII (V and VI joined, **32**), penis valve and spatha, dorsal view (**33**) and gonostyli, dorsal and ventral views (36, 37, the vestigial sternum IX appears hanging between the gonostyli), respectively. Scale bars = 0.5 mm.

Bionomics and nesting. The nest was established on August 26th, 2010, in a small wooden hive of about 20 x 10 x10 cm, in a meliponary that housed mainly nests of *Melipona* (*Michmelia*) *seminigra abunensis* Cockerell, 1912 and *Frieseomelitta trichocerata* Moure, 1990, besides species of *Plebeia* Schwarz, 1938, *Scaptotrigona* Moure, 1942, *Nannotrigona melanocera* (Schwarz, 1938), and other stingless bees. According to information from the beekeeper, the hive was previously occupied by other Meliponini but was empty when the new nest was established. Orchids (Orchidaceae), avocado (*Persea americana* Mill., Lauraceae), "Urucum" or Achiote (*Bixa orellana* L., Bixaceae), *Byrsonima* (Malpighiaceae) and several species of flowering plants were cultivated nearby.

Nest characteristics. The description presented here is based on few data, obtained during four days visiting the meliponary. The intention was to keep the nest preserved for future studies obtain detailed information on food gathering behavior, and to collect more specimens, including the queen. Unfortunately, the colony died a few months later and no additional studies were performed. No pieces of the nest or specimens were preserved.

The nest entrance was constituted only by a small orifice of ca. 3.5–4.0 cm in diameter, without a projecting tube, just a short ring of sticky, dark reddish resin (Fig. 38, detail). Dark resin was spread mainly above and lateral to the ring, in an area of about 3–6 mm long (Fig. 38), like a frame. The cavity, inside the wooden box, had a thin protective layer of cerumen, probably, but it is difficult to say if it was deposited by *T. camargoiana* **sp. nov.** or a previous occupant.

A large deposit of dark reddish and yellowish resin was found adjacent to the wall containing the nest entrance (Fig. 42). This mass of sticky (more recently deposited) and solid (older) resin was crossed by a gallery connecting the exterior of the nest with the brood chamber inside the box. Deposits like this were found also in the nests of *T. extranea* (Camargo & Pedro 2007a). One male was photographed carrying resin on tibia III (Fig. 42, detail).

The brood chamber was composed of a cluster with about 350 cells and cocoons; the older cocoons (with defecating and postdefecating larvae or pupae) were attached by short connectives of cerumen to the top of the box and continued joined after the box had been opened (Fig. 39, 43). The cluster of cells and cocoons had no involucrum surrounding it, as in *T. extranea* nests (Camargo & Pedro 2007a). The brood cells were arranged in irregular clusters, although some cells seemed to be aligned to compose a comb (Figs. 39, 43). The same pattern was found in one of the three nests of *T. extranea* (807c, Camargo & Pedro 2007a) and is probably related to the shape and diameter of the cavity available for the brood chamber. Long pillars and connectives were absent; only short connectives were found joining cells to the hive walls (Figs. 39, 41, 43).

The cylindrical cocoons, made with drier dark yellowish cerumen (darker at bottom), were about 5.8 mm high by 3.78 mm wide, while the cells, lighter and smoother, were a little more spherical (Figs. 39, 40, 41, 43, 44). Two cells were under construction (Fig. 44) and still without provisions. Open cells displayed liquid provisions and with eggs positioned vertically (Fig. 40).

FIGURES 38–46. *Trichotrigona camargoiana* **sp. nov.**: **38**—wood box where the nest (905c) was naturally established, in Candeias do Jamari, Rondônia, Brazil, on August 26th, 2010, with detail of the nest entrance with one guard bee; **39**—the nest opened with cells and cocoons; **40**—cells with liquid food and eggs indicated by black arrows; **41**—the gravid queen pointed by a knife; **42**—a large resin deposit with the gallery that connects the exterior with the inner side of the nest, the black arrow indicates the gallery aperture inside the nest and the white arrow a male carrying resin on the metatibia; **43**—detail of the cocoons; **44**—detail of the cells empty and with liquid food; **45, 46**—dorsal and ventral views of the larva. Scale bars = 1 mm.

Storage pots were not identified. Considering the uniformity, disposition and shape of the brood cells, there was no evidence of pollen or nectar pots.

Nest population. One physiogastric queen was observed (Fig. 31), however the stage of damage to the forewings, in order to estimate queen age, could not be determined. Adult males also were seen inside the nest (Fig. 42, detail). The nest population could be subjectively estimated at ca. 200 adult bees, following the calculation proposed by Roubik (1979) which considers the number of cells and cocoons (total brood), a field estimate of total adult bees and the proportions of brood and adult bees found by Camargo & Pedro (2007a) for the older nests of *T. extranea* (806c and 807c). The larva of *T. camargoiana* **sp. nov.** has high and well evident dorsolateral tubercles (Figs. 45, 46), much more prominent than in larvae of *Partamona* Schwarz, 1939, as described by Michener (1953).

Behavior. The workers of *T. camargoiana* exhibit a very docile behavior. Even when the cover of the wooden hive box was removed the workers exhibited no aggressive behavior. A guard was always present and occupied almost the whole entrance orifice, most of the time with the head upside down (Fig. 38, detail). She stood back only when a forager was arriving or when a bee was departing. The aperture is sized just for one bee and is closed with cerumen in the evening, then being re-opened at daylight. Apparently the same guard was seen ejecting a load of waste with its mandibles.

The flight of foragers was slow, and despite this it was not possible to follow them for long. Only four or five foragers left the nest per hour during the morning. Some collecting with an entomological net was carried out around the meliponary, but no *T. camargoiana* **sp. nov.** was caught or seen visiting any of the nearby plants. The bees were not found collecting resin on nearby tree trunks. The beekeeper said that he has never seen the bees on flowers. Of the bees collected, none of them carried pollen loads on their corbiculae or even on the mesepisternal setae. One of them had a mass of pollen between the mandibles and below the labrum. The dissection of another worker revealed no pollen carried internally in the crop. Odor baits (cineole, vanillin, benzyl acetate, methyl salicilate, eugenol and benzyl benzoate) were hung in the vicinity but none were visited by *T. camargoiana* **sp. nov.**

The nest entrances of *Frieseomelitta trichocerata* were observed but no *T. camargoiana* **sp. nov.** was seen attempting to enter the nests or even near them.

Larval provisions collected from one cell had the following pollen types, in decreasing order by frequency: *Didymopanax* (Araliaceae), *Mimosa* (Mimosoideae), Arecaceae (Palmae), *Hyptis* (Labiatae) and Anacardiaceae. In less quantity, there also were Poaceae (Gramineae), *Alchornea*/*Aparisthmium* (Euphorbiaceae), Urticaceae, Cyperaceae, Asteraceae, Melastomataceae and Myrtaceae.

Remarks. Considering the morphological similarity as well as the nest characteristics of *Trichotrigona camargoiana* **sp. nov.** and *T. extranea*, it is reasonable to infer they share the same food gathering behavior. Perhaps, a meaningful difference is presence of plumose setae on the face and mesepisterna of *T. camargoiana* **sp. nov.**, considering that bees with parasitic or cleptobiotic behavior generally have no or few plumose setae (e.g., *Lestrimelitta*). Nonetheless, both species present the same level of reduction in pollen-collecting apparatus, added to the facts that storage pots were not found in the nest of *T. camargoiana* **sp. nov.** and none of the bees collected had loads of pollen on the corbiculae or pollen grains on the mesepisternal plumose setae. One of the workers had a mass of pollen in the hypostomal region between the mandibles, which may imply that they can carry pollen in the crop and use it directly for cell provisioning. There is apparently no pollen storage within nests of this genus. The suspicion that *Trichotrigona* may steal provisions from nests of *Frieseomelitta* remains without strong support, except for the fact that all nests of *Trichotrigona* were found very close to nests of *Frieseomelitta*. Three nests of *T. extranea* occupied the same tree cavity as nests of *Frieseomelitta* [*F. paupera* (Provancher, 1888) and *Frieseomelitta* sp., Camargo & Pedro 2007a] but with no direct connection between them, being separated by a compact batumen (Camargo & Pedro 2007a). The nest of *T. camargoiana* was less than seven meters away from 10-15 colonies of *Frieseomelitta trichocerata*. It is interesting to note that both genera are phylogenetically closely related (Camargo & Pedro 2003; Rasmussen & Cameron 2010).

Another intriguing question is how the workers use the specialized setae on tibia I. One hypothesis is that this brush is used to handle resin. The workers probably carry resin on the corbicula, the same way males do using the external surface of tibia III (Fig. 42, detail), and the specialized setae could be a tool to aid removal from hard surfaces, but no evidence of resin was found on those setae. Males do not have the spatulate setae on tibia I, but carry resin on tibia III. Their use on manipulation of resin remains to be investigated. On the other hand, the hairs are always shinning, reflecting light as if they were lubricated with oil. But if these bees collect oils, in the same manner as Centridini (Apidae), then how they would be using this oil? Another interesting fact is that the inner side of tibia I lack those specialized setae (generally slightly spatulate, broadened near the apex or chiseled) possibly related to some grooming behavior (see Jander 1976), present in most, if not in all, of the bees. Could the long and narrow basitarsus II be filling some role of the tibia I? With some more detailed observation of bee behavior it will be possible to figure out how these legs work.

The observations presented here were made during a very short period of time (5 days), and the goal was to keep the colony alive for future studies. Unfortunately, the colony died prematurely, and it was not possible to more fully elaborate on the life history of this intriguing bee. Until other nests of *Trichotrigona camargoiana* **sp. nov.** or *T. extranea* are discovered and detailed studies on their behavior are carried out, many questions remain about these enigmatic bees.

FIGURE 47. Geographic distribution of *Trichotrigona* species, both known only from the type localities.

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