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## RESEARCH ARTICLE - ANTS

### A New Species of *Cryptopone* Emery (Hymenoptera: Formicidae: Ponerinae) from Brazil with Observations on the Genus and a Key for New Word Species

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#### Abstract

*Cryptopone* is a moderately large genus with 25 described species and subspecies. In the New World, only four species are known, *C. gilva*, *C. guianensis*, *C. holmgreni* and *C. mirabilis*. Recently four workers of an unidentified *Cryptopone* species were collected in the state of Rondônia, Brazil, in soil samples from the Floresta Nacional do Jamari (FLONA Jamari). These workers are described as *Cryptopone pauli* sp. nov. This is the first record of this genus for that state. We also present new records of *Cryptopone* for the Neotropical Region with some comments on its biology, systematics, and an updated key to the workers of *Cryptopone* in the New World.

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#### Introduction

The monophyly of Ponerinae is strongly supported by the detailed molecular phylogenetic study of Schmidt (2013). Within the subfamily, substantial changes were made to the taxonomy of the genus *Pachycondyla* Smith, 1858, found to be paraphyletic and recently fragmented into 19 genera (Schmidt & Shattuck, 2014), one of which is the genus *Cryptopone* Emery, 1893. The genus was also found as polyphyletic by Borowiec et al. (2019), which used two species belonging to different lineages in their study, *C. gilva* (Roger, 1863) and *C. hartwigi* Arnold, 1948, the former is a part of the *Ponera* genus-group and the latter is sister to *Fisheropone* Schmidt and Shattuck, 2014.

*Cryptopone* is a moderately large genus (25 described species and subspecies) with its probable radiation center in East and Southeast Asia (Brown, 1963; Bolton et al.,

2006; Schmidt & Shattuck, 2014). In the New World, we consider three species as currently valid: *C. gilva* (Roger, 1863) (United States to Panama), *C. guianensis* (Weber, 1939) (Mexico to southeastern Brazil), and *C. holmgreni* (Wheeler, 1925) (Caribbean islands to southeastern Brazil). *C. mirabilis* (MacKay & MacKay, 2010) was described from specimens collected in Bolivia and Mato Grosso State, Brazil, but Longino (2015) examined the *C. mirabilis* holotype from the Natural History Museum of Los Angeles County and concluded that it is in fact *Centromyrmex brachycola* (Roger, 1861). Longino also comments that the type series of *C. mirabilis* (collected by Mann from Bolivia, Rosario on Lake Rocagua) was obtained from a series already studied by Kempf (1966) and considered as *Centromyrmex brachycola* in his revision of the Neotropical members of the genus. As such, we exclude further consideration of *C. mirabilis* in the present study.



*Cryptopone* workers are particularly well-adapted to a hypogaecic lifestyle, with small body size, reduced or absent eyes, flattened scapes, and stout setae on the mesotibiae (Schmidt & Shattuck, 2014). Almost nothing is known about the social organization of *Cryptopone*, but colonies are typically small (*C. butteli* Forel, 1913; Wilson, 1958; *C. guianensis*: Weber, 1939). Creighton and Tulloch (1930) observed a single colony of *C. gilva* with five dealate queens and Smith (1934) observed polygynous colonies of *C. gilva*, noting they could have as many as several hundred workers.

After the revision by Mackay and Mackay (2010), no other *Cryptopone* species have been described for the New World. Recently an unidentified *Cryptopone* species was collected in soil samples from the state of Rondônia, Brazil, and it is hereafter described as a new species.

## Material and methods

The samples came from the Floresta Nacional do Jamari (FLONA do Jamari), a reserve spread out amongst the municipalities of Cujubim, Porto Velho, Ariquemes and Itapuã do Oeste, in the state of Rondônia, Brazil. The ants were extracted from a soil piece of 25x25cm taken at the depth of 10 cm (Anderson & Ingram, 1993). The soil samples were then put in Winkler bags (Bestelmeyer et al., 2000) for 48 hours for extraction of the ants.

Museum collections are referred by the following acronyms:

CPDC: Centro de Pesquisa do Cacau, Laboratório de Mirmecologia, Ilhéus, Bahia, Brazil.

INPA: Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil.

MPEG: Museu Paraense Emílio Goeldi, Belém, Pará, Brazil.

We follow morphological terminology of Bolton (1994) and Schmidt and Shattuck (2014). Specimens were identified and measured using a Leica M250A stereomicroscope, with magnifications 20x, 40x and 60x under a white light. Digital images were made using the same equipment. All measurements are given in millimeters and the abbreviations used are:

HW: Head width. In full-face view, maximum width of head.

HL: Head length. In full-face view, from the anterior edge of the clypeus to the medial posterior margin of the head.

SL: Scape length. In frontal view, measured from apex of first antennal segment to base, excluding the basal condyle.

WL: Weber's length. In lateral view, measured from the anterior surface of the pronotum (excluding the collar) to the posterior margin of the propodeal lobes.

PW: Pronotal width. The maximum width of pronotum in dorsal view.

PH: Petiole height. In lateral view, the distance from the ventrum of the petiolar sternite to the apex of the petiolar

tergite, taken as a vertical measurement perpendicular to the longitudinal axis of the petiole.

PL: Petiole length. In lateral view, maximum longitudinal distance between the anterior and posterior extensions of the petiolar node, excluding the anterior and posterior condyles.

PtL(A3): Posttergite length (A3). In lateral view, diagonal measurement, starting from the upper point of the limit between the pre- and posttergite, and going until the posterior most point of posttergite.

PtL(A4): Posttergite length (A4). In lateral view, straight measurement, starting from the upper point of the limit between the pre- and posttergite, and going until the posteriormost point of posttergite.

GL: Gaster length. In lateral view, maximum length of the gaster.

TL: Total length. The total outstretched length of the ant from the mandibular apex to the gastral apex.

## Results

*Cryptopone pauli* Fernandes & Delabie, new species (Fig. 1<sup>a</sup>-B; 2<sup>a</sup>-D)

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Type material: Holotype. BRAZIL, Rondônia, Floresta Nacional do Jamari (Flona Jamari), 63°01'24"W 9°09'40"S, Serra da Onça, 29.v.2018, in soil sample, D.C. Castro col., INPA (1 w.). Paratypes: 3 workers with same data as holotype, deposited in INPA (1 w.), MPEG (1 w.) and CPDC (1 w.).

Etymology: The species honors the first author's husband, Paulo Vilela Cruz, who has dedicated his life to studying mayflies, not ants (nobody is perfect!). The name is the genitive form of *Paulus*, his Latin name.

Diagnosis: Mandibles elongate-triangular, masticatory margin bearing 7 teeth with apical tooth large and acute; clypeus unarmed; petiole rectangular, with anterior margin almost straight in lateral view, its posterior margin straight in dorsal view; body large TL: >7.00 mm.

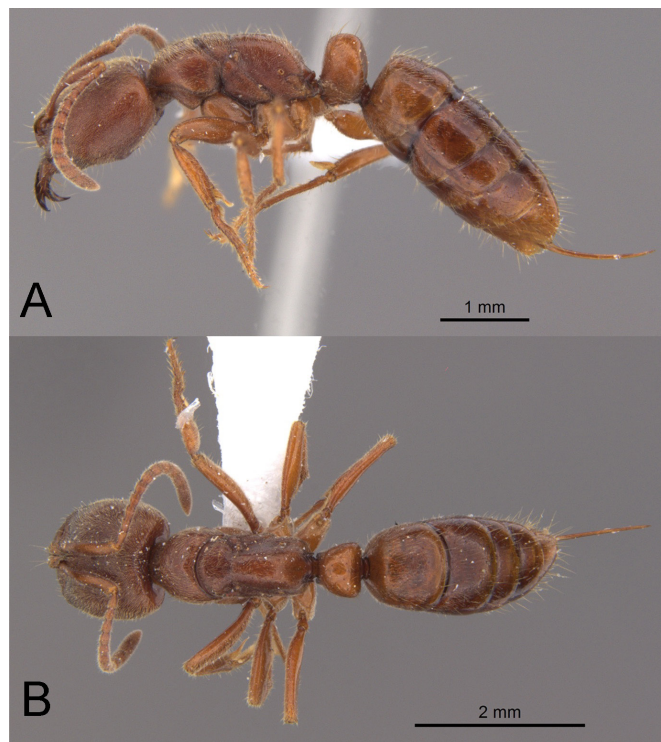
Measurements: Paratypes (holotype). SL: 0.98-1.02 (1.00), HW: 1.39-1.41 (1.41), HL: 1.39-1.40 (1.39), WL: 1.83-1.85 (1.85), PW: 0.90-0.93 (0.92), PL: 0.47-0.49 (0.49), PH: 0.59-0.67 (0.67), PtL (A3): 0.86-0.95 (0.89); PtL (A4): 0.64-0.68 (0.65); GL: 2.60-2.64 (2.63), TL: 7.05-7.11 (7.10).

## Worker description

Head and mesosoma punctate, mesopleuron and propodeum punctate-reticulate in lateral view. Mandible smooth and shining in dorsal surface (frontal view) with scattered punctures. Antennae and legs overall punctate. Propodeum punctate and shining in dorsal view; declivious (posterior) face of propodeum, petiolar dorsum and posterior face shining. Petiole punctate and shining, gaster shining and sparsely foveolate in dorsal view.

Body covered with dense pubescence which does not hide sculpturing, pubescence sparse on propodeal dorsum; body brown. Long suberect golden hairs on the occipital





**Fig 1.** *Cryptopone pauli* sp. nov. (A) Lateral view and (B) Dorsal view.

margin and ventral face of head. Four long suberect, golden hairs present on anteromedian clypeal margin. Mandible (dorsal surface) covered with sparse short golden hairs and ventral face with sparse long suberect hairs. Antennae and legs with dense pubescence. Inner surface of protibia with spiniform setae mixed with finer long pilosity. Surfaces of mesotibia with spiniform setae mixed with finer long pilosity. Protarsus, mesotarsus, and metatarsus with spiniform setae mixed with finer long pilosity (Fig. 2B-D).

Head subrectangular head in dorsal view, slightly longer than broad, broadened posteriorly, sides convex; fronto-vertexal margin shallowly concave. Mandible elongate-triangular; bearing 7 teeth along masticatory margin; diastema between apical tooth (at) and tooth II (t2) (Fig 2A); basal portion of mandible with distinct oval fovea dorsolaterally. Scape barely reaching posterior margin of head; frontal lobes small and closely approximated. Eye rudimentary, with 6–7 facets, placed at level of antennal torulus. Anterior margin of clypeus convex in frontal view.

Pronotum in dorsal view with dorsal and lateral faces meeting at blunt angle. Mesonotum approximately half as big as pronotum; promesonotal suture distinct; mesometanotal suture feeble; mesopleuron separated from mesonotum by notopleural suture; anapleural sulcus weakly impressed between katepisternum and anepisternum. Propodeum with strong constriction between mesonotum, distinctly narrower than mesonotum; propodeum in dorsal view much narrower than mesonotum, its lateral margins slightly diverge posteriorly; propodeum in lateral view slightly depressed below level of mesonotum, forming rounded angle with oblique, evenly convex declivity; metanotal spiracle covered

by distinct mesepimeral lobe; propodeal spiracle round, situated close to metapleural gland. Protibial apex with one pectinate spur and one simple spur; mesotibial apex with one simple spur and one barbulate spur; metatibial with two spurs, one barbulate and one simple.

Petiole in profile robustly subrectangular, narrowed toward apex, anterior margin slightly straight, posterior margin slightly straight in dorsal and lateral views; petiolar node in dorsal view trapezoid, node summit rounded in anterior view; subpetiolar process forming reduced keel with inconspicuous teeth.

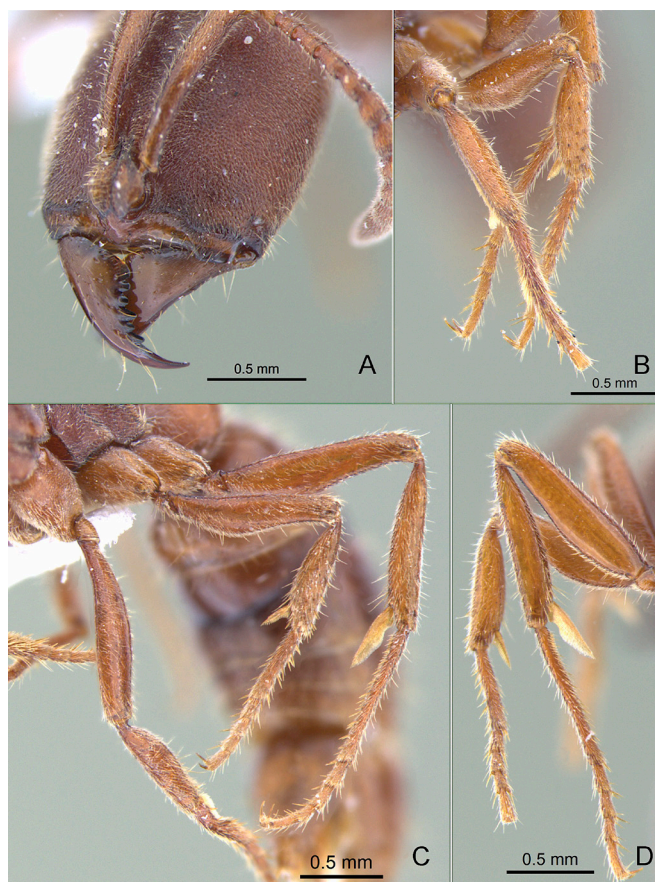
Gaster mostly cylindrical, segments gently curving ventrally, abdominal tergite 3 in lateral view with anterior margin weakly convex raising almost vertically; pre- and postsclerites of A4 separated by distinct constriction; prora absent; sting long, sharp, and upcurved.

Queen and Male: Unknown

Distribution. Brazil (Rondônia).

Other material observed for this study (all in CPDC):

***Cryptopone guianensis* (Weber, 1939): Costa Rica:** Heredia, Estación Biológica La Selva, 10°26'N 84°01'W, 50–150m, 2-12.vii.2004, Ant Course 2004 (1 q., 1 w.) [B. Jahyny, leg.]; **French Guiana:** Macoupa, 1999, P. Lavelle col. (1 w) [L. Cellini leg.].



**Fig 2.** *Cryptopone pauli* sp. nov. (A), Mandible with seven teeth along masticatory margin and diastema between the apical tooth (at) and tooth II (t2) (Fig 2A) (front-lateral view); (B) Legs in front-lateral view, note spiniform setae on mesotibia; (C) Mesotibia and metatibia in front-lateral view; (D) Metatibia and mesotibia in posterior view.

***Cryptopone holmgreni* (Wheeler, 1925): Brazil:** Amazonas, Manaus, Rs 3209, #4832, 19.i.1994, A.B. Casimiro col. (1 w.); Bahia, Boa Nova, Mata Úmida T4, Pitfall 03, 14°24'08.9"S 40°07'40.8"W, 12.ix.2014, A.S. Souza col. (1 w.); Bahia, Ilhéus, CEPEC Quadra G, #4483G, 17.xii.1991, A.L.B. Souza col. (3 w.); idem, I. Nascimento col. (4 w.); **French Guiana:** Macoupa, 1999, P. Lavelle col. (4 w.) [L. Cellini, leg.]; Petit-Saut, xi.2001, S. Lacau leg. (1 w.); Saint-Eugène, 19.xi.2001, S. Lacau leg. (1 w.).

#### Observations about Neotropical species of *Cryptopone*:

Most of the ants observed here were taken in soil samples, except a single specimen of *C. holmgreni* caught with a pitfall trap. All the Neotropical species of *Cryptopone* seem almost strictly cryptobiotic, but in rare cases, as already observed for *C. gilva* (Haskins, 1931 *In* Schmidt & Shattuck, 2014) and here for *C. holmgreni*, workers can forage for short periods on the ground. The Macoupa (French Guiana) specimens were found in soil samples (TSBF traps) during earthworm diversity studies. Although *Cryptopone* species are always rare and we have no natural history details about this series of specimens, the Macoupa material suggests that two species (*C. guianensis* and *C. holmgreni*) can live in sympatry. Due to its cryptobiotic habits, *Cryptopone* presents an important morphological convergence (mesotibial spiniform setae, Figure 2B-D) with several other Ponerinae genera (*Feraponera* Bolton & Fisher, 2008, *Promyopias* Santschi, 1914, *Buniapone* Schmidt & Shattuck, 2014 and, especially, *Centromyrmex* Mayr, 1866). These setae seem well adapted to allow rapid circulation in narrow tunnels built by earthworms and other underground organisms, as any movement of the legs in contact with the oblique walls would facilitate ant locomotion. Furthermore, the morphological convergence with *Centromyrmex* suggests that some species of *Cryptopone*, such as *C. holmgreni*, could be specialist predators of termites living in the ground (Delabie et al., 2000).

Key to the workers of *Cryptopone* species from the New World (modified from Mackay & Mackay, 2010).

1. Mandibles nearly elongate-triangular, oblique masticatory margin nearly continuous with basal border, the latter having 4 - 5 teeth; tooth at mid-length of mandible noticeably longer than others; petiolar node as seen from side subtriangular, tapered markedly to a narrowly rounded apex; Mexico (Veracruz), Central America to southeastern Brazil (São Paulo) ..... *C. guianensis* (Weber)
- 1'. Mandibles triangular, basal and masticatory margins meeting at distinct angle, with at least 6 teeth, approximately equal in length; petiole as seen from side nearly subquadrate, feebly tapered dorsally ..... 2
2. Dorsal face of petiole narrowly convex, shorter than posterior margin in lateral view; anterior half of subpetiolar process translucent and conspicuously larger; United States (Missouri south to Florida), Mexico, Central America at least as far south as Panama ..... *C. gilva* (Roger)

2'. Dorsal face of petiole broadly convex, nearly equal in length to posterior margin in lateral view; anterior half of subpetiolar process not translucent; Peru east to the Guianas, south to Bolivia ..... 3

3. Small species TL: >5.00 mm; mandible with 7 teeth; clypeus is slightly concave medially with a small raised medial tooth along the anterior margin; Caribbean Islands, Colombia to Brazil (São Paulo) ..... *C. holmgreni* (Wheeler)

3'. Large species TL: >7.00 mm; mandibles with at least 7 teeth; clypeus medially convex and unarmed (Rondônia) ..... *C. pauli* sp. nov

#### Discussion

*Cryptopone pauli* n. sp. is easily distinguished from others in the genus by the combination of large size (TL: >7.00 mm) and its clypeus lacking a concave median indentation. The worker of *C. holmgreni* can be separated from *C. pauli* sp. nov. by size, since the total length of *C. holmgreni* does not reach 5.00 mm and the triangular mandible is not elongate-triangular such as in *C. pauli* sp. nov. Also, *C. holmgreni* is easily recognized as it is the only one in the genus with medial clypeal tooth. *Cryptopone guianensis* can be separated from *C. pauli* sp. nov. by the elongate mandibles with an unusual tooth at mid-length, noticeably longer than the others. Finally, *C. gilva* can be easily separated from *C. pauli* sp. nov. by its subpetiolar process, which is translucent and also by the presence of a prora, while in *C. pauli* sp. nov., it is dull and absent, respectively.

Schmidt (2013) recovered *C. gilva* and *C. sauteri* (Wheeler, 1906) in the *Ponera* genus group, closely related with species from *Eumeryopone* Forel, 1912, *Mesoponera* Emery, 1901 and *Pseudoponera* Emery, 1900, but morphological synapomorphies have not yet been discovered (Schmidt & Shattuck, 2014). Although *Cryptopone* most closely resembles *Pseudoponera*, it differs in the presence of the mesotibial spiniform setae. Mackay and Mackay (2010) synonymized *Cryptopone* with *Pachycondyla* and also noted that *Wadeura guianensis*, the type species of *Wadeura* Weber, 1939, is basically a *Cryptopone* with unusual mandibles (Schmidt & Shattuck, 2014). The genus *Wadeura* differs from typical *Cryptopone* chiefly in mandibular shape (narrower and with longer teeth in *Wadeura*), in the shape of the mesonotum (bulging in *Wadeura*, with the consequent appearance of a depressed propodeum), body size (*Wadeura* is somewhat larger than most *Cryptopone* with TL 1.7–6.1 mm), and metatibial spur count (one in *Cryptopone*, two in *Wadeura*) (Schmidt & Shattuck, 2014). Our new species, *C. pauli* sp. nov. differs from the typical *Cryptopone* by its large size (TL: >7.00), with spur formulae 1:2:2. *C. pauli* sp. nov. also differs from the typical *Wadeura* by its mandibular shape, elongate-triangular (narrower and longer in *Wadeura*) and the size TL: >7.00 (TL: 4.10-4.60 in *Wadeura*) (Weber, 1969).



*Wadeura* could actually be unrelated to *Cryptopone* and represent a remarkable case of convergence and considering the morphological features mentioned above. *C. pauli* sp. nov. could shed light on this relationship. The study by Borowiec et al. 2019 implies the non-monophyly of *Cryptopone*, with *Cryptopone hartwigi*, a southern African species, more closely related to *Fisheropone*, while *Cryptopone gilva*, a New World species, is closer to *Ectomomyrmex* Mayr, 1867. As noted by Schmidt and Shattuck (2014) and Borowiec et al. 2019, the resolution of *Cryptopone* taxonomy would require a more thorough revision and sampling of all species attributed to the genus.

Regarding its distribution, *C. pauli* sp. nov. is only known from a single location in the state of Rondônia, Brazil. This is the first record of the genus for Rondônia. With exception of *C. gilva*, all other New World species of *Cryptopone* are found in South America. Brazilian records of the genus are very scarce, probably due to its hypogeic habits. Winkler extraction or other common sampling techniques (see Bestelmeyer et al., 2000) may be inadequate for sampling subterranean species (Fernandes et al., 2015). Additionally, nothing is known about the life histories, population structures, or reproductive biology of most rare ant species (Brandão et al., 2008). The discovery of *C. pauli* sp. nov. emphasizes the need for increased exploration of hypogeic ant diversity sometimes called “myrmecology’s last frontier” (Ryder Wilkie et al., 2007; Delabie et al., 2015; Wong & Guénard, 2017).

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