

## Calliphoridae from Chile: key to the genera and species (Diptera: Oestroidea)

*Calliphoridae de Chile:*

*clave para los géneros y especies (Diptera: Oestroidea)*

Christian R. González<sup>1</sup>, Lorena Llanos<sup>1</sup>, Christopher Oses<sup>1</sup>, Mario Elgueta<sup>2</sup>

### Resumen

La familia Calliphoridae incluye alrededor de 1.500 especies en 150 géneros, 120 de las cuales están citadas para las Regiones Neotropical y Andina. Actualmente, los Calliphoridae de Chile comprenden 20 especies, clasificadas en cuatro subfamilias y 12 géneros con 3 especies endémicas. Se entrega una clave para reconocer géneros y especies de Chile. Se discute la baja diversidad de especies de Calliphoridae comparada con otros países al sur de Estados Unidos.

### Palabras clave:

taxonomía, califóridos, clave, Patagonia, Chile.

### Abstract

The family Calliphoridae includes around 1,500 species belongs to 150 genera, 126 of them are recorded in the Neotropical and Andean regions. In Chile, the Calliphoridae family comprises 20 species belonged to four subfamilies and twelve genera, three of them are endemic to Chile. A key to all genera and species of blow flies recorded in Chile are provided. The low diversity of blow flies of Chile compared to other countries south of the United States is discussed.

### Key words:

Taxonomy, blow flies, key, Patagonia, Chile.

### INTRODUCTION

The family Calliphoridae was first defined

in its present status by Brauer and Bergenstamm (1889). Actually, this family includes more than 1,500 species in approximately 150 genera (Pape *et al.* 2011; Velásquez *et al.* 2017). Commonly, is subdivided into 11 subfamilies (Zhang *et al.* 2016); although recently Marinho *et al.* (2017) raised to family rank the subfamily Mesembrinellinae, a small group of strictly Neotropical calyprate flies, and as a monophyletic lineage inside Oestroidea.

Six subfamilies of Calliphoridae occur south of the United States: Calliphorinae, Chrysomyinae, Luciliinae, Melanomyinae, Polleniinae, and Toxotarsinae (Withworth, 2010). Studies of the family on South America have been mainly focused on Argentina (Mariluis *et al.* 1994), Brazil (Kosmann *et al.* 2013; Pinto de Mello, 2003), Colombia (Amat, 2009; Wolff *et al.* 2012; Wolff & Kosmann, 2016), Ecuador (Tantawi & Sinclair, 2013) and Venezuela (Velásquez *et al.* 2017), Whitworth (2010) studied the species present in the West Indies, providing keys and reviewing some species. Withworth (2012) carried out a revision of the Neotropical species of *Calliphora*, and Withworth (2014) conducted the revision of the genus *Lucilia* Robineau-Desvoidy, 1830. However, in Chile the taxonomic studies are very

<sup>1</sup> Instituto de Entomología, Facultad de Ciencias Básicas, Universidad Metropolitana de Ciencias de la Educación, Santiago, Chile. ✉ christian.gonzalez@umce.cl

<sup>2</sup> Área de Entomología, Museo Nacional de Historia Natural, Santiago, Chile. mario.elgueta@mnhn.cl

few (Mac-Lean & González, 2006).

Mac-Lean and González (2006) provided information available about the 20 species known from Chile, which belong to 13 genera and 3 subfamilies in addition to distribution data and synonymies, citing the genus *Chlorobrachycoma* Townsend, 1918 that is considered synonymous with *Sarconesia* Bigot, 1857 by Evenhuis *et al.* (2015). In Chile, the family is represented by only three endemic species (*Sarconesia dichroa* (Schiner, 1868), *Toxotarsus ambrosianus* (Lopes, 1961), and *T. humeralis* (Walker, 1837)) described from material collected in southern South America and the San Ambrosio Island. Other workers Macquart (1843), Blanchard (1852), and Bigot (1857) also described Chilean material. Shannon (1926) describes two new genera of Chile and mentions species of the country. Smart (1937) reported 16 species and six genera from southern South America, and Lopes (1961, 1962) describes new taxa from the country. The first attempt at cataloging the Calliphoridae of Chile was published by Reed (1888), who considered 4 genera and 9 species. Subsequently, Stuardo (1946) cited 8 genera and 14 species, and James (1970) in the catalog for Neotropical species cited 24 species grouped in 13 genera for the country.

The objective of this work is to provide a key for the identification of the adults of the blow flies genera and species known from Chile.

## MATERIAL AND METHODS

838 specimens were studied (383 females and 455 males). The specimens examined are deposited in the collection of the Instituto de Entomología of the Universidad Metropolitana de Ciencias de la Educación (IEUMCE) and Museo Nacional de Historia Natural (MNHN) both in Santiago, Chile. The observation of external characters was supplemented by the original descriptions of the species or revision of type material (Aldrich, 1931), we also consulted additional literature where Chilean material is considered (Dear, 1979; 1985; Carvalho & Ribeiro, 2000; Pinto de Mello, 2003; Amat, 2008; 2009; Carvalho & Mello-Patiu, 2008; Kosmann *et al.* 2013; Whitworth, 2014). In the key we have adopted the terminology of Cumming & Wood (2009) and Vargas & Wood (2010) for the external morphology. Photographs of the flies were taken using a Nikon trinocular stereomicroscope SMZ 1500 and digital camera DS-Fi2. Depth of field was enhanced by Nikon<sup>TD</sup> ACT-2U software stack multiple images.

In the construction of the key, the genera that only have one species that occurs in Chile independently that these have more than one species worldwide or are monotypic, both names of the genus and the species are included in the same couple. In the first case (*i.e.* only one species present in Chilean territory of a genus with more species), the characters that differentiate this species from its congeners are detailed.

## RESULTS

### *Key to the genera and species of blow flies from Chile*

- |       |   |  |
|-------|---|--|
| 1     | Dorsum of stem-vein of wing bare (Fig. 1A). Greater ampulla oval (Fig. 1B) .....  | 2  |
| 1'    | Dorsum of stem-vein of wing with a row of weak setulae (Fig. 1C). Greater ampulla reniform (Fig. 1D).....   | 4  |
| 2(1)  | Suprasquamal ridge bare. Lower calypter setose. Thorax apparently dull grey or black, no metallic. Abdomen metallic and blue (Fig. 1E) .....  | <b>Calliphora</b> Robineau-Desvoidy. <b>C. vicina</b> Robineau-Desvoidy (This species differs from the other species of the <i>Calliphora</i> in the following characters: frons half or more of gena orange to red, katepisternal setae 2:1, basicosta yellow or orange, and wing with hyaline base). |
| 2'    | Suprasquamal ridge with a conspicuous cluster of setulae near the base of the scutellum. Lower calypter bare above. Thorax and abdomen completely metallic, green or bronze (Fig. 1F) ..... | <b>Lucilia</b> Robineau-Desvoidy...3   |
| 3(2') | Thorax with two post-sutural acrostichal setae. Dark basicosta .....  | <b>L. eximia</b> (Wiedemann)   |
| 3'    | Thorax with three post-sutural acrostichal setae. Pale (yellowish) basicosta (Fig. 1G) .....  |  |

- ..... ***L. sericata*** (Meigen)
- 4(1') Stem-vein of wing bare on ventral surface. Anteroventral edge of the metathoracic spiracle with a row of setulae ..... 5
- 4' Stem-vein of wing with a row of weak setulae on ventral surface (Fig. 1H). Anteroventral edge of the metathoracic spiracle without setulae ..... 12
- 5(4) Greater ampulla with stiff, erect setae. Lower calypter with pilosity scattered over entire dorsal surface .... ***Chrysomya*** Robineau-Desvoidy, ***C. albiceps*** (Wiedemann) (This species differs from the other species of the *Chrysomya* in the following characters: proepisternal seta absent, and at least, presence of four proepisternal setae).
- 5' Greater ampulla bare or at most short pilosity. Lower calypter without pilosity or pilosity restricted to basal half of dorsal surface (Fig. 1I) ..... 6
- 6(5') Lower calypter bare in entire dorsal surface ..... 7
- 6' Lower calypter pilose in basal half of dorsal surface ..... 8
- 7(6) Mesonotum flattened midway. Greater ampulla covered with short pubescence. Anterior spiracle blackish to brown ..... ***Protophormia*** Townsend, ***P. terraenovae*** (Robineau-Desvoidy) (This species differs from the other species of the *Protophormia* in the following characters: arista plumose, with long hairs above and below, postpronotal lobe larger than anterior spiracle).
- 7' Mesonotum not flattened. Greater ampulla covered with short pilosity. Anterior spiracle whitish-

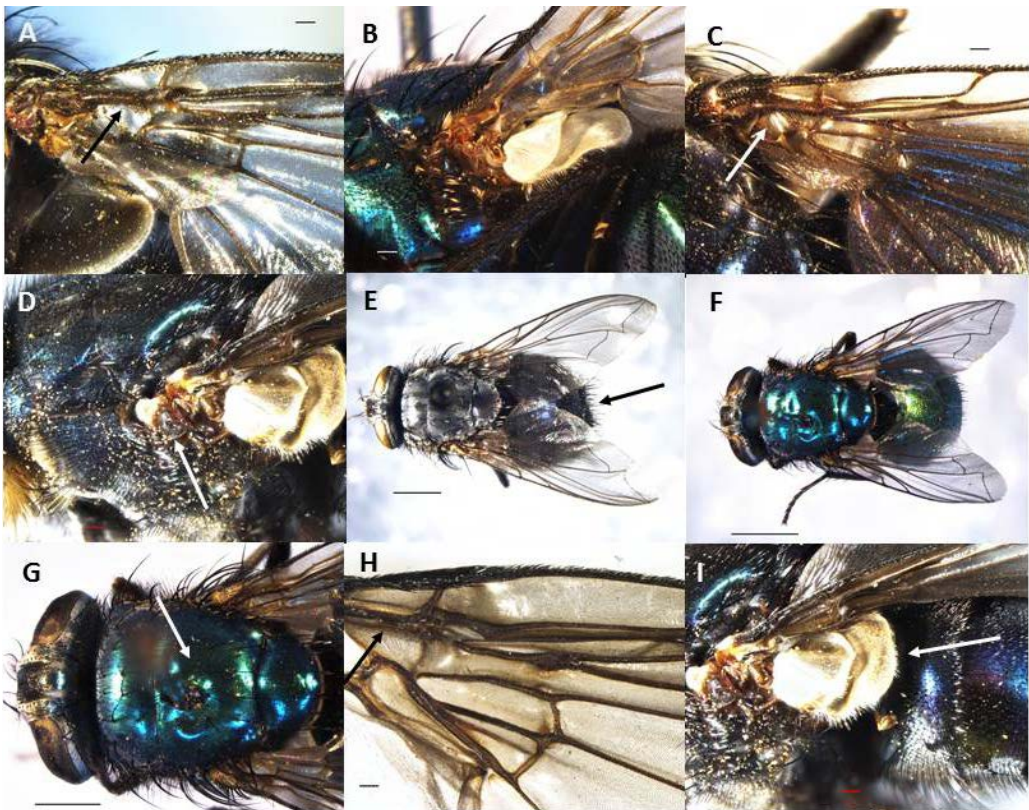


Fig. 1. A. *Calliphora vicina* stem-vein bare (scale bar = 0.1 mm). B. *Lucilia sericata* greater ampulla oval (scale bar = 1.0 mm). C. *Sarconesiopsis chilensis* stem-vein pilose above (scale bar = 0.1 mm). D. *Compsomyiops fulvicrura* greater ampulla reniform (scale bar = 0.1 mm). E. *Calliphora vicina* abdomen metallic blue (scale bar = 1.0 mm). F. *Lucilia sericata* thorax and abdomen completely metallic green (scale bar = 1.0 mm). G. *Lucilia sericata* postsutural acrostichal setae (scale bar = 0.5 mm). H. *Neta chilensis* stem-vein pilose below (scale bar = 0.1 mm). I. *Compsomyiops fulvicrura* lower calypter bare (scale bar = 0.1 mm).

yellow ..... **Hemilucilia** Brauer, **H. segmentaria** (Fabricius) (This species differs from the other species of the *Hemilucilia* in the following characters: pale posterior spiracle, postpronotal lobe, anepisternum and prosternum).

8(6') Palp filiform, not reaching oral margin (Fig. 2A) ..... **Cochliomyia** Townsend ... 9

8' Palp clavate, reaching the oral margin (Fig. 2B) ..... 10

9(8) Fronto-orbital plates with pale setae (Fig. 2C). Females with proclinate orbital setae. Fifth abdominal tergite ventrally with dense and clear pilosity. Female abdomen with conspicuous pruinosity. Wing of male with basicosta orange-yellowish ..... **C. macellaria** (Fabricius)

9' Fronto-orbital plates with dark setae. Females without orbital setae. Fifth abdominal tergite ventrally with dense and dark pilosity. Female abdomen without conspicuous pruinosity. Wing of male with basicosta black ..... **C. hominivorax** (Coquerel)

10(8') Parafacial plates bare. Dorsocentral presutural setae present ..... **Paralucilia** Brauer & Bergenstamm, **P. fulvinota** (Bigot) (This species differs from the other species of the *Paralucilia* in the following characters: mesonotum glossy, prescutum with silvery-brown pilosity, without vittae).

10' Parafacial plates setulose in the upper third (Fig. 2D). Dorsocentral presutural setae absent (Fig. 2E) ..... **Compsomyiops** Townsend ... 11

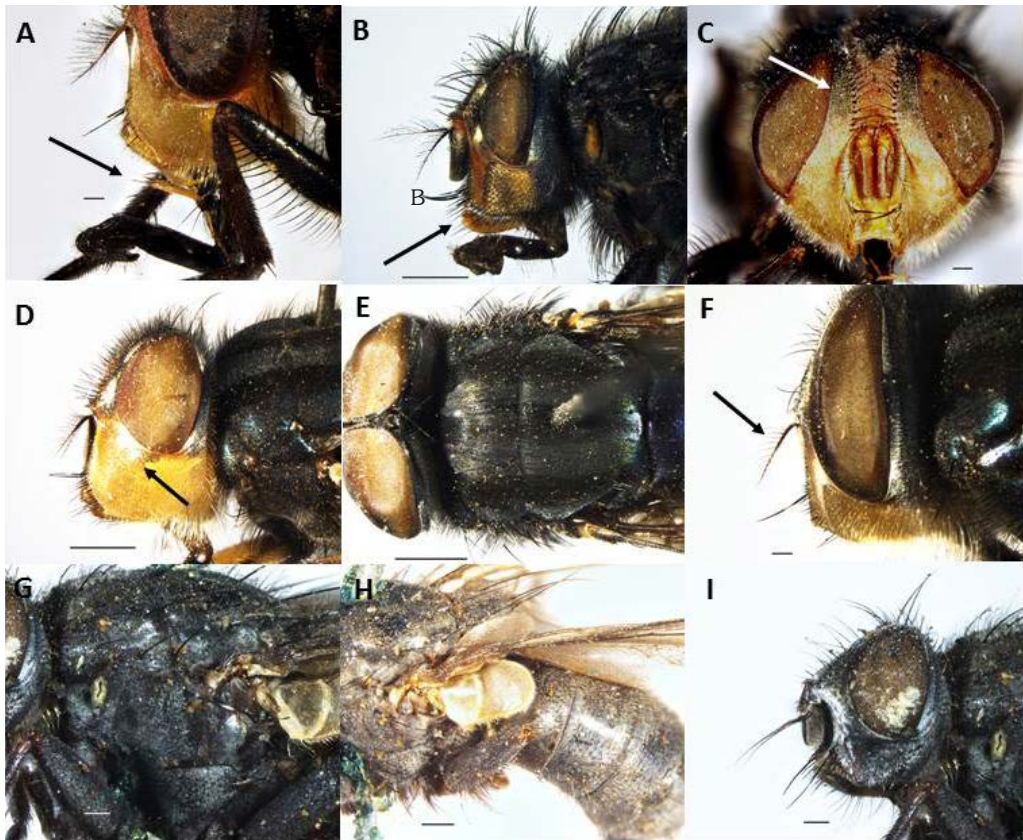


Fig. 2. **A.** *Cochliomyia macellaria* palp filiform (scale bar = 0.1 mm). **B.** *Calliphora vicina* palp clavate (scale bar = 0.5 mm). **C.** *Cochliomyia macellaria* fronto-orbital plate with pale setae (scale bar = 0.1 mm).

**D.** *Compsomyiops fulvicrura* parafacial setulose (scale bar = 0.5 mm). **E.** *Compsomyiops fulvicrura* dorsocentral presutural setae absent (scale bar = 0.5 mm). **F.** *Compsomyiops fulvicrura* arista plumose (scale bar = 0.1 mm). **G.** *Toxotarsus ambrosianus* spiracle white (scale bar = 0.5 mm). **H.** *Toxotarsus ambrosianus* lower calypter long (scale bar = 1.0 mm). **I.** *Toxotarsus ambrosianus* arista bare (scale bar = 0.5 mm).

- 11(10') Tergites 3-5 with lateral metallic and coppery patches on the dorsal surface. Genae with orange or pale yellow setulae ..... **C. alvarengai** (Mello)
- 11' Tergites 3-5 without lateral patches. Genae bare ..... **C. fulvicrura** (Robineau-Desvoidy)
- 12(4') Presutural acrostichal setae absent. Katepisternal setae 0:1. Arista with short setae or bare ..... **Toxotarsus** Macquart ... 13
- 12' Presutural acrostichal setae present. Katepisternal setae 1:1 or 2:1. Arista always plumose (Fig. 2F) ..... 15
- 13(12) Legs yellow. Spiracles orange. Pre and postacrostichal setae absent ..... **T. humeralis** (Walker)
- 13' Legs brown or black. Thoracic spiracles brown or white (Fig. 2G). Pre and postacrostichal setae present ..... 14
- 14(13') Lower calypter long and slender (Fig. 2H). Cell  $r_{4+5}$  open at wing margin. Dorsocentral setae 2:3. Thoracic spiracles white. Arista bare (Fig. 2I) ..... **T. ambrosianus** (Lopes)
- 14' Lower calypter lobulate. Cell  $r_{4+5}$  closed. Dorsocentral setae 3:3. Thoracic spiracles brown. Arista with hairs basally ..... **T. nigrocyaneus** (Walker)
- 15(12') Body robust, frequently longer than 20 mm (Fig. 3A). Body and legs exceptionally hairy (Fig.



Fig. 3. A. *Neta chilensis* body (scale bar = 1.0 mm). B. *Neta chilensis* hind femur hairy (scale bar = 1.0 mm). C. *Sarconesiopsis chilensis* hind femur straight (scale bar = 0.5 mm). D. *Sarconesiopsis chilensis* lower calypter dark brown (scale bar = 0.5 mm). E. *Sarconesia versicolor* postpronotal lobe with four setae (scale bar = 0.1 mm). F. *Sarconesia versicolor* palp and first flagellomere (scale bar = 0.5 mm).

- 3B). Male with hind femur swollen and arcuate (curved). Fifth abdominal tergite of female concave ..... **Neta** Shannon, **N. chilensis** (Walker) (This is the only known species of this genus and for this reason it can be identified by the generic characters).
- 15' Body not robust and shorter than 14 mm. Body and legs not exceptionally hairy. Male with hind femur straight (Fig. 3C). Fifth abdominal tergite of female not concave..... 16
- 16(14') Lower calypter hyaline ..... **Sarconesiopsis** Townsend ... 17
- 16' Lower calypter tinted grey ..... **Sarconesia** Bigot ... 18
- 17(16) Lower calypter dark brown with margin of the same color (Fig. 3D). Thorax without metallic reflections with black and gray pruinose stripes (like Sarcophagidae) ..... **S. chilensis** (Macquart)
- 17' Lower calypter brown with margin pale. Thorax metallic blue-green with white or silvery pruinose stripes reaching the scutellum ..... **S. magellanica** (Le Guillou)
- 18(16') Postsutural acrostichal setae absent ..... **S. chlorogaster** (Wiedemann)
- 18' Postsutural acrostichal setae present ..... 19
- 19(17') Four postpronotal setae (Fig. 3E). Intra-alar setae 3:2. Palp dark brown. First flagellomere blackish (Fig. 3F). Wing slightly yellowish in basal area. Veins brown-yellowish. Calypters yellow ..... **S. versicolor** Bigot
- 19' Three postpronotal setae. Intra-alar setae 2:2. Palp yellow-reddish. First flagellomere light brown. Wing hyaline. Veins brown. Calypters white ..... **S. dichroa** (Schiner)

## DISCUSSION

The diversity of blow flies species reported for Chile is reduced (Mac-Lean & González, 2006), in comparison to other countries in the Andean and Neotropical Regions (Mariluis & Mulieri, 2003; Amat *et al.* 2009; Kosmann *et al.* 2013; Velásquez *et al.* 2017). There are biogeographical, biological, and taxonomical aspects that could be related to the low diversity in Chile. The isolation of Chile could have been an impediment to colonization of some species with greatest distribution in some other areas of South America. At the other hand, there has been an unequal sampling effort at level latitudinal and altitudinal in the country. However, one must bear in mind that collections in areas with scarce knowledge in relation to its Diptera composition, such as high altitude regions of central and southern Chile (e.g. Mariluis & Schnack, 1996; Santibáñez *et al.* 2008) in addition to the high commercial and tourist traffic that is maintained with Argentina, could increase the number of genera and species reported for Chile.

In South America, the genera *Lucilia* Robineau-Desvoidy and *Calliphora* Robineau-Desvoidy are represented by 23 and six species, respectively (Whitworth, 2012, 2014); however, only *L. sericata* (Meigen, 1826), *L. eximia* (Wiedemann, 1819), and *C. vicina* Robineau-

Desvoidy, 1830 widespread species in the Neotropics, have been found in Chile (Reyes, 1967; Saiz *et al.* 1989; Artigas, 1994; Figueroa-Roa & Linhares, 2002; Mac-Lean & González, 2006; Ortloff *et al.* 2012; Kosmann *et al.* 2013).

The genus *Chrysomya* Robineau-Desvoidy is represented by five species (Kosmann *et al.* 2013), which were introduced to South America, specifically Brazil, from Africa (Baumgartner & Greenberg, 1984; Dear, 1985), and only *C. albiceps*, a worldwide species, has been reported for Chile (Mac-Lean & González, 2006; Ortloff *et al.* 2013). The revision of American species of Chrysomyini by Dear (1985) reported six species for *Hemilucilia* Brauer, six for *Compsomyiops* Townsend, four for *Cochliomyia* Townsend, and three for *Paralucilia* Brauer & Bergenstamm. For Chile, only *H. segmentaria* (Fabricius, 1805), *C. alvarengai* (Mello, 1968), *C. fulvicrura* (Robineau-Desvoidy, 1830), *C. macellaria* (Fabricius, 1775) and *P. fulvinota* (Bigot, 1877) have been reported (Figueroa-Roa & Linhares, 2002; Mac-Lean & González, 2006; Ortloff *et al.* 2012; Kosmann *et al.* 2013).

*Toxotarsus ambrosianus* (Lopes) has been found only on San Ambrosio Island and *T. humeralis* (Walker) in coastal areas of the Región del Bío-Bío and Juan Fernández Island, whereas *T. nigrocyaneus* (Walker, 1837) has

been found between lowland Valparaíso and Los Lagos regions, and Argentina (Dear, 1979; Kosmann *et al.* 2013). The monospecific genus *Neta* Shannon, represented by *N. chilensis* (Walker, 1837), is a blow fly that has been reported for Chile, Argentina (Dear, 1979; Reyes & Almonacid, 1984; Figueroa-Roa & Linhares, 2002; Mariluis & Mulieri, 2003; Mac-Lean & González, 2006) and for Bolivia and Perú (Kossmann *et al.* 2013). The genus *Sarconesia* Bigot is represented in Chile for *S. chlorogaster* (Wiedemann, 1831), *S. versicolor* Bigot and *S. dichroa* (Schiner), whereas the genus *Sarconesiopsis* Townsend incorporates only *S. magellanica* (Le Guillou, 1842) and *S. chilensis* (Macquart, 1843) (Figueroa-Roa & Linhares, 2002; Mac-Lean & González, 2006). *S. chlorogaster* and *S. versicolor* are high altitude species distributed principally in countries in southern South America (Dear, 1979), whereas *S. dichroa* is an endemic blow fly of central Chile and Juan Fernandez Islands (Dear, 1979; Mac-Lean & Gonzalez, 2006).

This contribution provides a quick tool to identify blow flies present in Chile, particularly important inasmuch as it is not uncommon to see incorrect identifications (Kosmann *et al.* 2013). The applicability of this key to the fauna of other regions with few collections - for example in the north, in the Andes and in the Cordillera de la Costa is not yet known. Nevertheless, this key will enable researchers to identify most species present in the country and provides a baseline for the development of a more comprehensive key incorporating all species present in Chile.

#### ACKNOWLEDGEMENTS

The authors would like to thank Dr. Stephen M. Smith (Biology, University of Waterloo) for the help in editing the English version and comments on the manuscript.

#### LITERATURE CITED

Aldrich, J. M. (1931). Notes on the types of American two-winged flies of the genus *Sarcophaga* and a few related forms described by the early authors. *Proceedings*

*of the United States National Museum*, 78(2855), 1-39.

- Amat, E. (2008). Clave ilustrada para la identificación de los géneros y las especies de califóridos (Diptera: Calliphoridae) de Colombia. *Caldasia*, 30(1), 231-244.
- Amat, E. (2009). Contribución al conocimiento de las Chrysomyinae y Toxotarsinae (Diptera: Calliphoridae) de Colombia. *Revista Mexicana de Biodiversidad*, 80, 693-708.
- Artigas, J. N. (1994). Entomología Económica, Insectos de interés agrícola, forestal, médico y veterinario (Nativos, introducidos y susceptibles de ser introducidos), Vol. 1. Ediciones Universidad de Concepción.
- Baumgartner, D. L., & Greenberg, B. (1984). The genus *Chrysomya* (Diptera: Calliphoridae) in the New World. *Journal of Medical Entomology*, 21(1), 105-113.
- Bigot, I. M. (1857). Diptères nouveaux provenant du Chili. *Annales de la Société entomologique de France*, 5, 277-308.
- Blanchard, E. (1852). Orden IX. Dipteros. In C. Gay (Ed), *Historia Física y Política de Chile* (pp. 327-468). Zoología vol. 7. París.
- Brauer, F., & Bergenstamm, J. E. von (1889). Die Zweiflügler des Kaiserlichen Museums zu Wien. IV. Vorarbeiten zu einer Monographie der Muscaria schizometopa (exclusive Anthomyidae). Pars I. F. Tempsky, Wien.
- Carvalho, C. J. B., & Ribeiro, P. B. (2000). Chave de identificação das espécies de Calliphoridae (Diptera) do sul do Brasil. *Revista Brasileira Parasitologia Veterinária*, 9(2), 169-173.
- Carvalho, C. J. B., & Mello-Patiu, C.A. (2008). Key to the adults of the most common forensic species of Diptera in South America. *Revista Brasileira de Entomologia*, 52(3), 390-406.
- Cumming, J. M., & Wood, D. M. (2009). Adult morphology and terminology. In: B.V. Brown, A. Borkent, J.M. Cumming, D.M. Wood, N.E. Woodley & M.A. Zumbado (Eds.). *Manual of Central American Diptera Vol. 1* (pp. 9-50). Ottawa: NRC, CNRC Research Press.
- Dear, J. P. (1979). A revision of the Toxotarsinae (Diptera: Calliphoridae). *Papéis Avulsos Zoologia Sao Paulo*, 32(13), 145-182.

- Dear, J. P. (1985). A revision of the New World Chrysomyini (Diptera: Calliphoridae). *Revista Brasileira de Zoologia*, 3, 109-169.
- Evenhuis, N. L., Pont, A. C., & Whitmore, D. (2015). Nomenclatural studies toward a World list of Diptera genus-group names. Part IV: Charles Henry Tyler Townsend. *Zootaxa*, 3978(1), 1-362.
- Figuroa-Roa, L., & Linhares, A. X. (2002). Sinantropía de los Calliphoridae (Diptera) de Valdivia, Chile. *Neotropical Entomology*, 31(2), 233-239.
- James, M. T. (1970). A Catalogue of the Diptera of the Americas south of the United States: family Calliphoridae. *Museu de Zoologia, Universidade de Sao Paulo*, 102, 1-28.
- Kosmann, C., Mello, R. P., Harterreiten-Souza, É. S., & Pujol-Luz, J. R. (2013). A List of current valid blowfly names (Diptera: Calliphoridae) in the Americas South of Mexico with key to the Brazilian species. *EntomoBrasilis*, 6(1), 74-85.
- Lopes, H. S. (1961). Sobre um novo genero de Calliphoridae de Ilha de Santo Ambrosio, Chile (Diptera). *Revista Brasileira de Biologia*, 8, 455-459.
- Lopes, H. S. (1962). Sobre dois Calliphoridae do Chile (Diptera). *Revista Brasileira de Biologia*, 28, 421-426.
- Lopes, H. S., & Albuquerque D. O. (1955). Los insectos de las islas Juan Fernández. 22. Calliphoridae et Sarcophagidae (Diptera). *Revista Chilena de Entomología* 4, 95-119.
- Mac-Lean, M. & González, C.R. (2006). Catálogo de los Calliphoridae (Diptera: Oestroidea) de Chile. *Acta Entomologica Chilena*, 30(1), 15-22.
- Macquart, J. (1843). Diptères exotiques nouveaux ou peu connus. *Mémoires de la Société Royale des Sciences, de l'Agriculture et des Arts de Lille* 1842; 162-460, 36 pl.
- Mariluis, J. C., González-Mora, D., & Peris, S.V. (1994). Notes on the *Phaenicia* Robineau-Desvoidy, 1863 of South America (Diptera, Calliphoridae). *Boletín de la Real Sociedad Española de Historia Natural, Sección Biológica*, 91, 25-33.
- Mariluis, J. C., & Schnack, J. A. (1996). Elenco específico y aspectos ecológicos de Calliphoridae (Insecta, Diptera) de San Carlos de Bariloche, Argentina. *Boletín de la Real Sociedad Española de Historia Natural (Sección Biología)*, 92, 1-4.
- Mariluis, J. C., & Mulieri, P. R. (2003). The distribution of the Calliphoridae in Argentina (Diptera). *Revista de la Sociedad Entomológica Argentina*, 62(1-2), 85-97.
- Marinho, M. A. T., Wolff, M., Ramos-Pastrana, Y., Lima de Azeredo-Espin, A. M., & de Souza Amorim, D. (2017). The first phylogenetic study of Mesembrinellidae (Diptera: Oestroidea) based on molecular data: clades and congruence with morphological characters. *Cladistics*, 33(2), 134-152
- Ortloff, A., Peña, P., & Riquelme, M. (2012). Preliminary study of the succession of necrobiont insects, colonising species and larvae on pig carcasses in Temuco (Chile) for forensic applications. *Forensic Science International*, 222, 36-41.
- Ortloff, A., Jara, A., Albornoz, S., Silva, R., Riquelme, M., & Peña, P. (2013). Primer reporte en Chile de *Chrysomya albiceps* (Diptera: Calliphoridae) en evidencia entomológica forense. *Archivos de Medicina Veterinaria*, 45, 83-89.
- Pape, T., Blagoderov, V., & Mostovski, M. B. (2011). Order Diptera Linnaeus, 1758. In: Zhang ZQ (Ed.) Animal Biodiversity: An Outline of Higher-level Classification and Survey of Taxonomic Richness. *Zootaxa*, 3148, 222-229.
- Pinto de Mello, R. (2003). Chave para a Identificação das formas adultas das espécies da familia Calliphoridae (Diptera: Brachycera: Cyclorrhapha) encontradas no Brasil. *Entomologia y Vectores*, 10(2), 255-268.
- Reed, E. C. (1888). Catálogo de los insectos dípteros de Chile. *Anales de la Universidad de Chile*, 73, 271-316.
- Reyes, H. (1967). Myiasis humana por *Phaenicia sericata*. *Boletín Chileno de Parasitología*, 22, 42.
- Reyes, E. A., & Almonacid, M. E. (1984). Ciclo biológico de *Neta chilensis* (Walker) (Insecta:



- Diptera). *Studies on Neotropical Fauna and Environment*, 19(4), 219-222.
- Robineau-Desvoidy, J. B. (1830). Essai sur les myodaires. *Mémoires présentés par divers savans à l'Académie Royale des Sciences de l'Institut de France (Sciences Mathématiques et Physiques)*, 2(2), 813 pp.
- Sáiz, F., Tosti-Croce, E., & Leiva, M.S. (1989). Estudio de los cambios de la mesofauna asociada a la descomposición de cadáveres de conejo en clima mediterráneo. *Anales del Museo de Historia Natural de Valparaíso*, 20, 41-74.
- Santibáñez, F., Roa, P., & Santibáñez, P. (2008). Capítulo I: El Medio Físico. In: *Comisión Nacional del Medio Ambiente (CONAMA) (Eds.), Biodiversidad de Chile: Patrimonios y Desafíos*. Santiago de Chile: Ocho Libros.
- Schiner, J. R. (1868). Diptera, Muscidae Calypterae 291-338. In: *Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodore B. Von Wüllerstorff-Urbair. Zoologischer Theil. Zweiter Band. 1. Abtheilung*. B.K. Gerold's Sohn, Wien.
- Shannon, R. C. (1926). Synopsis of the American Calliphoridae (Diptera). *Proceedings of the Entomological Society of Washington*, 28, 115-39.
- Smart, J. (1937). Calliphorinae. In: *Diptera of Patagonia and South Chile Part VII Fascicle 3*. (pp. 347-384). London.
- Stuardo, C. (1946). *Catálogo de los Dípteros de Chile*. Ministerio de Agricultura. Santiago de Chile: Imprenta Universitaria.
- Tantawi, T. I., & Sinclair, B. J. (2013). An update of the blow flies (Diptera: Calliphoridae) of the Galápagos Islands, and first record of *Chrysomya rufifacies* (Macquart) from mainland Ecuador. *Zootaxa*, 3750, 237-250.
- Vargas, J., & Wood, D. M. (2010). Calliphoridae. In: Brown, B.V., A. Borkent, J.M. Cumming, D.M. Wood, N.E. Woodley & M.A. Zumbado (Eds.), *Manual of Central American Diptera*. Vol. 2 (pp. 1297-1304). Ottawa: CNRC Research Press.
- Velásquez, Y., Martínez-Sánchez, A. I., Thomas, A., & Rojo, S. (2017). Checklist and distribution maps of the blow flies of Venezuela (Diptera, Calliphoridae, Mesembrinellidae). *ZooKeys*, 645, 103-132.
- Walker, F. (1837). Description of the insects collected by Captain P. P. King, R. N., F. R. S., in the survey of the straits of Magellan. *Transactions of the Linnean Society of London*, 17, 331-359.
- Whitworth, T.L. (2010). Keys to the genera and species of blow flies (Diptera: Calliphoridae) of the West Indies and description of a new species of *Lucilia* Robineau-Desvoidy. *Zootaxa*, 2663, 1-35.
- Whitworth, T. L. (2012). Identification of Neotropical blow flies of the genus *Calliphora* Robineau-Desvoidy (Diptera: Calliphoridae) with the description of a new species. *Zootaxa*, 3209, 1-27.
- Whitworth, T. L. (2014). A revision of the Neotropical species of *Lucilia* Robineau-Desvoidy (Diptera: Calliphoridae). *Zootaxa*, 3810(1), 1-76.
- Wolff, M., Ramos-Pastrana, Y., & Pujol-Luz, J.R. (2012). Description of the male of *Laneella perisi* (Mariluis) (Diptera: Calliphoridae) n. comb. *Neotropical Entomology*, 42(1), 58-62.
- Wolff, M., & Kosmann C. (2016). Families Calliphoridae and Mesembrinellidae. *Zootaxa*, 4122, 856-875.
- Zhang, D., Yan, L., Zhang, M., Chu, H., Cao, J., Li, K., & Pape, T. (2016). Phylogenetic inference of calyptrates, with the first mitogenomes for Gasterophilinae (Diptera: Oestridae) and Paramacronychiinae (Diptera: Sarcophagidae). *International Journal of Biological Sciences*, 12(5), 489-504.