

## Research Article

## Description of the male *Colletes vicugnensis* Rojas and Toro (Hymenoptera: Colletidae) with an updated key to the males of the *Colletes* species with a metallic-blue metasoma from Chile

Descripción del macho de *Colletes vicugnensis* Rojas y Toro (Hymenoptera: Colletidae), con una clave actualizada para los machos de las especies de *Colletes* con metasoma azul metálico de Chile

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**Abstract.** The male of the rare bee species *Colletes vicugnensis* Rojas and Toro is herein described and illustrated for the first time. Also, an identification key to the known males of the species of the genus with a metallic-blue metasoma found in Chile is provided.

**Key words:** Apoidea, bee, Colletinae, diagnosis, Neotropical region, taxonomy.

**Resumen.** Se describe e ilustra por primera vez el macho de la especie rara de abejas *Colletes vicugnensis* Rojas y Toro. Además, se proporciona una clave de identificación para los machos conocidos de las especies del género con metasoma azul metálico de Chile.

**Palabras clave:** Abeja, Apoidea, Colletinae, diagnóstico, región neotropical, taxonomía.

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### Introduction

The cellophane bee genus *Colletes* Latreille, 1802 (Hymenoptera: Colletidae) has a nearly cosmopolitan distribution (absent only in Oceania, Madagascar and other smaller islands), something of a rarity among the colletid genera given that almost all of them are entirely confined to the southern hemisphere (Michener 1979, 1989, 2007). Most of the approximately 520 valid described species currently recognized in *Colletes* are found in the arid or semi-arid regions of the planet (Bystriakova *et al.* 2018), such as the Andean region (*sensu* Morrone 2018) where the genus likely originated (Ferrari *et al.* unpubl.). In Chile *Colletes* is represented by 31 species (Ferrari 2017; Ascher and Pickering 2019), making it the fourth-most diverse genus of bees found in the country (Montalva and Ruz 2010; Packer and Ruz 2016). Among the Chilean *Colletes*, which were recently revised (Ferrari 2017), nine species exhibit an uncommon characteristic within the genus—their metasomal terga are light to dark metallic-blue (often times with some greenish and/or purplish reflections). These species are: *C. cyanescens* (Haliday, 1836), *C. cyaniventris* Spinola, 1851, *C. fulvipes* Spinola, 1851, *C. bicolor* Smith, 1879, *C. flaminii* Moure, 1956, *C. chusmiza* Rojas and Toro,

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1993, *C. guanta* Rojas and Toro, 1993, *C. quelu* Rojas and Toro, 1993 and *C. vicugnensis* Rojas and Toro, 1993. The latter three species are the rarest among all their congeners found in Chile, and are regrettably known only from females (Ferrari 2017).

The goals of this paper are to describe and illustrate the male of *C. vicugnensis* for the first time and to provide an updated key for the known males of the *Colletes* species with a metallic-blue metasoma that are known to occur in Chile.

## Material and Methods

Specimens are from the following collections: AMNH – American Museum of Natural History (New York, USA); MNHN – Museo Nacional de Historia Natural (Santiago, Chile); PCYU – Packer Collection at York University (Toronto, Canada). Information from their labels are reproduced as follows: Country – region, municipality or specific locality, collection date as “dd/mm in Roman numbers/yyyy”, [collector], number of specimens of each sex, (repository).

The external morphology of both sexes and male terminalia were examined under an Olympus SZ61 stereomicroscope (maximum magnification 75×); the latter were dissected and cleared according to standard protocols (as in Packer 2003). The images provided herein were produced with a Visionary Digital BK Plus Lab System using P-51 CamLift Controller v.2.6. Photographs from different planes of focus were imported with Adobe Lightroom v4.4 and then exported to Helicon Focus v.5.3.3 where they were amalgamated in high-quality, multifocal images. Final plates were mounted in Adobe Photoshop v.13.0.1.

Terminology for bee morphology used in this paper follows Ferrari (2017), which in turn was largely consistent with Michener (2007). Terminologies for leg surfaces and surface sculpture follow Aguiar and Gibson (2010) and Harris (1979), respectively. Antennal flagellomeres, metasomal terga and sterna are abbreviated with the letters F, T and S, respectively, followed by the appropriate numbers.

Body dimensions (such as head length and width) were measured using a micrometer mounted on one of the stereomicroscope’s eyepiece. Measurements were taken as indicated in Ferrari and Silveira (2015: 246). Punctuation density is given in terms of the relative sizes of punctures diameter (D) and the interspaces (I) among them (for instance, I=D). Hairs length (L) is compared to the median ocellus diameter (MOD; for instance, L=2×MOD).

## Result

### Taxonomy

#### *Colletes vicugnensis* Rojas and Toro, 1993

*Colletes vicugnensis* Rojas and Toro, 1993: 85; Toro 1999: 31; Moure *et al.* 2007: 689; Montalva and Ruz 2010: 22; Moure *et al.* 2012; Ferrari 2017: 44, 119-121; Ascher and Pickering 2019. Holotype ♀, examined (AMNH).

**Diagnosis.** The combination of clypeus carinate mid-longitudinally (carina almost complete in the female and restricted to lower 1/4 in the male), mesepisternum with black hairs and imbricate interspaces, and metasomal terga metallic dark-blue is sufficient to differentiate *C. vicugnensis* from all other *Colletes* species found in Chile, except *C. chusmiza*. However, the two species can be separated by ventral surface of F2-F7 black in *C. vicugnensis* (ventral surface of F2-F7 dark-orange in *C. chusmiza*), and hind basitarsus ~3× longer than broad in *C. vicugnensis* (hind basitarsus ~2.5× longer than broad in *C. chusmiza*).

**Description of male (Figs. 1-6).** Dimensions (mm): Approximate body length 8.4; head width 3.2; head length 2.5; intertegular distance 2.7; forewing length 7.5. Colouration: Black except T1-T6 throughout, S2-S5 posterolaterally and S6 disc metallic dark-blue (metasomal sterna blue areas also with purplish reflections). Mandible apically and distal 2/3 of tarsal claws reddish-brown. Femora and trochanters anteriorly, front distitarsus and hind tibia dorsally, tegula, S1 throughout and S2-S5 anteriorly dark-brown. Mid and hind tarsi and proximal 1/3 of tarsal claws pale-brown. Wing venation, stigma, tibial spurs and marginal zone of S1 pale-yellow. Structure: Labrum medially convex; convexity not margined by lateral ridges. Clypeal mid-longitudinal area shallowly and relatively broadly ( $0.8 \times \text{MOD}$ ) depressed for upper 3/4; lower 1/4 with longitudinal carina. Malar area  $\sim 2 \times$  as long as basal depth of mandible (30:14). F1  $\sim 1.2 \times$  as long as its apical width (28:24). Upper and lower interocular distances (72:63). Genal area concave behind upper summit of compound eyes in posterodorsal view. Anterolateral angle of pronotum rounded. Horizontal surface of metapostnotum  $\sim 0.5 \times$  as long as metanotum (20:42); metapostnotal pits well-delimited; posterior transverse carina sinuous and complete. Posteromedial surface of front coxa without spine. Posterior hind tibial spur ciliate. Hind basitarsus  $3 \times$  longer than broad (42:14). Outer rami of hind tarsal claws  $\sim 1.5 \times$  as long as inner rami (10:7). Posterolateral area of S6 flat, marginal zone not depressed. S7, S8 and genital capsule as in Figs. 4, 5, 6, respectively. Pubescence: Head with off-white, plumose, erect, very long ( $L > 3 \times \text{MOD}$ ) hairs; except paraocular, vertexal and genal areas with black hairs; mandible below with fulvous, erect, moderately long ( $L = 1.5-2 \times \text{MOD}$ ) setae; frontal area with pale-yellow, moderately long ( $L = 1.5-2 \times \text{MOD}$ ) hairs. Mesosoma with pale-yellow, plumose, erect, long ( $L = 2.5-3 \times \text{MOD}$ ) hairs; except pronotal lobe with fulvous, moderately long ( $L = 1.5-2 \times \text{MOD}$ ) hairs; mesepisternum, metepisternum and lateral surface of propodeum with black, very long ( $L > 3 \times \text{MOD}$ ) hairs. Legs with fulvous, plumose, erect, long ( $L = 2.5-3 \times \text{MOD}$ ) hairs; except hind femur with very long ( $L > 3 \times \text{MOD}$ ) hairs anteroventrally; tibiae and basitarsi with black, suberect, moderately short ( $L = 1-1.5 \times \text{MOD}$ ) setae (those erect and long [ $L = 2.5-3 \times \text{MOD}$ ] posteriorly). Metasomal terga with black hairs; T1 with plumose, erect, long ( $L = 2.5-3 \times \text{MOD}$ ) hairs; hairs only moderately long ( $L = 1.5-2 \times \text{MOD}$ ) on T2; T3-T6 with erect, short ( $L < \text{MOD}$ ) setae; setae much longer ( $L = 1.5-2 \times \text{MOD}$ ) on T4-T5 laterally, suberect on T6. Metasomal sterna with fulvous hairs; S1-S2 with plumose, erect, moderately long ( $L = 1.5-2 \times \text{MOD}$ ) hairs; S3-S5 discs with erect, moderately long ( $L = 1.5-2 \times \text{MOD}$ ) setae (except setae much shorter [ $L < \text{MOD}$ ] mid-longitudinally); S3 marginal zone with a transverse line of plumose, suberect, short ( $L < \text{MOD}$ ) hairs; S6 with suberect, moderately short ( $L = 1-1.5 \times \text{MOD}$ ) setae throughout. Surface sculpture: Clypeal mid-longitudinal depression finely and densely ( $I < D$ ) punctate; adjacent convex area moderately coarsely and sparsely ( $I > 2 \times D$ ) punctate, except overlapping punctures forming elongate pits below; interspaces smooth throughout. Supraclypeal area moderately coarsely and densely ( $I < D$ ) punctate; interspaces imbricate. Malar area with overlapping moderately coarse punctures forming coarse striae; interspaces imbricate, except substrigulate below. Paraocular area moderately finely punctate, except moderately coarsely punctate towards malar area; punctures dense ( $I < D$ ) below, moderately dense ( $I = 1-1.5 \times D$ ) above, interspaces imbricate throughout. Frontal area moderately coarsely and densely ( $I < D$ ) punctate; interspaces rugulose. Vertexal area finely and moderately densely ( $I = 1-1.5 \times D$ ) punctate; interspaces smooth, except rugose posteriorly. Mesoscutum coarsely and densely ( $I < D$ ) punctate, except sparsely ( $I > 2 \times D$ ) punctate posteromedially; interspaces smooth throughout. Scutellum moderately coarsely and sparsely ( $I > 2 \times D$ ) punctate, except densely ( $I < D$ ) punctate anteromedially; interspaces smooth anteriorly, rugulose posteriorly. Metanotum punctures difficult to discern among coarse rugose interspaces. Mesepisternum coarsely and densely ( $I < D$ ) punctate, except moderately sparsely ( $I = 1.5-2 \times D$ ) punctate towards ventral surface; interspaces imbricate. Metepisternum rugulose above and below; obliquely striate medially. Lateral surface of

propodeum moderately coarsely and sparsely ( $I > 2 \times D$ ) punctate; interspaces imbricate. Metasomal terga finely and densely ( $I < D$ ) punctate; interspaces smooth. Metasomal sterna finely and sparsely punctate ( $I = 1 - 1.5 \times D$ ) punctate, except S1 minutely punctate, S3-S6 moderately densely ( $I = 1 - 1.5 \times D$ ) punctate laterally.

**Female.** A detailed redescription of the female is given in Ferrari (2017: 119-121).

**Material studied.** Holotype ♀: Chile - Coquimbo, Baños del Toro, i/1988, [R. Solar], (AMNH).

Additional specimens: Chile - Antofagasta, Mucar, 18/i/1976, [L. Peña], 1♂ (MNHN). Coquimbo, Elqui, i/1996, [A. Ugarte], 1♀ (AMNH).

**Geographical range.** Chile (Antofagasta to Coquimbo Regions) at 3,000 m above sea level or higher.

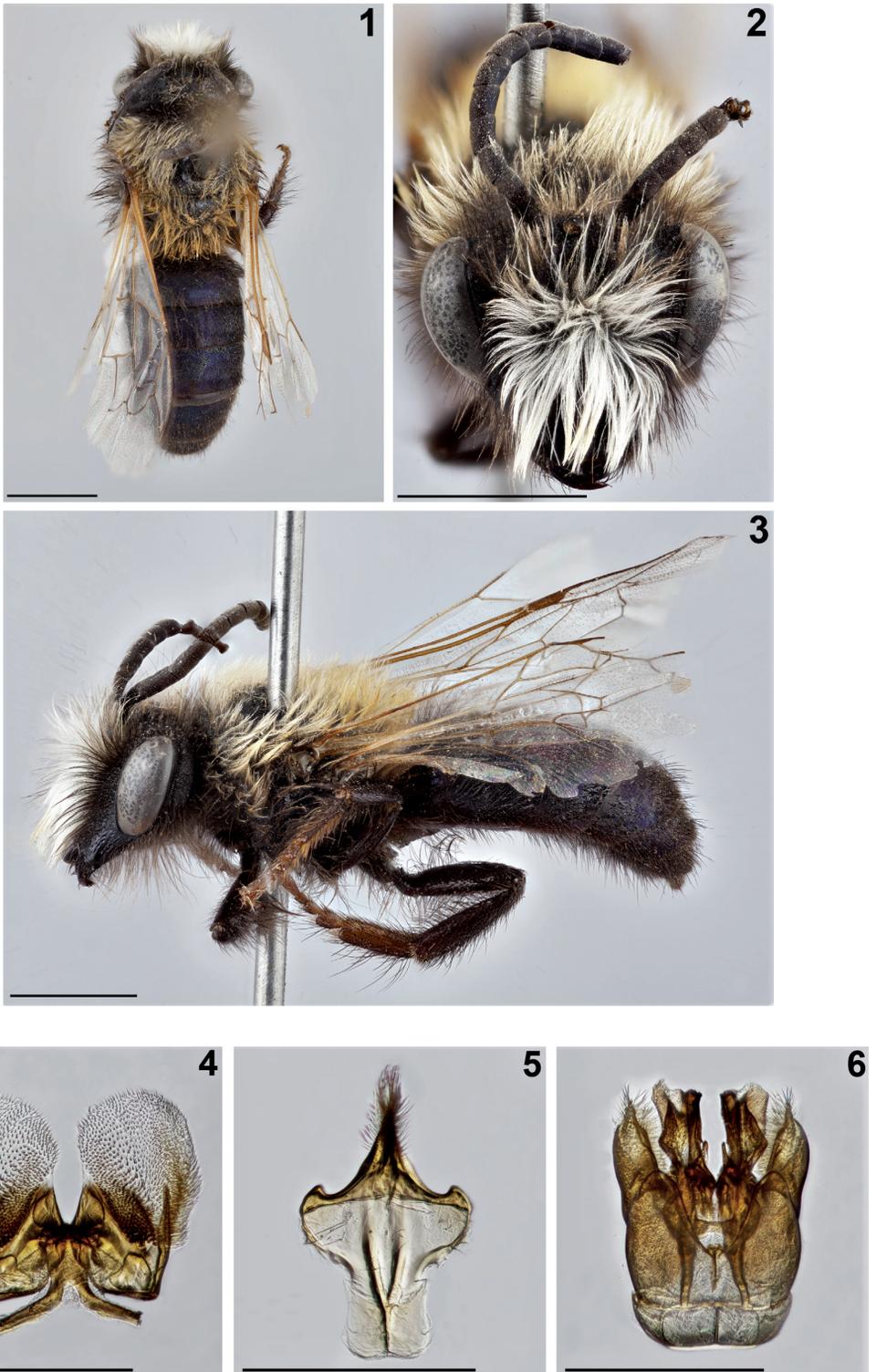
**Comments.** The male specimen described and illustrated in this paper can be assigned to the rare *C. vicugnensis* with certainty due to the following combination of characters, which is uniquely exhibited by the females of this species (according to Ferrari 2017): antenna black ventrally, hind basitarsus about 3× longer than broad and metasomal terga metallic-blue and covered with black pubescence. All three specimens (2♀♀ and 1♂) of *C. vicugnensis* that I have examined were collected in January. Regrettably, no floral host was indicated on their labels.

None of the four *Colletes* species described by Rojas and Toro (1993), including *C. vicugnensis*, was listed in Moure and Urban's (2002) catalog of the Neotropical Colletinae, although they were all later included in more recent bee checklists by the same authors (Moure *et al.* 2007, 2012).

**Key to the males of the *Colletes* species with metallic-blue metasoma found in Chile**

Note: The males of *C. guanta* and *C. quelu* are unknown.

- 1 Mesoscutum with off-white and black hairs intermixed (Ferrari 2017: Figs. 13F, 20F, 22F)..... 2
- Mesoscutum with pale-yellow, pale-orange or ferruginous hairs (Ferrari 2017: Figs. 11F, 24F, 28F)..... 4
- 2 Mesepisternum with smooth interspaces (Ferrari 2017: Fig. 66A)..... *C. cyaniventris* Spinola, 1851
- Mesepisternum with imbricate interspaces (Ferrari 2017: Fig. 66B)..... 3
- 3 Clypeus with mid-longitudinal carina (Ferrari 2017: Fig. 73C); mid and hind tarsi pale-brown (Ferrari 2017: Fig. 13B)..... *C. chusmiza* Rojas and Toro, 1993
- Clypeus without mid-longitudinal carina (Ferrari 2017: Fig. 73D); mid and hind tarsi dark-brown to black (Ferrari 2017: Fig. 20B)..... *C. cyanescens* (Haliday, 1836)
- 4 Tibiae dorsally and T1 with dark hairs (Ferrari 2017: Fig. 75D)..... 5
- Tibiae dorsally and T1 with pale hairs (Ferrari 2017: Figs. 24B, 28B)..... 6
- 5 Malar area ~1.5× as long as basal depth of mandible (Ferrari 2017: Fig. 11B); mesepisternum with smooth interspaces (Ferrari 2017: Fig. 66A)..... *C. bicolor* Smith, 1879
- Malar area ~ 2× as long as basal depth of mandible (Fig. 3); mesepisternum with imbricate interspaces (as in Ferrari 2017: Fig. 66B)..... *C. vicugnensis* Rojas and Toro, 1993
- 6 Paraocular area with a distinct longitudinal band of black hairs (Ferrari 2017: Fig. 28B); mid and hind tibiae and tarsi dark-orange (Ferrari 2017: Fig. 28B).... *C. fulvipes* Spinola, 1851
- Paraocular area without or with a few isolated black hairs, not forming distinct longitudinal band (Ferrari 2017: Fig. 24B); mid and hind tibiae and tarsi dark-brown to black (Ferrari 2017: Fig. 24B)..... *C. flaminii* Moure, 1956



**Figures 1-6.** 1-3. Male of *Colletes vicugnensis* Rojas and Toro. 1. Habitus, dorsal view. 2. Face, frontal view. 3. Habitus, lateral view. Scale bars: 2 mm. 4-6. Dorsal view of the male terminalia of *C. vicugnensis*. 4. S7. 5. S8. 6. Genital capsule. Scale bars: 1 mm.

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