Systematics, Morphology and Biogeography

Review of the New World genus Cholomyia (Diptera, Tachinidae), with a new species from Costa Rica

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The tachinid genus Cholomyia presents Neotropical and Nearctic distribution with three species: C. acromion (Wiedemann, 1824), C. filipes (Walker, 1857), and C. inaequipes Bigot, 1884. In the present paper, all species are reviewed and redescribed, and a new species from Costa Rica is described, C. zumbadoi sp. nov. An identification key based on males is provided. For the first time, the male terminalia of all species, and the female terminalia and first instar larva of C. inaequipes are described and illustrated. Finally, based on the detailed morphological study we discuss the systematic placement of Cholomyia into Myiophasiini-Tachininae. A list of host–parasite records is synthesized.

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Introduction

The genus Cholomyia was erected by Bigot (1884) for his new species, C. inaequipes, based on five males from Mexico. Later, two other species were transferred to the genus: C. acromion (Wiedemann, 1824) and C. filipes (Walker, 1857) (Guimarães, 1971). All species are distributed exclusively in the Neotropical region, except for C. inaequipes, which also occurs in the Nearctic region. The genus was previously placed in the Urodeixini-Dexinae (Townsend, 1936; Guimarães, 1971) and in the latest Neotropical Catalogue (O’Hara and Wood, 2004) was transferred to the Myiophasiini-Tachininae.

C. filipes (Walker, 1857) is known only from its original description and then listed in the Neotropical catalogue (Guimarães, 1971). C. acromion (Wiedemann, 1824) and C. inaequipes Bigot, 1884 are better known, for they parasitize the curculionid Conotrachelus Dejean, 1835, an important pest that attacks grown plums, apples and peaches (O’Brien and Couturier, 1995). Data on immature stages of C. inaequipes, parasitizing the plum–curculio Conotrachelus nenuphar (Herbst, 1797) were published elsewhere (Quaintance and Jenne, 1912). On the other hand, the male and female terminalia have never been described.

In the present paper, the genus Cholomyia is reviewed. The valid species are redescribed, and a new species is described from Costa Rica, C. zumbadoi sp. nov. An identification key is provided based on male specimens. Descriptions and illustrations of the male terminalia of all species and the female terminalia and first instar larva of C. inaequipes are presented for the first time. Finally, based on the detailed morphological study, we discuss the systematic placement of Cholomyia into the tribe Myiophasiini. A list of host–parasite records is synthesized from literature.

Material and methods

The examined material is deposited in the following institutions: The Natural History Museum, London, United Kingdom (BMNH); Coleção Entomológica do Instituto Oswaldo Cruz, Rio de Janeiro, Rio de Janeiro, Brazil (CEIOC); Instituto Nacional de Biodiversidade, Santo Domingo de Heredia, Costa Rica (INBio); Muséum National d’Histoire Naturelle, Paris, France (MNHN); Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ); Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZSP); Universidade Estadual de Feira de Santana, Feira de Santana, Brazil (UEFS) and Coleção Museu de História natural, Universidade de la Amazonia, Florencia, Colombia (UAM-E). Other repositories cited in the text: Museo di Zoologia dell’Università di Torino, Torino, Italy (MZUT); National Museum of Natural History, Washington, United States (USNM) and Zoological Museum, Copenhagen, Denmark (ZMUC). The labels of the type
material are represented with quotes (") to indicate the same label, slash (/) to line break, and semicolon to indicate a new label.

The following abbreviations are used for the position of the setae/setulae on legs: A – anterior; AD – anterodorsal; AV – anteroventral; D – dorsal; P – posterior; PD – posterodorsal; PV – posteroventral; and V – ventral.

Male and female terminalia and first instar larva were clarified in 10% solution of KOH at room temperature for 24 about hours, then neutralized with acetic acid (50%), and washed with distilled water and a series of ethanol solutions of increasing concentrations. After examination on microscope temporary slides, the terminalia were stored in plastic microvial with glycerin and attached to the respective specimen. A permanent microscope slide with the first-instar larvae was mounted for examination and measurements, and both slide and adult pinned specimen were properly labelled.

Morphological terminology follows Cumming and Wood (2009), but for antennal morphology follows Stuckenberg (1999), and for male terminalia Tschorsnig (1985). Female terminalia and larva morphology follow Cantrell (1988), but the term cephaloskeleton of Courtney et al. (2000) is used.

Species were identified by morphological characters using the original description and redescriptions, for C. inaequipes and C. acromion, and by previously identified specimens by the museum of origin, for C. filipes. Host records mentioned in this study were gathered form the literature. New data from specimens labels were not found. Geographical data were gathered based on specimens' labels and literature records. Those records without original geographic coordinates were georeferenced using GeoNames Search (http://www.geonames.org/export/geonames-search.html) and GeoHack (http://toolserver.org/~geohack/). The distribution map was produced using the software Diva-Gis 7.5.

Results

Genus Cholomyia Bigot, 1884

(Fig. 1)

Cholomyia Bigot, 1884: 42 (also 1884: xxxvii). Type species: C. inaequipes Bigot, 1884, by monotypy.

Acromiodexia Townsend, 1931a: 335. Type species: Musca acromion Wiedemann, 1824, by original designation.

References. Wulp, 1891: 246 (revision); Townsend, 1892: 275 (key to North American Tachinidae); Williston, 1908: 356 (key to North American Diptera); Coquillett, 1910: 522 (catalogue); Townsend, 1927: 222 (key to South American “muscoids”); Aldrich, 1929: 13 (notes and catalogue); Curran, 1934 (key to British Guyanan Tachinidae); Townsend, 1936: 43, 45 (key to Urodexiini genera); Townsend, 1939: 107 (redescription of Cholomyia); 97 (redescription of Acromiodexia); Guimarães, 1971: 105 (catalogue); Wood, 1987 (key to Nearctic Tachinidae genera); O’Hara and Wood, 2004: 275 (catalogue); Wood and Zumbado, 2010: 1387 (key to Central American Tachinidae genera); O’Hara, 2014: 18 (list).

Description. Eyes very close to each other in males, with frons tapering towards the vertex, not approximate in females. Fronto-orbital plate well developed in profile, twice the parafacial width, at midlength. Parafacial setulose with slight pale pruinosity. Eye bare. Ocellar setae procline and well differentiated from the adjacent setae; postocellar setae procline about ¼ the length of ocellar setae; inner vertical setae straight and barely differentiated from postocular setae; outer vertical setae procline and long. Gena height 0.4 mm in average. Genal dilation with pale pruinosity and covered with pale setulae. Facial ridge bare. Antenna usually brownish yellow, almost reaching lower facial margin and inserted below middle of eyes. Arista densely plumose with long inner dorsal

Fig. 1. Distributional map of Cholomyia species.

**Diagnosis.** *Cholomyia* differs from myiophasine *Gnadochaeta* mainly by the plumose arista (pubescent in *Gnadochaeta*), parafacial pale setulose (setulae longer and black in *Gnadochaeta*), notopleuron with anterior seta about twice longer than posterior seta (equal size in *Gnadochaeta*), mid legs elongate in males (not elongate in *Gnadochaeta*) and abdomen and legs almost entirely yellow (both entirely black in *Gnadochaeta*).

**Key to species of Cholomyia (males)**

1. Mid leg approximately twice the length of the other legs **(Figs. 23, 38)**; two katepisterna; postpronotum with two basal setae; abdominal sympotergite $1 + II$ entirely yellow **(Figs. 22, 23, 37, 38)** .......................... 2
   Mid leg approximately $1.5 \times$ the length of the other legs **(Figs. 3, 15)**; one katepisterna; postpronotum with 1 anterior seta and 2–3 basal setae; abdominal symtergite $1 + II$ with a light brown transverse band on posterior margin **(Figs. 2, 3, 14, 15)** .......................... 3
2. Anepipisternum with 2 upward setae on anterodorsal corner. Surstylus with rounded enlargement at apex in posterior view **(Fig. 29)**. Ejaculatory apodeme narrow at base and wide at apex (about twice the basal width), and $1.6 \times$ longer than cerci **(Fig. 26)** (USA, Mexico, Guatemala, Guiana, Venezuela, Colombia, Peru, Brazil) ........................................ C. inaequipes Bigot, 1884
   Anepipisternum with 4–5 set of upward directed setae on anterodorsal posterior. Surstylus with no apical enlargement in posterior view **(Fig. 44)**. Ejaculatory apodeme narrow at base and very wide at apex (about $4.5 \times$ the basal width), $1.3 \times$ longer than cerci **(Fig. 41)** (Costa Rica) ............ C. zumbadoi sp. nov.
3. Thorax light brown **(Figs. 3, 4)**, prescutum with thin white pruinosis **(Fig. 2)**; aepisternum with 1 upward setula on anterodorsal corner; abdominal tergite III with 1 median marginal pair of setae, usually strong (Peru, Guiana, Brazil) .... C. acromion (Wiedemann, 1824)
   Thorax dark brown **(Figs. 14, 15)**, prescutum with dense white pruinosis **(Fig. 14)**; abdominal tergite III without median marginal seta (Costa Rica, Guiana, Colombia, Brazil) .... C. filipes (Walker, 1857)

Figs. 2–9. *Cholomyia acromion* (Wiedemann), $\sigma$: 2, dorsal habitus; 3, lateral habitus; 4, head, lateral view; 5, head, frontal view. 6–9, $\sigma^\prime$ terminalia: 6, ejaculatory apodeme, lateral view; 7, aedegus and hypandrium, lateral view; 8, epandrium, surstylus and cerci, lateral view; 9, epandrium, surstylus and cerci, posterior view. (Legends: basiph, basiphallus; cer, cerci; distph, distiphallus; ejac apod, ejaculatory apodeme; ep, epandrium; hypd, hypandrium; phapod, phallopodeme; preg, pregonite; postg, postgonite; sur, surstylus). Scale bar from figures 2 to 5: 1 mm; figures 6 to 9: 0.1 mm.

C. acromion (Wiedemann, 1824)

(Figs. 2–13)

*M. acromion* Wiedemann, 1824: 47. Holotype $\sigma$ (ZMUC; not examined). Type locality: “South America”, *Wiedemann, 1830*: 412 (redescription).

**Acromioidexia acromion**; Townsend, 1936: 45 (comments).

C. acromion; Emden, 1950: 203 (host record); Parker et al., 1953: 12 (host record); Parker, 1953: 54, 66 (host record; figure of puparium, posterior spiracles and cephaloskeleton of first instar); Guimarães, 1971: 105 (catalogue); Guimarães, 1977: 30 (host–parasite catalogue); O’Brien and Couturier, 1995: 234 (host record).

**Diagnosis.** *C. acromion* differs from *C. inaequipes* and *C. zumbadoi*, and it resembles more with *C. filipes*, by having the postpronotal lobe with 1 anterior and 2–3 basal setae, one katepisternal seta, and abdominal syntergite $1 + II$ with a narrow light brown transverse band on distal margin. Moreover, *C. acromion* differs from *C.
filipes by having the thorax light brown, prescutum with thin white pruinosity, and abdominal syntergite I+II with median marginal pair of setae.

Redescription

Male (Figs. 2–5)

Body length: 6.7 mm in average (6.3–7.2 mm; n = 4). Wing length: 6.5 mm in average (5.9–6.9 mm; n = 4).

Colouration. Genal groove yellow. Antenna yellow. Proboscis and palpus yellow. Thorax light brown, with white pruinosity on prescutum. Fore and mid legs brown, hind leg yellowish with posterior half black, and all legs with tarsus, claw and pulvillus light brown. Abdomen translucent yellow, but with a light yellow thin band on posterior margin of syntergite I+II, a larger band on tergite III (about ¼), and tergite IV with black posterior margin, about distal ½ of width. 

Head. (Figs. 4, 5) Frontal vitta tapering towards the apex. Gena, when seen in profile, about 0.3–0.4 times as height as eye. Gena and parafacial with white pruinosity.

Thorax. (Figs. 2, 3) Postpronotal lobe with 1 anterior and 2–3 basal setae (nearly aligned). Supra-alar setae I+1. Postalar setae 2. Scutellum with 1 basal (weak), one subapical (weak) and one apical (weak or absent) pairs of setae. Aneipisternum with 4–5 strong setae and without upward setae on anterodorsal corner. Katepisternal setae 1 (posterior).

Wing. $R_{4+5}$ setulose dorsally from Rs node until half of distance to r-m crossvein, and $R_{1}$ setulose dorsally until distal 1/3. Rs node with 2–4 setulae ventrally.

Legs. (Fig 3) Fore femur with row of PD and PV setae; fore tibia with 1 submedian and 2 preapical setae on PD surface. Mid leg elongate with 1.5x of length of other legs, 13.5 mm in average (12.2–14.5 mm; n = 3); mid femur with 2 AV supramedian setae, 1 D supramedian seta; and mid tibia with 2 AD setae at apical third and 1 P seta on median third. Hind femur with a row of PD and AD setae, 1 D seta on basal third, 1 PV seta on median third and 2 preapical AD setae; and hind tibia with 1 PD seta on median third, 1 median AV seta, 1 median AD seta and 1 preapical seta on PV and on PD surfaces.

Abdomen. (Figs. 2, 3) Syntergite I+II with 1 to 2 pairs of lateral marginal setae. Tergite III with 1 lateral marginal and 1 median marginal pair of setae. Tergites IV and V with 2 lateral marginal and 1 median marginal pairs of setae.

Male terminalia. (Figs. 6–9) Cerci tapered and well separated at apex in posterior view, curved and with tip narrowed internally. Surstylus narrowing near the apex in posterior view (Fig. 9), concave and somewhat curved posteriorly in profile (Fig. 8). Base of pregonite sub-triangular, postgonite rod-shaped with strong setae, beginning at base of distiphallus (Fig. 7). Ejaculatory apodeme widening slightly at apex, and conspicuously supersized, about 1.3x length of cerci (Fig. 6).

Female (Figs. 10–13)

Body length: 5.1 mm in average (4.8–5.6 mm; n = 3); wing length: 4.6 mm in average (4.5–4.8 mm; n = 3). (Figs. 12–13).

Differs from male by the following: Fronto-orbital plate with reclinate orbital setae 2, and procline orbital seta 1. Ocellar setae not developed and straight, inner vertical setae well developed and reclinate; outer vertical setae developed, about ½ length of inner vertical seta. Thorax dark brown (sometimes light brown), with white pruinosity on scutum and scutellum. Postpronotal setae 2. Supra-alar setae 2. Katepisternal setae 1–2 (anterodorsal and posterdorsal). Mid leg dark brown and not elongate as in males, 6–7 mm (Fig. 11). Pulvillus not elongated (Fig. 10). Abdomen oval with anterior thin band of white pruinosity on tergites II–V; syntergite I+II dark yellow, tergite III black, with anterior margin dark yellow, tergites IV and V entirely black, the latter with conspicuous pointed tip.


Distribution. Peru, Guyana, Brazil (Minas Gerais, Rio de Janeiro, São Paulo). (Fig. 1).

C. filipes (Walker, 1857)

(Figs. 14–21)

Dexia filipes Walker, 1857: 202. Holotype ♂ (BMNH; not examined). Type locality: “Brazil”.

C. filipes; Guimarães, 1971: 105 (catalogue).

Diagnosis. C. filipes differs from C. inaequipes and C. zumbaidoi, and it resembles more with C. acromion, by having the postpronotal lobe with 1 anterior and 2–3 basal setae, one katepisternal seta, and abdominal syntergite I+II with a narrow light brown transverse band on distal margin. Moreover, C. filipes differs from C. acromion by having the thorax dark brown, prescutum with dense white pruinosity, and abdominal syntergite I+II without median marginal setae.

Redescription

Male (Figs. 14–17)

Body length: 6.6 mm in average (5.0–7.3 mm; n = 8). Wing length: 6.2 mm in average (5.2–6.8 mm; n = 8).

Colouration. Genal groove dark yellow. Antenna light yellow. Proboscis and palpus yellow. Thorax dark brown, with dense white pruinosity on prescutum. Fore leg with yellow femur black, mid and hind femur yellow (except for posterior margin blackish on distal ¼), and all legs tibia and tarsus black. Abdomen light
yellow, but light brown thin band on posterior margin on syn-tergite I + II and tergite III (about ¼), and tergite IV with black posterior margin, about ⅗ of width.

Head. (Figs. 16, 17) Frontal vitta tapering towards the apex. Gena, when seen in profile, about 0.2–0.3 times as height as eye. Gena and parafacial with pale pruinosity.

Thorax. (Figs. 14, 15) Postpronotal lobe with 1 anterior and 2–3 basal setae (nearly aligned). Supra-alar setae 1 + 2. Postalar setae 1 or 2. Intrapostalar seta present (weak). Scutellum with 1 basal, 1 subapical (or absent), 1 discal (weak) and 1 apical (decussate) pair of setae. Aeneisternum with 5–6 strong setae and with 1 upward setula on anterodorsal corner. Kaptopisternal seta 1 (posterior).

Wing. Rs2+5 setule dorsally from Rs node until half of distance to r-m crossvein. R1 setule dorsally (scarce) until distal ⅗. Rs node with 2 setae ventrally.

Legs. (Fig. 15) Fore femur with row of PD and PV setae; fore tibia with 1 submedian and 2 preapical setae on PD surface. Mid leg elongated, with 1.5× of length of other legs 12.3 mm in average (9.2–15.8 mm; n = 5); mid femur with 1 submedian and 1 preapical on PD surfaces and mid tibia with 2 supramedian AD setae at apical third, 1 PV seta on median third. Hind femur with row of PD and AD setae, 1 PD seta on basal third, 1 PV seta on median third and 2 preapicals seta on AD; hind tibia with 1 PD seta on median third, 1 median AD seta, 2 preapical PV surface.

Abdomen. (Figs. 14, 15) Syntergite I + II with 1 pair of lateral marginal setae. Tergite III with 1 pair of median marginal. Tergites IV and V with 2 lateral marginal and 1 median marginal pairs of setae.

Male terminalia. (Figs. 18–21) Ceri tapered at apex, touching each other in posterior view (Fig. 21), with narrowed and subtly curved edge internally in profile (Fig. 20). Surstylus narrowing near the apex in posterior view (Fig. 21), concave and somewhat curved posteriorly in profile (Fig. 20). Base of pregonite sub-triangular, and postgonite rod-shaped, with strong setulae, beginning at base of distiphallus (Fig. 19). Ejaculatory apodeme with wide apex and conspicuously supersized, with 1.6× length of cerci (Fig. 18).

Female. Unknown.


Distribution. Costa Rica, Guyana, Colombia (Florencea, Brazil (Rondônia, Amazonas, Pará, Mato Grosso, Goiás, Mato Grosso do Sul). (Fig. 1)

Remarks. José H. Guimarães during his studies at USNM in 1967 made some personal notes based on records from J.M. Aldrich performed in the BMNH in 1929, which he reports D. filipes as synonym of C. inaequipes. However, Guimarães (1971) in the Neotropical catalogue still kept C. filipes as a valid species. In our review, we recognized both C. filipes and C. inaequipes as separate and valid species. In fact, C. filipes shares more similarities with C. acrornion than with C. inaequipes.

C. inaequipes Bigot, 1884

(Figs. 22–36)

Musca longipes Fabricius, 1805: 398 (preoccupied Scopoli, 1763).

Holotype ♂ (ZMUC; not examined). Type locality: "Brazil".

C. inaequipes Bigot, 1884: 42 (also 1884: xxvii). Lectotype ♂ (BMNH; not examined). Type locality: "Mexico".

Theliarodas basalis Giglio-Tos, 1893: 3. Holotype ♀ (MZUT; not examined). Type locality: "Mexico".

C. nigricrus Williston, 1908: 353, Fig. 146 (figure of head and legs). Holotype ♂ (whereabouts unknown). Type locality: "unknown".


References. Wulp, 1891: 247 (redescription of C. inaequipes); Brauer, 1897: 365 (inaequipes as synonym of longipes); Johnson in Coquillett, 1905:78 (C. flavipes as junior synonym of T. basalis); Pierce, 1908: 381 (host record); Johnson, 1912: 102 (notes of C. longipes); Quaintance and Jenne, 1912: 150 (notes, hosts and figure of puparium); Pierce et al., 1912: 78 (host record); Brooks, 1922: 7, 11, 13, 16 (host record); Mutchler and Weiss, 1925:
10, 13 (host records); Aldrich, 1929: 13 (redescription and comments); Snapp, 1930: 77, 79 (host record); Townsend, 1931b: 93 (C. inaequipes as synonym of C. longipes); Townsend, 1936: 45 (comments about C. inaequipes); Curran, 1934: 502 (comments on female of C. inaequipes); Fattig, 1949: 12 (host record); Armstrong, 1958: 17 (host record); Patton, 1958: 36 (distributional records); Gibson, 1964: 525 (host record); Guimarães, 1971: 105 (catalogue); Arnaud, 1978: 15, 144, 611 (host—parasite catalogue); Maier, 1980: 61 (host record); O’Hara and Wood, 2004: 275 (catalogue); Jenkins et al., 2006: 438 (host record); Wood and Zumbado, 2010: 1401 (comments).

Diagnosis. C. inaequipes differs from C. acromion and C. filipes, and it resembles more with C. zumbadoi, by having the mid leg approximately twice the length of the other legs, two katepisternal setae, postpronotum with two basal setae and abdominal syntergite I + II entirely yellow. Moreover, C. inaequipes differs from C. zumbadoi by having the anepisternum with 2 upward setae on anterodorsal corner, surstylus with rounded enlargement in apex in posterior view, ejaculatory apodeme narrow at base and wide at apex (about twice the basal width), about 1.6 × longer than cerci and pregonites without narrowed basal portion.

Figs. 22–29. Cholomyia inaequipes Bigot, ♂: 22, dorsal habitus; 23, lateral habitus; 24 head, lateral view; 25 head, frontal view. 26–29, ♀ terminalia: 26, ejaculatory apodeme, lateral view; 27, aedeagus and hypandrium, lateral view; 28, epandrium, surstylus and cerci, lateral view; 29, epandrium, surstylus and cerci, posterior view. Scale bar from figures 22 to 25: 1 mm; figures 26 to 29: 0.1 mm.

Redescription

Male (Figs. 22–25)

Body length: 8 mm in average (7.1–8.8 mm; n = 30). Wing length: 8.2 mm in average (7.1–9 mm; n = 30).

Colouration. Genal groove dark yellow. Proboscis and palpus pale yellow. Antenna yellow. Thorax dark brown, with pruinosity usually yellow on prescutum. Fore and hind legs with femur yellow (except mid distal region black), and all legs with tibia and tarsus black. Abdomen yellow, but light brown thin band on posterior margin of tergite III (about ¼) and tergite IV with black posterior margin, about distal ⅔ of width.

Head. (Figs. 24, 25) Frontal vitta narrow. Gena, when seen in profile, about 0.4–0.5 times as height as eye. Gena and parafacial with white pruinosity. Parafacial with thin pale pruinosity.

Thorax. (Figs. 22, 23) Postpronotal lobe with 2 basal setae. Supralar setae 1 + 1. Postalar setae 1 or 2. Scutellum 1 one basal, 1 discal (weak or absent), 1 subapical and 1 apical (usually decussate) pairs of setae. Anepisternum with 5–6 strong setae and with 2 upward setulae on anterodorsal corner. Katepisternum 2 (posterior and anterior).

Wing. R4+5 setulose dorsally from Rs node until half of distance to r-m crossvein, and R1 setulose dorsally until distal ⅔ (rarily beyond). Rs node with 3–4 setae ventrally.
Legs. (Fig. 23) Fore femur with row of PD and PV setae, fore tibia with 2 PD setae at apical third and 1 PD on median third, and 1 D and 1 PV preupal setae. Mid leg very elongate twice longer than other legs, 18.8 mm in average (14.9–20.5 mm; n = 30); mid femur with 4 AD setae supramedian and 1 PV seta preupal, mid tibia with 2 supramedian AD setae and preapicals 1 D, 1 V and 1 P. Hind femur with a row of AV and AD setae, 1 submedian D seta, and 1 preapical P seta; tibia with 1 supramedian AD seta, 1 median AD seta, 1 median AV seta, 1 submedian D seta and 1 DV preapical seta. 

Abdomen. (Figs. 22, 23) Syntergite I+II with 2 pairs of lateral marginal setae. Syntergite III (rarely) with 1 pair of lateral marginal seta. Tergites IV and V with 2 pairs of lateral marginal setae and 1 pair of median marginal setae. Male terminalia. (Figs. 26–29) Cerci tapered at apex, touching each other or not, in posterior view (Fig. 29), with a subsequent narrowing and internally curved in profile (Fig. 28). Surstylus with a subsequent narrowing near the apex in posterior view (Fig. 29), and somewhat curved posteriorly in profile (Fig. 28). Base of pregonite sub-triangular, postgonite rod-shaped with strong setae, beginning at base of basiphallicus (Fig. 27). Ejaculatory apodeme wide at apex, and conspicuously supersized, about 1.6× length of cerci (Fig. 26).

Female (Figs. 30–33) Body length: 8 mm in average (8–8.1 mm; n = 2); wing length: 6.6 mm in average (6.5–6.8 mm; n = 2).

Differs from male by the following: (Figs. 32, 33) Fronto-orbital plate with reclinate orbital setae 2, and proclinate orbital setae 1. Ocellar setae not developed and straight, inner vertical setae well developed and reclinate; outer vertical setae developed about ½ length of inner vertical seta. (Figs. 30, 31) Prescutum with thin white pruinosity, denser on posterior half. Mid leg dark brown and not elongate as in males, 9.2 mm (n = 1). Pulvillus not elongated. Abdomen oval, not transluscent; yellow but abdominal tertigine III (with 1 developed marginal median seta) only posterior half black, tergites IV and V entirely black, the latter with conspicuous pointed tip. 

Female terminalia. (Fig. 34) Tergite 6 dorsally with 2 pairs of spiracles, 6th spiracle on membrane ventrally and 7th spiracle near ventral end of tergite, with several setae. Tergite 7, with a few setae dorsally and laterally. Tergite 8 as narrow strip, with one pair of setae laterally. Sternite 5 subrectangular with some scarce setae. Sternite 6 well developed as a complete ventral shield, with several small setae. Sternite 7 with setae on posterior margin and without small setae. Sternite 8 with one long and one small seta on posterior margin. Sternite 10 without lingualae, but with lateral projections dorsally and several scarce setae. Cerci well developed, sub-circular, with several setae apically. Syntergite 9+10 absent.

First instar larva (Fig. 35) Body length: 1.029 mm in average (1.008–1.062 mm). [70–80 larvae were measured from two ♀].

Colourless except for the pigmented cephaloskeleton and ventral cuticular spines on each segment posterior margin (without cuticular scales). Along all the segments, complete bands of minute spines (encircle all the segment). Antenna not visible. Posterior spiracle as a simple round opening in the 11th segment, with short internal tubule visible through the cuticle. The 12th segment is prolonged into a conical tail. Cephaloskeleton (Fig. 36) with fine mouth hook, slightly ventrally curved and sharply pointed, with well developed accessory sclerite. Long intermediate region, with salivary gland thin and long (almost as long as intermediate region), with posterior portion enlarged. Dorsal cornu larger and somewhat longer than ventral cornu, and both less pigmented than anterior parts of skeleton.


Distribution. United States of America (Arkansas, Arizona, California, Connecticut, Florida, Gainesville, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Maryland, Missouri, New Jersey, New York, Ohio, Pennsylvania, Texas, Virginia, Washington, West Virginia and Wisconsin), Mexico (Vera Cruz), Guatemala, Guyana, Venezuela, Colombia (Florenia), Peru, Brazil (Pará, Mato Grosso, Goiás, Mato Grosso do Sul, Minas Gerais, Rio de Janeiro, São Paulo, Santa Catarina), (Fig. 1) Remarks. This species presents the widest geographical distribution, ranging from northern USA (Wisconsin) to southern Brazil (Santa Catarina) (Fig. 1), and has the most extensive list of host records.

M. longipes Fabricius is synonym of C. inaequipes Bigot. Wulp (1891: 247), commented: “(…) it is possible that [C. inaequipes] is M. longipes Fabr. (…)”. Brauer (1897: 365) stated the possible synonymy between both species, and Aldrich (1929: 13) formally proposed such synonymy: “(…) inaequipes Bigot, new, is equals M. longipes Fabricius preoccupied.” Townsend (1931: 93) also agreed with this synonymy: “Musca longipes Fab. preoc. (…) is Cholomyia inaequipes Big. (…)”, and reproduced this in his Manual of Mythology (Townsend, 1939). However, some other authors placed C. longipes as synonym of C. acromion (e.g., Parker, 1953; Guimarães, 1971). Aldrich (1929) and Townsend (1931) examined and compared the types, while Parker (1953) and Guimarães (1971) did not mention about types examination.
C. zumbadoi *sp. nov.*

(Figs. 37–44) Diagnosis. *C. zumbadoi* differs from *C. acromion* and *C. filipes*, and it resembles more with *C. inaequipes*, by having the mid leg approximately twice the length of the other legs, two katepisternal setae, postpronotum with two basal setae and abdominal synstergite I + II entirely yellow. Moreover, *C. zumbadoi* differs from *C. inaequipes* by having the anepisternum with 4–5 upward setae on anterodorsal corner, surstylus without concavity and curved externally in profile view, ejaculatory apodeme narrow at base and very wide at apex (about twice the basal width), about 1.3 × longer than cerci and pregonites with basal portion narrowed.

**Description**

**Male** (Figs. 37–40) Body length: 8.3 mm in average (8.0–8.8 mm; *n* = 4). Wing length: 8.4 mm in average (8.0–8.5 mm; *n* = 4).

**Colouration.** Genal groove dark yellow. Antenna yellow. Proboscis and palpus pale yellow. Prescutum usually with yellow pruinosity. Thorax dark brown. Fore leg with yellow femur, mid and hind femur yellow (except for blackish posterior margin about distal ¼), and all legs with tibia and tarsus black. Abdomen yellow, but light brown thin band on posterior margins on tergite III (about ¼) and tergite IV with black posterior margin, about distal ⅔ of width.

**Head.** (Figs. 39, 40) Frontal vitta narrow. Gena, when seen in profile, about 0.4–0.5 times as height as eye. Gena and parafacial with thin pale pruinosity.

**Thorax.** (Figs. 37, 38) Postpronotal lobe with 2 basal setae. Supralar setae 1 + 2. Postalar setae 1 to 2. Scutellum with one basal, one discal (weak or absent), one subapical and one apical (generally decussate) pairs of setae. Aneisternum setae with 5–6 of strong setae and with 4–5 developed upward setae on anterodorsal corner. Katepisternal setae 2 (anterior and posterior).

**Wing.** *R*₄₅ setulose dorsally from Rs node until half of distance to r-m crossovein and R₁ fully setulose dorsally (scarce in the median region). Rs node with 5 setulae ventrally.

**Legs.** (Fig. 38) Fore femur with row of PD and PV setae, fore tibia with 2 PD and 1 PV setae on median third, and 1 D and 1 PV preapical setae. Med leg very elongate, twice longer than other legs, 20.5 mm in average (20.3–20.8 mm; *n* = 4), mid femur with 4 suprmedian AD setae, 1 preapical PV seta; mid tibia with 2 suprmedian AD setae, and 1 D, 1 V and 1 P preapical setae. Hind femur with a row of AV (usually) and AD setae, 1 submedian D seta, and 1 preapical P seta; hind tibia with 1 suprmedian AD seta, 1 median AD seta, 1 median AV seta, 1 submedian D seta and 1 PV preapical seta.

**Abdomen.** (Figs. 37, 38) Syntergite I + II with 2 pairs of lateral marginal setae. Tergite III (rarely) with 1 lateral marginal pair of seta. Tergites IV and V with 2 pairs of lateral marginal setae and 1 pair of median marginal setae.

**Male terminalia.** (Figs. 41–44) Cerci tapered at apex, touching each other or not, in posterior view (Fig. 44), narrowed tip without curvature in profile (Fig. 43). Surstylus without narrowing near the apex, in posterior view (Fig. 44), slightly curved posteriorly, with absence of concavity, in profile (Fig. 43). Base of pregonite subtriangular with basal portion narrowed, postgonite rod-shaped with strong setae, beginning at the base of distiphallus (Fig. 42). Ejaculatory apodeme very wide at apex, with conspicuously super-sized, about 1.3 × length of cerci (Fig. 41).

**Female.** Unknown.


**Type locality.** Costa Rica, Alajuela, P.N. Volcán Tenorio.

**Distribution.** Costa Rica (Alajuela) (Fig. 1)

**Etymology.** This species is named in honour of Dr. Manuel A. Zumbado, curator of Diptera at the Instituto Nacional de Biodiversidad (INBio).
Host–parasite records

1) *C. acromion* (Wiedemann):
   - Curculionidae: Molytinae.
   - Peru: Iquitos.
   - *Conotrachelus curvostatus* Marshall, 1929 – (Guimarães, 1977; Parker et al., 1953)
   - Brazil: São Paulo.
   - Curculionidae: Curculioninae
   - *Curculio (Balaninus)* sp. (Curculionidae: Curculioninae) – (Emden, 1950).

2) *C. filipes* (Walker):
   - No records.

3) *C. inaequipes* Bigot:
   - Curculionidae: Molytinae
   - *Conotrachelus affinis* Boheman, 1837 – (Quaintance and Jenne, 1912: 150; Brooks, 1922: 13; Mutchler and Weiss, 1925: 10; Arnaud, 1978: 611)
   - USA: West Virginia.
   - *Conotrachelus aratus* (Germar, 1824) – (Brooks, 1922: 16; Mutchler and Weiss, 1925: 13; Arnaud, 1978: 611)
   - USA: West Virginia.
   - *Conotrachelus crataegi* Walsh – (Maier, 1980: 61)
   - USA: Connecticut.
   - *Conotrachelus elegans* (Say, 1831) – (Pierce, 1908: 381; Pierce et al., 1912: 78; Quaintance and Jenne, 1912: 150; Arnaud, 1978: 611)
   - USA: Texas.
   - *Conotrachelus juglandis* Leconte, 1876 – (Quaintance and Jenne, 1912: 150; Brooks, 1922: 7; Arnaud, 1978: 611)
   - USA: Louisiana, Missouri and West Virginia.
   - *Conotrachelus naso* Leconte, 1876 – (Gibson, 1964: 525; Arnaud, 1978: 611)
   - USA: Alabama, Georgia and Ohio.
   - *C. nenuphar* (Herbst, 1797) – (Pierce et al., 1912: 78; Snapp, 1930: 77, 79; Fattig, 1949: 12; Armstrong, 1958: 17; Arnaud, 1978: 611; Maier, 1980: 61; Jenkins et al., 2006: 438)
   - USA: Arkansas, Connecticut, Georgia, Maryland, Pennsylvania and Virginia.
   - *Conotrachelus posticatus* Boheman, 1837 – (Gibson, 1964: 525; Arnaud, 1978: 612)
   - USA: Alabama, Georgia and Ohio.
   - *Conotrachelus reticulus* Say, 1831 – (Brooks, 1922: 11)
   - USA: Pennsylvania.

4) *C. zumbadoi*:
   - No records.

On the systematic placement of Cholomyia

In a detailed comparative study of the male terminalia of Tachinidae, Tschorsnig (1985: 99) characterized the terminalia of members of the tribe Myiophasiini, where he pointed out: (1) a large epandrium (in Tschorsnig, 1985: Fig. 46 can be noticed that the apical region is short and not tapered in lateral view); (2) cerci separated at apex (by his Fig. 46, the proximal region is not fully fused); (3) the surstylus is narrow and curved internally; (4) progonite with a plate-like form with setae and in front of basiphallus (Tschorsnig, 1985: Fig. 133); and (5) the ejaculatory apodeme is large and fan-shaped. Tschorsnig’s observations were based on two species of Angiorychina, which is currently a junior synonym of Gnadochaeta (sensu O’Hara and Wood, 1998).

The male terminalia of Cholomyia species mostly agree with the tribal characterization provided by Tschorsnig (1985): (1) the epandrium is large with its elongated apical region and tapered in posterior view; (2) cerci are separated at the apex but with fully fused proximal region; (3) the surstylus is narrow, but slightly curved internally (although in *C. zumbadoi sp. nov.*, it is rectilinear); (4) the progonite has a sub-triangular form, and is in front of basiphallus, but it lacks setae, and is expanded on the distal region; and finally, (5) the ejaculatory apodeme is large and also has a fan shape. Therefore, based on your detailed analysis of Cholomyia species, including male terminalia, the systematic placement of Cholomyia, transferred from the Urodexini (sensu Guimarães, 1971) to the Myiophasiini (sensu O’Hara and Wood, 2004) is supported and confirmed herein.

Besides the external morphology and male terminalia, characters from immature stage also support the placement of Cholomyia into the Myiophasiini. By comparing the 1st instar larva and cephaloskeleton of *C. inaequipes* with those of *Gnadochaeta globosa* (Townsend, 1892), illustrated and described by Townsend (1942) and Bissel (1945), we could observe some resembling features shared by both species. The 1st instar larva of *G. globosa* has the ventral cuticular spines on each segment of the posterior margin, the posterior spiracles located at the 11th segment, lacks a spine-like microtrichia in all segments, and the last segment is prolonged into a conical tail, exactly as *C. inaequipes* (Fig. 35). The cephaloskeleton of *G. globosa* has a down-curved and sharply pointed mouth hook, also present in *C. inaequipes* (Fig. 36) and in *C. acromion* (Parker, 1953: Fig. 60). The well-developed accessory sclerite and the salivary gland with the same posterior enlargement strongly resemble those observed in *C. inaequipes* (Fig. 36).

In the first cladistic analysis of the family performed by Cerretti et al. (2014), the tribe Myiophasiini was only represented by some species of *Gnadochaeta Macquart* (*G. puncticeps* Zetterstedt, 1859 and some spp.), and was recovered as sister group of three genera of Palpostomatini, forming a monophyletic group, “clade B” (*Gnadochaeta + Palpostomatini*) of Cerretti et al. (2014). The only synapomorphy that supports this group is the presence of a membranous medial surface of male progonite (105:1). Despite regarding the presence of this membrane as doubtful (we believe this could be a weaker sclerotization), we considered this character state as present in Cholomyia. Although the taxonomic sampling was extremely biased by Palearctic taxa and the Myiophasiini was underrepresented by a single genus in Cerretti et al. (2014), the genus Cholomyia seems to be placed in the clade B. However, not conclusively in Myiophasiini because the autapomorphy of *Gnadochaeta*, the presence of a postero medial connection between pregonites (108:1), that could be a synapomorphy of this tribe, is not present in Cholomyia (even though the two homoplasies for the Palpostomatini are not present in the genus Cholomyia).

Conflicts of interest

The authors declare no conflicts of interest.

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Pierce, W.D., 1908. A list of parasites known to attack American Rhynchoptera. J. Econ. Entomol. 1, 380–396.


