

Review of *Thompsoniella* Guimarães with description of a new species from Colombia (Diptera, Calliphoridae, Mesembrinellinae)

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ABSTRACT. Review of *Thompsoniella* Guimarães with description of a new species from Colombia (Diptera, Calliphoridae, Mesembrinellinae). The Mesembrinellinae (Diptera, Calliphoridae) are exclusively Neotropical with nine genera comprising 36 recognized species, including the genus *Thompsoniella* Guimarães with a single species, *T. anomala* Guimarães. We describe a new species, *Thompsoniella andina* sp. nov., from the Departments of Antioquia and Caldas, Colombia (Cordillera Central of the Andes, between 2600–2700 m) and redescribe *T. anomala*. A key to the nine genera of Mesembrinellinae and a key to the males of the two species of *Thompsoniella* are provided. Color photographs to illustrate the two species of *Thompsoniella* and drawings of the male genitalia of both species are also provided. Here we record *Thompsoniella* for the first time in Colombia.

KEYWORDS. Andean biodiversity; Calliphoridae; Insecta; taxonomy.

Thompsoniella Guimarães, 1977 is one of the nine valid genera of the Neotropical subfamily Mesembrinellinae (Calliphoridae), which includes 36 species from southern Mexico to northern Argentina (Guimarães 1977; Bonatto & Marinoni 2005; Wolff *et al.* 2013; Wolff 2013). *Thompsoniella* was originally proposed for *Thompsoniella anomala* Guimarães 1977, male (holotype) from San Diego (Venezuela) and female (paratype) from Aragua (Venezuela), at an altitude of 1000 m.

Herein, we describe *Thompsoniella andina* sp. nov. from the Departments of Antioquia and Caldas (Andean System), Colombia and redescribe *T. anomala*.

MATERIAL AND METHODS

The type material of *Thompsoniella andina* sp. nov. is deposited in *Laboratorio de Colecciones Entomológicas de la Universidad de Antioquia*, Colombia (CEUA). The male holotype and the female paratype of *T. anomala* Guimarães, 1977 are deposited in the *Museu de Zoologia, Universidade de São Paulo*, Brazil (MZUSP). Other examined material is deposited in the Natural History Museum, London, U.K. (BMNH) and in the National Museum of Natural History, Washington D.C, U.S.A (USNM).

The specimens of the new species were collected with net in a cloud forest of the Cordillera Central, in Colombia. This well-preserved, primary cloud forest is in very wet montane forest life zone, with a mean temperature range of 12–18°C and mean annual precipitation range of 2–4 m (IGAC 2002; Holdridge 1947) at an altitudinal belt of 2000–3000 m. Epiphytes are common and abundant and the canopy is closed at about 25 m.

The new species was identified first by comparing it with the original description of *T. anomala* by Guimarães (1977) and then by comparing it with the holotype of *T. anomala*. Terminology follows McAlpine (1981) and Bonatto & Marinoni (2005). Body length was measured from the frons to the apex of the abdomen, and wing length from the alar sclerite to the wing apex. The measurements ‘head width’ and ‘frons width’ follow Whitworth (2006), in which the frons width is taken from the narrowest point. For examination of male terminalia, the abdomen was removed and submerged in 10% potassium hydroxide (KOH) at room temperature for 24 hours, then rinsed in acetic acid for 10 minutes, followed by distilled water for 10 minutes, after which it was placed in 70% ethanol with glycerin (9:1) for dissection. An Olympus SZ60 microscope was used for dissection of male terminalia as well as general observation and illustration. Photographs were taken using a digital camera Leica DFC500 attached to a stereomicroscope Leica MZ16 and the images edited in the software IM50 (Leica) and Automontage (Syncrosopy). All dissected structures were preserved in 200 µl plastic tubes with glycerin and the remaining parts of the specimen were mounted on insect pins.

TAXONOMY

Mesembrinellinae Shannon, 1926

Mesembrinellinae Shannon 1926: 116, 117; Hall 1948: 60; Roback 1951: 357; Hennig 1952: 423; Crosskey 1965: 44; Mello 1967: 2; Mello 1969: 244; Hori 1967: 226; James 1969: 251; James 1970: 12; McAlpine 1981: 1136; McAlpine 1989: 1499; Rognes 1986: 88; Rognes 1997: 28, 53; Toma & de Carvalho 1995: 127; Bonatto & Marinoni 2005: 883; Vargas & Wood 2010: 1297; Wolff, Ramos-Pastrana & Pujol-Luz 2013: 58; Wolff, Ramos-Pastrana & Pujol-Luz 2013: 129; Wolff 2013: 120.

Diagnosis. Medium to large calyptrate flies, macrolarviparous. Eye and parafacial bare; arista plumose; two notopleural setae; row of vertical setae well developed on meron; scutellum with erect hair-like setae on ventral portion; subscutellum developed or fairly prominent to some degree; vein M slightly curved, not forming a sharp angle; post-alar wall weakly ciliated; anterior spiracle with a characteristic dorsal opening; metathoracic spiracle large, reniform, with a single membrane, dorsal opening, and thin setulae originating at the membrane; abdomen often with metallic greenish-blue or violet reflections. Male often holoptic; tergite 6 and tergites 7+8 separated by a membrane, or fused; surstyli fused to the epandrium. Female dichoptic; one pair of crossed interfrontal setae, three elongated and sclerotized spermathecae, each with an independent duct; female terminalia without a telescopic ovipositor, tergite eight discontinuous with or without marginal setae (Toma & Carvalho 1995; Rognes 1997; Guimarães 1977; Vargas & Wood 2010).

Key to genera of Mesembrinellinae

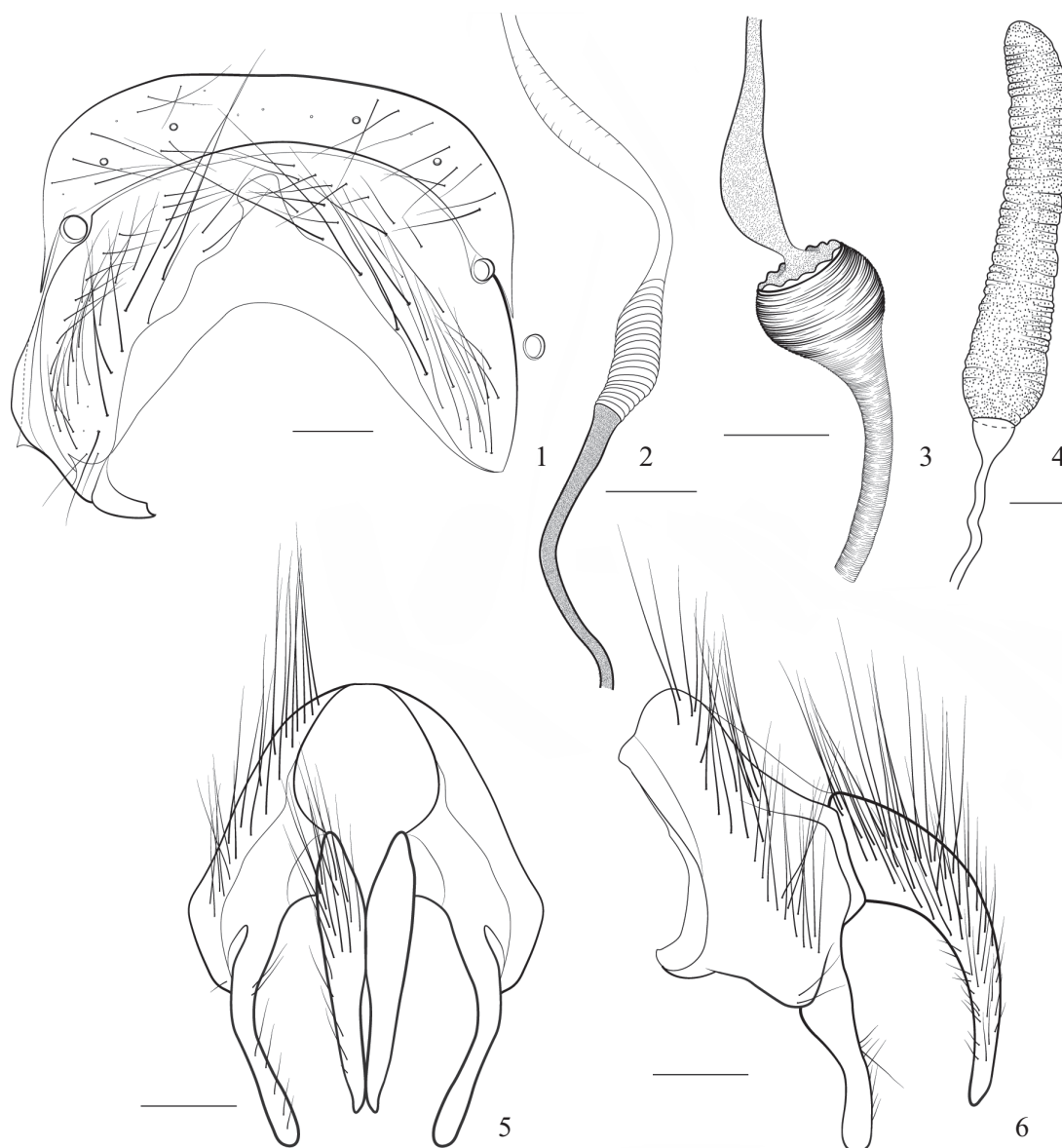
1. Abdomen not metallic; tergites 6 and 7+8 of the male not fused (Fig. 1), separated by a membrane; cerci of male arched; spermatheca tuberiform or bulbous 2
- 1'. Abdomen metallic; tergites 6 and 7+8 of the male partly or completely fused, without a membrane between the tergites; cerci of male straight or slightly curved; spermatheca filiform (Fig. 2) 3
2. Body length longer than 11 mm; basal half of tarsal claws dark-brown; with strong marginal setae; tergites 6 and 7+8 of male separated by sclerotized membrane; aedeagus with hypophallic lobe without teeth and with lateral projections; spermatheca bulbous (Fig. 3) *Souzalopesiella* Guimarães, 1977
- 2'. Body length shorter than 11 mm; basal half of tarsal claws white; with normal marginal setae; tergites 6 and 7+8 of male separated by non-sclerotized membrane; aedeagus with hypophallic lobe with teeth and without lateral projections; spermatheca tuberiform (Fig. 4)
..... *Laneella* Mello, 1967
3. Intra-alar setae 1:2, pair of pre-sutural setae developed or reduced; mesonotum with six to eight narrow, ill-defined pollinose stripes 4
- 3'. Intra-alar setae 0:2, pre-sutural setae absent; mesonotum with four wide, well-defined pollinose stripes or mesonotum pollinose without stripes 5
4. Male front 0.19–0.22 mm of head width (dichoptic); frontal vitta wide, present; interfrontal setae present; parafrontalia of female without proclinate orbital setae
..... *Albuquerquea* Mello, 1967
- 4'. Male front less than 0.18 mm of head width (holoptic); frontal vitta narrow, partial or totally absent; interfrontal setae absent; parafrontalia of female with one or two pairs of proclinate orbital setae
..... *Mesembrinella* Giglio-Tos, 1893
5. Disc of T_{1+2} with a row of discal lateral setae present; facial carina not prominent, with a few setae concentrated only at base; sternite 5 of male with lobes 6
- 5'. Disc of T_{1+2} with row of lateral setae absent; facial carina prominent, with setae on basal half; sternite 5 of male with projections instead of lobes
..... *Henriquella* Bonatto, 2005
6. Meral setae in a straight line or as an inverted "L"; subcostal sclerite ciliate or bare 7
- 6'. Meral setae in a slightly curved row (as an arch); subcostal sclerite bare *Eumesebrinella* Townsend, 1931
7. Post-ocular setae reaching the gena; meral setae as an inverted "L"; T_4 and T_5 similar in size; male with T_6 and T_{7+8} partially fused, suture between the tergites conspicuous; cerci and surstyli shaped as usual (Figs. 5, 6) 8
- 7'. Post-ocular setae not reaching the gena; meral setae in a straight line; T_5 approximately 1.5 to 2 times larger than T_4 ; male with T_6 and T_{7+8} totally fused, suture not evident; cerci and surstyli conspicuously modified (Figs. 15, 16, 22, 23) *Thompsoniella* Guimarães, 1977
8. T_5 with a row of discal setae; intra-alar setae 1:2; pre- or post-sutural acrostichal setae present; wing membrane variable, most commonly hyaline and without maculae surrounding the veins *Huascaromusca* Townsend, 1918
- 8'. T_5 with discal setae poorly differentiated or absent; intralar setae 1:1; acrostichal setae absent; wing veins with maculae *Giovanella* Bonatto, 2005

Thompsoniella Guimarães 1977

Thompsoniella Guimarães 1977: 54 (Type species: *Thompsoniella anomala* Guimarães 1977, by original designation); Toma & Carvalho 1995: 139.

Diagnosis. Medium-sized (9–10 mm in length); male holoptic; facial carina not prominent; post-ocular setae not reaching the gena; mesonotum with fine dispersed pollinosity, not forming stripes; with two humeral setae; pre-sutural acrostichals absent; intralar setae 0:2; meral setae in a straight line; scutellum without discal setae; subcostal sclerite and stem vein naked; T_{1+2} with a row of lateral discal setae parallel to the margin of tergite; T_5 without discal setae; T_5 of male elongate, approximately twice the length of T_4 .

Monophyly. According to Toma & Carvalho (1995), the following character states support the monophyly of this genus: T_5 elongate, approximately twice the size of T_4 ; hypoproct longer than wide; sternite 8 of female present and tergite 8 absent. Certainly, the genus *Thompsoniella* has the greatest number of autapomorphies in the family. Other characters of *Thompsoniella*, not used by Toma & Carvalho (1995), are the complete fusion of tergites 6 and 7+8 in the male; cercus and especially the epandrium and surstyli strongly modified; apodeme of sternite 6 of male strongly developed (Fig. 12).



Figs. 1–6. 1, Tergites 6 and 7+8 (*Souzalopesiella*); 2–4, Spermatheca. 2, filiform (*Mesembrinella townsendi*); 3, bulbous (*Souzalopesiella facialis*); 4, tuberiform (*Lanella perisi*). 5–6, Male terminalia of *Laneella perisi*. 5, epandrium, surstylus and cerci, left lateral view; 6, epandrium, surstyli and cerci, posterior view

Thompsoniella anomala Guimarães, 1977

Figs. 7–8, 11–17

Thompsoniella anomala Guimarães, 1977: 54 (Type locality: San Diego, Venezuela); Toma & Carvalho, 1995: 128.

Type-material. Holotype male “San Diego [Venezuela]/abril 1937 [handwritten by pencil]”; “463 [pointed black margin]”; “Holotype [dark red, partially handwritten]”. Holotype in good condition, mid right tarsomeres missing; abdomen glued to the thorax and terminalia in a plastic tube with glycerin, attached to the pin. Female paratype (MZSP) without locality label, with rectangular label with “464” and yellow paratype label. According to Guimarães (1977) the locality data are: Venezuela: Aragua, 1000 m.

Diagnosis. Ventral region of body, particularly coxae, and femora of males covered with thin, white hairs, similar to

those on the occiput and post-gena; epandrium, cerci, surstyli, St_5 and St_6 as in (Figs. 7–8, 11–17). Epiphallus long and strongly recurved (Figs. 13–14); surstyli and epandrium as in Figs. 15–16; sternite 6 of male very developed (Fig. 12).

Male redescription. Body length 9 mm ($n = 3$).

Head. Front at vertex about 0.22 of head width (taken from Guimarães 1977); frontal vitta present, approximately three times the diameter of the anterior ocellus at narrowest, with small basal orange region, the rest is black; frons increasingly widened towards lunula; fronto-orbital plate black and parafacial orange, both silver pollinose, without setulae; gena orange, silver pollinose, naked, with only subvibrissae; post-gena and occiput white pollinose and with white, slender and long hairs; face flat, at the same level of parafacialia, pale and intensely silver pollinose; clypeal membrane white;



Figs. 7–10. *Thompsoniella*. 7–8. Habitus of *Thompsoniella anomala*. 7, Holotype male lateral view; 8, paratype female, lateral view. 9–10. Habitus of *Thompsoniella andina* sp. nov., Holotype male with abdomen removed: 9, dorsal view; 10, lateral view.

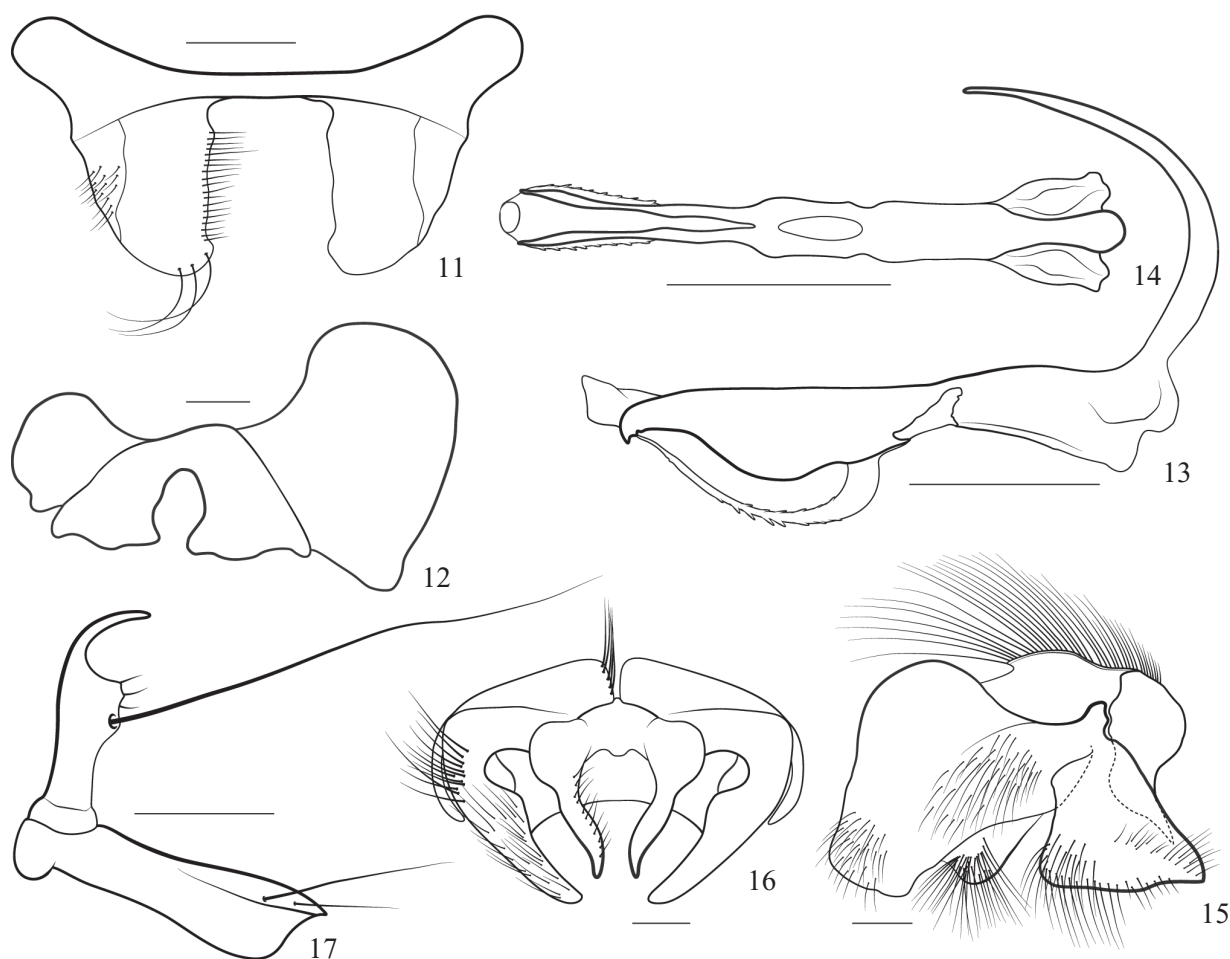
ocellar triangle elongate and black; pedicel and scape orange, first flagellomere base orange, remaining brown; palp orange-yellow. Chaetotaxy: two pairs of weak and parallel ocellar setae; one pair of parallel post-ocellar setae; outer vertical setae slender, as long as post-ocular, divergent and slightly proclinate; inner vertical setae not crossed; one pair of convergent paraverticilar setae; post-ocular setae black, homogeneously distributed up to half length of eye; proclinate interfrontal setae and orbital setae absent; facial carina not very prominent, with few short black setae at base; vibrissae crossed; subvibrissae very short, approximately one-quarter of vibrissae length.

Thorax. Mesonotum black, with light green color reflexion, finely and densely white pollinose, not forming stripes; pleura and humeral callus orange with darkened areas having pollinosity similar to that portions of the mesonotum; anterior and posterior spiracles golden, the latter has few weak and pale setulae on posterior portion; coxae, trochanters and mid and hind femora orange yellow, apex dark-brown; fore femora brown; tibiae and tarsomeres dark-brown; mid femur has three apical postero-dorsal and one antero-medial setae. Chaetotaxy: Humeral (postpronotal of

McAlpine 1981) setae 2; post-humeral setae 0–1; acrostichal setae 0:1 or 0:0; dorsocentral setae 2:2; intralar setae 0:2; supra-alar setae 3; pre-sutural seta 1; post-alar setae 2; apical scutellar seta 1; discal, pre-basal and sub-apical scutellar setae absent; basal scutellar seta 1; proepimeral setae 2; anepisternal setae 6; katapisternal setae 1+1; meral setae in a row; post-alar wall with few setulae; suprasquamal bridge naked.

Wing. Hyaline with pale alar macula, beginning on apex of subcostal vein, restricted to subcostal and r_1 cells, remainder slightly infuscated around the veins; veins pale; tegula and basicosta brown; subcostal sclerite and stem vein naked; junction between R_{2+3} and R_{4+5} with three setulae. Distance between apices of M and R_{4+5} shorter than half the distance between the apex of R_{2+3} and R_{4+5} . Calypters hyaline, upper one with margin slightly darkened; inner margin of lower calypter with lobular inner margin, not directed towards the scutellum.

Abdomen. Brown, base of T_{1+2} and lateral margins of T_3 and T_4 yellow, remainder blackened; T_5 very long, approximately twice the length of T_4 ; T_{1+2} with row of discal setae parallel to margin of tergite; T_{1+2} , T_3 and T_4 without lateral



Figs. 11–17. Male terminalia of *Thompsoniella anomala*. 11, sternite 5, dorsal view; 12, sternite 6, dorsal view; 13, aedeagus, right lateral view; 14, aedeagus, right dorsal view; 15, epandrium, surstyli and cercus, left lateral view; 16, epandrium, surstylus and cerci, posterior view; 17, postgonite and pregonite, right lateral view. Scale bars: 0.25 mm.

marginal setae; posterior edge of T_5 with slight central median projection and complete row of marginal setae.

Terminalia. T_6 completely fused with T_{7+8} ; apex of paraphallus without denticles; epiphallus very long and recurved; epandrium, cerci, surstylus very modified; St_5 rectangular with round lobes and St_6 asymmetric (Figs. 11–17); pregonite long and with truncate apex and postgonite with hook shaped apex (Fig. 17).

Female differs from male as follows: Measurements. Length of body 9–10 mm ($n = 2$). Head. Front at vertex 0.18 head width (Guimarães 1977); frontal vitta wide, with orange basal third, remaining black; divergent ocellar seta weaker than in male; one pair of weak interfrontal seta; proclinate and upper orbital seta absent; post-ocular seta black up to basal third of eye; all femora yellow, darkened at apex. Thorax. Pleura paler, or as in male. Abdomen. T_5 not elongate; T_4 and T_5 with complete row of marginal seta; T_6 with central dorsal projection where the tergite seta are found. Terminalia. Epiproct normal, without seta; T_7 discontinuous (not like an arch) with strong seta; T_8 absent; sternites trapezoidal; St_8 present, discontinuous (bilobate); pleura without seta; hypoproct with central prominence; spermathecae filiform as Fig. 2.

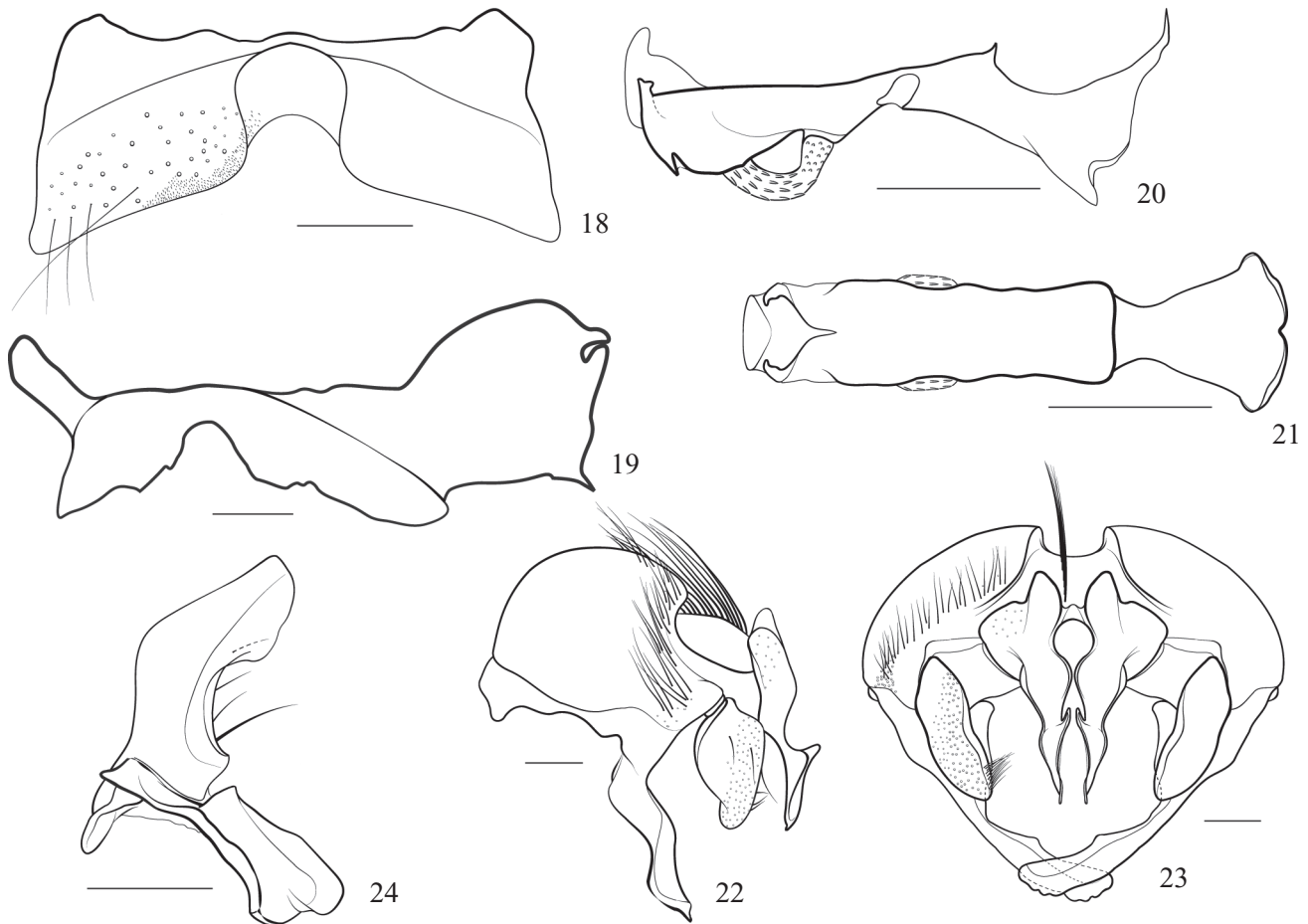
Distribution. Ecuador (Napó), Venezuela (San Diego, Aragua).

Remarks. There are at least seven places named San Diego in Venezuela. Although they are near each other, varying from 9–11°N and 62–71°W, some imprecision remains as to the location of the type locality. Until recently, *T. anomala* was known only from the type series. The two specimens from Ecuador that we identified as *T. anomala* are slightly different from the type by the absence of acrostichals and post-humeral setae. These differences are most likely a result of geographical variation since other characteristics, including male terminalia, do not vary.

Thompsoniella andina sp. nov.

Figs. 9–10, 18–24

Type-material. Holotype male, pinned, with genitalia in a separate microvial. Original label: CO Ant [Colombia Antioquia] Andes/Vda [vereda] La Mesenia/Reserva Fundación Colibri/700m s.n.m./Jama/Oct [October] 25 de-2010/CEUA/L. Gómez. [red label] [dissected]. Paratype male (CEUA): “CO Cal [Colombia Caldas], Manizales/Reserva Rio Blanco/5°7.2'6.58"N 75°43'7.58"W. 2592 [meters] s.n.m./Trampa Vansomerén Rydon pezcado/en bosque. Abril 4 de 2005/CEUA/. Seminario Entomología [white label].



Figs. 18–24. Male terminalia of *Thompsoniella andina* sp. nov., holotype male: 18, sternite 5, dorsal view; 19, sternite 6, dorsal view; 20, aedeagus, right lateral view; 21, aedeagus, right dorsal view; 22, epandrium, surstyli and cercus, left lateral view; 23, epandrium, surstylus and cerci, posterior view; 24, postgonite and pregonite, right lateral view. Scale bars: 0.25 mm.

Diagnosis. *Thompsoniella andina* sp. nov. differs from *T. anomala* in the following characters: acrostichal setae 0:0; legs with coxa, trochanter and femur orange, with apices dark chestnut; epandrium globulose and prominent, cerci curved forward (Figs. 22, 23); epiphallus short and truncated at the edge (Figs. 20–21); postgonite and pregonite apically truncated (Fig. 24), sternite 5 with rectangular lobes (Fig. 18), sternite 6 as in Fig. 19.

Male description. Body length 9 mm ($n = 2$).

Head. Width 3.5 mm ($n = 2$), frons wide, its width at the narrowest point 0.75 mm (0.7–0.8, $n = 2$), frontal vitta narrow, at narrowest portion nearly three times diameter of anterior ocellus, mostly black with a small basal orange portion; frons gradually widening at lunule; fronto-orbital plate black, parafacial yellow, both with silver pollinosity; gena yellow with silver pollinosity, seta at median region and a subvibrissa approximately half length of vibrissa; postgena and occiput white pollinose, with thin, long hairs; face pale, silver pollinose; clypeal membrane white; ocellar triangle black and elongated; scape and pedicel dark, chestnut color, first flagellomere dark chestnut at base, remainder yellow; palp pale yellow. Chaetotaxy: two pairs of thin and parallel ocellar setae; one

pair of parallel post-ocellar setae; one pair of thin, proclinate and divergent outer vertical setae of same length as post-ocellar setae; inner vertical setae not crossed; one pair of convergent paraverticilar setae; post-ocular black, homogeneously distributed up to middle of eyes; inter-frontal setae and orbital setae absent; facial carina slightly prominent with few short black setulae at base, above vibrissae; vibrissae crossed; subvibrissae approximately one-half length of vibrissae.

Thorax. Mesonotum black, with a light blue reflection and fine white pollinosity, without defined bands; pleura and humeral callus dark, except for area around anterior spiracle; anterior and posterior spiracles pale yellow; legs with coxae, trochanters and femora orange, with apices dark chestnut; mid femur with three apical posterodorsal setae and one antero-medial seta. Chaetotaxy: humeral setae 2; post-humeral seta 1; acrostichal setae 0:0; dorsocentral setae 2:2; supra-alar setae 3; pre-sutural seta 1; post-alar setae 2; apical scutellar seta 1; discal scutellar and prebasal scutellar setae absent; subapical scutellar seta 1; basal-scutellar seta 1; proepimeral setae 2; anepisternal setae 6; katepisternal setae 1+1; meral setae as an inverted “L”; post-alar wall with few black setulae; suprasquamal bridge naked.

Wing. Hyaline with a brown spot starting at the extremity of subcosta, restricted to subcostal cell, r_1 and r_{2+3} cells, remainder only infuscate around veins; tegula and basicosta chestnut; subcostal sclerite and remigium naked; meeting point of R_{2+3} and R_{4+5} with three setulae. Distance between apex of M and R_{4+5} much less than half length between apexes of R_{2+3} and R_{4+5} . Upper calypter hyaline, with dark edge; lower calypter with lobular inner margin, not directed towards scutellum.

Abdomen. Brown, base of T_{1+2} and sides of T_3 and T_4 yellow, remainder blackened; T_5 elongated, approximately 1.5 times length of T_4 ; T_{1+2} with lateral discal setae parallel to tergite margin; T_{1+2} , T_3 and T_4 without marginal lateral setae; posterior edge of T_5 with a slight central projection aligned with marginal setae.

Terminalia. St_5 with rectangular lobes (Fig. 18) and St_6 very asymmetric (Fig. 19); T_6 short and separated from T_{7+8} ; apical tip of paraphallus without denticles; epiphallus very short, rectangular and thick (Figs. 20–21); globulose epandrium with very long hairs at central portion; cerci strongly sinuous and surstylus almost oval and shorter and highly modified. (Figs. 22–23); post- and pregonite with truncated apices (Fig. 24).

Female. Unknown.

Etymology. The name indicates where the type series was collected in the Cordillera de Los Andes.

Distribution. Colombia, departments of Antioquia and Caldas (Cordillera Central of the Andes).

Key to the species of *Thompsoniella* (males only)

1. T_5 approximately twice the length of T_4 ; fore femur brown; acrostichal setae 0:1 or 0:0; epandrium with distal extension, not uniformly round (Fig. 15), epiphallus long and slightly curved at apex (Fig. 13) *T. anomala*
- 1'. T_5 approximately 1.5 times length of T_4 ; fore femur orange; acrostichal setae 0:0; epandrium swollen (Fig. 22), epiphallus very short and truncated at apex (Fig. 20) *T. andina* sp. nov.

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REFERENCES

Bonato S.R. & Marinoni, L. 2005. Gêneros e espécies novos de Mesembrinellinae (Diptera, Calliphoridae) da Costa Rica e Venezuela. *Revista Brasileira de Zoologia* 22: 883–890.

- Crosskey, R.W. 1965. A systematic revision of the Ameniinae (Diptera: Calliphoridae). *Bulletin of the British Museum (Natural History), Entomology* 16: 33–140.
- Guimarães, J.H. 1977. A systematic revision of the Mesembrinellidae, stat. nov. (Diptera, Cyclorrhapha). *Arquivos de Zoologia* 29: 1–109.
- Hall, D.G. 1948. *The blowflies of North America*. Vol. 4. Baltimore, Monumental Printing Company, The Thomas Say Foundation, Entomology Society of America, 477 p.
- Hennig, W. 1952. *Die Larvenformen der Dipteren* 3. Berlin, Akademie-Verlag, 628 p.
- Holdridge, L.R. 1947. Determination of world plant formation from simple climatic data. *Science* 105: 367–368.
- Hori, K. 1967. Comparative anatomy of the internal organs of the calyptrate muscoid flies V. Consideration on the phylogeny of Calyptratae. *Science Reports of Kanazawa University* 12: 215–254.
- I.G.A.C (Instituto Geográfico Agustín Codazzi). 2002. *Atlas de Colombia*. Santafé de Bogotá, D.C., Instituto Geográfico Agustín Codazzi, 342 p.
- James, M.T. 1969. A study on the origin of parasitism. *Bulletin of the Entomological Society of America* 15: 251–253.
- James, M.T. 1970. *A catalogue of the Diptera of the Americas south of the United States*. 102. Family Calliphoridae. São Paulo, Museu de Zoologia, Universidade de São Paulo, 28 p.
- McAlpine, J.F. 1981. Morphology and terminology – Adults, p. 9–63. In: McAlpine, J.F., Peterson, B.V., Shewell, G.E., Teskey, H.J., Vockeroth, J.R. & Wood, D.M. (Eds.), *Manual of Nearctic Diptera*. Vol. 1. Research Branch Agriculture Canada Monograph, 27, 674 p.
- McAlpine, J.F. 1989. Phylogeny and classification of Muscomorpha, p. 1397–1518. In: McAlpine, J.F. & Wood, D.M. (Eds.), *Manual of Nearctic Diptera*. Vol. 3. Research Branch Agriculture Canada Monograph, 32.
- Mello, R.P. de. 1967. Contribuição ao estudo dos Mesembrinellinae sul-americanos (Diptera, Calliphoridae). *Studia Entomologica* 10: 1–80.
- Mello, R.P. de. 1969. Notes on “*Laneella brunniipes*” (Surcouf, 1919) (Diptera, Calliphoridae). *Revista Brasileira de Biologia* 29: 243–247.
- Roback, S.S. 1951. A classification of the muscoid Calyptrate Diptera. *Annals of the Entomological Society of America* 44: 327–361.
- Rognes, K. 1986. The systematic position of the genus *Helicobosca* Bezzi with a discussion of the monophyly of the calyptrate families Calliphoridae, Rhinophoridae, Sarcophagidae and Tachinidae (Diptera). *Insect Systematics and Evolution* 17: 75–92.
- Rognes, K. 1997. The Calliphoridae (blowflies) (Diptera: Oestroidea) are not a monophyletic group. *Cladistics* 13: 27–66.
- Shannon, R.C. 1926. Synopsis of the American Calliphoridae (Diptera). *Proceedings of the Entomological Society of Washington* 28: 115–139.
- Toma, R. & de Carvalho, C.J.B. 1995. Estudo filogenético de Mesembrinellinae com ênfase no gênero *Eumesembrinella* Townsend (Diptera, Calliphoridae). *Revista Brasileira de Zoologia* 12: 127–144.
- Vargas, J. & Wood, D.M. 2012. Calliphoridae (blow flies), p. 1297–1304. In: Brown, B.V., Borkent, A., Cumming, J.M., Wood, M.D., Woodley, N.E. & Zumbado, M.A. (Eds.), *Manual of Central American Diptera*. Vol. 2. Ottawa, National Research Council of Canada, 728 p.
- Whitworth, T. 2006. Keys to the genera and species of blow flies (Diptera: Calliphoridae) of America North of Mexico. *Proceedings of the Entomological Society of Washington* 108: 689–725.
- Wolff, M., Ramos-Pastrana, Y. & Pujol-Luz, J.R. 2013. Description of the male of *Laneella perisi* (Mariluis) (Diptera, Calliphoridae) n. comb. *Neotropical Entomology* 42: 58–62.
- Wolff, M., Ramos-Pastrana, Y. & Pujol-Luz, J.R. 2013. A new species of *Giovanella* Bonatto (Diptera, Calliphoridae, Mesembrinellinae) from Colombia. *Revista Brasileira de Entomologia* 57: 129–132.
- Wolff, M. 2013. A new species of *Mesembrinella* (Diptera: Calliphoridae: Mesembrinellinae) from Colombia. *Revista Colombiana de Entomologia* 39: 120–124.

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