



## RESEARCH ARTICLE - ANTS

## *Hylomyrma villemantae* sp. nov. (Hymenoptera: Formicidae), a New Ant Species from Mountain Rainforests of the Atlantic Forest Biome

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### Abstract

A new species of Myrmicinae, *Hylomyrma villemantae* Neves and Lacau (Hymenoptera: Formicidae), is described after the morphology of the worker. This species is easily distinguished from any other ones in the genus by a unique combination of characters, including the fourth abdominal tergite wholly smooth and shining. This ant is probably endemic from southern Bahia in Brazil. It was collected in a forest remnant of Tropical Mountain Rainforests in the Atlantic Forest biome.

### Introduction

With only 15 valid species, *Hylomyrma* Forel, 1912 (Formicidae: Myrmicinae) is a small Neotropical genus originally proposed as a subgenus of *Pogonomyrmex* Mayr, 1868 and later definitely raised to the genus-level by Kempf (1964) who also offered the first identification key to species. Kempf (1973) first revised the genus, describing six new species and providing a new key for all species. Later, Kutter (1977) described a new species and updated the key. Recently, in a robust phylogeny based on analyses of a data matrix comprising 251 species and 11 nuclear gene fragments, Ward et al. (2015) revised the tribal classification of the genera of Myrmicinae Lepeletier de Saint-Fargeau, 1835. In the result, the genera *Pogonomyrmex* and *Hylomyrma* form together a well-supported clade, the new tribe Pogonomyrmecini, that

is sister group to all remaining myrmecines, except the tribe Myrmecini Lepeletier de Saint-Fargeau, 1835. Also, taking an integrative approach to taxonomy based on molecular and morphological data, Pierce et al. (2017) revealed multiple cryptic species within Central American *Hylomyrma* and described two new species. Additional information on the taxonomy of *Hylomyrma* species is offered in Bolton et al. (2017).

*Hylomyrma* species are distributed from Mexico to northern Argentina, with occurrence in Caribbean islands (Kempf, 1973; Antmaps, 2017). These ants inhabit the superficial layers of the soil of wet lowland and riparian forests of Central and South America, being collected up to 1340m altitude (see Fernandez, 2003; Baccaro et al., 2015). Because of their medium to small size and their cryptic habits, specimens of *Hylomyrma* are relatively rare in collections and the biology of these ants remains poorly known until recently. However,



they are rather easily sampled with litter sifting and extraction techniques such as Winkler traps (Bestelmeyer et al., 2000), so their diversity and distribution are being currently better understood. This ant species establishes colonies by nesting in the superficial layers of the soil (i.e.: sandy soils), in the litter and fallen logs (see Brown, 2000; Fernandez, 2003; Baccaro et al., 2015). The species are defined as generalized foragers (Brown, 2000) or generalist epigeic predators (Brandão et al., 2009; Baccaro et al., 2015).

Hereafter we describe a new species of *Hylomyrma* after the morphology of the worker. It was discovered in a mountain from the Southwestern Bahia, Brazil, in a remnant fragment of forest (about 400 ha, in a primary and secondary vegetation stage) belonging to the ecological system known in Brazil as “Floresta Ombrófila Densa Montana” (Instituto Brasileiro de Geografia e Estatística [IBGE], 2012), also called “Mountain Forests” (Thomas, 2003) or “Tropical Mountain Rainforests” (Amorim et al., 2009). Its discovery represents a significant contribution to our knowledge about the diversity of ants in this ecosystem which remains until now very poorly studied, while forest remnants of the region where this new species was discovered is strongly threatened by agropastoralism (Lacau & Delabie, 2002). This paper is a result of the project “Contribution to the Study of the Ants Fauna in Tropical Mountain Rainforests in the Atlantic Forest Biome” of the research team “Grupo de Estudo sobre a Biossistemática dos Artrópodes Neotropicais” of the State University of Southwestern Bahia - UESB.

## Material and methods

The taxonomic nomenclature follows Bolton (2017). The taxonomic definition of the new species of *Hylomyrma* hereafter described, results from the integrative establishment of its diagnosis and taxonomic affinities, based on a complex analytical process of a large amount of elementary morphological and taxonomic data relative to all valid species of this genus. Original morphological descriptions, as well as any subsequent revisions, of all taxa relating to the Neotropical species of *Hylomyrma* have been rigorously examined, as well as any associated iconographic elements. Moreover, the morphology of the type specimens of *Hylomyrma balzani* (Emery, 1894), *Hylomyrma columbica* (Forel, 1912), *Hylomyrma dentiloba* (Santschi, 1931), *Hylomyrma goeldii* (Forel, 1912), *Hylomyrma reginae* Kutter, 1977, *Hylomyrma reitteri* (Mayr, 1887) and *Hylomyrma versuta* Kempf, 1973 were studied through direct examination of high-resolution microphotographs available (depending of the species) at the following Websites: MCZ Type Database (2017), Smithsonian Ant Type Specimen Image Database (2017) and Antweb (2017).

The taxonomic and specimens' data were managed by using the software Mantis® Version 2.0 (Naskrecki, 2008). Abbreviations of the specimen depositories are: CPDC, Centro de Pesquisas do Cacau, Comissão Executiva do Plano de

Lavoura Cacaueira (CEPLAC), Itabuna, State of Bahia, Brazil; LBSA, Laboratório de Biossistemática Animal, Universidade Estadual do Sudoeste da Bahia, Itapetinga, State of Bahia, Brazil; MPEG, Museu Paraense Emílio Goeldi, Belém, State of Pará, Brazil; MZSP, Museu de Zoologia da Universidade de São Paulo, São Paulo, State of São Paulo, Brazil. Each type specimen bears a unique specimen-level identifier (ID) label affixed to the pin, with the following information: “[LBSA\_SA\_specimen-ID]”.

Morphological and morphometric data relative to each species were stored and compared by using the software Xper<sup>2</sup>® (LIS, 2016). Depending of the structures and concepts, considered terminology used in this paper follows Richards (1956), Eady (1968), Harris (1979), Gauld and Bolton (1988), Goulet and Huber (1993), Kugler (1994), Bolton (1994) and Keller (2011). Morphological study of specimens used a light stereomicroscope (Olympus SZX7, with maximum magnification of 56x). The following measurements (abbreviations in parenthesis) were made with a Carl Zeiss measuring microscope: EL (Eye Length) - the maximum diameter of the eye; GL (Gaster Length) - the length of the gaster in lateral view from the anterior most point of first gastral segment (third abdominal segment) to the posterior most point; HL (Head Length) - maximum distance from the mid-point of the anterior clypeal margin to the mid-point of the posterior margin of the head, measured in dorsal view; HL (Head Length with clypeal spines) - maximum measurable length of head, between two parallels drawn through the tip of the clypeal spines and the posteriormost part of occiput in dorsal view; HW (Head Width) - the maximum width of the head in dorsal view; MDL (Mandible Length) - length of a mandible measured in ventral view from its basal articulation to its apex; MFL (Metafemur Length) - maximum length of metafemur, measured from the junction with the trochanter to the junction with the tibia; PPH (Postpetiole Height) - maximum height of postpetiole, measured in lateral view; PPL (Postpetiole Length) - the maximum length of postpetiole, in lateral view; PPW (Postpetiole Width) - maximum width of postpetiole, measured in dorsal view; PSL (Propodeal Spine Length) - measured from tip of propodeal spine to closest point on outer rim of propodeal spiracle in lateral view; PTH (Petiolar Node Height) - maximum height of petiolar node measured in lateral view; PTL (Petiole Length) - the maximum length of the petiole in lateral view; PTW (Petiolar Node Width) - maximum petiolar node width, measured in dorsal view; PW (Pronotal Width) - maximum width of pronotum measured in dorsal view; SL (Scape Length) - maximum scape length, excluding basal condyle and neck; TL (Total Length) - TL=HL+WL+PTL+PPL+GL; WL (Weber's Length) - diagonal length, measured in lateral view, from the anterior margin of the pronotum (excluding the collar) to the posterior extremity of the metapleural lobe. All measurements were recorded to the nearest 0.001 mm and are given in millimeters in the text. Indices have the following abbreviations and definitions:

Cephalic Index (CI): HW/HLx100; Metafemur Index (MFI): MFL/HLx100; Scape Index (SI): SL/HLx100.

Images Management (photographs and drawing) with indexation by key-words was carried out using the Organizer module of the software Adobe Photoshop Elements® Version 13.1. Standard microphotographs of the new species were carried out through two different operating procedures. First, the figures 1, 3, 4, 6, 7 and 8 (see results) were produced using a semi-automatic sequential process in which the specimens were first filmed using a Sony Camera Handycam Video HDR-SR11 attached to a Zeiss Jena light microscope, continuously varying the focal from the top to the bottom. Then, based on this video sample (“mts” format), a series of sharp source images at multiple focal lengths were produced using the software ImageGrab 5.0 (available at: <http://paul.glagla.free.fr/imagegrab.htm>). Next, the same were compiled into a single image with all focal planes in focus by using the Combine ZP software (available at: <http://www.hadleyweb.pwp.blueyonder.co.uk/index.htm>). On the second hand, the figures 2 and 5 (see results) were produced through an automatic multi-focused montage processing using the LAS V4.4 software (<https://www.leica-microsystems.com/applications/education/details/product/leica-las-ez/>), from a series of source images taken by a Leica CH-9435 Heerburugg digital camera attached to a Leica M165C microscope. Finally, to erase and cleaned up noises (ghost images) and unnecessary parts or surrounding objects, each final microphotograph was improved using the Editor module of the software Adobe Photoshop Elements® Version 13.1.

## Results

### Taxonomic treatment

Class Insecta Linnaeus, 1758

Order Hymenoptera Linnaeus, 1758

Family Formicidae Latreille, 1809

Subfamily Myrmicinae Lepeletier de Saint-Fargeau, 1835

Tribe Pogonomyrmecini Ward, Brady, Fisher and Schultz, 2015

Genus *Hylomyrma* Forel, 1912

### *Hylomyrma villemantae* Neves & Lacau, new species

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**Type material:** Holotype: one worker deposited in CPDC and labeled (data in brackets): [LBSA\_SA\_14015869] [Brazil, Bahia, Ibicuí, Serra das Piabas, 14°51'57.93"S, 40° 2'34.54"W, elev. 1070 m] and [Col.: Lacau S., Neves M.S., Rocha I.N., Oliveira M.L., Silveira B.A., Rodrigues F.S., 12.v.2017]. Paratypes (n=44): 10 workers with the same data as holotype, in CPDC ([LBSA\_SA\_14016086], [LBSA\_SA\_14016087], [LBSA\_SA\_14016088], [LBSA\_SA\_14016089], [LBSA\_SA\_14016091], [LBSA\_SA\_14016093], [LBSA\_SA\_14016094], [LBSA\_SA\_14016095], [LBSA\_SA\_14016096], [LBSA\_SA\_14016097]); six workers

with the same locality data as holotype and [col.: Lacau S., Neves M.S., Oliveira M.L., Rocha I.N., Silveira B.A., Rodrigues F.S., 02.v.2017] deposited in MZSP ([LBSA\_SA\_14016100], [LBSA\_SA\_14016101], [LBSA\_SA\_14016102]) and MPEG ([LBSA\_SA\_14016092], [LBSA\_SA\_14016099], [LBSA\_SA\_14016103]); 20 workers with the same locality data as holotype and [col.: da Silva Jr M.R., Godinho L.B., Lacau S., Prado J.V., Ramos Lacau L.S., 29.vi.2008] in CPDC ([LBSA\_SA\_14011273], [LBSA\_SA\_14016104], [LBSA\_SA\_14016105], [LBSA\_SA\_14016109], [LBSA\_SA\_14016110], [LBSA\_SA\_14016111], [LBSA\_SA\_14016115], [LBSA\_SA\_14016116], [LBSA\_SA\_14016117], [LBSA\_SA\_14016118], [LBSA\_SA\_14016119], [LBSA\_SA\_14016120], [LBSA\_SA\_14016123], [LBSA\_SA\_14016124], [LBSA\_SA\_14016125], [LBSA\_SA\_14016126], [LBSA\_SA\_14016128], [LBSA\_SA\_14016129], [LBSA\_SA\_14016162], [LBSA\_SA\_14014791]); six workers [Brazil, Bahia, Ibicuí, Serra das Piabas] and [col.: da Silva Jr M.R., Godinho L.B., Lacau S., Prado J.V. e Ramos Lacau L.S., 29.vi.2008] MZSP ([LBSA\_SA\_14016106], [LBSA\_SA\_14016107], [LBSA\_SA\_14016108]) and MPEG ([LBSA\_SA\_14016112], [LBSA\_SA\_14016113], [LBSA\_SA\_14016114]); two workers [Brazil, Bahia, Itati, Serra das Piabas, 14°54'50.06"S, 40°2'9.49"W, 951 m alt.] [col. Jahyny B.J., Lacau S., Ramos Lacau L.S., 19.xi.2004] in CPDC ([LBSA\_SA\_14011396], [LBSA\_SA\_14011397]).

**Etymology:** This species is named in honor to Dr. Claire Villemant, a French entomologist, curator of the Hymenoptera Collection at Muséum National d'Histoire Naturelle de Paris (MNHN). Insect lover, she devoted her life studying the diversity and taxonomy of hymenopters in many parts of the world, while passing on all her passion to the numerous generations of students she trained. The specific name “*villemantae*” is the feminine genitive of her patronymic name.

**Diagnosis:** The worker morphology of this new species exhibits all the diagnostic characters of the genus *Hylomyrma sensu* Kempf (1973). It differs from all other known species by a unique combination of characters:

1. Head in dorsal view with a subquadrate shape (CI 90.9±2.21).
2. Eyes medium-sized, their maximum diameter with about 12 ommatidia, being less than two times longer than minimum diameter, and strongly shorter than one fourth of head length.
3. Eyes with anterior border broadly rounded, not drawn out into a blunt point.
4. Scape sharply bent at base.
5. Scape relatively short, its apex not reaching the vertexal border, and its length less than the maximum head width (SI 71.63±2.88).
6. Propodeal spines well developed, needle like, much longer than width of petiolar node.
7. Metafemur length shorter than maximum head length (MFI 85.61±3.33).



8. Abdominal segment 2 (petiole) in lateral view with a long anterior peduncle (more than twice as long as high), followed by a well differentiated node which anterior and dorsal faces are separated by a rounded, nearly right angle.

9. Abdominal sternite 2 in lateral view with outline not differentiating any tooth.

10. Abdominal tergite 3 (postpetiole) in lateral view with outline of dorsal face differentiating a continuous convexity (wide and weak), not truncated posteriorly.

11. Head dorsum entirely covered by longitudinal, thick and well-marked costae, smooth and shining, and regularly interspaced by narrow and deep sulci.

12. Mesosoma with dorsum and lateral faces covered by longitudinal, thick and well-marked costae, smooth and shining, and regularly interspaced by narrow and deep sulci.

13. Pronotum with posterior margin of neck covered by longitudinal thick and well-marked costae, smooth and shining, and regularly interspaced by narrow and deep sulci.

14. Propodeum with dorsal and posterior faces covered by transversal, thick and well-marked costae, smooth and shining, and regularly interspaced by narrow and deep sulci.

15. Pronotum with anterior sloping face covered by transversal, thick and well-marked costae, smooth and shining, and regularly interspaced by narrow and deep sulci.

16. Outer faces of pro- and meso thoracic coxae sculptured with transversal, straight, regularly spaced, well-marked carinae.

17. Pronotum with anterior margin of neck sculptured with transversal, straight, regularly spaced, well-marked carinulae.

18. Abdominal tergite 2 (petiole) with nearly all surface of dorsal face smooth and shining, except the posterior part bearing superficial, transversal carinulae.

19. Abdominal sternite 2 (petiole) with ventral surface of petiolar node smooth and shining.

20. Abdominal tergite 3 (postpetiole) entirely smooth and shining (without any dense punctuations, nor longitudinal carinulae).

21. Abdominal tergite 4 entirely smooth and shining (without any dense punctuations, nor longitudinal carinulae).

22. Tibiae with extensor face smooth and shining.

23. Fore femora with posterior face smooth and shining.

24. All body surfaces without any plumose or multibranching setae.

25. Gaster with hairs sharpened at tip.

26. Gaster with hairs nearly as long as or longer than width of hind tibiae.

**Description:** hereafter, we provide a complement of descriptive elements of the worker morphology of this new species through the presentation of high resolution microphotographs (see figures 1-8) and the following morphometric information (data for holotype given in brackets; means with standard deviations for holotype and paratype (n=10) together, given in parenthesis; maximum range for holotype and paratype (n=10) together, given in braces). **Measurements:** EL [0,19] (0,20±0,01) {0,17-0,21}, GL [0,9] (0,95±0,10) {0,87-1,17}, HL [0,91] (0,91±0,03) {0,87-0,96}, HW [0,85] (0,83±0,03) {0,79-0,9}, MDL

[0,57] (0,56±0,06) {0,51-0,68}, MFL [0,81] (0,78±0,04) {0,7-0,84}, PPH [0,28] (0,26±0,01) {0,25-0,27}, PPL [0,29] (0,29±0,02) {0,27-0,32}, PPW [0,29] (0,27±0,03) {0,2-0,3}, PSL [0,29] (0,28±0,02) {0,25-0,31}, PTH [0,23] (0,22±0,01) {0,21-0,24}, PTL [0,55] (0,55±0,05) {0,48-0,66}, PTW [0,2] (0,20±0,01) {0,18-0,22}, PW [0,59] (0,58±0,04) {0,51-0,63}, SL [0,6] (0,59±0,03) {0,55-0,65}, WL [1,11] (1,12±0,05) {1,05-1,17}. **Indices:** CI [93,41] (90,62±2,15) {86,0-93,75}, MFI [89,0] (85,23±3,29) {79,6-89,9}, SI [70,6] (71,74±3,03) {68,08-77,5}.

The gyne and male morphologies remain unknown for this new taxon.

**Geographic range:** *Hylomyrma villemantae* sp. nov. is known only from the type locality which belongs to a relatively big isolated forest fragment, remnant of Tropical Mountain Rainforest located on the top of a mountain (1070m alt. max.) known as “Serra das Piabas” in the Ibicuí municipality (Southwest of Bahia state, Brazil). This mountain is part of the geographical relief unit known as “Colinas e Cristas pré-litorâneas” (Instituto Brasileiro de Geografia e Estatística [IBGE], 2006). In this region, landscapes are covered by a mosaic of remnants of native vegetation (ombrophilous forests) situated in its higher parts, isolated between them inside a matrix of huge pasture and cocoa plantations. Unfortunately, there is no data available on the climatic conditions for the fragment in which this new species was found. However, the regional climate is referred as of the “Tropical Nordeste Oriental Warm Semi-humid” type (Instituto Brasileiro de Geografia e Estatística [IBGE], 2002), with about 4-5 dry-months over the year. Also, in the neighboring lowland areas in the Iguai municipality (distant to about 12 Km), the average annual temperature is 23.2 °C and the average annual precipitation is 1161.9 mm (Superintendência de Estudos Econômicos e Sociais da Bahia. [SEI], 1999). No other *Hylomyrma* species were collected in this area. Also, due to the lack of studies on ants’ diversity in the Tropical Mountain Rainforest of Southwestern Bahia, it was not possible to find any available published data that would allow to discuss some putative cases of sympatry with other *Hylomyrma* species.

**Biology:** The whole biology of this new species remains unknown. The specimens were found in 24 of a total of 62 leaf-litter samples (1 m<sup>2</sup>), using Winkler traps. Depending on the samples, they were caught with between five and 15 other ants’ species (Neves et al., unpub.). This suggests that the species is relatively abundant in the type locality and that colonies may nest in the leaf-litter. In the type locality, 71 ants’ species were collected with *Hylomyrma villemantae* sp. nov. in the 50 Winkler traps during a 2008’s expedition (Neves et al., unpub.).

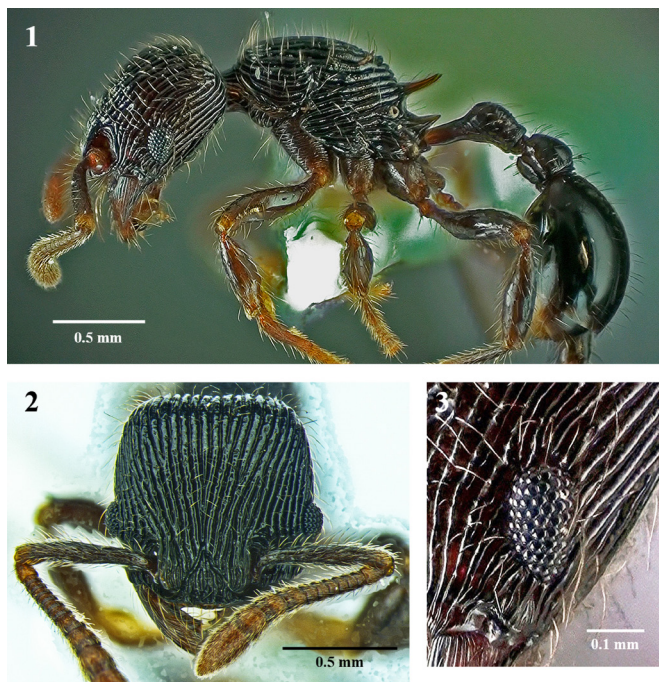
## Discussion

The description of *Hylomyrma villemantae* raises the genus species account to 14 valid species, and represents the

seventh one recorded in Brazil. One must note the relative high frequency of this new species which was found in almost 40% of the 62 leaf-litter samples collected in the type locality.

Regarding to its morphological definition, the new species here described is easily distinguished from any other one in the genus. *Hylomyrma villemantae* is the sole species in the genus to have an entirely smooth and shining abdominal tergite 4 (character 21). By using the taxonomic identification key of Kempf (1973), at dichotomy 1, *Hylomyrma villemantae* sp. nov. differs from *H. immanis* by its diagnostic characters 10 (differences in the shape of abdominal segment 3), as well as 11 and 21 (differences in the sculpture pattern of head and metasoma). Moreover, *H. villemantae* also differs from this species by its diagnostic characters 8 (difference in the shape of abdominal segment 2) and 20 (difference in the sculpture pattern of abdominal segments 3 and 4).

Also, at dichotomy 2, *Hylomyrma villemantae* differs from *H. longiscapa* and *Hylomyrma transversa* Kempf, 1973 by its diagnostic characters 24 (absence of any plumose or multibranched setae). Moreover, *H. villemantae* also differs from *H. longiscapa* by its diagnostic characters 5, 7 and 8 (differences in the shape of head, mesosoma and metasoma), as well as 12, 18, 19, 20 and 21 (differences in the sculpture pattern of mesosoma and metasoma). Moreover, *H. villemantae* also differs from *H. transversa* by its diagnostic characters 8 (differences in the shape of abdominal segment 2), as well as 12, 18, 19, 20 and 21 (differences in the sculpture pattern of mesosoma and metasoma).



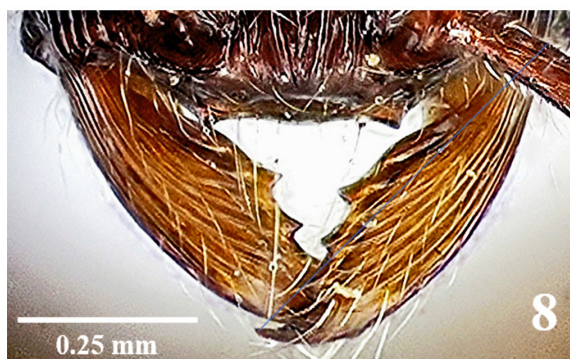
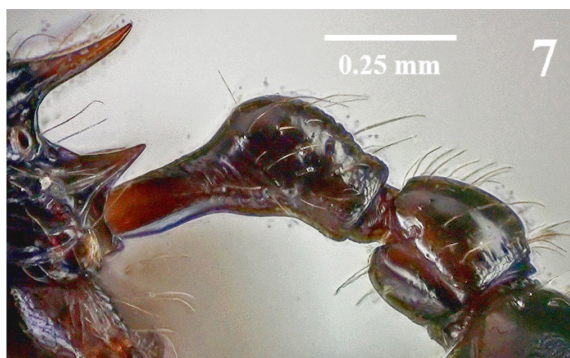
**Plate 1.** *Hylomyrma villemantae* sp. nov. **Fig 1.** Habitus, left lateral view (holotype worker, [LBSA\_SA\_14015869]). **Fig 2.** Head, dorsal view (paratype worker, [LBSA\_SA\_14014791]). **Fig 3.** Detail of the left eye, head in lateral view (holotype worker, [LBSA\_SA\_14015869]).



**Plate 2.** *Hylomyrma villemantae* sp. nov. **Fig 4.** Mesosoma, left lateral view (holotype worker, [LBSA\_SA\_14015869]). **Fig 5.** Mesosoma, dorsal view (paratype worker, [LBSA\_SA\_14014791]).

Finally, *Hylomyrma villemantae* cannot be any one of the species keyed at dichotomy 4: *Hylomyrma praepotens* Kempf, 1973; *H. dolichops*; *H. columbica*; *H. blandiens*; *H. dentiloba*; *Hylomyrma sagax* Kempf, 1973; *H. versuta*; *H. reitteri* and *H. balzani* because of its diagnostic character 21 (abdominal tergite 4 entirely smooth and shining). Moreover, *H. villemantae* differs from *H. columbica* by its diagnostic characters 1 (difference in the shape of head), as well as 11, 12, 18 and 20 (differences in the sculpture pattern of head, mesosoma and metasoma). Also, *H. villemantae* also differs from *H. blandiens* by its diagnostic characters 3 and 8 (differences in the shape of head and metasoma), as well as 18, 19 and 20 (differences in the sculpture pattern of metasoma). *Hylomyrma villemantae* also differs from *H. dentiloba*, *H. versuta* and *H. sagax* by its diagnostic characters 8 (differences in the shape of abdominal segment 2), as well as 11, 12, 18 and 20 (differences in the sculpture pattern of head, mesosoma and metasoma). Likewise, *H. villemantae* also differs from *H. praepotens* and from *H. dolichops* by its diagnostic characters 8 (differences in the shape of abdominal segment 2), as well as 18, 19 and 20 (differences in the sculpture pattern of metasoma). Furthermore, *H. villemantae* also differs from *H. reitteri* and *H. balzani* by its diagnostic characters 11, 12, 18 and 20 (differences in the sculpture pattern of head, mesosoma and metasoma).





**Plate 3.** *Hylomyrma villemantae* sp. nov. **Fig 6.** Third and fourth abdominal segments, dorsal view (holotype worker, [LBSA\_SA\_14015869]). **Fig 7.** Second and third abdominal segments, lateral view (holotype worker, [LBSA\_SA\_14015869]). **Fig 8.** Anterior margin of clypeus and mandibles, dorsal view (paratype worker, [LBSA\_SA\_14011273]).

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