Observations on *Camposella insignata* (Diptera: Acroceridae) from the Tropical Andes of Ecuador

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**ABSTRACT**

In the Neotropics, Panopinae spider flies are the most diverse within Acroceridae, specializing as endoparasites of mygalomorph spiders. *Camposella insignata* Cole, 1919 is one of the most enigmatic flies within this subfamily, given its conspicuously enlarged antennal flagellum and apparent rarity, with only two specimens known to this day. This paper describes recently collected *C. insignata* specimens from the Ecuadorian Andes and provides pictures and measurements. We also discuss the possible function of the enlarged antennal flagellum and give recommendations on future collection efforts to increase knowledge about this enigmatic genus.

Acrocerids are cosmopolitan flies whose planidia develop as spider endoparasites [1–3]. Adults have a small head, swollen abdomen, hunchbacked thorax, and in most species, elongated mouthparts [4]. They diversified during the Cretaceous [5,6] and their morphology is supported based on morphological characters, endoparasitic lifestyle [7–9], and molecular evidence [6]. There are approximately 530 species [10] in five subfamilies: Acrocerinae, Cyrtinae, Oecogcininae, Panopinae, and Philoptotinae [11,12].

In the Neotropics, there are 19 genera and 100 species. Recently, taxonomic studies [13–15], species descriptions [10,16,17], and generic revisions [18] have increased the interest in this group. Panopinae are parasites of mygalomorph spiders [2,6,16]. They can be diagnosed by a cylindrical or paddle-shaped flagellum that lacks an arista, widely separated postpronotal lobes, presence of tibial spines, and wings with cells *m₅, d, bm,* and basal *r₄+s* present [9,19]. In the Neotropics, Panopinae is the most species-rich subfamily with ten genera, six which are endemic: *Archipialea, Camposella, Coquena, Exetasis, Lasioides, Pialea,* and *Pteropexus.* Five Panopinae species have been reported for Ecuador: *Camposella insignata,* *Lasia ecuadorensis,* *Ocnaea falcifer,* *O. gigas* and *Pialea ecuadorensis.*

Morphologically, *Camposella* is related to *Eulonchus* and *Lasia* [11]. Its only species, *C. insignata* can be identified by its conspicuous enlarged antennal flagellum modified into paddle-like plates [11,20,21]. The holotype was sent to the National Museum of Natural History (USNM) by Francisco Campos-Rivadeneira [22–24], and described by Frank Cole (1919) [20,25]. Later, another specimen was reported from the National Museum of Natural History (MNHN) [21]. No other records have been reported ever since. Here, we describe a recently collected *C. insignata* specimen, report the finding of two museum specimens, provide pictures of its habitat, and a preliminary list of potential hosts.

We follow the terminology by Schlinger et al. [10], references therein [4,9,26,27] and, Kirk-Spriggs & Sinclair (eds.) for wing venation [28]. Specimens were identified following Schlinger [10], and Cole [20]. Coloration is described according to Köhler’s Catalogue [29]. Photographs were taken using an Olympus DP73 camera adapted to an Olympus SZX16 stereo microscope. To obtain images with greater focus depth, we used the Z-Stack function in cellSens Dimensions v1.8.1 © (Olympus Corp. 2009–2013). Examined specimens are deposited at Museo de Zoología, Universidad San Francisco de Quito (ZSFQ) and Museo de Zoología, Pontificia Universidad Católica del Ecuador (QCAZ), Quito, Ecuador.

The following measurements were taken from ZSFQ-i5155 specimen (see Distribution): head capsule length (HCL), in frontal view, length from the dorsal occipital border to inferior head border; head capsule width (HCW), length across head’s widest section (eyes included); third antennal segment length (TAS), in lateral view, length from middle of antenna base to distal tip; antennal length (ANL), length from middle of first antennal segment base to antenna’s most distal tip; antennal width (ANW), length across the broadest section of the antenna; proboscis length (PL), in ventral view, length from proboscis base to its most distal tip.

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thorax length (TL), in dorsal view, length from pronotum anterior border to posterior border of scutellum; abdomen length (AL), length from first abdominal segment’s anterior border to posterior border of the last abdominal segment (excluding genitalia); and abdomen width (AW), length across the broadest part of the abdomen. All measurements were taken five times, and the mean (n = 5) and standard deviation are reported.

**Camposella insignata Cole, 191**

**Diagnosis:** 1) antennae contiguous, visible dorsally, and separated by a medial ridge, 2) second antennomere trapezoid-shaped and tapering towards the apex, 3) second antennomere with light chrome-orange short setae, 4) proboscis olive-brown, lighter towards the tip, 5) and covered with short sulfur-yellow setae, 6) posterior half of scutum with dispersive pilosity, not extending anteriorly, 7) abdominal tergites 1–4 with short setae, 8) third medial cell (m3), discal cell (d), basal medial cell (bm), and fs2,5 cell present, 9) cell r4 +5 narrow and elongated, 10) first branch of medial cell (M1) not in contact with wing’s lower margin, and connected with the lower large branch of cell r4+5, 11) bm not directly in contact with m3, but connected through a short vein. **Head.** Capsule and eyes dusky-brown, eyes covered with procline dark grayish brown pilosity. Orbital setae behind eyes dark grayish brown, posterior setae immediately behind and extending towards occipital border longer, procline and light chrome-orange. Inner and outer occipital margins visible in frontal view, meeting below head capsule in a pointed plate with numerous dark grayish brown long setae. Eyes contiguous above antennal insertions, separated at about the upper third section and widely separated below antennae. Antennae contiguous at the base, separated by a medial ridge. First antennomere devoid of setae and visible, trapezoidal in shape, base dusky-brown turning walnut brown towards the apex. Plate above antennal base, and between eyes, similar to the first segment. Second segment about a third longer than the first, trapezoidal and tapering towards the distal section, dusky-brown with short light-chrome orange setae, originating from midline and reaching distal border. Third segment as broad as the second at its base, tapering to form a thin plate of uniform width throughout all its length, when viewed laterally, it forms a paddle-like plate about twice as long as head capsule, and its width less than half its length, fuscous-colored and devoid of setae. Proboscis rudimentary, slender, and pointy; olive-brown and lighter towards the tip, covered with short sulphur-yellow setae. Region below antennae concave. Occiput slightly swollen. Ocellar triangle rudimentary, same color as head capsule, with a small central concavity with dark grayish brown setae; ocelli absent.

**Thorax.** Dorsally, large and swollen with a rounded profile. About two-thirds of anterior half of scutum covered with abundant medium chrome-orange pilosity that, when looked at from certain angles, switches to light chrome-orange. Posterior half of scutum with dispersive dark grayish brown pilosity. Thorax integument vandyke-brown, as postalar callus, which is also covered with dark grayish brown setae. Scutellum flat and sub-rectangular; coloration and pilosity similar to scutum, except for lateral and posterior margins that have lighter setae. Postpronotal lobes swollen and covered with similar pilosity as that covering the scutum; laterally, triangular-shaped and with dense pilosity at the upper margin, and with a dense group of setae at the lower corner. Upper pleura swollen, with maroon integument, medium chrome-orange pilosity anterodorsally, and dusky-brown elsewhere. Squamae smoky-white at the base, with long dusky-brown setae turning hyaline towards the posterior region, and short dispersed setae over its surface. Inferior margin of squamae with long dusky-brown setae and posterior margin with short ones. **Legs.** Coxae uniformly maroon with light orange-yellow setae more abundant towards lateral and ventral margins. Femora uniformly maroon, anteriorly with long reclinate light orange-yellow setae. Medium and hind femora with long reclinate dusky-brown setae. Tibiae maroon at its base and becoming lighter towards distal portion; distal portion of the tibia wider, particularly at hind leg. Tibiae with pointed apical spur on fore and medium legs, blunter on hind legs, reclinate dusky-brown setae present on tibiae but shorter and sparser from fore to hind tibiae, which only has a few short setae. Tarsi cream-yellow with simple claws and no empodia or pulvilli. **Wings.** Brownish-hyaline, darker towards the base, without markings or microtrichia. Veins sepia colored. Third medial cell (m3), discal cell (d), basal medial cell (bm), and cell r4+5 present. M1 not contacting the wing’s lower margin, continuously connected to the lower large branch of cell r4+5. Cell bm not directly in contact with m3, but connected through a short vein. R4 not straight as in holotype but wavy, with proximal half pointing towards wing’s dorsum, and distal half towards ventral margin. **Abdomen.** Tergites one to four vandyke-brown, rounded and broader than thorax, covered with dusky-brown short setae, except for median zone in which setae are sparse. Viewed laterally, abdomen curved. Tergite five covered with long light-chrome orange setae. Sternum concave and covered with light-chrome orange pilosity, except for median line that is devoid of setae, and laterally where setae are dusky-brown. **Genitalia.** Viewed laterally, epandrium dusky-brown with upper side concave and lower side convex, converging on a pointed apex. Gonocoxite cuticle raw-umber and covered in vandyke-brown, and light chrome-orange setae. Upper and lower margin parallel, and posterior margin
convex. Gonostylus hyaline concave, darker at the tip. Phallus dusky-brown thin and, dorsally, ending in two divergent tips.

**Measurements (in millimeters):** HCL = 2.88 ± 0.04; HCW = 2.94 ± 0.1; TAS = 5.69 ± 0.02; ANL = 5.93 ± 0.02; ANW = 2.50 ± 0.01; PL = 4.22 ± 0.02; TL = 7.63 ± 0.24; AL = 8.82 ± 0.07; AW = 8.98 ± 0.06.

**Distribution:** *C. insignata* is known from five localities in the northern Ecuadorian Andes. Although the type locality was not mentioned in the original description, the name “Aloag Ecua.” is written on its label. Aloag is a small town on an inter-Andean valley, ca. 20 km SSW of Quito, at 2922 m.a.s.l. [30,31]. Campos (1960) [32], however, cites “Guayaquil” as the collecting locality for the holotype. Guayaquil is a city on the Pacific coastal lowlands. Since all localities of *C. insignata* are in the Andes, we consider that Aloag is the correct type locality, and the citation of Guayaquil was probably an error. Of all known localities, Aloag is the only one above 2000 m.a.s.l. Aloag was probably used as a general name for the collecting area, but the holotype was probably collected at lower elevations, in areas easily reachable by road ca. 20 km W of Aloag. Specimen ZSFQ-i5155 was collected at Mindo Scientific Station (−0.0379°, −78.76161°; 1460 m.a.s.l.), province of Pichincha, on 21 October 2017. The station is managed by Universidad San Francisco de Quito and is located near Mindo. This is a small town on the northwestern slopes of the Andes, embedded on a matrix of agricultural lands, secondary and primary forest. The specimen was collected on a trail crossing secondary forest and leading to a primary forest plot (**Figure 1**). Specimen QCAZ I 259303 was collected at El Pahuma Reserve (0.02586°, −78.6324°; 1941 m.a.s.l.), province of Pichincha, on 29 January 2012, and QCAZ I 259302 at Otonga Reserve (ca. −0.40°, −78.00°; 2000 m. a.s.l.), province of Cotopaxi, on 23 January 1994. All three localities are on the Western Andean Evergreen Mountain Forest ecosystem [33]. The specimen at the MNHN of Paris was reported only as “Quito”, but it was probably collected at one of the localities on the northwestern Andean slopes (Mindo, Gualea, Pacto-Pachijal) visited by Capitan Fernand D’Espinay, French military attaché in Venezuela and Ecuador, who collected natural history specimens in Ecuador between 1921–1922 [34–38].

**Material examined:** Male. “ECUADOR COTOPAXI”, “OTONGA 2000 m”, “23JAN1994 GOnore”, “QCAZ I”, “259,302” (QCAZ); Male. “Ecuador Pichincha”, “El Pahuma 1941 m”, “0.0258638 – 78.63236”, “29Ene.12 A.Péres”, “QCAZ I”, “259,303” (QCAZ); Male. “Ecuador Pichincha”, “Mindo 1460 m”, “Lat: −0.037892°; Lon: −78.761611°”, “S. Ramos 21Oct2017”, “SR061”, “Net collecting/ Bushes next to road/ Secondary forest” (**Figure 1**, collection site), “ZSFQ-i5155” (ZSFQ) (**Figures 2,3**).

**Other known specimens:** Holotype: Male. “Aloag Ecua.”, “F Campos R”, “1919” [20,25] (USNM); Male. “MUSEUM PARIS”, “ÉQUATEUR”, “Quito?”, “Cap D’ESPINAY 1922” [21,39]. “Camposella”, “insignata”, “Cole”, “Det. E Brunetti 1924”, “Camposella”, “insignata”, “Cole”, “Brunetti det. 1924” (MNHN).

**Comments:** Specimen ZSFQ-i5155 antennae were accidentally broken after pictures and measurements were taken. One was glued back, and the other is kept on a tube beside the specimen. Specimen QCAZ I 259302 was missing both antennae.

**Remarks**

Cole [20] suggested that the enlarged antennal flagella of this species might be a product of sexual selection; antennae would be antler-like structures to indicate male fitness [40]. There are several examples of sexually selected

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**Figure 1.** Collection site of *C. insignata* ZSFQ-i5155 specimen on a road crossing a secondary forest near the town of Mindo, Pichincha, Ecuador (a). Picture of the hilly landscape of the zone (b). Photo credits: GMRC, taken on 21 October 2017.
characters in flies; eye-stalks, for example, have appeared independently on several families [41]. In situ studies of the reproductive fitness of males with varying flagella sizes would help test this hypothesis.

Enlarged flagella might also help males locate females [20] since a larger surface would accommodate more sensilla [42]. Given the sexual dimorphism seen in related genera, it is likely that females have smaller

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**Figure 2.** Photographs of the *C. insignata* ZSFQ-i5155 specimen. Lateral (a), frontal (b), and dorsal (c). Scale bar: 1 mm. Photo credits: AGTR.

**Table 1.** Mygalomorph spider species found on the Andean slopes of northwestern Ecuador, where *C. insignata* inhabits, and that might serve as hosts for Panopinae spider flies.

| Species                   | Family          | Record localities                                      | Province                        | Source                      |
|---------------------------|-----------------|--------------------------------------------------------|---------------------------------|-----------------------------|
| *Idiophthalma ecuadoriensis* | Barychelidae    | Santo Domingo de los Colorados                         | Santo Domingo de los Colorados | [44]                        |
| *Ischnothele caudata*     | Ischnothelidae  | Pichincha volcano slopes                               | Pichincha                       | [45]                        |
| *Linothele longicauda*    | Dipluridae      | Andean slopes near Quito                               | Pichincha                       | [46]                        |
| *L. pukachumpi*           | Dipluridae      | Reserva Otonga                                         | Cotopaxi                        | [47]                        |
| *L. quori*                | Dipluridae      | La Florida, Alluriquin, San Francisco de las Pampas     | Santo Domingo de los Colorados, Cotopaxi | [47]                        |
| *L. tsachilas*            | Dipluridae      | La Florida, Alluriquin                                  | Santo Domingo de los Colorados  | [47]                        |
| *L. yanachanka*           | Dipluridae      | San Francisco de las Pampas                            | Cotopaxi                        | [47]                        |
| *L. zaia*                 | Dipluridae      | La Florida, Alluriquin                                  | Santo Domingo de los Colorados  | [47]                        |
| *Linothele spp.*          | Dipluridae      | Mindo                                                  | Pichincha                       | Unidentified species recorded by authors |
| *Mastenia lasdamas*       | Dipluridae      | Reserva Otonga                                         | Cotopaxi                        | [48]                        |
| *M. otaongachi*           | Dipluridae      | Reserva Otonga, Reserva Otonga                          | Cotopaxi                        | [48]                        |
| *Neschnocolus spp.*       | Theraphosidae   | Mindo                                                  | Pichincha                       | Unidentified species recorded by authors |
| *Pamphobeteus augusti*    | Theraphosidae   | Los Puentes                                            | Pichincha                       | [49]                        |
| *P. vespertinus*          | Theraphosidae   | Los Puentes                                            | Pichincha                       | [49]                        |
| *Pamphobeteus spp.*       | Theraphosidae   | Los Puentes                                            | Pichincha                       | Unidentified species recorded by authors |
| *Paratropis elicii*       | Paratropididae  | Reserva Otonga, Reserva Pristirana                     | Cotopaxi                        | [47,50]                     |
| *P. otinga*               | Paratropididae  | Reserva Otonga                                         | Cotopaxi, Pichincha             | [50]                        |
| *P. pristirana*           | Paratropididae  | Reserva Pristirana, Mindo                              | Cotopaxi, Pichincha             | [50]                        |
| *Paratropis spp.*         | Paratropididae  | Mindo                                                  | Pichincha                       | Unidentified species recorded by authors |
Figure 3. Photographs of the *C. insignata* ZSFQ-i5155 specimen. Wing (a) and head in lateral view showing the antenna (b). Scale bar: 1 mm. Abbreviations: *A*, first branch of anal vein; *bm*, basal medial cell; *br*, basal radial cell; *Cu*, posterior cubital cell; *d*, discal cell; *M*, first branch of medial vein; *M*, second branch of medial vein; *m-cu*, medial cubital crossvein; *m*, third medial cell; *r*, anterior branch of radius; *R*, second branch of radius; *u*, upper branch of third branch of radius; *r*, lower branch of third branch of radius; *R*, *R*, *R*, cell; *r*-*m*, radial-medial crossvein; *Sc*, subcostal vein. Photo credits: AGTR.

flagella [10]. Even if not as large, enlarged flagella might help females locate spider hosts or oviposition sites [2]. Studies on antenial morphology and ultrastructure would help to understand their role in olfaction.

There are at least nineteen mygalomorph species (Table 1) that might serve as hosts for Panopiniae flies on the northwestern Andean slopes of Ecuador, where *C. insignata* inhabits. Unfortunately, information on Ecuadorian mygalomorphs is scarce and many species remain undescribed in this part of the Tropical Andes biodiversity hotspot [43]. Further field studies in this region might reveal more Panopiniae species. Given the apparent rarity of these flies [2], a possible strategy could be to rear parasitized spider hosts until adults emerge [16].

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Author contributions

AGTR first detected the ZSFQ-i5155 specimen at ZSFQ Collection, identified the specimens, took the measurements and photographs, and wrote the manuscript. DFCH collected and provided information on the possible hosts of the species, analyzed the localities and distribution, and reviewed the manuscript. SARR collected the specimen from Mindo. GMRC coordinated the description process, examined specimens of *C. insignata* at QCAZ and ZSFQ, collaborated on the morphological description, wrote the manuscript, and assembled the table and figures.

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