

REVISION OF THE *ERISTALIS* FLOWER FLIES (DIPTERA: SYRPHIDAE) OF  
THE AMERICAS SOUTH OF THE UNITED STATES

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*Abstract.*—Three new species are described (*Eristalis alleni*, *E. gatesi*, and *Palpada eristaloides*); lectotypes are designated for *bogotensis* Macquart, *circe* Williston, *latifrons* Loew, *rufoscutata* Bigot, *stipator* Osten Sacken; new synonyms noted (*Eristalis tenuifrons* Curran 1930 = *Palpada semicircula* Walker 1852; *Eristalis aztecus* Hull 1935 = *circe* Williston 1891; *Eristalis colombica* Macquart 1855 = *tenax* Linnaeus 1758); and all species redescribed (*Eristalis bellardi* Jaennicke and *persa* Williston).

*Key Words:* key, neotropical

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The Biodiversity Crisis is now the rage (NBS 1989; Wilson 1985a, 1988, 1992). Much has been written in both the scientific and popular literature. The world biota is disappearing at an alarming rate never before equaled in the history of this universe. That is not disputed. What we do not really know is what is being lost as our knowledge of our biota is abysmal. The big creatures, such as birds and mammals, as well as flowering plants, are known, named and classified, but the little ones, from the small, such as flies, worms and fungi, to the microscopic, such as protozoans, bacteria and viruses, are not well known, mostly unnamed and poorly classified (Erwin 1992; May 1990, 1992; Wilson 1987). To make them known will require the collaborative effort of many people, from collectors and taxonomists to computer scientists, statesmen and philanthropists (Raven and Wilson 1992; Roberts 1988; Yoon 1993). Costa Rica has started to build this collaboration. Their view of conservation is that biodiversity can only be conserved if people deem biodiversity to be of value. So, con-

servation is a process of saving it, then knowing it, so that it can be used sustainably (Janzen 1991). Costa Ricans have set aside a significant portion of their land to conserve wild biodiversity. They have established a national institute for biodiversity (INBio) to develop a cadre of professionals to inventory Costa Rican biodiversity and then to help others to find sustainable and profitable uses of this biotic wealth (Tangle 1990, Hovore 1991, Gamez and Gauld 1993). This inventory requires a universal naming system, which is provided by taxonomy (Thompson 1996). Taxonomy is global science, as many organisms are wide ranging and the groups that they are placed in are not necessarily defined by geography. Taxonomists, who tend to be clustered in the developed North (Gaston and May 1992), are themselves a dying breed (Wilson 1985b, Holden 1989, Culotta 1992, Novacek 1992). So, for taxonomists, the challenge is not only to name and classify our unknown biota before it is lost, but also to do it before they themselves are extinct! Or the alternative is to demonstrate more clear-

ly their value. So, together some taxonomists have begun to work with Costa Ricans to inventory their biodiversity. This paper, which describes two new and spectacular flies known only from Costa Rica, is one result of this unique collaboration.

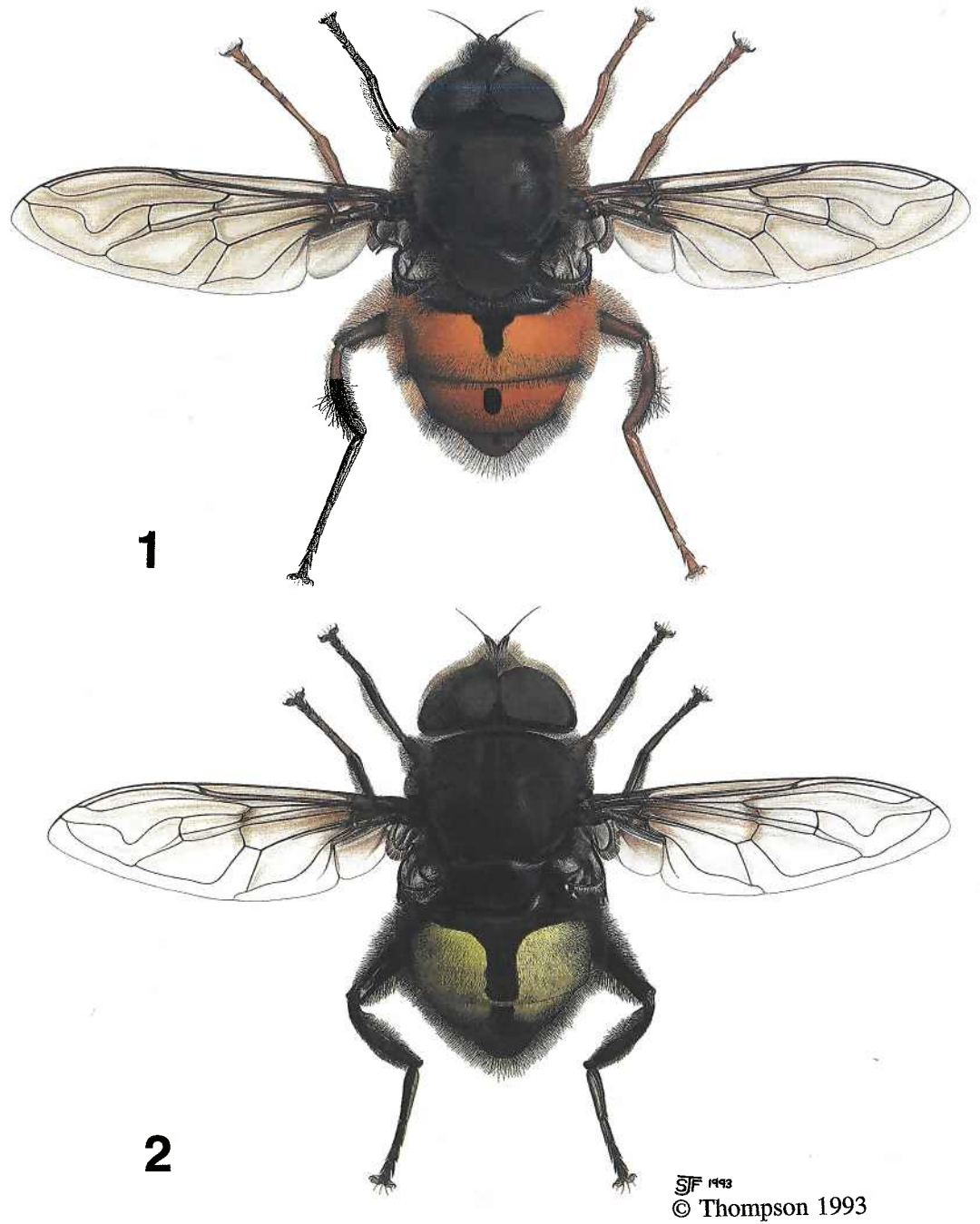
The pair of new species herewith described are most striking and beautiful species of *Eristalis* (Figs. 1, 2) that I know. Hence, I have named them after the brilliant pair of Paul Allen and Bill Gates, who have done more to bring power to the people through computer software. That in turn has allowed for the blossoming of all of our talents, not the least the ability of systematists to more effectively and efficiently describe our disappearing biota.

*Eristalis* flower flies are common, sometimes abundant, in northern and montane temperate habitats. The adults are pollinators and the larvae, called rat-tailed maggots, are filter-feeders in organically rich waters, such as ponds, pools and ditches, aiding in nutrient recycling. Because of their diverse life-cycle, the species are good indicators of the health of their environments.

*Eristalis* was a broadly defined group when first established by Latreille (1804) and that definition was further enlarged by Fabricius (1805), whose interpretation was characterized as "ein mischmasch" by Meigen (1822: 382). Meigen restricted the name to those species with sinuate vein R4+5 and a petiolate cell R1 (although he didn't use these characters). Except for Zetterstedt (1837, 1838, 1842-60), who incorrectly used the name for *Cheilosia* of authors, all subsequent workers have followed Meigen's definition of *Eristalis*. Later, some authors, such as Rondani (1845, 1857) and Mik (1897), did subdivide *Eristalis* into smaller components, but most authors continued to use the name in the broad sense. The first and only modern attempt at subdivision of *Eristalis* was by Kanervo (1938), but his work was ignored. Vockeroth (in litt.) and Thompson (1972) re-examined Kanervo's work, and divided *Eris-*

*talis* into a few monophyletic groups. Most of the Neotropical species previously placed in *Eristalis* belong to *Palpada*; only a few belong to *Eristalis*, *sensu stricto*. A key to separate the Neotropical components of *Eristalis* of prior authors is appended. There has never been a revision of the Neotropical species of *Eristalis* (*sensu lato*). However, Curran (1930, 1934) did publish keys, which covered most of the species.

The *Eristalis* flower flies of Latin America present an interesting zoogeographic problem. Unfortunately, a character analysis of the genus *Eristalis* as whole has not been done, so a zoogeographic analysis of the Latin American species is speculative. What prior authors called *E. bogotensis* is a superspecies, consisting of *E. bellardii* in Mexico, *E. bogotensis* in northern and central South America and *E. croceimaculata* in southern South America. The *E. bogotensis* superspecies is characterized by a monomorphic abdominal pattern which consists of large reddish to orange lateral maculae, the extent of which varies clinally: *Eristalis bellardii* has the most extensive pale maculae, whereas *E. croceimaculata* has the least extensive pale maculae, and *E. bogotensis* is intermediate. This clinal variation in color has been noted in other flies and insects (see Zuska and Berg 1974) and is related to temperature. There is no component of the *E. bogotensis* superspecies in Central America. In Middle America, there are 4 species. In northern areas (Mexico (Chiapas) and El Salvador), there is a pair of sympatric sexually dimorphic species, *E. circe* and *E. persa*, in which the male has an orange abdomen and the female has a black abdomen. In the south (Costa Rica), there are two sympatric monomorphic species, one with an orange abdomen and the other with a black and yellow abdomen. The scenario these distributions and characters suggest is that there was a widespread ancestral species, which vicariated into 4 allopatric components, with the Middle American component undergoing further vicariance [Ancestral species = *E. bel-*



Figs. 1–2. Adult, dorsal view. 1, *Eristalis alleni*. 2, *E. gatesi*. ©Thompson 1993.

*lardii* + ((*E. circe* + *E. persa*) + (*E. gatesi* + *E. alleni*)) + *E. bogotensis* + *E. croceimaculata*]. The significance of such a scenario is that the higher elevations of Middle

America have richer and more diverse faunas that those to the north or south, which is not unusual given the isolated nature of these areas (Fig. 3). Unfortunately, these ar-



Fig. 3. Middle America showing in black the areas of 2,000 meters or higher.

eas are limited in size and threatened by development.

KEY TO GENERA OF *ERISTALIS*-LIKE FLOWER FLIES FOUND IN THE NEW WORLD

- 1. Postalar pile tuft present; eye maculate; anepimeron with dorsomedial and posterior portions pilose; katepimeron bare; arista bare . . . . . *Eristalinus*
- Postalar pile tuft absent; eye plain, without dark maculae; anepimeron with dorsomedial and posterior portions bare . . . . . 2
- 2. Meron with pile anterior to and/or ventral of posterior spiracle; katepimeron pilose. Eye with uniform pile; wing microtrichose or bare . . . . . *Palpada*
- Meron without pile near posterior spiracle; wing bare . . . . . *Eristalis* . . . . . 3
- 3. Katepimeron pilose; eye pilose, with 2 vertical

- vittae of darker, contrasting pile; arista pilose basally . . . . . *Eristalis* (*s.s.*)
- Katepimeron bare; eye uniformly pilose, without darker vittae; arista bare or pilose . . . . . *E. (Eoseristalis)*

KEY TO *ERISTALIS*-LIKE FLOWER FLIES OF AMERICAS SOUTH OF THE UNITED STATES

- 1. Katepimeron pilose . . . . . 3
- Katepimeron bare . . . . . 2
- 2. Meron without pile anterior to or ventrad of spiracle; arista with short but distinct pile on basal 1/2; eye densely pilose, with 2 vertical vittae of darker pile; wing bare . . . . . *Eristalis tenax*
- Meron with pile anterior to and/or ventrad of spiracle; arista bare; eye pilose dorsally, without contrasting fascia of pile; wing microtrichose or bare . . . . . *Palpada* species

- 3. Arista bare . . . . . 7
- Arista pilose at least on basal half . . . . . 4
- 4. Legs entirely black; pleura and femora black pilose; frons extensively yellowish-white pilose (Costa Rica) . . . . . *Eristalis gatesi*
- Legs partially orange, at least on basal 1/3 of tibiae; pleura orange to yellowish pilose; femoral and frontal pile variable, usually femora partially yellow pilose and frons with at least some black pile . . . . . 5
- 5. Hind tarsus black; fore and mid tibiae with apical 1/4 or more black; fore and mid tarsi brownish black apically; mesonotum including postalar callus and scutellum entirely orange to fulvous pilose; male abdomen orange with medial black maculae; female abdomen black (Mexico) . . . . . *Eristalis circe*
- Hind tarsus, fore and mid tibiae, and tarsi orange; postalar callus at least partially black pilose; mesonotum and scutellum frequently partially black pilose . . . . . 6
- 6. Hind tibia almost entirely black, only with base and apex narrowly orange; face black; female abdomen entirely black; male abdomen orange to fulvous pilose; male fore femur with basoposterior tuft of long dense black pile (Mexico to El Salvador) . . . . . *Eristalis persa*
- Hind tibia extensively orange, rarely with indistinct medial brownish annulus; face extensively tawny to orange in ground color; female abdomen reddish orange with medial black maculae; abdomen extensively black pilose; male fore femur without such a tuft of long pile (Costa Rica) . . . . . *Eristalis alleni*
- 7. Mesonotum with 3 transverse gray pollinose fasciae (Costa Rica, Panama) . . . . . *Palpada semicircula*
- Mesonotum without pollinose fasciae . . . . . 8
- 8. Second tergum with a complete posterior black fascia (northern Mexico) . . . . . *Eristalis stipator*
- Second tergum entirely reddish laterally, without a complete posterior black fascia, with black color restricted to medial area . . . . . 9
- 9. Antenna orange; hind tibia entirely orange; face orange (Ecuador) . . . . *Palpada eristaloides*
- Antenna dark, brown to black; hind tibia black on apical 1/2 or more; face black medially . . . . . 10
- 10. Coxae, katapisternum and metasternum yellow pilose; male with orange abdominal color extending laterally to apex of 4th tergum; front of female usually entirely pale pilose on ventral 2/3; male eye contiguity much longer than vertical triangle (2.5 to 1.5 times) (Mexico) . . . . . *Eristalis bellardii*
- Coxae, metasternum and katapisternum ventrally partially to entirely black pilose; male with orange abdominal color extending only to base of 4th tergum; front of female partially black pilose on ventral 2/3; male eye contiguity shorter than vertical triangle (0.9 times) (South America) . . . . . 11
- 11. Female: 3rd tergum completely black; 2nd tergum with sides narrowly dark and posterior margin black on medial 2/3 or more. Male: 2nd tergum black on posteromedial 1/2 or more; 4th tergum completely black; male genitalia usually black pilose; aedeagus with ventral curved prongs narrow; superior lobe with only a short lateral carina (Chile, southern Argentina) . . . . . *Eristalis croceimaculata*
- Female: 3rd tergum orange basolaterally; 2nd tergum with sides entirely orange, with posterior margin black only on medial 1/2 or less. Male: 2nd tergum with posterior margin black on medial 1/3 or less; 4th tergum frequently narrowly orange basolaterally; male genitalia yellow pilose; aedeagus with ventral prongs broad, flared; superior lobe with long carina extending from base to apex (Columbia, s. to Peru, Bolivia, & northern Argentina) . . . . . *Eristalis bogotensis*

Genus *Eristalis* Latreille

*Tubifera* Meigen 1800: 34. Type species, *Musca tenax* Linnaeus (subsequent designation by Coquillett 1910: 618). Suppressed by ICZN 1963: 339.

*Elophilus* Meigen 1803: 274. Type species, *Musca tenax* Linnaeus (subsequent designation by Latreille 1810: 443). Suppressed by ICZN 1993: 256.

*Eristalis* Latreille 1804: 194. Type species, *Musca tenax* Linnaeus (subsequent designation by Curtis 1832: pl. 432).

*Eristaloides* Rondani 1845: 453. Type species, *Musca tenax* Linnaeus (subsequent designation of Coquillett 1910: 540).

*Eristalomya* Rondani 1857: 38. Type species, *Musca tenax* Linnaeus (original designation).

*Eriops* Lioy 1864: 743 (preocc. Klug 1808). Type species, *Musca tenax* Linnaeus (subsequent designation by Goffe 1946: 29).

Head: Face broadly pilose and pollinose laterally, usually shiny and bare medially, rarely entirely pollinose, straight except for medial tubercle and slight anterior produc-

tion at antennal pits; tentorial pit short, extending along ventral third of eye; facial stripes indistinct; frontal prominence low, on dorsal third of head; eye pilose, holoptic in males; antenna short, about  $\frac{1}{4}$  as long as face; basoflagellomere quadrate, slightly longer than broad.

Thorax: Slightly longer than broad, with long pile; anterior anepisternum bare; katepisternum continuously pilose from ventral to dorsal margin; anepimeron with dorsomedial and posterior portions bare; metathoracic pleuron bare; metathoracic spiracle, large, larger than basoflagellomere; plumula long and multibranching.

Legs: Simple, hind femur not swollen, hind tibia without basal nor apical carina nor apical dens. Wing: Bare; cell R1 closed and petiolate; cell R4+5 petiolate, with petiole as long as stigmatic crossvein; stigmatic crossvein present.

Abdomen: Oval to suboval.

#### Subgenus *Eristalis*

Eye with two denser vertical vittae of pile; arista bare; katepimeron pilose.

The subgenus *Eristalis* contains only 2 species, *E. proserpina* Wiedemann from China, and *E. tenax* Linnaeus, an Old World synanthropic species which is now cosmopolitan.

#### *Eristalis (Eristalis) tenax* (Linnaeus) (Figs. 4, adult; 5, larva)

*Musca tenax* Linnaeus 1758: 591 Sweden (restricted Thompson et al. 1982: 160). LT ♂ LSL (designated Thompson et al. 1982: 160).

*Eristalis tenax*: Brèthes 1907: 293 (Argentina, catalog citation); Kertész 1910: 238 (catalog citation); Porter 1921: 447, 1924a: 82, 1924b: 98, 1927: 122, 1928: 224, 1932: 190, 1934: 170, 1938: 155 (Chile); Hull 1925: 305 (description); Curran 1930: 6, 1934: 410 (key references); Shannon & Aubertin 1933: 163 (Chile); Ruiz & Stuardo 1935: 318 (Chile); Gutierrez 1939: 35 (Chile); Enderlein 1940: 662 (Juan Fernandez Is.);

Stuardo 1946: 128 (catalog citation, Chile); Fluke 1957: 144 (catalog citation, Chile, Argentina); Etcheverry & Shenefelt 1962: 208 (Male genitalia figured); Etcheverry 1963: 44 (synonymy, Chile); Thompson et al. 1976: 101 (catalog citation); Thompson 1972: 140 (Male genitalia figured), 1981: 146 (West Indies, status).

*Eristalomyia tenax*: Enderlein 1940: 662 (Juan Fernandez Islands).

*Tubifera tenax*: James 1947: 151 (habitus illustrated, description, myiasis, distr.).

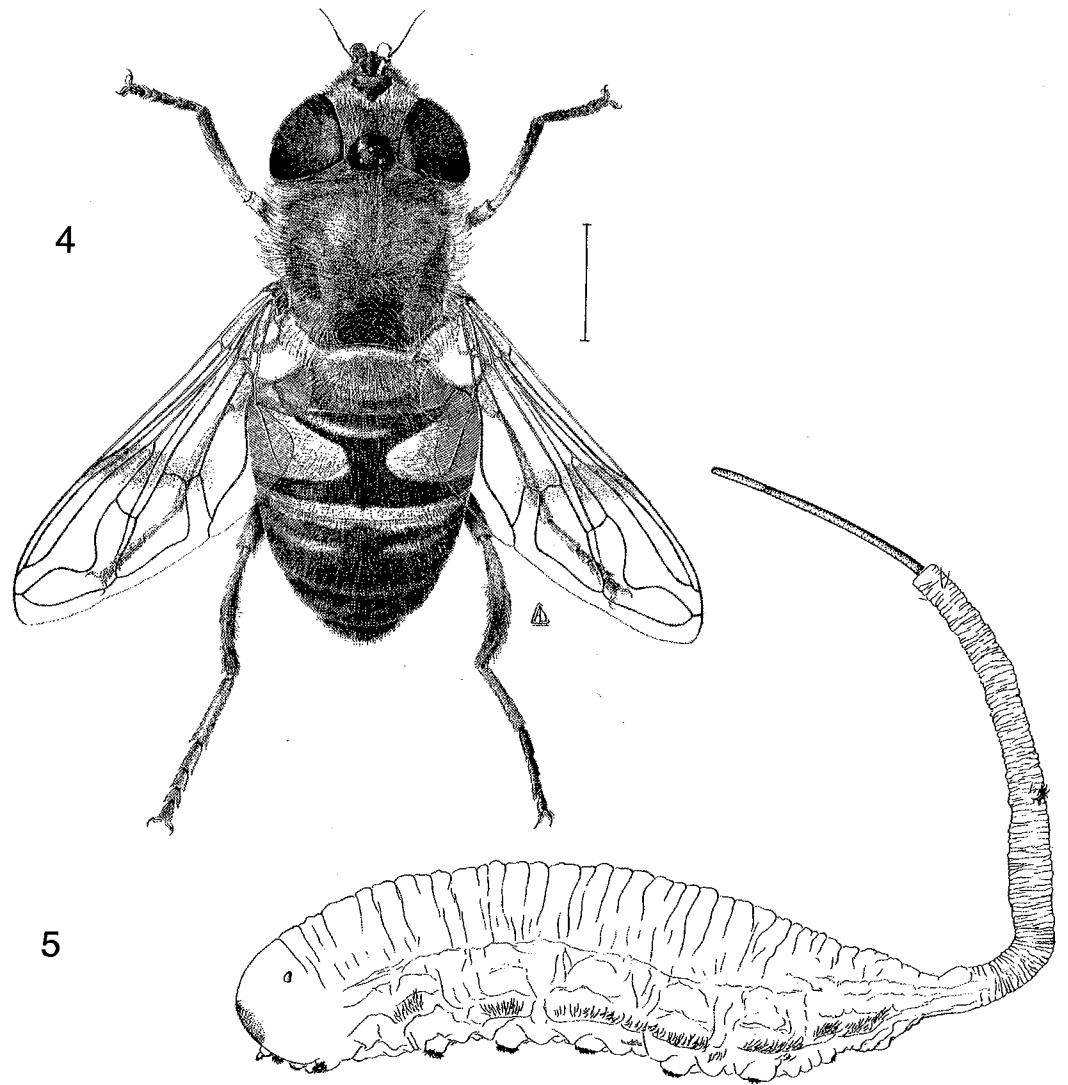
*Eristalis columbica* Macquart 1855: 108 ♀ Columbia. LT ♀ BMNH here designated. Williston 1886: 319 (catalog citation); Kertész 1910: 215 (catalog citation); Fluke 1957: 154 (catalog citation, sp. incerta sedis). **New synonym.**

*Palpada columbica*: Thompson et al. 1976: 104 (catalog citation)

Male.—Head: Black; face yellowish-gray pollinose except broad shiny medial vitta, yellow pilose; gena shiny, yellow pilose; frontal lunule brownish orange except black medially; frontal triangle shiny and black pilose apicomediaally, yellowish-gray pollinose and yellow pilose laterally; vertical triangle dull black pollinose, black pilose; eyes holoptic, with eye contiguity short, about as long as ocellar triangle; occiput yellowish-gray pollinose, yellow pilose; antenna brownish black; arista bare, brown.

Thorax: Black, yellowish gray pollinose, yellow pilose, postalar callus yellow pilose; scutellum yellow, shiny, yellow pilose; squama and plumula orange yellow; spiracular fringes light brownish yellow; halter yellow, with brown head; wing hyaline, bare; epaulet yellow pilose; basicosta black and yellow pilose. Legs: Brownish black except orange femoral-tibial joints and mid basotarsomere on basal  $\frac{3}{4}$ , yellow pilose except hind femur black pilose apicoventrally on posterior edge, hind tibia black pilose posteriorly and hind tarsus black pilose.

Abdomen: Brownish yellow pilose; 1st



Figs. 4-5. *Eristalis tenax*. 4, Adult, dorsal view. 5, Larva, lateral view.

sternum gray pollinose, brownish black except paler laterally; 2nd sternum shiny, yellow except medial  $\frac{1}{3}$  brownish black; 3rd sternum shiny, black except paler basolaterally; 4th sternum shiny, black; 1st tergum gray pollinose, black; 2nd tergum black except orange apical margin and large mediolateral ovoid orange macula, with macula occupying full lateral width and extending to medial  $\frac{1}{4}$ ; 3rd tergum shiny, black except narrow orange apical, broader orange anterior margin except medial  $\frac{1}{4}$ , and broad

orange mediolateral fascia, with fascia connected basolaterally to pale anterior margin, with fascia from  $\frac{1}{6}$  to  $\frac{1}{4}$  tergal length; 4th tergum shiny, black, rarely narrowly orange basolaterally; genitalia shiny, black.

Female.—Similar; front shiny dorsad lunule and anterior to ocellar triangle, elsewhere yellowish gray pollinose, which is lighter ventrolaterally and darker dorsomedially, extensively black pilose, with yellow pile intermixed medially and ventrolaterally, about .4 times as wide as head at anten-

na, tapering to about .35 times as wide dorsally; frequently with abdominal orange maculae reduced, sometimes greatly so, in such specimens no pale macula on 3rd tergum and macula on 2nd tergum reduced so as to be broadly isolated from apical margin; 5th sternum gray pollinose, black; 5th tergum shiny, black.

Type data.—*Musca tenax* Linnaeus, lectotype ♀ Linnaean Collection, London, labelled "tenax 41" and "Lectotype, *Musca tenax* Linnaeus, Thompson et alia 1981."

*Eristalis columbica* Macquart, lectotype ♀ British Museum (Natural History), London, labelled "Holotype" [red circular type label], "ex. coll. Bigot, Pres. by, G. H. Verrall, B. M. 1894—234;" "Eristalis, columbicus, ♀ Macq." [in Macquart's hand] and "E. columbicus ♀, Columbia Macq." [Bigot determination label].

Neotropical material examined.—MEXICO. *Aguascalientes*: 1 Dec 1909, F. C. Bishopp (1 ♂ 1 ♀ USNM). *Baja California Norte*: Ensenada, 6 Sep 1958, P. H. Arnaud, jr. (1 ♀ USNM); Estero Beach, 9 km south of Ensenada, sea level, 5 Jul 1973, P. H. Arnaud, Jr., 5 Jul 1973 (1 ♂ USNM). *Chiapas*: San Cristobal las Casas, 7100 ft., 1–5 Aug 1966, D. E. Breedlove (1 ♂ USNM); "Las Casas," 27 Apr 1945, A. J. Sharp (1 ♀ USNM). *Federal District*: 7/8/10, F. C. Bishopp; Federal district: "7+8 10" (1 ♀ USNM); Coapa, 25 Aug 1970, E. G. Smyth (1 ♀ USNM); Mexico City, 17 Sep (1 ♀ USNM); same data, but Crawford (1 ♀ USNM). *México*: 20 May 1922, E. G. Smyth (1 ♂ 1 ♀ USNM); Atzcaap'co, 31 Aug 1922, E. G. Smyth (3 ♀ USNM); Teotihuacann, Pyramid to the sun, 27 Dec 1970, P. H. Arnaud (1 ♂ USNM). *Michoacán*: Morelia, Jun 1965, N. L. H. Krauss (1 ♀ USNM); Velez Sarssfield, 9 Sep 1926, M. R. Riesel (1 ♀ USNM). *Nuevo León*: Villa de Garcia, 25 May 1975, J. Abercrombie (1 ♀ USNM). *Veracruz*: 5 miles southwest of Perote, 29 Feb 1972, F. Parker & D. Miller (1 ♂ 1 ♀ USNM); 9 miles southwest of Toluca, 27 Nov 1965, M. W. McFadden (5 ♂ 3 ♀ USNM). GUATE-

MALA. *Guatemala*: Puerta Parada, 14.5 km east Guatemala City, 16 May 1979 (1 ♂ USNM). BRAZIL. *Paraná*: Curitiba, 27 Dec 1936, Westermann (1 ♀ USNM); *Santa Catarina*, Nova Teutonia, 27°11'S 52°23'W, 300-500 m, F. Plaumann, 19 Feb 1940 (3 ♂ USNM), Apr 1947 (1 ♀ USNM); Nov 1971 (12 ♂ 12 ♀ USNM), Nov 1964 (2 ♂ 8 ♀ USNM). *Rio Grande do Sul*: Pelotas, C. M. Biezanko, 19 Jan 1956 (2 ♀ USNM), 29, 30 Sep 1961 (5 ♂ 4 ♀ USNM), 27, 29 Oct 1960 (2 ♂ 4 ♀ USNM), 31 Oct 1959 (1 ♂ 3 ♀ USNM), 5, 11 Nov 1956 (3 ♂ 4 ♀ USNM), 3, 7 Nov 1960 (8 ♂ 6 ♀ USNM). URUGUAY. Montevideo, J. Tremoleras (1 ♂ 1 ♀ USNM). ARGENTINA. *Buenos Aires*: Bahia Blanca, 29 Jan 1922, D. S. Bullock (2 ♂ USNM); Rio Santiago, Palo Blanco Berisso, 3 Dec 1979, C. M. & O. S. Flint; Baradero, Rio Parana de las Palmas Lima, 16 Dec 1979, C. M. & O. S. Flint (1 ♂ USNM); Balneario Municipal, Baradero, 15 Dec 1979 (1 ♀ USNM); Buenos Aires, Jun 1928, A. Copello (4 ♂ 2 ♀ USNM); La Plata, 20 Apr 1927, Kisluk (1 ♂ USNM); Zalaya, Nov 1939, J. B. Daguerre (1 ♂ 2 ♀ USNM); Capital, Feb 1939, J. B. Daguerre (1 ♀ USNM); 7, 24 & 25 Feb 1962, W. L. Jellison (1 ♂ 3 ♀ USNM); Azul, 7 -25 Feb 1962, W. L. Jellison (1 ♂ 3 ♀ USNM); Villa Eliza, 15-29 Dec 1979 (1 ♂ MZUSP); Villa Eliza, Ao. Carnaval, 3 Dec 1979, C. M. & O. S. Flint (4 ♂ 1 ♀ USNM); *Catamarca*: Andalgalá, 20 & 28 Oct 1972, J. L. Neff (2 ♂ 2 ♀ USNM); *Entre Rios*: Pronunciamento, Apr & Dec 1966, F. Walz (3 ♂ 3 ♀ USNM); *Neuquen*: Rio Alumine, 9 km north Alumine, 27 Feb 1978, C. M. & O. S. Flint (1 ♀ USNM); Ao. Chapelco Chico E. S. M. d. l. Andes, 25 Feb 1978, C. M. & O. S. Flint (1 ♂ USNM). CHILE. Southern Chili, 25 Jan 1907, M. J. Rivera (5 ♂ 5 ♀ USNM). *Aconcagua*: ConCon, 16 Dec 1950, Ross & Michelbacher (1 ♂ USNM). *Antofagasta*: Nov 1932, A. Pirion (1 ♂ USNM). *Araucania*: Angol, D. S. Bullock (1 ♂ 3 ♀ USNM); 11, 23 Mar 1925 (4 ♂ 4 ♀ USNM), 15 Jun 1933 (1 ♀ USNM), 22 Nov



1951 (1 ♀ USNM). *Cautín*: Rio Cautin, Cajon, 3 Jan 1966, Flint & Cekalovic (1 ♀ USNM). *Concepción*: Concepcion, Dec 1926, R. & E. Shannon (1 ♂ 1 ♀ USNM); Hualpencillo, 31 Dec 1965, Flint & Cekalovic (1 ♂ USNM). *Llanguihue*: Puerto Varas, Dec 1926, R. & E. Shannon (1 ♀ USNM). *Maule*: Pellines, south of Constitucion, 16 Dec 1976, A. B. Gurney (1 ♀ USNM). *Osorno*: Anticura, 1 km west of, 430 m, 11–12 Feb 1978, W. N. Mathis (4 ♂ 1 ♀ USNM); Aguas Calientes, 1 km southeast of, 530 m, 7–8 Feb 1978, W. N. Mathis (1 ♂ USNM); Pucatrihue, 27–30 Jan 1978, W. N. Mathis (1 ♀ USNM). *Santiago*: Santiago (1 ♂ USNM); El Portezuelo, 7 km north of Santiago, 500 m, 22–25 Oct 1981, D. & M. Davis (1 ♀ USNM); near Pta. Yeso, ca. 70 km southeast Santiago, 1250 m, 27–28 Oct 1981, D. & M. Davis (1 ♀ USNM); Santiago, "10.K.N.09" 29 Jan 1932, Kisliuk & Cooley (1 ♀ USNM), 29 Feb 1932, Kisliuk & Cooley (1 ♀ USNM); *Valdivia*: Rio Bueno, 8 miles east of, 15 Jan 1951, Ross & Michelbacher (1 ♂ USNM). *Valparaiso*: Valparaiso, A. Faz (1 ♂ 1 ♀ USNM), 5 Aug, Cockerell (1 ♂ USNM); Quillota, Quintolaurel, Kisliuk & Cooley (1 ♀ USNM).

**Distribution.**—Cosmopolitan. *Eristalis tenax* is rare in collections from the Neotropics. In temperate areas the species has spread everywhere humans have. In the Americas south of the United States, *Eristalis tenax* is amphitropical, ranging south to Guatemala and north to Southern Brazil.

**Discussion.**—*Eristalis tenax* is a mimic of the honey bee (*Apis mellifera* L.). Much has been written on the species as it has been used as an experimental subject in various laboratory studies, a pollinator in greenhouse, and the basis of the Bugonia myths.

#### Subgenus *Eoseristalis* Kanervo

*Eoseristalis* Kanervo, 1938: 12. Type species, *Eristalis cerealis* Fabricius (Orig. des.).

Eye without contrasting pile fasciae; arista usually sparsely pilose basally; meron bare.

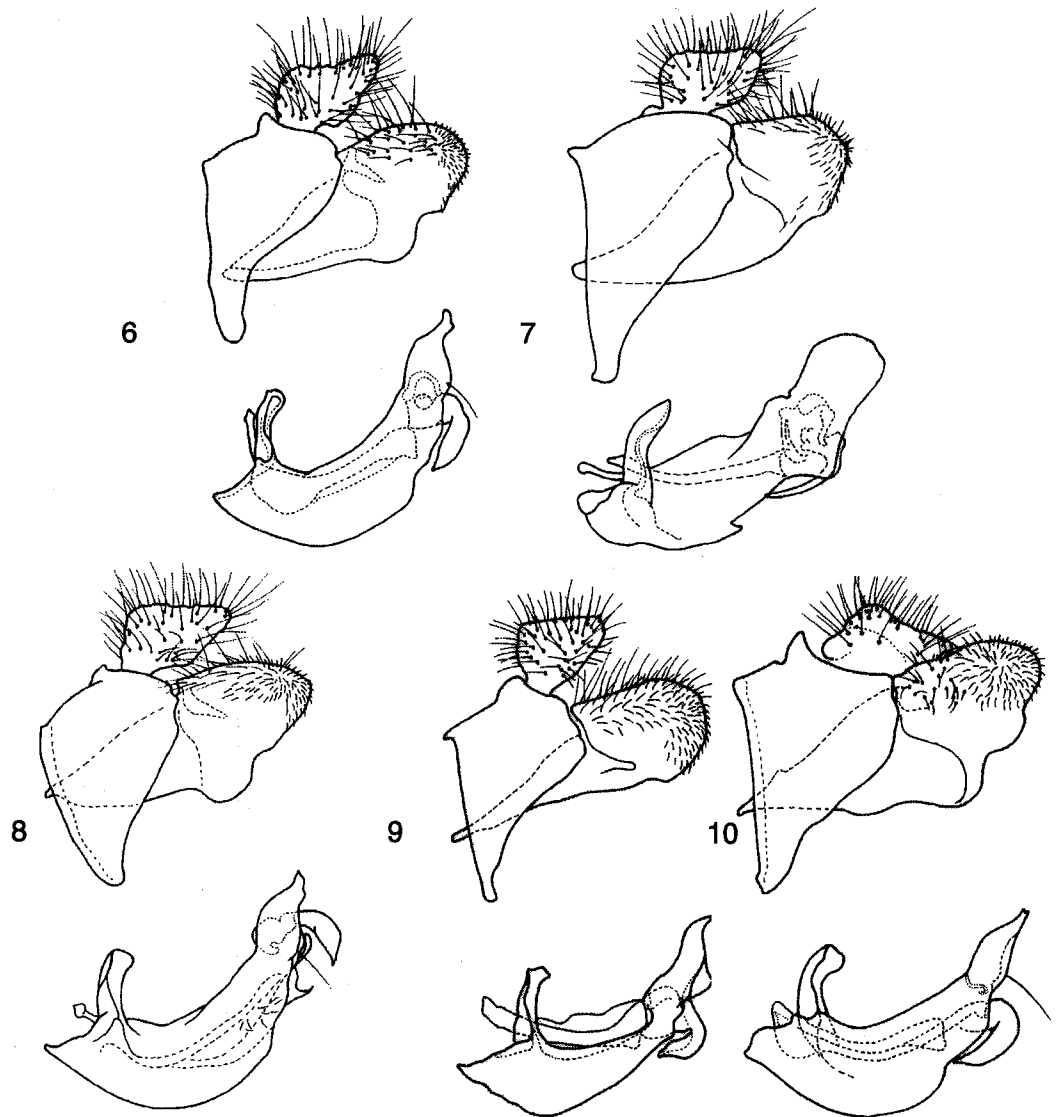
The subgenus *Eoseristalis* includes some 60 species, mainly distributed in the north temperate regions (39 Palaearctic species, 20 Nearctic species), with fewer species in the cooler areas of the Afrotropics (4 species), Orient (11 species) and the Neotropics (5 species).

#### *Eristalis (Eoseristalis) allenii* Thompson, new species

(Fig. 1, habitus; 8, male genitalia)

**Male.**—Head: Black; face brownish orange except for black oral margin and a narrow medial black vitta which extends vertically above tubercle, brownish orange pilose, dull grayish white pollinose, with pollinosity thin, not obscuring ground color; gena grayish white pollinose; frontal and vertical triangle brownish orange pollinose, black pilose; eye brown pilose on dorsal  $\frac{1}{2}$ , yellow on ventral  $\frac{1}{2}$ ; occiput silvery white pollinose, yellow pilose, with some black pile on dorsal  $\frac{1}{3}$ ; antenna orange except darker brown on dorsoapical  $\frac{2}{3}$  of basoflagellomere; arista orange, distinctly pilose, with pile about  $\frac{1}{2}$  as long as basoflagellomere width; eye contiguity short, about as long as ocellar triangle.

**Thorax:** Black, grayish brown pollinose; scutum with very indistinct pattern of darker pollinose narrow submedial and broader interrupted sublateral vittae, extensively black pilose, with orange pilose marginally (anteriorly, laterally and posteriorly); scutellum dark orange, dull, black pilose except apical margin yellow pilose; pleuron orange pilose except black pile dorsoposteriorly on anepisternum and posteriorly on katepimeron; metasternum black pilose. **Legs:** Orange except black coxae, trochanters and basally on femora; orange pilose except black pilose on mid and hind coxa, dorsoapical  $\frac{1}{3}$  of hind femur, dorsoposteriorly on hind tibia; anterior spiracular fringe light brown; posterior spiracular fringe dark brown; halter brownish or-



Figs. 6-10. Male genitalia, lateral view. 6, *Eristalis persa*. 7, *E. croceimaculata*. 8, *E. alleni*. 9, *E. bellardii*. 10, *E. circe*.

ange, black head; plumula brown; squama large, orange brown, with black margin and fringe; epaulet black and orange pilose; basicosta black pilose; wing bare, light brown.

Abdomen: 1st sternum black, gray pollinose, yellow pilose; 2nd thru 4th sterna orange, rarely black medially, yellow pilose; 1st tergum black, gray pollinose, yellow pilose; 2nd tergum orange except black

narrowly apicomediaally, orange pilose except black on apical  $\frac{1}{3}$ ; 3rd tergum orange except small black basomedial macula, black pilose except orange on basal  $\frac{1}{4}$  and laterally; 4th tergum orange except for very small black basomedial macula, black pilose except for a few scattered intermixed orange pile basally and laterally; genitalia black, dull, yellow and black pilose.

Female.—Similar, but darker; front or-

angish brown pollinose, black pilose, about .40 times as wide as head at antenna, tapering to about .20 times as wide dorsally; fore femur sparsely black pilose posteriorly; mid and hind femur extensively black pilose; sterna more extensively brownish black; terga more extensively black pilose, 2nd tergum black pilose on apicomedial  $\frac{1}{2}$ , 3rd tergum entirely black pilose, 4th tergum extensively black pilose, only orange pilose laterally; 5th tergum orange basally, black on apical  $\frac{1}{3}$ , dull pollinose except shiny apically; 5th sternum black, shiny except pollinose apically and laterally.

Type data.—Holotype ♂ from COSTA RICA, Heredia, Braulio Carrillo National Park, Estacion Barva, 2500 m, L-N 233400 523200, Mar 1990, G. Rivera (INBIOCRI000164804), deposited in Instituto Nacional de Biodiversidad, Santo Domingo.

Paratypes: COSTA RICA. Same locality as the holotype but with the following dates and collectors: Sep 1989, G. Rivera (1 ♀ INBIOCRI000111222); Nov 1989, A. Fernandez (1 ♀ INBIOCRI000143385 (USNM)); Dec 1989, A. Fernandez (1 ♂ 1 ♀ INBIOCRI000203524 (USNM), INBIOCRI000290037); Jan 1990, G. Rivera (4♂ 6♀ INBIOCRI000174715, INBIOCRI000174710, INBIOCRI000206578 (USNM), INBIOCRI000206836, INBIOCRI000192229, INBIOCRI000192230 (USNM), INBIOCRI000206813 (USNM), INBIOCRI000206585, INBIOCRI000206580, INBIOCRI000192224); Feb 1990, A. Fernandez (INBIOCRI000191262-3, INBIOCRI000191265-6, INBIOCRI000191268-73, INBIOCRI000191287); Feb 1990, G. Rivera (17 ♂ 24 ♀ INBIOCRI000154527, INBIOCRI000202034-5, INBIOCRI000202078-9, INBIOCRI000202082, INBIOCRI000202084-5, INBIOCRI000202087, INBIOCRI000202088 (USNM), INBIOCRI000202089-90, INBIOCRI000202097, INBIOCRI000202105, INBIOCRI000202108-110, INBIOCRI000202114 (USNM), INBIOCRI000202115-6, INBIOCRI000202118, INBIOCRI000202120-1, INBIOCRI00020212

5-8, INBIOCRI000202130, INBIOCRI000202131 (USNM), INBIOCRI000202132, INBIOCRI000202134-6, INBIOCRI000202140-1, INBIOCRI000202143-5, INBIOCRI000202162 (USNM), INBIOCRI000202168-9, INBIOCRI000202173); Mar 1990, G. Rivera (2 ♂ INBIOCRI000164804 (USNM), INBIOCRI000169585); Mar 1990, A. Fernandez (9 ♀ INBIOCRI000165148, INBIOCRI000165153, INBIOCRI000164394, INBIOCRI000164327 (USNM), INBIOCRI000164461 (USNM), INBIOCRI000169474, INBIOCRI000169479, INBIOCRI000169427, INBIOCRI000169435). *Heredia*: Braulio Carrillo N. P., Transecto, 2050-2600 m, Oct 1989, R. Aguilar & M. Zumbado (1 ♂ 1 ♀ INBIOCRI000131440-1). *Alajuela*: Volcan Poás, 9000 ft., 26 Aug 1966, R. D. Akre (1 ♀ USNM); Volcan Pass, 21 Feb 1980, L. Laverty (2 ♂ 1 ♀ CNC). *Cartago*: Volcan Irazu, 15 Jul 1965, G. Fuentes (1 ♂ USNM). *San Jose*: Villa Mills, 25 May 1979, L. Laverty (1 ♀ CNC), 10 Aug 1979, L. Laverty (1 ♀ CNC); Rancho Rudondo, 1 Dec 1959, A. Wille (1 ♂ WSU); Cerro de la Muerte, 6 km w Villa Mills, Inter-Am H'wy, 3340 m, on flowers of *Seneico* sp. #234, 24 Feb 1972 0830-1100 hours, collector E. R. Heithaus (#10773) (1 ♂ BMNH), 2-3 Jan 1972, E. R. Heithaus, on flowers of *Seneico oerestedianus* (3 ♀ USNM), 25-26 Jan 1972, E. R. Heithaus, on flowers of *Seneico oerestedianus* (1 ♂ 7 ♀ USNM), 23-25 Feb 1972, E. R. Heithaus, on flowers of *Seneico* sp. (6 ♂ 6 ♀ USNM, 1 ♀ CNC), 21 Jul 1971, E. R. Heithaus, on flowers of *Seneico* sp. (1 ♂ USNM), 25 Jul 1971, E. R. Heithaus, on flowers of Roseaceae (2 ♂ USNM), 23-26 Oct 1971, E. R. Heithaus, on flowers of *Seneico oerestedianus* (4 ♂ 4 ♀ USNM), 23-29 Nov 1971, E. R. Heithaus, on flowers of *Seneico oerestedianus* (17 ♂ 10 ♀ USNM, 1 ♂ CNC).

**Etymology.**—This species is named after Paul Allen, the co-founder of Microsoft in recognition of his contributions to the PC revolution.

**Distribution.**—*Eristalis alleni* is known

only from the central highlands of Costa Rica.

Discussion.—*Eristalis alleni* is similar in appearance to the males of *E. circe* and *E. persa*, but is readily distinguished by its leg color.

*Eristalis (Eoseristalis) bellardii* Jaennicke  
(Fig. 9, male genitalia)

*Eristalis bellardii* Jaennicke, 1867: 400.

Type-loc.: "Mexico." Syntypes ♂ SMF, Frankfurt. Williston 1892: 60 (key reference, description note, Mexico); Curran 1930: 6, 1934: 410 (key references); Thompson et al. 1976: 101 (catalog citation).

*Eristalomyia rufoscutata* Bigot, 1880: 221.

Type-loc.: "Mexico." Lectotype ♂ UMO (here designated). Synonymy Thompson et al. 1976: 101.

*bogotensis* of: Giglio-Tos 1893: 4 (description, Mexico); Lynch Arribalzaga 1893: 262 (cit.); Aldrich 1905: 385; Kertész 1910: 214 (in part).

Male.—Head: Black except face sometimes reddish brown laterally; face pale yellowish-white pollinose except for shiny medial vitta which extend  $\frac{3}{4}$  distance to antennal bases, yellow pilose; gena shiny, pale yellow pilose; frontal lunule reddish brown; frontal triangle sparsely pale pollinose, yellow and black pilose; vertical triangle sparsely pollinose, black pilose anteriorly, yellow and black pilose posteriorly; occiput densely white pollinose on ventral  $\frac{2}{3}$ , very sparsely pollinose on dorsal  $\frac{1}{3}$ , white pilose becoming more yellowish on dorsal  $\frac{1}{3}$ , with a few black cilia on dorsal  $\frac{1}{3}$ ; antenna black; arista bare, orange; eye pile brownish yellow, white ventrally; eye contiguity long, about 1.5 times as long as vertical triangle.

Thorax: Black, yellow pilose except black pilose on disc of scutellum and rarely with a few black hairs on postalar callus, very sparsely dull pollinose; plumula, halter and squama pale white to yellowish; spiracular fringes brownish yellow; scutellum

shiny dark reddish brown. Wing: Epaulet, tegula yellow pilose; basicosta black pilose; hyaline, bare except for a few microtrichia anterobasally on alula. Legs: Extensively black, pale orange only on apices of femora, basal  $\frac{1}{3}$  to  $\frac{1}{2}$  of tibiae and on mid basitarsomere, pale yellow pilose except black pilose on anterior surface of fore and mid femora and posterior surface of hind femur.

Abdomen: Venter ranging from entirely brownish black to extensively reddish orange apically, yellow pilose, shiny except 1st sternum sparsely grayish pollinose. Dorsum yellow pilose except black pilose apicomediaally on terga; 1st tergum black; 2nd tergum dull, orange on lateral  $\frac{2}{3}$ , black on medial  $\frac{1}{3}$ , with apical margin yellow; 3rd tergum same as 2nd except for indistinct shiny medial fascia; 4th tergum orange on basolateral  $\frac{1}{3}$ , black on apicomediaal  $\frac{2}{3}$ , extensively dull pollinose, with shiny medial fascia, apical margin yellow; male genitalia black, shiny.

Female.—Similar; front pale yellowish-white pollinose, yellow pilose on ventral  $\frac{3}{4}$ , black pilose on dorsal  $\frac{1}{4}$ , about .45 times as wide as head at antenna, tapering to about .30 times as wide dorsally; 1st tergum black medially, orange laterally; 3rd tergum orange only on basolateral  $\frac{1}{3}$  and along apical margin, elsewhere black; 4th tergum black, dull pollinose except for broad shiny medial fascia; 5th tergum black, shiny medially, dull pollinose on base and apex.

Type data.—*Eristalis rufoscutata* Bigot, lectotype ♂ in The Natural History, London, labelled with "ex. coll. Bigot, Pres. by, G. H. Verrall, B. M. 1894-234." There are another 2 males in The Natural History Museum and 3 more in the Verrall/Collin Collection at Oxford, all of which are labelled paralectotypes.

Material examined.—MEXICO. no further data (1 ♂ BMNH). *Chihuahua*: Sierra Madre, Head of Rio Piedras Verdes, about 7300 ft., C. H. T. Townsend, 21 Jul–11 Sep (1 ♂ 1 ♀ USNM), 27 Jun (1 ♀ BMNH), 3 Jul (2 ♀ BMNH), 17 Jul on *Rhus glabra* (1 ♀ BMNH); 21 Jul (1 ♂ 2 ♀ BMNH), 23

Jul (1 ♂ 3 ♀ BMNH), 29 Aug (2 ♂ 2 ♀ BMNH), 10 Sep "flo 273" [=flower #273?] (1 ♂ BMNH), 11 Sep on *Solidago trinervata* (1 ♂ BMNH), no date (1 ♂ BMNH); *Durango*: El Salto, 10 miles W, 9000 ft., 10 Jun–10 Aug, J. F. McAlpine & J. E. Martin (94 ♂ 105 ♀ CNC); Buenos Aires, 10 miles west La Ciudad, 21 Apr 1961 (1 ♂, 2 ♀ CNC); Navios, 26 miles east El Salto, 8000 ft., (3 ♂, 1 ♀ CNC); La Ciudad, 10 miles west along Mexico highway #40, 8 Nov 1970, D. E. Breedlove (4 ♂ USNM); Ciudad, 8100 ft., Forrer (4 ♂ 6 ♀ BMNH); Huachichilas, 3 miles north, north base of Las Tabletas, Cerros Huehuetto, on lumber road, 53 miles north of Coyotes, 9000 ft., on flowers *Eupatorium* and/or *Stevia*, 5 Nov 1970, D. E. Breedlove (1 ♂ USNM). *Jalisco*: Volcan Tequila, 10–14 km SSW of Tequila, 2134 m, 8 Sep 1974, Breedlove (1 ♂ CAS). *Mexico*: Mexico City, Jun 1918, J. Muller (1 ♂ USNM); *Morelos*: Tres Cumbres, 3 road miles south of, 9000 ft., at flowers of *Lopezia minitata*, 16 Jan 1966, D. P. Gregory (1 ♂ USNM). *Oaxaca*: (1 ♂ BMNH). *Chiapas*: San Cristobal de las Casas, 11000 ft., 4 Aug 1962, H. E. Milliron (1 ♀ CNC); 7200 ft., 25 May 1969, Mason (1 ♂ 1 ♀ CNC); 7200 ft., 16 May 1969, Mason (1 ♂ CNC); 7087 ft., 16 May 1969, R. V. Peterson (2 ♂ CNC); 7000 ft., 21 May 1969, H. Teskey (4 ♂ 2 ♀ CNC); San Cristobal de las Casas, 5 miles west, 10 May 1969, J. E. Martin (1 ♂ CNC); San Cristobal, 10 km South, 21 May 1981, C. M. & O. S. Flint (5 ♂ 1 ♀ USNM); Cerro Huitepec, west San Cristobal de las Casas, 2591 m, 23 May 1972, Breedlove (1 ♂ USNM); San Cristobal de las Casas, 7100 ft., 3 Aug 1966, Breedlove (1 ♀ CAS)

**Distribution.**—*Eristalis bellardii* is restricted to southwestern United States and Mexico, where it ranges from Chihuahua to Chiapas. The northern-most record and only USA record for *E. bellardii* is from southeastern Arizona (Portal). *Eristalis bellardii*, *E. circe* and *E. persa* are sympatric in Chiapas; *E. bellardii* and *E. circe* are

broadly sympatric from Durango to Chiapas.

**Discussion.**—*Eristalis bellardii* represents the northern component of the *E. bogotensis* super species and is distinguished by pale pile on ventral parts of the thorax and coxae and the more extensive red coloration on the abdomen.

*Eristalis (Eoseristalis) bogotensis* Macquart (Fig. 13, male genitalia)

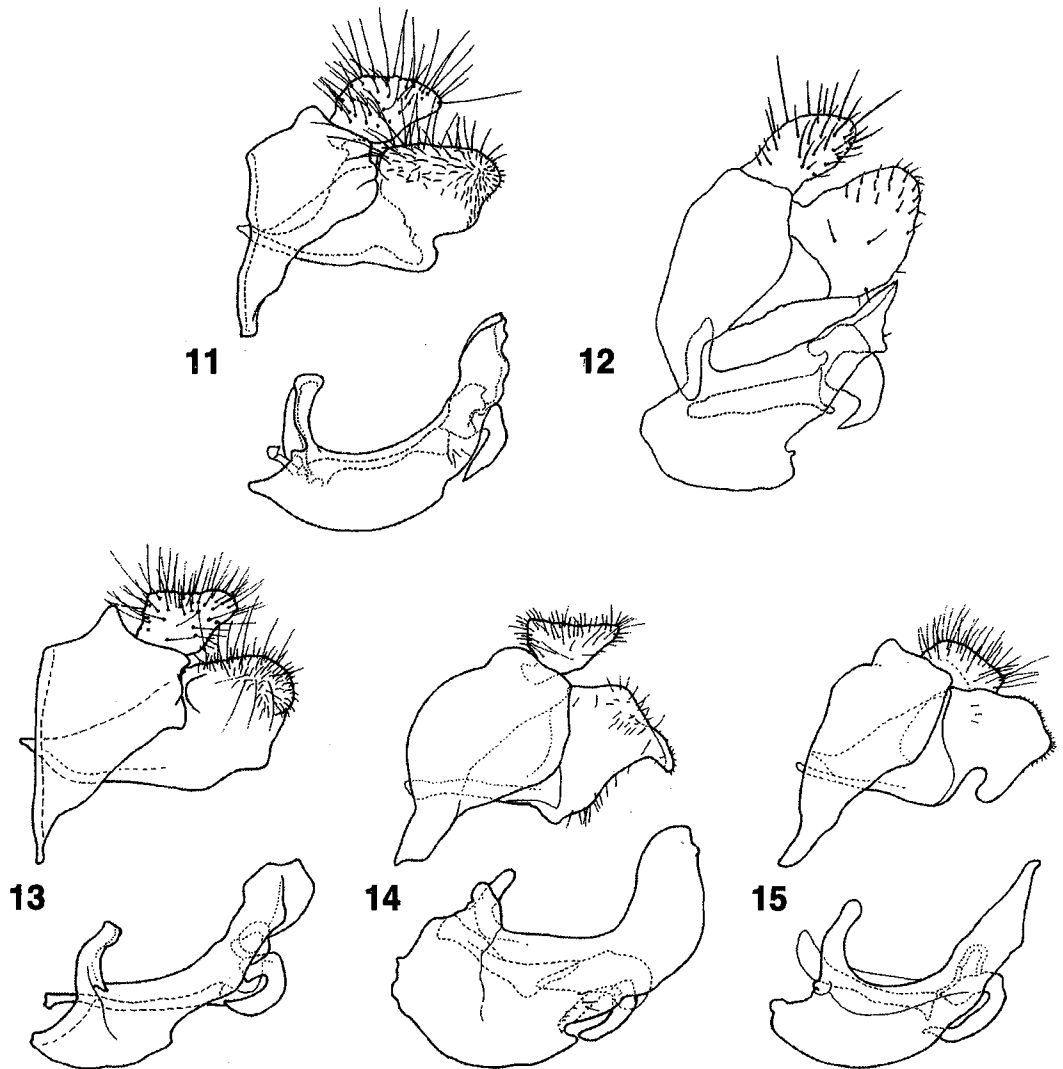
*Eristalis bogotensis* Macquart, 1842: 112.

Type-loc.: Colombia, Santa Fe de Bogota. Lectotype ♀ MNHN, Paris (here designated). Williston 1886: 319 (catalog citation); Wulp 1882a: 79, 1882b: 129 (Argentina); Lynch Arribalzaga 1892: 253, 1893: 262 (description, Argentina); Aldrich 1905: 385 (catalog citation); Brèthes 1907: 293 (catalog citation); Kertész 1910: 214 (catalog citation); Hull 1925: 308, pl. 2:15 (mesonotum figured, key reference, description, Bolivia, Peru); Fluke 1957: 131 (catalog citation, in part); Gaunitz 1969: 75 (male genitalia figured); Thompson et al. 1976: 101 (catalog citation)

*Eristalis assimilis* Macquart, 1846: 257.

Type-loc.: "Colombia." Syntypes ♂ ♀ Zurich (lost?). Macquart 1850: 499 (in Collection at Lille, Colombia); Schiner 1868: 361 (descriptive note); Williston 1886: 319 (catalog citation); Kertész 1910: 213 (catalog citation); Hull 1925: 308, pls. 1:7, 2:12 (abdomen figured, head figured, key reference, description, Peru); Curran 1930: 6, 1934: 410 (key reference); Fluke 1957: 130 (catalog citation, in part); Etcheverry 1963: 34 (synonymy, Chile?). Synonymy Thompson, et al. 1976: 102.

**Male.**—Head: Black except face brownish laterally; face shiny except sparsely white pollinose laterally and ventrad antenna, white pilose; gena shiny, white pilose posteriorly; lunule brownish orange; frontal triangle sparsely white pollinose laterally, mainly black pilose, with some white pile



Figs. 11-15. Male genitalia, lateral view. 11, *Eristalis gatesi*. 12, *Palpada semicircula*. 13, *E. bogotensis*. 14, *P. eristaloides*. 15, *E. stipator*.

intermixed laterally; antenna black, black pilose; arista bare, brownish black; eye pile brown; eye contiguity short, as long as vertical triangle, about  $\frac{1}{4}$  as long as frontal triangle; vertical triangle gray pollinose, mainly black pilose, with a few yellow hairs intermixed; occiput densely white pollinose, white pilose with some black cilia on dorsal  $\frac{1}{5}$ .

Thorax: Black except orange humerus, postalar callus and scutellum; mesonotum gray pollinose, mainly yellow pilose with

black pile intermixed; pleuron sparsely gray pollinose, yellow pilose except black pilose ventrally; postalar callus yellow pilose; scutellum shiny, yellow and black pilose; squama yellowish orange; spiracular fringes brownish yellow; halter yellow. Wing: Bare, hyaline; tegula yellow and black pilose. Legs: Coxae and trochanters black, black pilose; femora black except yellow apex, yellow and black pilose; tibiae yellow on basal  $\frac{1}{3}$  to  $\frac{1}{2}$ , black apically, yellow pilose; tarsi black, yellow pilose.

Abdomen: 1st tergum black, black pollinose, yellow pilose; 2nd tergum orange except for medial black T-shaped macula, dull pollinose, yellow pilose except for a few apicomedial black hairs, with apical margin (incisure) yellow; 3rd tergum orange except black medially and apical margin (incisure) yellow, dull pollinose except for shiny medial fascia, yellow pilose except for black pile apicomediaally; 4th tergum black except orange basolaterally and yellow apical margin (incisure), shiny except dull apicomediaally, yellow pilose except with a few black hairs apicomediaally; sterna black, shiny, yellow pilose; genitalia black, shiny, yellow pilose.

Female.—Similar; front grayish white pollinose laterally, more brownish black pollinose medially, white pilose laterally, yellow and black pilose medially, about .40 times as wide as head at antenna, tapering to about .25 times as wide dorsally; abdomen with black medial area more extensive, 5th tergum and sternum black, shiny, yellow pilose.

Type data.—*Eristalis bogotensis* Macquart, lectotype ♀ #1673 in box 54 of Macquart Collection, Museum National d'Histoire Naturelle, Paris, labelled "No 1144, *Eristalis, bogotensis*" and "E. bogotensis Macq., Bogota." There are no original Bigot/Macquart labels either in Paris, Oxford nor London. There are 3 other females in London and 2♂ 1 ♀ in Oxford. All are labelled as paralectotypes.

*Eristalis assimilis* Macquart, types (♂♀) in the collection of Marquis de Brême. 1 ♀ with Macquart/Bigot label in BMNH; another listed for Lille.

Material examined.—COLOMBIA. Meta Dist., 1932, B. Guevara (1 ♂ 1 ♀ USNM); Bogota, B. Guevara (50 ♂ 26 ♀ USNM); Bogota, Dr. A. Balfour, Feb–Apr 1915 (5 ♀ BMNH), Dec 1912 (2 ♂ 1 ♀ BMNH); Bogota, 12 miles southeast, 2930 m, 13 Mar 1955, E. I. Schlinger & E. S. Ross (1 ♂ USNM); Volcan Galeras, Narino, 2400 m, 13 Jan 1959, J. F. G. Clarke (1 ♀ USNM); Atrat Valley, Boca de Arquia, May–Jun

1914 (7 ♂ 4 ♀ BMNH). ECUADOR. Antisamilla to Pinatura, 11000 ft., Ed Whympers (2 ♀ BMNH). Quito, Santa Catalina Expt. Station, 2780 m, 4 Feb 1971 (3 ♂ 7 ♀ USNM); Quito, 2850 ft., F. Campos R. (1 ♂ USNM). *Chimborazo*: Tixan, 8 mi northeast of, 14 Feb 1955, E. I. Schlinger & E. S. Ross (7 ♂ 1 ♀ CAS, USNM); Lago Zurucuchu, 11 miles west of Cuenca, 16 Feb 1955, E. I. Schlinger & E. S. Ross (2 ♂ 8 ♀ CAS, USNM). *Tungurahua*: Ambato, 14 mi northeast of, 2700 m, 8 Feb 1955, E. I. Schlinger & E. S. Ross (1 ♀ ???); Ambato, Nov 1965, J. Foerster (2 ♂ 2 ♀ CNC). *Carchi*: Troya, 11–13 Jun 1965, L. Pena (3 ♂ CNC); Tulcan, 2800m, 27 Jun 1965, L. Pena (1 ♂ 2 ♀ CNC); El Angel, 2700m, 23–25 Jun 1965, L. Pena (7 ♂ 11 ♀ CNC); Tulcan, 10 km southwest of, 2900 m., L. Pena (2 ♂ CNC). Canar, El Tambo, 2800 m, 4–7 Mar 1965, L. Pena (2 ♂ 3 ♀ CNC). *Pichincha*: Pomasqui, 2200 m, 6 Jun 1965, L. Pena (1 ♂ 3 ♀ CNC); Valle de Machachi, 2900 m, 26 Nov 1940, F. Campos R. (2 ♂ 9 ♀ USNM); Machachi, 9-10000 ft., Ed Whympers (1 ♀ BMNH). Loja: west of Loja, 2500 m, 25 Mar 1965 (2 ♂ 10 ♀ CNC). Azuay: Tarqui, 2800 m, 7–8 Mar 1965, L. Pena (2 ♀ CNC); Cuenca, 28 km south of, 2500–2800m, 15 Mar 1965, L. Pena (1 ♂ CNC); Cuenca, 2200 m, 10-20 Mar 1965, L. Pena (3 ♂ CNC); Cuenca, 2 km north of, 2200 m., 14 Mar 1965, L. Pena (1 ♂ 1 ♀ CNC). PERU. Parish (3 ♂ USNM); Tinco?, Aug 1922, Cockerell (1 ♂ USNM); Orova, 7 May 1914, C. H. T. Townsend (1 ♂ USNM); Matucana, C. H. T. Townsend, 30 Jan 1913 (1 ♂ USNM). *Amazonas*: Cerros Calla-Calla, 45 km east of Balsas, 3100 m, 20 Jun 1964, P. C. Hutchison & K. Wright (1 ♂ USNM). *Arequipa*: 2400 m, Aug–Nov 1936, R. M. Straw (6 ♂ 7 ♀ USNM); Arequipa, 1926, Dr. Escobel (1 ♀ BMNH); Arequipa, 2500 m, 30 Jul–1 Aug 1971 (1 ♂ 1 ♀ BMNH); Cuzco, 3200 m, 20–21 Oct 1962, L. Pena (5 ♂ 4 ♀ CNC); Cuzco, Las Salineras, 17 Sep 1972, J. Escalante (1 ♂ 1 ♀ CNC); Cuzco, Limatambo, 11 Feb 1979, W. E.

Steiner (2 ♂ 1 ♀ USNM); Cuzco, Quispicamchis, Huambutio, 2900 m, 1 Sep 1988, A. Freidberg (1 ♀ USNM); Cuzco, Urbama, 2900 m, 9 Aug 1971, C & M Vardy (2 ♂ BMNH); Cuzco, NW of Cuzco, Barrio Magisterial, C & M Vardy, 3500 m, 7 Aug 1971 (1 ♂ BMNH), 8 Aug 1971 (1 ♂ BMNH); 8 kms S of Cuzco, 3500 m, C & M Vardy, 6 Aug 1971 (1 ♂ 3 ♀ BMNH); Moquegua, Yacango, 8 Oct 1965, J. C. Hitchcock (1 ♂ 1 ♀ USNM). Ancashi: Huaylas, 2800 m., 4 May 1984, P. Hocking (1 ♂ 1 ♀ USNM). *Junin*: 22 Mar 1974, J. Alata (1 ♂ USNM); Huancayo, 3300 m, 13 Sep 1984, P. Hocking (1 ♀ USNM); Tarma, 8 miles west of, 3500 m, 5 Jan 1955, E. I. Schlinger & E. S. Ross (1 ♂ 2 ♀ CAS, USNM). *Huanco*: Panao, 3700 m, 27 Jun 1984, P. Hocking (1 ♀ USNM). *Puno*: Lago Titicaca, 11 Mar 1979, W. E. Steiner (2 ♂ 1 ♀ USNM); Roi, 22 Oct 1965, J. C. Hitchcock (1 ♂ 1 ♀ USNM). Mamara, O. Garlepp c., Coll. W. Schnuse 1911-3 (1 ♀ BMNH); Mamara, Apurimac, 3500 m, 14 Feb 1910 (1 ♀ BMNH). BOLIVIA. *Cochabamba*: Cochabamba, 10 Oct 1966, B. D. Burks (1 ♂ USNM), 14-17 Jun 1942 (3 ♂ USNM); Cochabamba, 2600 m, Schoenfelder, Apr 1950 (1 ♀ BMNH), 10 Apr 1949 (1 ♀ BMNH); Lake Titicaca, 26 Apr 1953, J. A. Munro (1 ♂ USNM); La Paz, O. Garlepp c., Coll. W. Schnuse 1911-3 (1 ♂ BMNH); Altiplano, Pillapi, 70 km east of La Paz, 3780 m, J. L. Chudley, 11 Apr 1964 (1 ♂ BMNH), 5 May 1964 (1 ♂ BMNH); ?Yungas del Palmar, 2000 ft., Schoenfelder (1 ♂ BMNH). ARGENTINA. *Tucumán*: Tucumán, 5 Jul 1917 (1 ♂ USNM); Tucuman, 18 Apr 1913 (1 ♂ USNM); Tucumán, Tafi del Valle, 2100 m, 2-3 Dec 1979, C & M Varley (2 ♀ BMNH); Tafi Viejo, La Toma, 10 Oct 1926 (2 ♂ 1 ♀ USNM). *Mendoza*: 5 Jan 1927, F & M Edwards (1 ♀ BMNH).

Distribution.—*Eristalis bogotensis* is restricted to South America, where it ranges from Colombia to northern Argentina. The southern-most record of *E. bogotensis* is from "Mendoza Prov.," which means that

*E. bogotensis* and *E. croceimaculata* are broadly disjunct in distribution. However, more collections for central Chile and Argentina are desired to prove that this disjunction is not an artifact due to lack of collecting. Records of *Eristalis tenax*, which does occur in central Chile, strongly suggest the disjunction is natural.

Discussion.—*Eristalis bogotensis* of authors is a superspecies, which includes *E. bellardii* (USA, Mexico south to El Salvador), *E. bogotensis* (Colombia to northern Argentina) and *E. croceimaculata* (Chile and southern Argentina). The component species are readily distinguished by the extent of pale (red to yellow) maculae on the abdomen and pale pile on the thorax, with the amount of pale color being reduced clinally. The shape of the superior lobe [=paramere of some] and surstyle of male genitalia of all species are also distinctive.

*Eristalis (Eoseristalis) circe* Williston  
(Fig. 10, male genitalia)

*Eristalis circe* Williston, 1891: 59. Type-loc.: Mexico, Guerrero, Omilteme, 8000 ft. Lectotype ♂ BMNH, London (here designated). Giglio-Tos 1893: 321 (description, Mexico); Aldrich 1905: 385 (catalog citation); Kertész 1910: 215 (catalog citation); Hull 1925: 25 (key reference, description), 1935: 327 (description, Mexico); Curran 1930: 6, 1934: 410 (key reference); Fluke 1957: 132 (catalog citation); Thompson et al. 1976: 102 (catalog citation).

*Eristalis bombusoides* Giglio-Tos, 1892: 4. Type-loc.: Mexico, Oaxaca. Syntypes ♂ ♀ IMZ, Turin. Synonymy by Giglio-Tos 1893: 3.

*Eristalis aztecus* Hull, 1935: 326. Type-loc.: Mexico, Real del Monte, 9000 ft. Holotype ♂ USNM, Washington. Fluke 1957: 131 (catalog citation); Thompson et al. 1976: 101 (catalog citation) **New synonym.**

Male.—Head: Black; face shiny except sparsely grayish-yellow pollinose ventrad



antenna, yellow pilose; gena shiny, yellow pilose; frontal lunule yellow; frontal triangle brownish-yellow pollinose, yellow and black pilose; eye yellow pilose vertically, brown pilose dorsally, with yellow and brown pile medially; eye contiguity short, about as long as vertical triangle, vertical triangle brownish-yellow pollinose, yellow and black pilose; occiput dense grayish-yellow pollinose, white pilose ventrally becoming orange dorsally except with black cilia on dorsal  $\frac{1}{3}$ ; antenna brown except orange basoventral  $\frac{1}{3}$  of basoflagellomere, black pilose; arista distinctly pilose on basal  $\frac{1}{2}$ , with pile about as long as 2nd antennal segment width.

Thorax: Black except orange scutellum, grayish-brown pollinose; mesonotum with indistinct medial black pollinose vitta; pile orange; squama brownish black; spiracular fringes brown; halter yellow with black knob. Wing: Bare; hyaline except brownish basally; tegula orange pilose. Legs: Coxae and trochanters black, orange pilose; fore and mid femora black except orange on apical  $\frac{1}{5}$ , orange and black pilose; hind femur black except orange apex, shiny, orange and black pilose; fore tibia orange on basal  $\frac{1}{3}$ , black apically, orange pilose; mid tibia orange on basal  $\frac{2}{3}$ , black apically, orange pilose; hind tibia slightly arcuate, black except orange on basal  $\frac{1}{3}$ , black pilose; fore and hind tarsi black, orange pilose; mid tarsus orange on basal 2 tarsomeres, apically black, orange pilose.

Abdomen: 1st tergum black, grayish-yellow pollinose, yellow pilose; 2nd tergum orange except black medial T-shaped macula, orange pilose; 3rd tergum orange except for black quadrate medial maculae, orange pilose; 4th tergum orange, orange pilose; sterna black, yellow pilose; 3rd and 4th sterna with posterior medial edge forming a triangular tooth; genitalia black, orange and black pilose.

Female.—Dissimilar. Head: Similar, front brownish pollinose, black and orange pilose on basal  $\frac{1}{3}$ , orange pilose elsewhere, about .40 times as wide as head at antenna,

tapering to about .25 times as wide dorsally. Thorax: Similar. Wings and legs: Similar. Abdomen: Entirely black; 1st tergum gray pollinose, yellow pilose; 2nd tergum shiny except for apical brown pollinose fascia which is interpreted medially, yellow pilose on basal  $\frac{2}{3}$ , brown pilose apically; 3rd and 4th terga shiny except for subapical brown pollinose fasciae, brown pilose; 5th tergum shiny, yellow pilose; sterna black, shiny, white pilose, without apical tooth.

Type data.—*Eristalis circe* Williston, lectotype ♂ in The Natural Museum, London, labelled "Omiteme, Guerrero, 8000 ft., Jul H. H. Smith," "Biol. Centr. Amer., Dipt.-Syrphidae, F. D. Godman, O. Salvin, 1903-51" and "Eristalis, circe, Williston" [a Williston bordered determination label]. There are another 2 males labelled as paralectotypes in London, but there are none in New York.

*Eristalis azteca* Hull, holotype ♀ the National Museum of Natural History, Washington, labelled "Real del Monte, Mex. El 9,000'," "Coll. by H. T. Vanastrand," "Coll. of W. R. Walton," "Eristalis, montanus, Will.," "Eristalis, aztecus, n. sp." [determination label in Hull's hand" and "Type No., 42076, U.S.N.M." [Red USNM type label]. The type of *aztecus* Hull is a pale immature specimen with brownish orange maculae on 2nd tergum like *tenax*, otherwise the specimen agrees well with my concept of *circe*.

Material examined.—MEXICO. Cerrapotosi, 4 Mar 1964, J. F. Reinert (2 ♂ USNM); Real del Monte, 9000 ft., H. T. Vandstrand (1 ♂ USNM). Durango: La Ciudad, 24 miles west of, 7000 ft., 2 Jul 1964, J. F. McAlpine (1 ♂ CNC); Buenos Aires, 10 miles west of La Ciudad, 9000 ft., 8 May 1961, H. Howden & J. Martin (1 ♂ CNC); El Salto, 10 miles west of, 9000 ft., 10 Aug 1964 (CNC), 12 Jun 1965, J. McAlpine (CNC), 30 Jun 1964, J. Martin (CNC). México: Mexico City, J. Muller (1 ♂ USNM). Morelos: Huitzilac, 25 Jul 1978, J. Butze (2 ♂ 1 ♀ UNAM); Tetela del Volcan, 15 Jun 1978, G. Arzate (1 ♀ UNAM).

*Oaxaca*: Ixtlan de Juarez, 13 miles northeast of, on Rigidella, 25 Jul 1966, Molseed, Baptista & Kirchanghi (1 ♂ 1 ♀ CAS); Sierra de Miahuatlan, 2 km southeast of San Jose del Pacifico, 2438 m, 29 Oct 1974, Breedlove (3 ♂ CAS, USNM). *Chiapas*: San Cristobal, 8 miles northeast of, 7500 ft., 9 May 1969, H. Teskey (1 ♂ CNC); 6 May 1969, J. E. Martin (1 ♀ CNC); Mt. Tzontehuitz, 9500 ft., 27 May 1969, H. Teskey (2 ♂ 4 ♀ CNC, USNM). EL SALVADOR. Monte Cristo, 2418 m., 3 Mar 1978, D. R. Barger (1 ♂ USNM), 26 Mar D. R. Barger (4 ♂ USNM), 25 Apr 1977, D. R. Barger (1 ♂ USNM), 24 May 1977, D. R. Barger (1 ♂ USNM), 28 Jun 1977, D. R. Barger (1 ♂ USNM), 10 Sep 1977, D. R. Barger (1 ♂ USNM); 13 Sep 1977, D. R. Barger (1 ♂ 1 ♀ USNM), 15 Sep 1978, D. R. Barger (1 ♀ USNM).

**Distribution.**—*Eristalis circe* is found in Mexico (north to Durango) and northern Middle America (El Salvador), is broadly sympatric with *E. bellardii*, and occurs with *E. persa* in Chiapas.

**Discussion.**—*Eristalis circe* and *E. persa* are very similar in appearance, but are readily separated by their leg color. In both species, the sexes are strongly dissimilar, the males having orange colored abdomens and the females having black colored abdomens. Most *Eristalis* species are monomorphic, but *E. arbustorum* Linnaeus and *E. brousi* Williston (two north temperate species) are also dimorphic. Hence, this species pair may represent the sister group to the *bogotensis* super species.

*Eristalis (Eoseristalis) croceimaculata*

Jacobs

(Fig. 7, male genitalia)

*Eristalis croceimaculata* Jacobs, 1900: 107.

Type-loc.: Argentina, Tierra del Fuego, Isla de los Estados, Golfe Saint-Jean. Holotype ♀ IRSNB, Brussels. Jacobs 1906: 69, pl. 3, fig. 3 (habitus, Argentina); Brèthes 1907: 293 (catalog citation); Kertész 1910: 216 (catalog citation); Shannon &

Aubertin 1933: 122 (?*bogotensis*); Fluke 1957: 133 (catalog citation).

*Palpada croceimaculata*: Thompson et al. 1976: 104 (catalog citation).

*bogotensis* of: Lynch Arribálzaga 1892: 253, 1893: 262 (Argentina); Shannon & Aubertin 1933: 162 (description note, Chile, Argentina); Stuardo 1946: 128 (catalog citation, Chile); Fluke 1957: 130 (in part); Etcheverry 1963: 34 (synonymy, Chile)

**Male.**—Head: Blackish brown except face brownish yellow laterally; face shiny except sparsely white pollinose laterally and ventrad antenna, yellow pilose except for a few black hairs dorsolaterally; gena shiny, white pilose posteriorly; lunule yellowish orange; frontal triangle sparsely white pollinose laterally, mainly black pilose, with some yellow pile intermixed laterally; antenna black, black pilose; arista bare, brownish black; eye pile brown; eye contiguity short,  $\frac{1}{2}$  as long as vertical triangle, about  $\frac{1}{3}$  as long as frontal triangle; vertical triangle gray pollinose, mainly black pilose, with a few yellow hairs intermixed; occiput densely white pollinose, white pilose ventrally, becoming yellow pilose dorsally, with some black cilia on dorsal  $\frac{1}{5}$ .

**Thorax:** Black except orange humerus, postalar callus and scutellum; mesonotum gray pollinose with indistinct submedial black pollinose vittae, mainly yellow pilose with black pile intermixed; pleuron sparsely gray pollinose, yellow pilose except black pilose ventrally; postalar callus yellow pilose; scutellum shiny, yellow and black pilose; squama yellowish orange; spiracular fringes dirty white; halter yellow. **Wing:**—Bare, hyaline; tegula yellow and black pilose. **Legs:** Coxae and trochanters black, black pilose; femora black except yellow apex, yellow and black pilose; tibiae yellow on basal  $\frac{1}{3}$  to  $\frac{1}{2}$ , black apically, yellow pilose; tarsi black, yellow pilose.

**Abdomen:** 1st tergum black, black pollinose, yellow pilose; 2nd tergum orange

except for medial black transverse H-shaped macula, dull pollinose, yellow pilose except for a few apicomedial black hairs, with apical margin (incisure) yellow; 3rd tergum black except orange basolaterally and yellow apical margin (incisure) yellow, dull pollinose except for shiny medial fascia, yellow pilose except for black pile posteriorly; 4th tergum black except yellow apical margin (incisure), shiny except dull apicolaterally, black pilose except yellow pilose basolaterally; sterna brownish black, shiny, yellow and black pilose; genitalia black, shiny, yellow and black pilose.

Female.—Similar; front grayish white pollinose laterally except shiny anteriorly, white pilose, about .40 times as wide as head at antenna, tapering to about .25 times as wide dorsally; abdomen with black medial areas more extensive, 3rd tergum entirely black, 5th tergum and sternum black, shiny, black pilose.

Type data.—Holotype ♀ in the Institut Royal des Sciences Naturelles des Belgique, Brussels, labelled “♀,” “107,” “Ile des Etats, Argentine, 8. I. 1897,” “Eristalis, #5, crocei-, maculata J,” “Eristalis, croceimaculata J., det. Jacobs,” “TYPE [pink],” “cf. Expéd. Antaret. Belg., (Belgica) Zool. (Ins.), 1906 p. 69 -10,” “Reg. Mus. Hist. Nat., Belg. I. G. 10131,” and “Eristalis croceimaculata, J.” The type is double-mounted and in good condition, only the antennae are missing. The apical tarsomere of the hind leg is mounted separately and labelled “A. Collart vid. , 1934; onote de la patte, postérieure, droite d’Eristalis, croceimaculata J.” and “Reg. Mus. Hist. Nat., Belg. I. G. 10131.”

Material examined.—ARGENTINA. *Chubut*: Valle del Lago Blanco, J. Koslowsky, 1904-26 (2 ♂ BMNH). *Rio Negro*, Bariloche, 25-28 Oct 1926, F & M Edwards (1 ♀ BMNH), Nov 1926, R. & E. Shannon (10 ♂ 1 ♀ USNM), 1 Dec 1926, F & M. Edwards (1 ♂ USNM); Lake Gutierrez, 3-14 Nov 1926, F & M Edwards (3 ♂ BMNH); Lake Nahuel Huapi, Eastern End, 1 Nov 1926, F & M Edwards (3 ♂ 2 ♀

BMNH). *Tierra del Fuego*, Rio Grande, Estancia Viamonte, P. W. Reynolds (4 ♂ 1 ♀ BMNH). FALKLAND ISLANDS. Port Stanley, Nov 1984–Feb 1985 (1 ♂ BMNH); East Falklands, Stanley area, Maj. C. Kirke, Nov 1986 (7 ♂ 2 ♀ BMNH), 1–15 Dec 1986 (9 ♂ 3 ♀ BMNH), 14–31 Dec 1986 (2 ♂ 5 ♀ BMNH), Jan 1987 (3 ♀ BMNH). CHILE. “R. N. El Bolson,” 30 Nov 1961, A. Kovacs (1 ♀ BMNH). *Aysen*: Chico, Lag. Buenos Aires, 24–31 Dec 1960, L. Pena (3 ♀ CNC); Puerto Cisnes, 72°40’W 44°45’, 16-28 Nov 1960, L. Pena (1 ♀ CNC); Coihaique, Rio Simpson, 23–24 Jan 1961, L. Pena (1 ♀ CNC), 7–9 Mar 1961, L. Pena (1 ♀ CNC). *Magallanes*: Lag. Amarga, Natales, east of Mt. Payne, 200 m, 14–20 Dec 1960, L. Pena (1 ♂ CNC); Lena Dura, 4 Dec 1932, E. P. Reed (1 ♂ USNM). *Tierra del Fuego*: Punta Arenas, 40 km northeast of, 11 Dec 1960, L. Pena (1 ♂ CNC); Puerto Williams, Isla Navarino, 22–29 Nov 1960, L. Pena (1 ♀ CNC); Punta Arenas, 9–15 Jan 1966, Flint & Cekalovic (1 ♀ USNM), 3 Mar 1959, J. E. F. Clarke (1 ♂ 1 ♀ USNM). *Malleco*: Marimenuco, 1100 m., 10–13 Dec 1959, L. Pena (1 ♀ CNC). *Llanquihue*: Puerto Varas, Dec 1926, R. & E. Shannon (2 ♂ USNM); Casa Panque, F & M Edwards, 4–10 Dec 1926 (1 ♂ 2 ♀ BMNH).

Distribution.—*Eristalis croceimaculata* is restricted to south temperate regions of South America, being found in Chile and south Argentina. The northern-most record for *E. croceimaculata* is from Marimenuco in Malleco (Chile). The type-locality on Staten Island makes it one of the southern-most recorded flower fly. No other eristaline flower fly is known from so far south. However, when a Smithsonian group visited Staten Island in 1971, no flower flies were found.

***Eristalis (Eoseristalis) gatesi* Thompson,  
new species**

(Fig. 2, habitus; 11, male genitalia)

Male.—Head: Face tawny brown except broadly black along oral margin and with

black medial vitta extending over tubercle, brown pollinose, with pollinosity sparse on black areas, yellow pilose; gena black, sparsely gray pollinose, yellow pilose posteriorly; frontal lunule orange; frontal triangle black, gray pollinose, yellow pilose with a few black hairs intermixed; eye pile brown; eye contiguity long, as long as vertical triangle, about  $\frac{3}{4}$  as long as frontal triangle; antenna orange except narrowly brownish black on dorsal edge of basoflagellomere, black pilose; arista orange, sparsely pilose on basal  $\frac{1}{2}$ , with 5-6 long dorsal hairs and more short vertical ones, with dorsal hairs about as long as 2nd antennal segment width; occiput densely white pollinose, yellowish white pilose ventrally becoming yellow orange dorsally, with black cilia on dorsal  $\frac{1}{4}$ .

Thorax: Black; mesonotum gray pollinose, without pattern, yellow pilose except with black pile intermixed posteriorly; pleuron gray pollinose, black pilose except with yellow pile intermixed on episternum; postalar callus black pilose; scutellum brown pollinose, black pilose; squama black; halter gray with black knob; spiracular fringes black. Wing: Fumose basally, hyaline apically, bare; tegula black pilose. Legs: Black, black pilose except yellow pilose on fore tibia and fore and mid tarsi; hind femur narrow, very slightly arcuate, without short black apicoventral spinose hairs.

Abdomen:—1st tergum black, black pollinose, black pilose; 2nd tergum yellow except black T-shaped basomedial macula and black basolaterally, black pilose except for a few yellow hairs basomedially; 3rd tergum yellow except for black T-shaped apicomедial macula, black pilose; 4th tergum black, black pollinose except shiny medial macula, black pilose; genitalia black, sparsely black pollinose, black pilose; 1st sternum black, gray pollinose, black pilose except for a few yellow apicomедial hairs; 2nd and 3rd terga yellow except narrowly black medially, shiny, yellow pilose; 4th sternum black, shiny, black pilose except yellow pilose apicomедially.

Female.—Similar except abdomen more extensively black; front brown pollinose, brownish orange pilose, about .40 times as wide as head at antenna, tapering to about .20 times as wide dorsally; 2nd tergum black except narrowly yellow apically, black pollinose except yellow on apical margin, entirely black pilose; 3rd tergum yellow except black laterally and medially, black pilose; 4th tergum as in male; 5th tergum black, black pollinose basally, shiny apically, black pilose; 2nd thru 5th sternum black, shiny, black pilose.

Type data.—Holotype ♂ from Costa Rica, Heredia, Braulio Carrillo National Park, Estacion Barva, 2500 m, L-N 233400 523200 G. Rivera (INBIOCRI000139939). In Instituto Nacional de Biodiversidad, Santo Domingo.

Paratypes: COSTA RICA. Same locality as the holotype but with the following dates and collectors: Sep 1989, G. Rivera (2♂ I NBIOCRI000111006, INBIOCRI000111219); Oct 1989, G. Rivera & A. Fernandez (5♀ INBIOCRI000108636, INBIOCRI000108635 (USNM), INBIOCRI000108634, INBIOCRI000108683 (USNM), INBIOCRI000108684); Nov 1989, A. Fernandez (1♂ INBIOCRI0001433650); Nov 1989, G. Rivera (2♂ 1♀ INBIOCRI000139937 (USNM), INBIOCRI000139932, INBIOCRI000140172 (USNM)); Dec 1989, A. Fernandez (1♀ INBIOCRI000290043); Jan 1990, G. Rivera (2♂ 4♀ INBIOCRI000192196 (USNM), INBIOCRI000206816, INBIOCRI000206810, INBIOCRI000206807, INBIOCRI000174448, INBIOCRI000192232); Feb 1990, A. Fernandez (1♂ 2♀ INBIOCRI000191254-6); Feb 1990, G. Rivera (1♂ 4♀ INBIOCRI000202149 (USNM), INBIOCRI000202137, INBIOCRI000202107, INBIOCRI000202139, INBIOCRI000202172, INBIOCRI000202148); Mar 1990, A. Fernandez (1♀ INBIOCRI000169656 (USNM); Mar 1990, G. Rivera (1♀ INBIOCRI000164807); Apr 1989, M. Zumbado & A. Fernandez (INBIOCRI000052536). *Limon*: Cerro Chirripo, 2 Aug 1987, A. Solis (1♀ INBIO0001007910). *Alajuela*: Vol-

can Pass, 21 Feb 1980, T. Lavery (1 ♂ CNC); Volcan Poás, 9000 ft., 26 Aug 1966, R. D. Akre (2 ♂ USNM, WSU). *San Jose*: Cerro de la Muerte, 2 Mar 1980, T. Lavery (1 ♀ CNC); Cerro de la Muerte, 10,000 ft., 24 Aug 1970, R. W. Merritt (1 ♀ WSU); Cerro de la Muerte, 6 km w Villa Mills, Inter-Am H'wy, 3340 m, on flowers of *Senecio oerestdianus* Benth #234, 23 X 1971 0715-1030 hours, collector E. R. Heithaus (#10773) (1 ♂ BMNH), 3 Jan 1972, E. R. Heithaus, on flowers *Senecio oerestdianus* (4 ♂ 3 ♀ USNM, 1 ♂ 1 ♀ CNC), 25-27 Jan 1972, E. R. Heithaus, on flowers *Senecio oerestdianus* (5 ♂ 10 ♀ USNM), 23 May 1972, E. R. Heithaus, on flowers *Senecio* sp. (1 ♀ USNM), 25 Aug 1971, E. R. Heithaus, on flowers Rosaceae (3 ♂ USNM), 23 Aug 1971, E. R. Heithaus, resting on ground, overcast sky 18°C (1 ♀ USNM), 18 Aug 1971, E. R. Heithaus, resting on *Vaccinium* (1 ♀ USNM), 23-26 Oct 1971, E. R. Heithaus (1 ♂ 4 ♀ USNM), 24 Nov 1971, E. R. Heithaus (6 ♂ USNM).

**Etymology.**—This species is named after William Gates, III, the co-founder of Microsoft in recognition of his contributions to the PC revolution.

**Distribution.**—*Eristalis gatesi* is known only from the central highlands of Costa Rica.

**Discussion.**—The black and yellow abdominal color pattern of *E. gatesi* is unique among eristaline flower flies.

*Eristalis (Eoseristalis) persa* Williston  
(Fig. 6, male genitalia)

*Eristalis persa* Williston, 1891: 58. Type-loc.: Mexico, Guerrero, Sierra de las Aguas Escondidas, 9000 ft. Holotype ♀ BMNH, London. Aldrich 1905: 388 (catalog citation); Kertész 1910: 229 (catalog citation); Hull 1925: 24 (key reference, description); Fluke 1957: 140 (catalog citation); Thompson et al. 1976: 102 (catalog citation).

**Male.**—Head: Black; face shiny except sparsely grayish-yellow pollinose ventrad

antenna, yellow pilose; gena sparsely grayish-yellow pollinose, yellow pilose; frontal lunule yellow; frontal triangle brownish-yellow pollinose, yellow and black pilose; eye yellow pilose; eye contiguity short, about as long as vertical triangle, vertical triangle brownish-yellow pollinose, yellow and black pilose; occiput dense grayish-yellow pollinose, with a brown pollinose macula on ventral  $\frac{1}{4}$ , yellow pilose except with black cilia on dorsal  $\frac{1}{2}$ ; antenna orange, black pilose; arista distinctly pilose on basal  $\frac{1}{2}$ , with pile about as long as 2nd antennal segment width.

**Thorax:** Black, grayish-brown pollinose; mesonotum with medial and submedial black pollinose vittae, with vittae indistinct anteriorly; pile dark orange, intermixed black and orange on scutellum and postalar callus; squama and halter brownish black; anterior spiracular fringe brown, posterior spiracular fringe brownish black. **Wing:** Bare; hyaline except brownish basally; tegula orange pilose. **Legs:** coxae and trochanters black, orange pilose; fore and mid femora black except orange on apical  $\frac{1}{3}$ , orange pilose; fore femur with dense tuft of black pile on posterobasal  $\frac{1}{4}$ ; hind femur black, shiny, mainly orange pilose, with some scattered black pile intermixed; fore and mid tibiae orange, orange pilose; hind tibia slightly arcuate, black except orange basally and on apical  $\frac{1}{4}$ , black pilose; tarsi orange, orange pilose.

**Abdomen:** 1st tergum black, grayish-yellow pollinose, yellow pilose; 2nd tergum orange except black medial T-shaped macula, orange pilose; 3rd and 4th terga orange except for black quadrate medial maculae, orange pilose; sterna brownish orange, orange pilose; genitalia black, orange and black pilose.

**Female.**—Dissimilar. **Head:** Similar except more extensively black pilose on front; front about .35 times as wide as head at antenna, tapering to about .20 times as wide dorsally. **Thorax:** Similar except more extensively black pilose; pleuron extensively black pilose except anepisternum extensive-

ly yellow pilose; mesonotum with posterior  $\frac{1}{2}$  black pilose except narrowly laterally and posteriorly orange pilose; scutellum and postalar callus entirely black pilose. Wings and legs: Similar except without black pile tuft on fore femur. Abdomen: Entirely black and black pilose.

Type data.—Holotype ♀ in The Natural History Museum, London, labelled "Sierra de las Aguas Escondidas, Guerrero, 9500 ft., Jul H. H. Smith," "Biol. Centr. Amer., Dipt.-Syrphidae, F. D. Godman, O. Salvin, 1903-51" and "Eristalis, persa, Williston" [a Williston bordered determination label].

Material examined.—MEXICO. Santa Ana, 9 Jan 1957, P. A. B. (1 ♀ USNM), 16 Oct 1956, P. A. B. (1 ♂ USNM). *Chiapas*: Municipio Las Margaritas, 48 km northeast Las Margaritas on road to Campo Alegre, 2134 m, 25 Oct 1976, D. E. & J. A. Breedlove (1 ♀ USNM). EL SALVADOR. Monte Cristo, 26 Mar 1978, D. R. Barger (1 ♂ USNM).

Distribution.—*Eristalis persa* is known only from southern Mexico (Chiapas) and El Salvador and is sympatric with *E. bellardii* and *E. circe* in Chiapas.

Discussion.—Williston and subsequent authors did not know the male. The species is dimorphic like *E. circe* (*q.v.*). The male of *E. persa* is readily distinguished from all other *Eristalis* species by having a tuft of long black pile on the base of the fore femur.

*Eristalis (Eoseristalis) stipator* Osten Sacken

(Fig. 15, male genitalia)

*Eristalis latifrons* Loew, 1866: 169 (preocc. Zetterstedt, 1843). Type-loc.: Mexico, Matamoros. Lectotype ♂ MCZ, Cambridge (here designated). Williston 1892: 60 (key reference, Mexico); Giglio-Tos 1893: 5 (description, Mexico); Aldrich 1905: 386 (catalog citation); Kertész 1910: 224 (catalog citation); Hull 1925: 295 (key reference, description); Curran 1930: 6, 1934: 410 (key reference); Fluke 1957: 137 (catalog citation).

*Eristalis stipator* Osten Sacken, 1877: 336.

Type-loc.: USA, Colorado, Manitou Park. Lectotype ♂ MCZ, Cambridge (here designated). Thompson et al. 1976: 102 (catalog citation).

*Eristalis latifrons* var. *maculipennis* Townsend, 1897: 93. Type-loc.: USA, New Mexico, Las Cruces. Lectotype ♀ USNM, Washington (here designated). Townsend 1895: 49 (descriptive note); Aldrich 1905: 387 (catalog citation); Kertész 1910: 224 (catalog citation).

Male.—Head: Black; face densely white pollinose except shiny medially on tubercle, white pilose; gena shiny, white pilose posteriorly; frontal lunule brownish black; frontal triangle white pollinose, shiny apicomediaally, white pilose; vertical triangle sparsely brownish pollinose, yellow and black pilose; eye white pilose; eye contiguity long, about  $\frac{1}{3}$  longer than vertical triangle; occiput densely white pollinose, white pilose ventrally becoming more yellow on dorsal  $\frac{1}{4}$ .

Thorax: Black except orange scutellum, shiny, orange pilose dorsally, yellow pilose on pleuron; halter yellow; squama white; spiracular fringes white. Wing: Bare, hyaline, tegula yellow pilose. Legs: Coxae and trochanters black, yellow pilose; femora brownish black except yellow apical  $\frac{1}{5}$ , yellow pilose except with some black pile anteroventrally on mid and hind femora; fore tibia orange on basal  $\frac{2}{3}$ , brownish black apically, yellow pilose; mid tibia orange on basal  $\frac{3}{4}$ , brownish black apically, yellow pilose; hind tibia orange on basal  $\frac{1}{2}$ , brownish black apically, yellow pilose except with black pile intermixed on apical  $\frac{1}{2}$ ; fore tarsus brown, yellow pilose; mid tarsus yellow on basal  $\frac{3}{4}$  of 1st tarsomere and basal  $\frac{1}{2}$  of 2nd tarsomere, brown elsewhere, with pale areas with yellow pile, with yellow and black pile elsewhere; hind tarsus black, yellow pilose except with black pile intermixed anteriorly.

Abdomen: 1st tergum brown, grayish-white pollinose, white pilose; 2nd tergum

brown-black medially in form of X-shaped macula, yellow elsewhere, shiny except for brown pollinose apicomedial fascia and white pollinose apical margin (incisure), yellow pilose on basal  $\frac{2}{3}$  and laterally, black pilose on apicomedial  $\frac{1}{3}$ ; 3rd tergum brown, with or without medial transverse orange macula, shiny except narrowly white pollinose along anterior margin and apical margin (incisure), yellow pilose; 4th tergum shiny except narrowly white pollinose along anterior margin and apical margin (incisure), brownish-black except yellowish-white apical margin, white pilose; genitalia brownish black, shiny, yellow pilose; 1st sternum brown, gray pollinose, yellow pilose; 2nd sternum brownish medially, yellow laterally, shiny, yellow pilose; 3rd and 4th sterna brownish black, shiny, yellow pilose.

Female.—Similar; front entirely white pilose, about .45 times as wide as head at antenna, tapering to about .30 times as wide dorsally; 5th tergum and sternum black, yellow pilose.

Type data.—*Eristalis latifrons* Loew, lectotype ♂ in Museum of Comparative Zoology, Cambridge, labelled "Mat," "Loew Coll," "Type, 4073" and "Eristalis, latifrons, m." [in Loew's hand].

*Eristalis stipator* Osten Sacken, lectotype ♂ in Museum of Comparative Zoology, Cambridge, labelled "Manitou, Park," "Osten, Sacken, Coll.," "Type, 7,885" and "latifrons." There are another 8 specimens from various localities that have been labelled as paralectotypes.

*Eristalis latifrons* var. *maculipennis* Townsend, lectotype ♀ in National Museum of Natural History, Washington, labelled "Las Cruces, 6.7 N.M." and "Coll. Townsend." No other syntypes were found. George Byers carefully checked the Snow Museum collections, where additional material should have been deposited. While this variety was formally named in 1897, Townsend referred back to his description of it in his 1895 paper. Hence, the type series consists of the female mentioned in the

1897 as well as those mentioned in the earlier paper. The Las Cruces material of his 1895 paper is undoubtedly what he refers to as "numerous specimens from Mesilla valley of the Rio Grande" in his 1897 paper.

Material examined.—MEXICO. *Chihuahua*: Sierra Madre, Head of Rio Piedras Verdes, about 7,300 ft., 3 Jul, C. H. T. Townsend (1 ♂ USNM); same locality, but "9.6" (1 ♀ USNM). Also, numerous specimens from the United States were examined.

Distribution.—*Eristalis stipator* is found in southern Canada (British Columbia to Nova Scotia), throughout the United States and in northern Mexico. The above record is the southern-most for the species.

#### OTHER SPECIES

A few other species of *Eristalis* have been erroneously reported from the neotropics. *Eristalis arbustorum* and *E. transversa* were incorrectly recorded from Jamaica (Thompson 1981: 147). Macquart (1842: 32) described *Eristalis quadelupensis* from Guadeloupe which was based on an apparently mislabeled specimen of *E. pertinax* (Scopoli) (Thompson 1981: 146). Likewise, Bigot (1880: 217) described *E. inca* from Peru. Verrall (1901: 514; Kertész 1910: 230) noted that the name was based on a specimen of *E. pertinax*, an identification which has been confirmed recently (Nielsen, in litt.). The following two *Palpada* species are treated here as they may be confused with *Eristalis* species due to their bare katepimera.

#### *Palpada eristaloides* Thompson, new species

(Fig. 14, male genitalia)

Male.—Head: Face brownish yellow, yellow pollinose except shiny medial vitta, yellow pilose; gena yellow brown, shiny, yellow pilose posteriorly; occiput white pollinose and pilose on ventral  $\frac{3}{4}$ , more grayish pollinose on dorsal  $\frac{1}{4}$ , black pilose dorsally; frontal lunule yellow; front dark,

brownish black pollinose except more yellowish pollinose laterally along eye margin, black pilose; frontal triangle yellow, yellowish-white pollinose, black pilose; vertex black, brownish-black pollinose, black pilose; eye black pilose on dorsal  $\frac{1}{2}$ , yellow pilose ventrally; eye contiguity short, about  $\frac{1}{3}$  as long as vertical triangle; eyes dichoptic, separated by distance equal to arisal width; antenna orange, orange pilose except for a few long black bristle-like hairs on 2nd segment; basoflagellomere with a large basoventral sensory pit on mesal surface; arista brownish black, bare.

Thorax: Black; mesonotum generally dull black pollinose, with pale grayish-white pollinose pattern, black pilose medially, dark brownish-orange pilose anteriorly and laterally; mesonotal pale areas anteriorly and laterally, on transverse suture, and in form of broad submedial vittae which extend  $\frac{2}{3}$  distance to scutellum; postalar callus dark brownish-black pilose; scutellum yellowish orange, slightly brownish black basomedially, black pilose; pleuron gray pollinose, brownish-orange pilose; ampulla orange; plumula and halter yellow; squama brownish black on dorsal lobe and brown on margin of ventral lobe, yellowish orange elsewhere; spiracular fringes white. Wing: Hyaline, bare except microtrichose posterior to stem vein and basoanterior corner of alula. Legs: Coxae black, gray pollinose, yellow pilose; trochanters black, shiny except fore trochanter gray pollinose, yellow pilose; hind trochanter with dense apical tuft of black setulae; fore and mid femora blackish brown except yellow apically, yellow on apical  $\frac{1}{2}$  anteriorly, apical  $\frac{1}{4}$  posteriorly, yellow pilose; hind femur arcuate, blackish brown except yellow on apical  $\frac{1}{4}$ , yellow pilose with short black spinose hairs ventrally; tibiae yellow, yellow pilose; hind tibia with ventromedial carina on basal  $\frac{1}{4}$ , with apicolateral spinose setal patch; fore tarsus black except yellow basotarsomere, yellow pilose; mid and hind tarsi black except yellow basotarsomere and basal  $\frac{1}{2}$  of 2nd tarsomere, yellow pilose.

Abdomen: 1st tergum yellow except brown on medial  $\frac{1}{3}$ , gray pollinose, yellow pilose; 2nd tergum dull yellowish orange except black medial T-shaped maculae and apicolateral corners, yellowish orange pilose except for a few black hairs apicomediaally; 3rd tergum dull black except large orange basolateral maculae on basal  $\frac{2}{3}$  and yellow apical margin, black pilose except for a few longer lateral yellow hairs; 4th tergum dull black except yellow apical margin, black pilose; 5th tergum black, shiny on apical  $\frac{1}{2}$ , dull black pollinose on basal  $\frac{1}{2}$ , black pilose; 1st sternum reduced, yellow, sparsely white pollinose, yellow pilose; 2nd thru 4th sterna yellow, slightly more brownish medially and laterally, shiny, yellow pilose; 5th tergum black, shiny, yellow pilose.

Female.—Similar; front entirely black pilose, dark brown pollinose medially and entirely on dorsal  $\frac{1}{3}$ , light tan pollinose laterally on ventral  $\frac{2}{3}$ , brown pollinose elsewhere, about .35 times as wide as head at antenna, tapering to about .15 times as wide dorsally. Legs: Darker, basal  $\frac{2}{3}$  of front and middle femora brown, basal  $\frac{3}{4}$  of hind femur brown, hind tibia and trochanter without black setal patches or tufts; 5th tergum brownish black, black pollinose on basal  $\frac{1}{2}$ , shiny apically.

Type data.—Holotype ♂ in Canadian National Collection, Ottawa, labelled EC-UADOR: Carchi, 10 km SW Tulcan, 2900 m, 28 Jun 1965 (L. Peña).

Paratypes: ECUADOR. Carchi, Troya, 2950 m, 11-13 Jun 1965 (L. Peña) 1 ♂ (USNM); Azuay, Cerro Tinajillas, 3100 m, 18-21 Mar 1965 (L. Peña) 1 ♀ (CNC); Napo, 0°22'S 78°8'W, 3500 m, 4-7 Mar 1976 (G. & M. Wood) 2 ♀ (CNC, USNM).

Etymology.—This species is named *eristaloides* as it is phenotypically like *Eristalis* in having the katepimeron bare.

Distribution.—*Palpada eristaloides* is known only from high elevations in Ecuador.

Discussion.—*Palpada eristaloides* is dis-



tinctive with its mesonotal pollinose pattern and bare katepimeron.

*Palpada semicircula* Walker  
(Fig. 12, male genitalia)

*Eristalis semicirculus* Walker, 1852: 249. Type-loc.: Honduras. Lectotype ♂ BMNH, London (here designated). Wiliston 1892: 78 (citation); Wulp 1896: 114 (East Indies [error]), 1899: 52 (correction of previous error); Aldrich 1905: 389 (catalog citation); Kertész 1910: 235 (catalog citation); Fluke 1957: 143 (catalog citation).

*Palpada semicirculus*: Thompson et al. 1976: 109 (catalog citation).

*Eristalis tenuifrons* Curran, 1930: 12. Type-loc.: Panama, Canal Zone, Fort Randolph. Holotype ♀ AMNH, New York. Curran 1934: 409 (key reference); Fluke 1957: 145 (catalog citation); Thompson et al. 1976: 102 (catalog citation). **New synonym.**

Male.—Head: Black; face white pollinose except for shiny narrow medial vitta, white pilose; gena shiny; frontal triangle shiny apicomediaally, white pollinose elsewhere, black pilose medially, white pilose laterally; vertical triangle gray pollinose anteriorly, black pollinose on ocellar triangle, black pilose; occiput densely white pollinose and pilose on ventral  $\frac{2}{3}$ , more brownish black pollinose and black pilose dorsally; antenna black pilose; scape and pedicel brownish orange; basoflagellomere orange-brown on basoventral  $\frac{1}{3}$ , brownish black elsewhere; arista bare; eye pile short, white; eyes narrowly dichoptic, separated by about basal width of arista.

Thorax: Black, extensively yellowish white pilose, black pilose on scutellum and postalar callus, with some intermixed black pile on posterior  $\frac{1}{2}$  of scutum; mesonotum dull black pollinose except broadly gray pollinose anteriorly, laterally, across transverse suture and anterior to scutellum; gray pollinose areas appear as 2 broad anterior fasciae connected to a large U-shaped mac-

ula posteriorly; pleuron gray pollinose, with pollinosity densest on katepisternum; scutellum yellow except black basal  $\frac{1}{3}$ ; halter orange; plumula white; squama white with black margin and yellow apical fringe; spiracular fringes dirty white. Legs: Black except brownish orange femoral-tibial joints, pale pilose except black pile on anterior and ventral surfaces of mid tibia, black pilose on anterodorsal surface of fore and mid femora, black pilose on apex and apicoventral margin of hind femur and black pilose on tarsi; hind femur swollen; hind tibia with ventromedial carina on apical  $\frac{1}{2}$  in addition to basoventral carina; hind trochanter with only normally white pile; epaulet black pilose except for some orange pile; tegula brown pilose; basicosta black pilose; wing hyaline, bare except for a few widely scattered microtrichia apically and posteriorly.

Abdomen: Sterna 1, 3 and 4 black, gray pollinose, white pilose; sternum 2 yellow, shiny, white pilose; 1st tergum black, gray pollinose, white pilose; 2nd tergum extensively black, dull black pollinose, white pilose, with large subtriangular shiny yellow basolateral macula and yellow apical margin (incisure), with macula narrowly separated from lateral margin and occupying basolateral  $\frac{2}{3}$  of tergum; 3rd tergum similar to 2nd, with macula smaller, occupying only basolateral  $\frac{1}{2}$ , more extensive black pilose on apicomediaal  $\frac{2}{3}$ ; 4th tergum black except yellow apical margin (incisure), shiny on basal  $\frac{2}{3}$ , dull pollinose apically, black pilose on apical  $\frac{1}{3}$ , elsewhere black pilose medially, yellow pile laterally.

Female.—Similar to male (see Curran's description).

Type data.—*Eristalis semicirculus* Walker, lectotype of unknown sex, in The Natural History Museum, London, labelled "Type" [green circular type label], "Holotype" [red circular type label], "Hond., Dys.," "S. America, Hondura," "Eristalis, semicirculus, Wlk." [in Austen's hand] and "semicirculus" [in Walker's hand]. A mere fragment remains of the type of *E. semicir-*

*cula* Walker, only the thorax and basal two segments of the abdomen are extant. However, enough remains to be certain of its identity.

*Eristalis tenuifrons* Curran, holotype ♀ in American Museum of Natural History, New York, labelled "Panama, Canal Zone, Fort Randolph, Feb 6, 1929, C. H. Curran," holotype *Eristalis tenuifrons* Curran [red type label in Curran's hand].

Material examined.—BELIZE. Stann Creek, Sittes Point, Malaise trap at Possum Point Biological Station, 22–30 April 1987, Spangler & Faitoute (57 ♂ USNM). PANAMA. *Darien*: Garachine, Feb 1953, F.S. Blanton (1 ♂ USNM). *Canal Zone*: Camaron, Fort Kobbe, 22 Jul 1952, F. S. Blanton (1 ♂ USNM).

Distribution.—*Palpada semicircula* is currently known only from Belize and Panama, but probably will be found throughout the lowlands of Central America.

Discussion.—*Palpada semicircula* is a small eristaline fly with the typical *Palpada* appearance of gray pollinose fasciae on the mesonotum and pale maculae on the abdomen. However, the species is immediately separated from almost all other *Palpada* species by the bare katapimeron. *Palpada eristaloides* is the only other *Palpada* species with a bare katapimeron and is distinguished by its larger size and lack of gray fasciae on the mesonotum.

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#### LITERATURE CITED

- Aldrich, J. M. 1905. A catalogue of North American Diptera. Smithsonian Miscellaneous Collections 46(2), 680 pp.
- Bigot, J. M. F. 1880. Diptères nouveaux ou peu connus. 14e partie, XXI: Syrphidi (mihi), Genre *Eristalis* (Fabr.). Annales de la Société Entomologique de France (5) 10: 213–230.
- Brèthes, J. 1907. Catálogo de los Dípteros de las Repúblicas del Plata. Anales Museo Nacional de Buenos Aires (3)9: 277–305. (28 Oct.)
- Coquillett, D. W. 1910. The type-species of the North

- American genera of Diptera. Proceedings of the United States National Museum 37: 499–647.
- Culotta, E. 1992. Museums cut research in hard times. *Science* 256: 1268–1271.
- Curran, C. H. 1930. New species of Eristalinae with notes (Syrphidae, Diptera). *American Museum Novitates* 411, 27 pp. (21 Mar.)
- Curran, C. H. 1934. The Diptera of Kartabo, Bartica District, British Guiana. *Bulletin of the American Museum of Natural History* 66: 287–532. (30 Jul.)
- Curtis, J. 1832. *British Entomology: Being illustrations and descriptions of the genera of insects found in Great Britain and Ireland*. Vol. 9, pls. 384–433. London.
- Enderlein, G. 1940. Die Dipterenfauna der Juan-Fernández-Inseln und der Oster-Inseln. Pp. 643–680. In Skottsberg (ed.), *Natural History of Juan Fernández and Easter Island*. *Zoology* 3.
- Erwin, T. L. 1992. A current vision of insect diversity, pp. 91–97. In Sarukhán, J. and Dirzo, R., comp., *México ante los de la biodiversidad*. 343 pp. Comisión Nacional para el conocimiento y uso de la Biodiversidad, Mexico
- Etcheverry, M. 1963. Descripciones originales, sinonimia y distribución geográfica de las especies de la familia Syrphidae (Diptera) en Chile. *Publicaciones del Centro de Estudios Entomológicos, Universidad de Chile* 5, 144 pp.
- Etcheverry, M. and R. D. Shenefelt 1962. A preliminary study of the genitalia of Chilean Syrphidae. XI. *Internationaler Kongress für Entomologie, Wien* 17. bis 25. August 1960. *Verhandlungen* 1: 207–214.
- Fabricius, J. C. 1805. *Systema antliatorum secundum ordines, genera, species adiectasynonymis, locis, observationibus, descriptionibus*. 373 pp., + 30 pp. Reichard, Brunsvigae [=Brunswick].
- Fluke, C. L. 1957. Catalogue of the family Syrphidae in the Neotropical Region. *Revista Brasileira de Entomologia* 7: 1–181.
- Gámez, R. and I. D. Gauld 1993. Costa Rica: An innovative approach to the study of tropical biodiversity, pp. 329–336. In LaSalle, J. and Gauld, I. D., eds., *Hymenoptera and Biodiversity*. xx + 999 pp., C.A.B. International, Redwood Brooks.
- Gaston, K. J. and R. M. May 1992. Taxonomy of taxonomists. *Nature* 356: 281–282.
- Gaunitz, S. 1969. Studien über die unterfamilie Eristalinae. Der Bau des männlichen genitalapparats (Dipt., Syrphidae). *Entomologisk Tidskrift* 90: 73–99. (15 Aug.)
- Giglio-Tos, E. 1892. Diagnosi di nuove specie di Ditteri. VI. Sirfidi del Messico (1). *Bollettino dei Musei di Zoologia ed Anatomia Comparata della R. Università di Torino* 7 (123), 7 pp.
- Giglio-Tos, E. 1893. Ditteri del Messico. Pt. 2, Syrphidae—Conopidae—Pipunculidae. 80 pp. Torino. Also published in *Mem. Reale Accademia delle Scienze Torino* (2) 43: 321–398, 1 pl.
- Goffe, E. R. 1946. The genera in Syrphidae of Liroy, 1864 (Diptera). *Journal of the Society for British Entomology* 3: 27–30. (25 Jun.)
- Gutiérrez, R. 1939. Insectos capturados en Río Blanco. *Revista Chilena de Historia Natural* 43: 32–35.
- Holden, C. 1989. Entomologists wane as insects wax. *Science* 246: 754–756.
- Hovore, F. T. 1991. INBio: By biologists for biologists. *American Entomologist* 37: 157–158.
- Hull, F. M. 1925. A review of the genus *Eristalis*. *Ohio Journal of Science* 15: 11–43 [Part 1], 285–310 [Part 2].
- Hull, F. M. 1935. Some undescribed species of *Eristalis* from North America in the United States National Museum. *Journal of the Washington Academy of Sciences* 25: 326–331.
- International Commission on Zoological Nomenclature (I.C.Z.N.) 1963. Opinion 678. The suppression under the Plenary Powers of the pamphlet published by Meigen, 1800. *Bulletin of Zoological Nomenclature* 20: 339–342.
- International Commission on Zoological Nomenclature (I.C.Z.N.) 1993. Opinion 1747. *Eristalis* Latreille, 1804, *Helophilus* Fabricius, 1805, *Xylota* Meigen, 1822, and *Eumerus* Meigen, 1822 (Insecta, Diptera) conserved. *Bulletin of Zoological Nomenclature* 50: 256–258.
- Jacobs, J. Ch. 1900. Diagnoses d'Insectes recueillis par l'expédition Antarctique Belge. *Annales de la Société Entomologique de Belgique* 44: 107.
- Jacobs, J. Ch. 1906. *Bibionidae, Chironomidae, Culicidae, Tipulidae, Syrphidae, Muscidae, Rhyphidae, Anthomyidae*, pp. 67–71, pl. 3, figs. 3–5. In Belgium, Commission de la Belgica. *Expédition Antarctique Belge. Résultats du Voyage du S. Y. Belgica en 1897-1898-1899 sous le commandement de A. de Gerlache de Gomery*. Rapports scientifiques. *Zoologie, Insectes (Diptères)*.
- Jaenicke, F. 1867. Neue exotische Dipteren. *Abhandlungen herausgegeben von der Senckenbersichen Naturforschenden Gesellschaft* 6: 311–408, pls. 43–44. Also, published separately.
- James, M. T. 1947. The flies that cause myiasis in man. U. S. Department of Agriculture, Miscellaneous Publication 631, 175 pp.
- Janzen, D. H. 1991. How to save tropical biodiversity. *American Entomologist* 37: 159–171.
- Kanervo, E. 1938. Zur systematik und Phylogenie der westpaläarktischen *Eristalis*-arten (Dipt. Syrphidae) mit einer Revision derjenigen Finnlands. *Annales Universitatis Turkuensis (A)* 6(4), 54 pp.
- Kertész, K. 1910. *Catalogus dipterorum hucusque descriptorum*. Vol. 7, 470 pp. Budapest.
- Latreille, P. A. 1804. Tableau méthodique des Insectes, pp. 129–200. In *Société de Naturalistes et*

- d'Agriculturs, Nouveau dictionnaire d'histoire naturelle, appliqué aux arts, principalement à l'économie rurale et domestique. Vol. 24: Tableaux méthodiques d'histoire naturelle. 238 pp. Paris.
- Latreille, P. A. 1810. Considérations générales sur l'ordre naturel des animaux composant les classes des Crustacés, des Arachnides, et des Insectes; avec un tableau méthodique de leurs genres, disposés en familles. 444 pp. Schoell, Paris. (23 May)
- Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum caracteribus, differentiis, synonymis, locis. Ed. 10, Vol. 1. 824 pp. L. Salvii, Holmiae [=Stockholm]. (1 Jan.)
- Lioy, P. 1864. I ditteri distributi secondo un nuovo metodo di classificazione naturale. Atti dell' I. R. Istituto Veneto di Scienze, Lettere ed Arti (3) 9: 738–760.
- Loew, H. 1866. Diptera Americae septentrionalis indigena. Centuria sexta. Berliner Entomologische Zeitschrift (1865) 9: 127–186.
- Lynch Arribalzaga, F. 1892. Dipterología Argentina (Syrphidae). [part] Anales de la Sociedad Científica Argentina 33: 236–254. (Jun.)
- Lynch Arribalzaga, F. 1893. Dipterología Argentina (Syrphidae). [part] Anales de la Sociedad Científica Argentina 34: 241–280. (Jan.)
- Macquart, J. 1842. Diptères exotiques nouveaux ou peu connus. Mémoires de la Société des Sciences, de l'Agriculture et des Arts de Lille 1841 (1): 65–200, 22 pls. Also published separately as his "Diptères exotiques nouveaux ou peu connus," vol. 2, Pt. 2, pp. 5–140, 22 pls. Paris.
- Macquart, J. 1846. Diptères exotiques nouveaux ou peu connus. Supplément. Mémoires de la Société des Sciences, de l'Agriculture et des Arts de Lille (1845) 1844: 133–364, 20 pls. Also published separately as his "Diptères exotiques nouveaux ou peu connus. Supplément," pp. 5–238, 20 pls. Paris.
- Macquart, J. 1850. Animaux invertébrés. Catalogue du Musée d'Histoire naturelle de la Ville de Lille. Tome 2, iv+ 634 pp. Lille.
- Macquart, J. 1855. Diptères exotiques nouveaux ou peu connus. 5.º supplément. Mémoires de la Société des Sciences, de l'Agriculture et des Arts de Lille (2) 1: 25–156, 7 pls. (before 18 Aug.)
- May, R. M. 1990. How many species? Philosophical Transaction of the Royal Society, London 330 (B): 293–304.
- May, R. M. 1992. How many species inhabit the earth? Scientific American, Oct, pp. 42–48.
- Meigen, J. W. 1800. Nouvelle classification des mouches a deux ailes (Diptera L.) d'après un plan tout nouveau. 40 pp. Paris. A Facsimile appears in Hemming, 1945: 121–160. This publication has been suppressed (I.C.Z.N. 1963).
- Meigen, J. W. 1803. Versuch einer neuen Gattungseintheilung der europäischen zweiflügeligen Insekten. Magazin für Insektenkunde 2: 259–281.
- Meigen, J. W. 1804. Klassifikation und Beschreibung der europäischen zweiflügeligen Insekten (Diptera Linn.). Erster Band. Abt. I. pp. i–xxviii + 1–152, pls. 1–8; Abt. II, pp. i–vi + 153–314, pls. 9–15. Braunschweig.
- Meigen, J. W. 1822. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Vol. 3, x + 416 pp., pls. 22–32. Hamm.
- Mik, J. 1897. Einige Bemerkungen zur Dipteren-Familie der Syrphiden [concl.] Wiener Entomologische Zeitung 16: 113–119. (31 Mar.)
- National Science Board (NSB). 1989. Loss of biological diversity: A global crisis requiring international solutions. Report NSB-89-171, vii + 19 pp. National Science Foundation, Washington.
- Novacek, M. J. 1992. The meaning of systematics and the biodiversity crisis, pp. 101–108. In Eldredge, N., ed., Systematics, ecology, and the biodiversity crisis. xiv + 220 pp., Columbia University Press, New York.
- Osten Sacken, C. R. 1877. Western Diptera: Descriptions of new genera and species of Diptera from the region west of the Mississippi and especially from California. Bulletin of the United States Geological and Geographical Survey of the Territories 3: 189–354.
- Porter, C. E. 1921. Sobre algunos Sífidos de Chile. Revista Chilena de Historia Natural 25: 446–447.
- Porter, C. E. 1924a. Algunos Insectos colectados en el sur del país por el enor Faminio Ruiz P. Revista Chilena de Historia Natural 28: 81–82.
- Porter, C. E. 1924b. Enumeración de sírfidos colectados en San Jose de Maipo en Octubre y Novbre. de 1923. Revista Chilena de Historia Natural 28: 98.
- Porter, C. E. 1927. Algunos insectos de Mancera. Revista Chilena de Historia Natural 31: 121–122.
- Porter, C. E. 1928. Entomología Chilena. Primera lista de insectos de Panimavida. Revista Chilena de Historia Natural 32: 221–225.
- Porter, C. E. 1932. Acerca de algunos insectos Chilenos. Revista Chilena de Historia Natural 36: 190–193.
- Porter, C. E. 1934. Insectos colectados en Puente Alto (1). Revista Chilena de Historia Natural 38: 169–171.
- Porter, C. E. 1938. Algunos insectos de las provincias de Atacama y Coquimbo. Revista Chilena de Historia Natural 42: 154–155.
- Raven, P. H. and Wilson, E. O. 1992. A fifty-year plan for biodiversity surveys. Science 258: 1099–1100.
- Roberts, L. 1988. Hard choices ahead on biodiversity. Science 241: 1759–1761.
- Rondani, C. 1845. Ordinamento sistematico dei generi italiani degli insetti ditteri. Nuovi Annali delle

- Scienze Naturali e Rendiconto delle Sessioni della Società Agraria, e dell' Accademie delle Scienze dell'Istituto di Bologna (2) 2: 256–270, 443–459.
- Rondani, C. 1857. *Dipterologiae Italicae prodromus*. Vol. 2: Species Italicae ordinis dipterorum in genera characteribus definita, ordinatim collectae, methodo analitica distinctae, et novis vel minus cognitis descriptis. Pars prima: Oestridae, Syrphidae, Conopidae. 264 pp., 1 fig. Parmae (=Parma).
- Ruiz P, F and Stuardo Ortiz, C. 1935. Insectos colectados en las termas de Chillán. *Revista Chilena de Historia Natural* 39: 313–322.
- Schiner, J. R. 1868. Diptera. In *Reise der osterreichischen Fregatte Novara*. Zoologia. Vol. 2, Abt. 1, B. 388 pp. Wien.
- Shannon, R. C. and Aubertin, D. 1933. Syrphidae. Diptera of Patagonia and South Chile. *Brit. Mus. (Nat. Hist.)* 6: 120–170.
- Stuardo Ortiz, C. 1946. *Catalogo de los Dipteros de Chile*. 251 pp. Min. Agric. Chile, Santiago.
- Tangley, L. 1990. Cataloging Costa Rica's diversity. *BioScience* 40: 633–636.
- Thompson, F. C. 1972. A contribution to a generic revision of the Neotropical Milesinae (Diptera: Syrphidae). *Arquivos de Zoologia* 23: 73–215.
- Thompson, F. C. 1981. The flower flies of the West Indies (Diptera: Syrphidae). *Memoirs of the Entomological Society of Washington* 9, 200 pp. (2 Sep.)
- Thompson, F. C. 1996. Names: The keys to biodiversity, pp. 199–211. In *Readka-Kudla, M. L., D. E. Wilson and E. O. Wilson, eds., Biodiversity II*. J. Henry Press, Washington
- Thompson, F. C., J. R. Vockeroth and Y. S. Sedman. 1976. Family Syrphidae. A catalogue of the Diptera of the Americas south of the United States 46, 195 pp.
- Thompson, F. C., J. R. Vockeroth and M. C. D. Speight. 1982. The Linnaean species of flower flies (Diptera: Syrphidae). *Memoirs of the Entomological Society of Washington* 10: 150–165 (30 Sep.)
- Townsend, C. H. T. 1895. Contributions to the Dipterozoology of North America.—I. Syrphidae. *Transaction of the American Entomological Society* 22: 33–55.
- Townsend, C. H. T. 1897. Diptera from the headwaters of the Gila River. I. *Psyche* 8: 38–41, 92–94.
- Verrall, G. H. 1901. Platypozidae, Pipunculidae, and Syrphidae of Great Britain. Vol. 8, 691 pp. In his *British Flies*. Cambridge.
- Walker, F. 1852. [Diptera. Continued], pp. 157–252, pls. v–vi. In his *Diptera*. In [Saunders, W. W.], ed., *Insecta Saundersiana*. London "1856."
- Williston, S. W. 1886. Catalogue of the described species of South American Syrphidae. *Transaction of the American Entomological Society* 14: 308–324.
- Williston, S. W. 1891. Fam. Syrphidae, pp. 57–79. In *Godman, F. D. and O. Salvin, eds., Biologia Centrali-Americana. Zoologia-Insecta-Diptera*, vol. 3, 127 pp. (Feb.)
- Wilson, E. O. 1985a. The biological diversity crisis: a challenge to Science. *Issues in Science and Technology* 2: 20–29.
- Wilson, E. O. 1985b. Time to revive systematics. *Science* 230: 1227.
- Wilson, E. O. 1987. The little things that run the World (The importance and conservation of invertebrates). *Conservation Biology* 1: 344–346.
- Wilson, E. O. 1988. The current status of biological diversity, pp. 3–18. In *Wilson, E. O. and Peters, F. M., eds., Biodiversity*. xiii + 521 pp., National Academy Press, Washington.
- Wilson, E. O. 1992. *The diversity of life*. 424 pp. Harvard University Press, Cambridge.
- Wulp, F. M. van der 1882a. Remarks on certain American Diptera in the Leydon Museum and description of nine new species. *Notes from the Leyden Museum* 4: 73–92.
- Wulp, F. M. van der 1882b. *Amerikansche Diptera*. *Tijdschrift voor Entomologie* 25: 77–136, pls. 9–10.
- Wulp, F. M. van der 1896. *Catalogue of the described Diptera from South Asia*. 220 pp. "Dutch Entomological Society," The Hague.
- Wulp, F. M. van der 1899. *Verbeteringen en Aanvullingen in den Catalogue of the described Diptera from South Asia*. *Tijdschrift voor Entomologie* 42: 41–57.
- Yoon, C. K. 1993. Counting creatures great and small. *Science* 260: 620–622.
- Zetterstedt, J. W. 1837. *Conspectus familiarum, generum et specierum dipterorum, in Fauna Insectorum Lapponica descriptorum*. *Isis, Jena* 21: 28–67. (Jan.)
- Zetterstedt, J. W. 1838. *Sectio Tertia: Diptera*, pp. 477–868. In his *Insecta Lapponica*. vi + 1,140 (pp.). L. Voss, Lipsiae [=Leipzig]. (before Sep.)
- Zetterstedt, J. W. 1842–60. *Diptera Scandinaviae. Disposita et descripta*. Vol. 1, pp. iii–xvi + 1–440 (1842); vol. 2, pp. 441–894 (1843); vol. 3, pp. 895–1280 (1844); vol. 4, pp. 1281–1738 (1845); vol. 5, pp. 1739–2162 (1846); vol. 6, pp. 2163–2580 (1847); vol. 7, pp. 2581–2934 (1848); vol. 8, pp. 2935–3366 (1849); vol. 9, pp. 3367–3710 (1850); vol. 10, pp. 3711–4090 (1851); vol. 11, pp. v–xii + 4091–4546 (1852); vol. 12: Sup. 3, pp. v–xx + 4547–4942 (1855); vol. 13: Sup. 4, pp. v–xvi + 4943–6190 (1859); vol. 14, pp. 6191–6609 (1860). *Lundbergiana, Lundae* [=Lund].
- Zuska, J. and Berg, C. O. 1974. A revision of the South American genus *Tetanoceroides* (Diptera: Sciomyzidae), with notes on colour variations correlated with mean temperature. *Transaction of the Royal Entomological Society of London* 125: 329–362. (28 Feb.)