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Description and notes on natural history of a new species of *Parosus* Sharp, 1887 (Coleoptera, Staphylinidae, Oxytelinae) living in floral bracts of *Columnea medicinalis* L. (Gesneriaceae)

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Abstract

A new species of the recently revised genus *Parosus* is described, *P. amayae* López-García & Marín-Gómez **sp. nov.**, from adult and larval specimens collected in bracts of *Columnea medicinalis* in the Natural Reserve Río Ñambí (Southwestern Colombia). Observations on the interaction with the plant, subsocial behavior, and population density are presented and discussed. Adults and larvae apparently live together and feed on eggs and larvae of flies that develop inside the decomposing fruits of *C. medicinalis*. The new species is illustrated by color habitus photos, as well as its L1 and L3 larvae, male and female genitalia are depicted by line drawings.

Key words: Oxytelinae, new species, decomposing fruits, gesneriads, subsocial behavior, cloud forest, Colombia, larvae

Introduction

Staphylinidae is the largest animal family with more than 61,300 described species (Newton 2015) and is dominant in a great variety of ecosystems, showing several ecological interactions (Thayer 2005). However, biological information is lacking for most species because of scarce field data, taxonomic limitations, and a high number of undescribed species. Although associations with plants have been little documented, there are cases of phytophagy (Klimaszewski *et al*. 2010), pollination (Ervik *et al*. 1999), hunting in phytotelmata (Frank & Barrera 2010), and perching on the underside of leaves (López-García & Méndez-Rojas 2014). Rove beetles found on plants seldom are phytophagous, but frequently saprophagous or predators (Thayer 2005). Another interesting aspect of the rove beetle biology is the subsocial behavior which has evolved several times in Aleocharinae (Ashe 1987), Oxyporinae (Setsuda 1994), and Oxytelinae (Hinton 1944). The subsociality refers to post-ovipositional parental behavior that promotes the survival of offspring, requiring reproduction confined to specific periods and places, and considerable adult longevity (Tallamy & Wood 1986). The known subsocial species of Oxytelinae live on dung, moist sand, or intertidal mud, but associations with plants have not been well documented.

Among the flat-bodied Oxytelinae, the Neotropical genus *Parosus* Sharp, 1887 can be differentiated by a median deeply emarginated labrum and a median serration on the posterior margin of the seventh tergum (Herman 1970; Makranczy 2014). The genus was described by Sharp and for a long time included only three species from Panama and the Lesser Antilles (Sharp 1887; Herman 1970), but Makranczy (2014) described 17 additional species and expanded the known geographical distribution of *Parosus* from Costa Rica to Southern Brazil. The genus is restricted to cloud forests and Atlantic forest and some species seem to live in foliage (Makranczy 2014), but information about collection methods is only available for half of the species and there were no specific data on the vegetation where they live. One third of the species was described based on very few specimens (three or less), and larval stages were unknown (Makranczy 2014).

In Colombia, there are only two described species of *Parosus*, collected from the Sierra Nevada de Santa Marta, and lacking bionomic information. Samplings of arthropods associated with the species of the genus *Columnea* L. (Gesneriaceae) from the Natural Reserve Río Ñambí, allow finding adults and larvae of a new species

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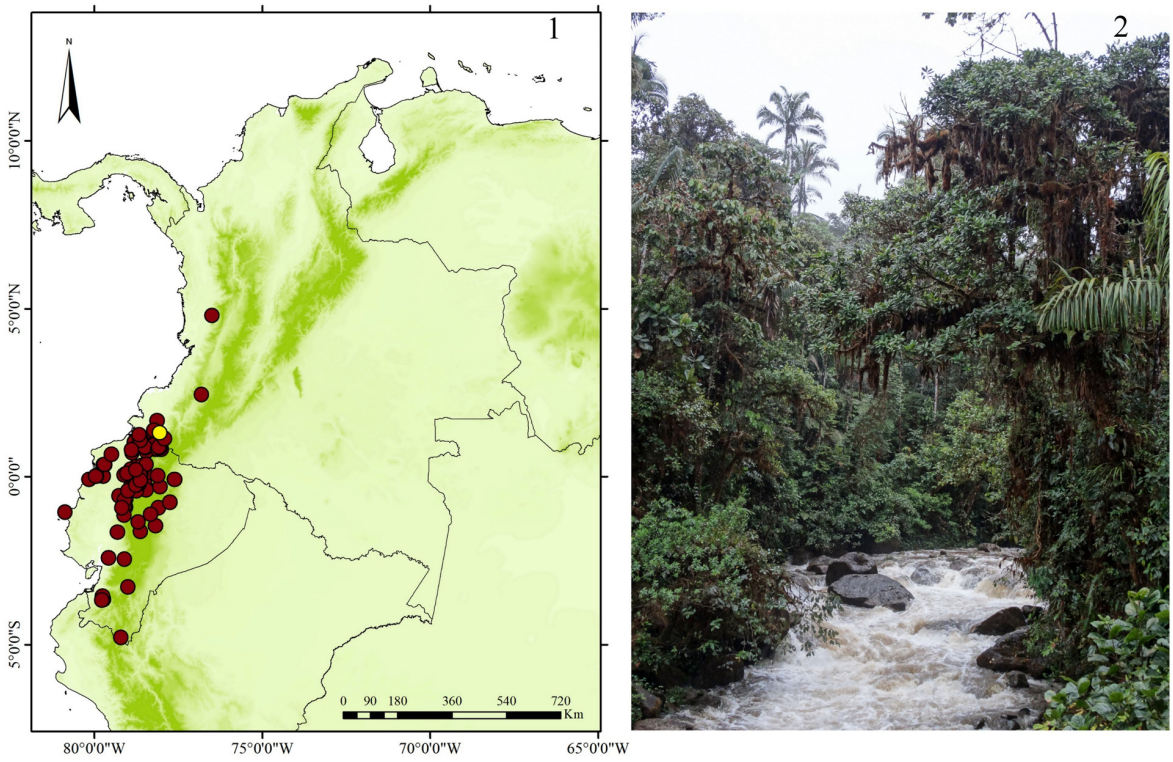
of *Parosus* that evidently live in the floral bracts of *Columnea medicinalis* (Wiehler) L.E. Skog & L.P. Kvist. Here, we describe *P. amayae* López-García & Marín-Gómez **sp. nov.,** including observations on the association with the plant, subsocial behavior, and population density.

Material and methods

Taxonomy. The taxonomic keys by Herman (1970) and Kasule (1966) were used to identification of the adults to genus and of the larvae to subfamily, respectively. The techniques for preparation and illustration of male genitalia follow Makranczy (2006). Structure terminology and measurements follow Makranczy (2014). Measurements are given in mm and were taken from ten well-developed specimens using an ocular micrometer. HW = head width with eyes; TW = head width at temples; PW = maximum width of pronotum; SW = approximate width of elytra at shoulders; MW = approximate maximum width of elytra; AW = maximum width of abdomen; HL = head length from front margin of clypeus to the beginning of neck; EL = eye length; FL = faceted eye length; TL = length of temple; PL = length of pronotum in the middle-line; SL = length of elytra from shoulder; SC = length of elytra from hind apex of scutellum; FB = forebody length (combined length of head, pronotum, and elytra); BL = approximate body length.

The type material was deposited at Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia (ICN-MHN), Field Museum of Natural History, Chicago, IL, USA (FMNH), Muséum d'histoire naturelle, Geneva, Switzerland (MHNG), and Naturhistorisches Museum Wien, Vienna, Austria (NHMW).

Observations on natural history. The Natural Reserve Río Ñambí is in the municipality of Barbacoas, Nariño, Colombia (1°18'N 78°05'W; Fig. 1). This reserve is located in the Chocó Biogeographic Region, an important global biodiversity hotspot (Myers *et al.* 2000) due the high levels of diversity and endemism (Rangel-Ch 2015). It preserves a continuous fragment of 1400 ha of premontane pluvial forest with an elevational gradient from 1100–1900 m.a.s.l. The annual average values for rainfall and temperature are 7160 mm and 19.2ºC, respectively (Salaman 2001). The climatic conditions are very humid and wet reflecting a particular forest physiognomy (Fig. 2): a canopy of 20 to 25 m dominated by palms, a dense understory layer and high density of terrestrial and arboreal epiphytes (Salaman 2001; Marín-Gómez & Amaya-Márquez 2015; Rangel-Ch 2015).



FIGURES 1–2. 1) Known localities for *Columnea medicinalis* (GBIF 2017), location of the Natural Reserve Río Ñambí (yellow circle), 2) Forest physiognomy in the Natural Reserve Río Ñambí.

Columnea medicinalis is an endemic species from well preserved tropical to montane forests from Southwestern Colombia and Northwestern Ecuador between 80–2400 m.a.l.s (Kvist & Skog 1993; Fig. 1). This Gesneriaceae is an hemiepiphytic herb up to 4 m tall, with strongly dorsiventral stems and red apical spots on the leaves (Figs. 7–8). The inflorescences are disposed in axils with 2–5 flowers (Fig. 9). The bracts are large, densely congested, and cover up to 75% of the flower length. Flowers are white or yellow, tubular, and subventricose, with two purple lines on the corolla lobes (Kvist & Skog 1993). The fruits are globosous whitish berries that ripe and decompose inside the bracts, and the seeds can germinate there. In the Río Ñambí reserve, this plant has a high population density (22 ind/ha), shows a clustering spatial distribution, and is exclusively pollinated by the Tawny bellied hummingbird, *Phaethornis syrmatophorus* (Marín-Gómez & Amaya-Márquez 2015).

In July 2013 and February 2014, we sampled 18 individuals of *C. medicinalis* along its distribution (1100–1500 m.a.s.l.) in the reserve. We collected one to three branches per plant and stored them immediately in a plastic bag. Then we checked each sample removing one bract at a time looking for arthropods. When we found rove beetles we recorded their movements along the bracts and their behavior. We collected all the arthropods in ethanol (96%) and larvae were put later in a mixture of glycerol and ethanol (1:1). Some buds and fruits stored in FAA were posteriorly dissected in laboratory.

Results

Taxonomy

***Parosus amayae* López-García & Marín-Gómez, sp. nov.**
(Figs. 3–6, 10–12)

Type material. Holotype. Colombia, Nariño, Barbacoas, Altaquer, Reserva Natural Río Ñambí, brácteas de *Columnea medicinalis*, 26.vii.2013, Col: O.H. Marín-Gómez (1 male, ICN-MHN). Paratypes (10 males, 14 females). Colombia, Nariño, Barbacoas, Altaquer, Reserva Natural Río Ñambí, brácteas de *Columnea medicinalis*, 26.vii.2013, Col: O.H. Marín-Gómez (2 males, 2 females ICN-MHN). Colombia, Nariño, Barbacoas, Altaquer, Reserva Natural Río Ñambí, Brácteas de *Columnea medicinalis* (Gesneriaceae), 29.vii.2013, leg. O.H. Marín-Gómez (3 males, 3 females, ICN-MHN). Colombia, Nariño, Barbacoas, Altaquer, Reserva Natural Río Ñambí, Brácteas de *Columnea medicinalis* (Gesneriaceae), 26.vii.2013, leg. O.H. Marín-Gómez (1 dissected female, FMNH). Colombia, Nariño dept., Barbacoas, Correg. Altaquer, Reserva Natural Río Ñambí, La Paila, 1°17’12.0"N 78°04’19.4"W, 1400 m, En brácteas de *Columnea medicinalis*, 3.ii.2014, leg. O.H. Marín-Gómez (1 male, 3 females, NHMW). Colombia, Nariño, Barbacoas, Correg. Altaquer, Reserva Natural Río Ñambí, En brácteas de *Columnea medicinalis*, 4.ii.2014, leg. O.H. Marín-Gómez (2 males, 2 females, ICN-MHN, 1 male, FMNH, 1 male, 3 females, MHNG).

Larvae. Two L3 larvae collected with the holotype are deposited in FMNH (also deposited here a possibly non-conspecific species, L1 larva and L3 larva, sampled at the same event). Further larvae (an L1 and L3 larvae illustrated in Figs. 7-8) have the data "Colombia, Nariño, Barbacoas, Correg. Altaquer, Reserva Natural Río Ñambí, En brácteas de *Columnea medicinalis*, 4.ii.2014, leg. O.H. Marín-Gómez" and are in various conditions and completeness (in FMNH). The larval specimens are similar to those of *Paraploderus* (Figs. 78–79 in Makranczy, 2016) except the very distinctive dark "stretch marks" found in the abdominal intersegments (Peter M. Hammond, pers. comm.) that are present in *Parosus* and this is a common feature with *Ochthephilus*, *Thinodromus* and *Carpelimus*, but lacking in *Paraploderus*.

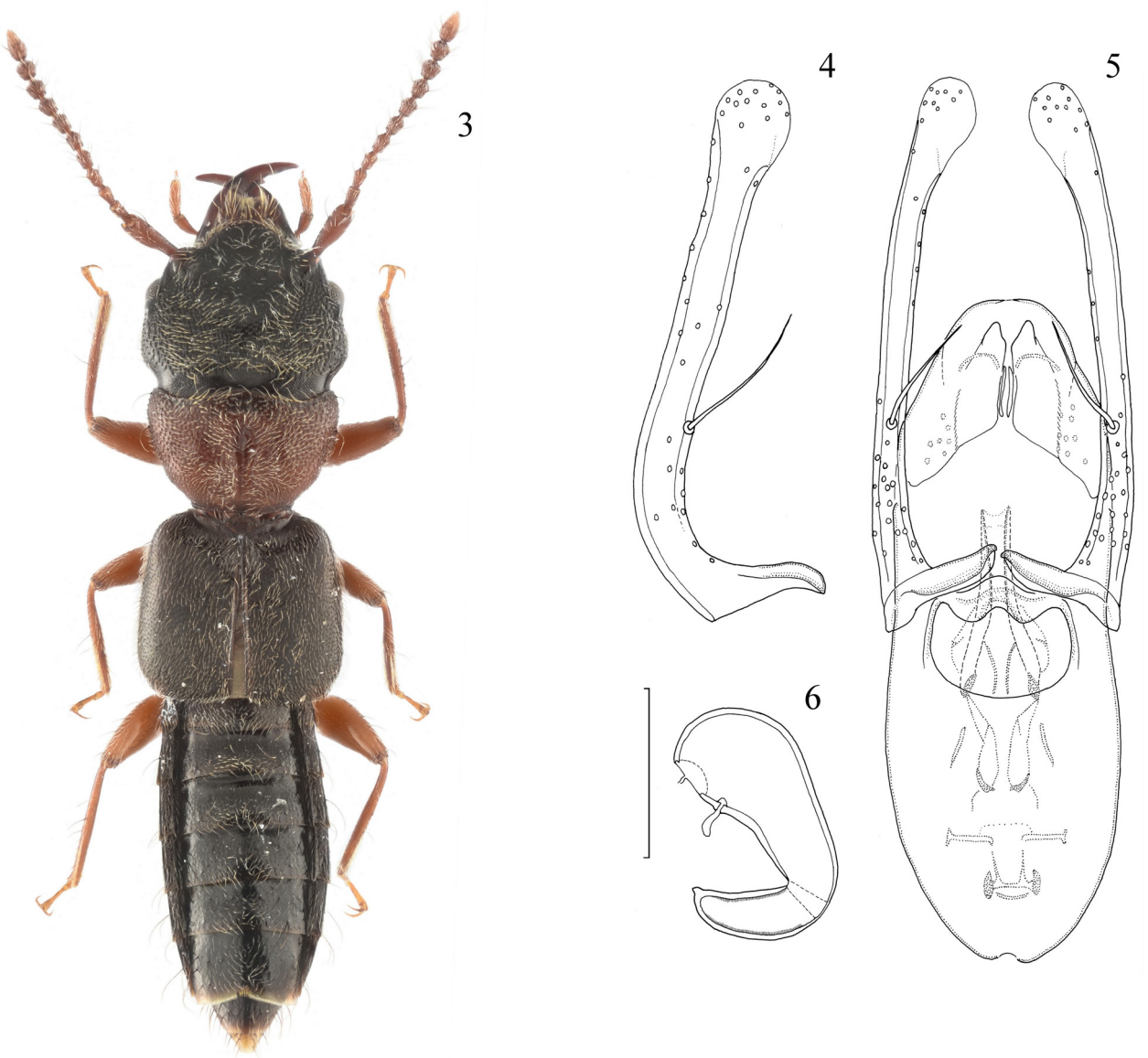
Diagnosis. *Parosus amayae* López-García & Marín-Gómez **sp. nov.** is similar to *Parosus rossii* Makranzcy, 2014 from Ecuador on its color and general habitus. However, the new species can be differentiated by the completely dark brown to black abdomen, larger body size (4.42–5.50 mm), and spoon shaped apexes of the parameres (Fig. 4). In *P. rossii* the base of the abdomen is lighter, the body size is shorter (2.73–3.72 mm), and the apexes of the parameres are wider and straight.

Description. Habitus as in Fig. 3. Measurements (n=10): HW = 1.02 (0.94–1.11); TW = 1.08 (1.01–1.15); PW = 0.96 (0.89–1.04); SW = 0.87 (0.78–0.93); MW = 1.04 (0.89–1.13); AW = 0.86 (0.70–0.91); HL = 0.87 (0.79–0.93); EL = 0.17 (0.16–0.21); FL = 0.12 (0.10–0.17); Tl = 0.32 (0.30–0.36); PL = 0.63 (0.57–0.69); SL = 0.91 (0.85–0.94); SC = 0.86 (0.83–0.90); FB = 2.67 (2.53–3.0); BL = 4.95 (4.42–5.50). Body 'bicolored'. Head black

(supra-antennal prominences only slightly lighter), pronotum strongly reddish brown, elytra and abdomen black to dark brown. Legs, mouthparts, and antennae light reddish brown to orange. Dorsal surface with medium short and medium dense pale setae, slightly longer and sparse on frons, abdomen with much longer and sparser setae.

Head slightly wider than long. Mid-antennal articles moderately elongated (antennomere 6 length:width = 0.096:0.065 mm). Clypeus trapezoidal, ratio of longitudinal distance of supraantennal prominence tip from eyefront to the same from clypeal front = 0.48–0.50. Infraocular ridge conspicuous, ending in a short keel after the posterior ocular edge. Temple straight strongly curved at the posterior 2/3. Eye strongly bulging. Clypeus and supraantennal ridges very shiny, with a few small, scattered punctures only. Vertex dense and strongly punctate. Clypeus slightly elevated, frontoclypeal groove inconspicuous, only as a borderline before the strongly punctured area. Head with about 32–34 'longitudinal' puncture lines, punctation becoming very dispersed in the triangle of the supraantennal prominences and the mid-vertex.

Pronotum wider than long, maximum pronotal width 1.91x base width. Base straight, apex medially curved upwards, sides curved, anterior pronotal angles slightly sharp. Pronotal midline slightly elevated, shiny, and glabrous. Each side of midline broadly depressed. Pronotal disc densely punctate, punctures slightly smaller than those on head. Pronotal margins with four widely separated macrosetae on each side, one on the apical margin and the remaining three on the lateral margins.



FIGURES 3–6. *Parosus amayae* López-García & Marín-Gómez **sp. nov.** 3) Male habitus, 4) Right paramere in lateral view, 5) Aedeagus in frontal view, 6) Spermatheca. Scale bar=0.1 mm for Figs. 4–6.

FIGURES 7–12. *Columnea medicinalis*: 7) Hemiepiphytic habitus, 8) Detail of a branch, 9) Detail of an inflorescence. *Parosus amayae* López-García & Marín-Gómez **sp. nov.**: 10) L1 and L3 larvae, 11–12) Larva and adult on bracts of *C. medicinalis*.

Elytra slightly dilated posteriorly, with two small, elongate impressions behind scutellum. Elytral punctation not umbilicate, as large as on pronotum, separated by about 2 puncture diameters. Hind margin of tergite VII with a medially serrate fringe. Aedeagus as in Fig. 4–5. Spermatheca as in Fig. 6.

Etymology. *Parosus amayae* López-García & Marín-Gómez **sp. nov.** was named after professor Marisol Amaya-Márquez (Universidad Nacional de Colombia) who has studied the taxonomy and ecology of the species of *Columnea* for more than twenty years and has made important contributions for knowing the diversity of Gesneriaceae in Colombia.

Distribution. The species is only known from the Natural Reserve Río Ñambí (Nariño, Colombia).

Key to the described species of *Parosus* from Colombia

(based on original descriptions by Makranczy 2014)

1. Body bicolored; pronotum strongly reddish brown, head, elytra, and abdomen black to dark brown . . . . . *Parosus amayae* López-García & Marín-Gómez **sp. nov.**
1'. Body unicolored; head, pronotum, elytra, and abdomen black to dark brown 2
2. Body length 3.23–3.58 mm. Infraocular ridge strong and thickened anteriorly, but vanishing posteriorly. Antennomere 6 about as long as wide . . . . . *Parosus colombiensis* Makranczy, 2014
2'. Body length 4.55–5.40 mm. Infraocular ridge strong and continuing behind the eye. Antennomere 6 moderately elongated . . . . . *Parosus gigantulus* Makranczy, 2014

Natural history

Eighty-three individuals (48 adults and 35 larvae) of *P. amayae* López-García & Marín-Gómez **sp. nov.** were found in *Columnea medicinalis*. The new species was observed in all the sampled plants (18 individuals), and its mean density was three adults and two larvae per branch (five individuals per branch). The estimated population density of the species in the studied area was 650 individuals/ha. Frequently, two well-developed individuals were found along with a much smaller one, and two or three larvae in each branch. However, there were a few cases where only one well-developed individual was accompanied by two small individuals. For the larvae, three stages were identified with the following mean values of body length: L1 (1.9 mm; Fig. 10), L2 (3.8 mm), and L3 or mature (5.2 mm; Fig. 10).

Adults and larvae remained hidden among the floral bracts of *C. medicinalis*, but sometimes they were moving outside of the bracts (Figs. 11–12, video on Supplementary Material). They were also found inside the fruits and sometimes an adult was alongside a larva among eggs and freshly hatched larvae of Diptera (Chironomidae). They were not observed feeding on plant structures, but an adult was observed with one fly larvae in its mandibles. Other insects were also found in the floral bracts of the plant but in very low abundance and in a few plants. They were Staphylinidae (*Hypotelus* sp., Philonthina, Tachyporinae, Aleocharinae), Nitidulidae, Cantharidae, Formicidae (*Pheidole* and *Ectatomma*), Hemiptera, Dermaptera, Blattidae, and larvae of Lepidoptera.

Discussion

Parosus amayae López-García & Marín-Gómez **sp. nov.** is just the third species of the genus known in Colombia, but further samplings of specific plant microhabitats in cloud forests will allow discovering many others in the next years. This kind of specific sampling will also help to collect the larvae of other Oxytelinae as very few have been described so far (e.g. Makranczy 2016) and almost nothing is known about their biology. The present study supports the suggestion of Makranczy (2014) that the species of *Parosus* live on foliage and their strongly flattened body allow inhabiting among narrow microhabitats such as floral bracts. There is evidently a strong association between *P. amayae* López-García & Marín-Gómez **sp. nov.** and *C. medicinalis*, but wider collections through the distribution of this gesneriad, including North Ecuador (Fig. 1), are needed to prove the co-occurrence of the beetle and the plant.

Columnea medicinalis is the only species of the genera in which the fruits decompose inside the floral bracts providing a particular microhabitat. These bracts cumulate organic material and abundant food for *P. amayae*

López-García & Marín-Gómez **sp. nov.** Although most Oxytelinae are saprophagous that feed on decaying plants and algae (Thayer 2005; Makranczy 2006), the predator behavior has been found in adults and larvae of two subsocial *Platystethus* that live on cattle dung (Palomino & Dale 1989; Hu & Frank 1995). However, the range food of these oxyteline is not clear, and it has been not possible to known if they are coprophagous, mycophagous, predators (Hu & Frank 1995), or a combination of all. In the case of *P. amayae* López-García & Marín-Gómez **sp. nov.**, the decaying fruits of *C. medicinalis* could be also a food resource, but only gut content analyses would allow us to confirm it.

The subsocial parental care seems to evolve in response to unusually favorable environments that provide food resources, which are rich but also scattered and ephemeral (Wilson 1971; Tallamy & Wood 1986). The decomposing fruits of *C. medicinalis* provide a locally distributed resource for *P. amayae* López-García & Marín-Gómez **sp. nov.**, whether being predator or saprophagous, but also many other generalist predators can attack the adults and the larvae of this species. As a defense mechanism, all the Oxytelinae have abdominal glands that release secretions when are disturbed (Dettner & Schwinger 1982), which can be used by the adults of *P. amayae* López-García & Marín-Gómez **sp. nov.** to avoid predators and protect the larvae. This territorial behavior could play an important role in the reduction of floral herbivory (florivory) of *C. medicinalis*, as only a few herbivore ants were collected in all the sampled bracts. The effects of florivory on pollination, the potential defense rol of *P. amayae* against herbivores and the interaction with *C. medicinalis* along its distribution deserves further research.

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