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A revision of the Neotropical species of *Lucilia* Robineau-Desvoidy (Diptera: Calliphoridae)

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Table of contents

Abstract	3
Introduction	4
Material and methods	5
Subfamily Luciliinae	8
Genus <i>Lucilia</i> Robineau-Desvoidy	8
Key to the Species of Neotropical <i>Lucilia</i>	14
Species descriptions	22
1. <i>Lucilia albofusca</i> sp. nov.	22
2. <i>Lucilia cluvia</i> (Walker, 1849)	24
3. <i>Lucilia cuprina</i> (Wiedemann, 1830)	25
4. <i>Lucilia deceptor</i> (Curran, 1934b)	26
5. <i>Lucilia eximia</i> (Wiedemann, 1819)	26
6. <i>Lucilia fayeae</i> Whitworth, 2010	30
7. <i>Lucilia ibis</i> Shannon, 1926	30
8. <i>Lucilia japuhybensis</i> (Mello, 1961)	31
9. <i>Lucilia lucigerens</i> (James, 1971)	33
10. <i>Lucilia mexicana</i> Macquart, 1844	33
11. <i>Lucilia nitida</i> sp. nov.	35
12. <i>Lucilia ochricornis</i> (Wiedemann, 1830)	36
13. <i>Lucilia ponia</i> (Walker, 1849)	39
14. <i>Lucilia problematica</i> Johnson, 1913	39
15. <i>Lucilia pulverulenta</i> sp. nov.	39
16. <i>Lucilia purpurascens</i> (Walker, 1836)	42
17. <i>Lucilia retroversa</i> (James, 1971)	45
18. <i>Lucilia rica</i> Shannon, 1926	45
19. <i>Lucilia rognesi</i> sp. nov.	46
20. <i>Lucilia sericata</i> (Meigen, 1826)	47
21. <i>Lucilia setosa</i> (James, 1966)	48
22. <i>Lucilia vulgata</i> sp. nov.	49
23. <i>Lucilia woodi</i> sp. nov.	50
Erratum	52
Acknowledgements	52
Literature cited	73

Abstract

A key to 23 species of Neotropical *Lucilia*, including six new species is given. Information is provided on all known *Lucilia* species found in the region, including the West Indies, Galápagos Islands, and Central and South America. The following six new species are described based on the examination of over 2700 adult specimens from Central and South America: *Lucilia albofusca* sp. nov. from southern Central America and northern South America, *Lucilia nitida* sp. nov. from Brazil, Peru and Venezuela, *Lucilia pulverulenta* sp. nov. from Central America (Honduras south to Panama) and South America (Colombia and Ecuador), *Lucilia rognesi* sp. nov. from Costa Rica, Honduras and Panama, *Lucilia vulgata* sp. nov. from South America (widespread from Venezuela to Argentina), and *Lucilia woodi* sp. nov. from Central America (Honduras south to Panama). The status of *Phaenicia japuhybensis* Mello, 1961 is clarified; it is considered a valid species of *Lucilia*. *Musca ochricornis* Wiedemann, 1830 is removed from its current synonymy with *Musca eximia* Wiedemann, 1819 and considered a valid species of *Lucilia*. *Lucilia mera* Shannon & Del Ponte, 1926 and *L. primavera* Shannon & Del Ponte, 1926 are synonymized with *L. ochricornis*, syn. nov. *Lucilia littoralis* Blanchard 1938 is synonymized with *L. eximia* (Wiedemann, 1819), syn. nov. Lectotypes are designated for *L. mera*, *L. primavera*, and *L. ochricornis*.

Introduction

The taxonomy of Neotropical *Lucilia* Robineau-Desvoidy is currently in a state of confusion and badly in need of revision (Vargas & Wood 2010). A variety of authors have attempted to clarify the taxonomy of *Lucilia* species in the region (Shannon 1926; Aubertin 1933; Hall 1948; Mello 1961; James 1970; Mariluis *et al.* 1994; Kosmann *et al.* 2013), but their efforts have done little to resolve the species status for any but the most common species. Many of the older descriptions are poor, so it is difficult to verify what species they represent without seeing the original types, and most previous authors were not able to examine types. Aubertin (1933) was able to examine some types, but, for most species, she did not have enough specimens to clearly define species. Clarifying the taxonomy of species from this region poses some special problems as noted by Aubertin (1933) and Whitworth (2010) who observed that adult Neotropical *Lucilia* have few reliable characters useful to separate species in a key. Even male genitalia, which usually can be relied upon to separate blow fly species, show little variation for most Neotropical *Lucilia*. Another normally useful character, body color, is virtually useless for species distinctions for most species of *Lucilia* found in this region. Individuals within most species exhibit a wide range in body colors from metallic green, blue, coppery, violet, to purple. Often a specimen will have one color on the thorax and another on the abdomen and colors of pinned specimens can change as they age. Older taxonomic works on species of *Lucilia* often relied heavily on body color to distinguish species which led to the same species repeatedly being described as a new species, producing numerous synonyms (Aubertin 1933). Many of the published works on Neotropical *Lucilia* used the synonym *Phaenicia* Robineau-Desvoidy as the valid name for the genus.

Townsend (1908) provided a key to 14 species of Nearctic *Lucilia*; including 10 new species. All of the new species are currently considered junior synonyms of other species. Two species that Townsend listed from the Neotropical Region were *L. oculata* Townsend (currently a synonym of *L. coeruleiviridis* Macquart) and *L. pilatei* Hough (currently a synonym of *L. cluvia* (Walker)). The former was listed from Cuba and the latter from Guatemala and Peru. James (1970) included *L. coeruleiviridis* (misspelled as *L. caeruleiviridis*, following Aubertin 1933 and Hall 1948; see discussion in Whitworth 2010) in his catalog because a paratype of *L. oculata* originated from Cuba (Townsend 1908). Shannon (1926) made one of the first efforts to clarify the taxonomic status of Neotropical *Lucilia*. He described four new species of *Lucilia* from the region, two of which are currently considered valid, *L. ibis* Shannon and *L. rica* Shannon, and provided a key and descriptions for the known species at the time. He also described in the same work *L. hirtiforceps* Shannon and *L. ocularis* Shannon, but Aubertin (1933) later synonymized *L. hirtiforceps* with *L. eximia* (Wiedemann) and *L. ocularis* with *L. purpurascens* (Walker); other authors agreed with these synonyms (Hall 1948; James 1970; Mariluis *et al.* 1994). Shannon & Del Ponte (1926) described two new species of *Lucilia* from Argentina, *L. primaveris* Shannon & Del Ponte and *L. mera* Shannon & Del Ponte. Aubertin considered these species “unplaced”, while Mello (1961) considered them synonyms of *L. eximia*, as did James (1970) and Mariluis *et al.* (1994). Aubertin (1933), as part of a worldwide revision of *Lucilia*, recognized ten species in the Neotropical Region, namely *L. cluvia* (Walker), *L. cuprina* (Wiedemann), *L. eximia*, *L. ibis*, *L. mexicana* Macquart, *L. ochricornis* (Wiedemann), *L. pionia* (Walker), *L. purpurascens*, *L. rica*, and *L. sericata* (Meigen). Most later authors considered *L. ochricornis* as a synonym of *L. eximia* (Hall 1948; Mello 1961; James 1970; Mariluis *et al.* 1994) while Baumgartner & Greenberg (1985) considered *L. ochricornis* as valid, but did not clearly explain why. Aubertin (1933) examined the types for many species and provided a lengthy list of over 150 synonyms of the ten *Lucilia* species she recognized as valid. Blanchard (1938) described *L. littoralis*, which James (1970) treated as unplaced.

Hall's (1948) publication on North American calliphorids included a total of eight *Lucilia* (as *Phaenicia*) species found in the Neotropics, namely *L. cluvia*, *L. eximia*, *L. mexicana*, *L. problematica* Johnson, *L. purpurascens* and *L. rica* as well as the cosmopolitan *L. cuprina* (as *Phaenicia pallescens* Shannon) and *L. sericata*. Hall misspelled the name *L. purpurascens* as *L. purpurescens* and this incorrect spelling has been followed by most subsequent authors. Hall broadly defined North America to include Central America (north of the Panama Canal) and the West Indies north of Jamaica.

Mello (1961) reviewed the *Lucilia* (as *Phaenicia*) species of Brazil. He provided redescriptions of *L. cuprina*, *L. eximia*, *L. mexicana*, and *L. sericata*. He also described a new species, *L. japyhybensis* (Mello), for which only a single male specimen was known. He included *L. mexicana* from Mexico because Hall (1948) had stated it occurred as far south as Brazil, but he did not find it there. James (1970) listed *Bufolucilia silvarum* (Meigen) (since moved to *Lucilia*) and *Lucilia illustris* (Meigen) in his *Catalog of Diptera of the Americas south of the*

United States because they are found in Mexico. He also listed 11 species under *Phaenicia*; all these species are now considered *Lucilia* (Rognes 1991). James (1971) described two new species *L. lucigerens* (James) and *L. retroversa* (James) from the West Indies which are currently considered valid (Whitworth 2010). Baumgartner & Greenberg (1985) in their study of the distribution of Calliphoridae in Peru discussed six species of *Lucilia* (as *Phaenicia*): *L. eximia*, *L. cuprina*, *L. ibis*, *L. ochricornis*, *L. purpurascens*, and *L. sericata*. They commented that, though James (1970) synonymized *L. ochricornis* with *L. eximia*, they believed it was a distinct species, but unfortunately did not elaborate further. Mariluis *et al.* (1994) provided descriptions, synonymies and figures for six species of *Lucilia* (as *Phaenicia*) found in the Neotropical Region. They included a total of 11 species of *Lucilia* in their key. Mariluis & Mulieri (2003) provided distribution maps for five species of *Lucilia* (as *Phaenicia*) in Argentina, namely *L. cluvia*, *L. cuprina*, *L. eximia*, *L. purpurascens* (under the synonym *L. peruviana* Robineau-Desvoidy) and *L. sericata*. (see Appendix by Rognes & Whitworth in Whitworth (2012) for an explanation of the status of *L. peruviana*, this species is considered to be a *nomen dubium*). Whitworth (2010) provided keys to the calliphorids of the West Indies including detailed descriptions and illustrations for the ten species of *Lucilia* known from that area. He described one new species, *L. fayeae* Whitworth. Whitworth (2010) followed Townsend (1908) and included *L. coeruleiviridis* in the region. Kosmann *et al.* (2013) provided a list that updated the names of known Neotropical *Lucilia* and a key to selected blow flies of Brazil. Tantawi & Sinclair (2013) studied seven species of calliphorids found in the Galápagos Islands, including four species of *Lucilia*.

This study was initiated to address the following issues: to establish the valid species of *Lucilia* in the Neotropical Region by examining the fauna over the whole region; to provide a key to assist in the identification of species; to redescribe the endemic species previously described from the region; to describe new species found in the region; and to examine types available for all described species where identity is uncertain to determine if the species are valid or should be considered synonyms. Until valid species are clearly defined, researchers have little incentive to study species life histories and life stages which may reveal more distinctive species characters.

Material and methods

Geography. The Neotropical Region is defined as including South America, Central America, the West Indies, and portions of southern Mexico along the east and west coasts (see Brown 2009, fig. 1.1, for a map showing the boundary between the Nearctic and Neotropical Regions). Some data is given for specimens from farther north in Mexico, since species in this area are poorly known. Bermuda, although far northeast of Bahamas and part of the Nearctic Region, is included in this revision because of a shared fauna with the Neotropics. Location coordinates given for many INBIO specimens use the Lambert Norte system and are expressed as L_N_.

Distribution data is provided for all species, but only new or poorly known species are mapped. For the remaining species, location of specimens examined is listed in the text, or the reader is referred to other publications which provide further distribution data.

Terminology. The terminology herein primarily follows McAlpine (1981), but see exceptions discussed in Whitworth (2006).

Specimen Data. Specimen data provided herein is taken from specimen labels. Many were written in Spanish or Portuguese with a variety of abbreviations, and it was sometimes difficult to determine what was meant. Some abbreviations have been standardized, but usually the data was entered as written.

For all new species and selected described species the following information is provided: specimen sex; location where collected; coordinates and elevation, if given; date of collection; collector(s); museum acronyms and notes on how collected, if given. If any of this data is not provided, it was missing from the label.

Abbreviations. For abdominal sclerites, tergites are abbreviated as T and sternites as ST. T1+2 is the first apparent abdominal segment, followed by T3–5 in males and T3–8 in females; sternites are ST1–5 in males and ST1–8 in females.

The acronyms of collections cited in this work are as follows:

BG Bernard Greenberg private collection, currently, in part, in TW collection, ultimately to be permanently deposited in other institutions.

BMNH	Natural History Museum [formerly British Museum (Natural History)], London, United Kingdom.
BYU	Brigham Young University, Provo, Utah, USA.
CAS	California Academy of Sciences, San Francisco, California, USA.
CMNH	Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA.
CNC	Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada.
EMEC	University of California, Essig Museum of Entomology, Berkeley, California, USA.
FIOC	Fundação Instituto Oswaldo Cruz, Rio de Janeiro, Brazil.
FMNH	Field Museum of Natural History, Chicago, Illinois, USA.
FSCA	Florida State Collection of Arthropods, Gainesville, Florida, USA.
INBIO	Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica.
KR	Knut Rognes, private collection, Oslo, Norway.
LACM	Los Angeles County Museum of Natural History, Los Angeles, California, USA. Most of the material listed as from this museum was originally borrowed from Utah State University (USU). According to LACM curator Brian V. Brown, they now have all USU Diptera; all USU material borrowed for this study will be returned to LACM.
MACN	Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
MEM	Mississippi State University, Mississippi, Mississippi, USA.
MNHN	Museum National d’Histoire Naturelle, Paris, France
NMW	Naturhistorisches Museum Wien, Wien, Austria.
OUMNH	Oxford Museum of Natural History, Hope Entomological Collections, Oxford, United Kingdom.
TAMU	Texas A&M University, College Station, Texas, USA.
TW	Terry Whitworth, private collection, Tacoma, Washington, USA.
UCDC	University of California, R.M. Bohart Museum of Entomology, Davis, California, USA.
UGG	University of Guelph, Guelph, Ontario, Canada.
UPR	University of Puerto Rico, Mayaguez, Puerto Rico.
USNM	National Museum of Natural History (formerly United States National Museum), Smithsonian Institution, Washington, District of Columbia, USA.
USU	Utah State University, Logan, Utah, USA. See comments under LACM.
UVGC	Universidad del Valle de Guatemala, Colección de Atrópodos, Guatemala City, Guatemala.
WSUP	M.T. James Entomological Collection, Washington State University, Pullman, Washington, USA.
YV	Yelitza Velásquez, private collection, University of Alicante, Alicante, Spain.
ZMHB	Museum für Naturkunde der Humbolt-Universität, Berlin, Germany.
ZMUC	Zoological Museum, Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark.

Illustrations and dissections. Characters unique to species of Neotropical *Lucilia* are illustrated herein or the reader is referred to illustrations elsewhere. See Hall (1948), McAlpine (1981), Rognes (1991) and Whitworth (2006, 2010) for illustrations and explanations of other genus and species characters.

Details of how genitalic dissections were performed were given in Whitworth (2012). In males, dissected parts were placed in a genitalia vial under the specimen, the abdomen, less the sternites was glued to a piece of card stock and pinned with the specimen. In females, sclerites T, ST 6–8 of the ovipositor were generally mounted on a slide in Euparal while the epiproct, hypoproct and spermathecae were stored in a genitalia vial under the specimen. The abdomen was glued on a piece of thin card stock and pinned as with the male. Dissections were performed primarily with a Bausch and Lomb Stereozoom 7 microscope equipped with 10–20x oculars allowing magnification to 140x. Most photography was done with a Nikon D90 camera through a Meiji Techno stereomicroscope with a focus range of 7.5–112.5x using 1.0x or 1.5x objectives. To improve depth of field for most photos, a series of 5–20 images were taken through the microscope, then Helicon software (heliconsoft.com) was used to merge the images. Slides of small specimens were studied with the aid of a CHT model Olympus compound microscope with 40–400x lenses. Lighting was supplied by dual fiberoptic lights, and a light ring and dome were used for photos of adult flies. See Kerr *et. al.* (2008) for more information about using a reflective dome

for photography. Additional information on this subject can be found under dome lighting on the California Department of Food and Agriculture website (<http://www.cdffa.ca.gov/phpps/ppd/entomology/Dome/kd-200.html>). Fiberoptic lights can produce very bright light which tends to wash out some colors compared to what is seen by researchers using incandescent lights.

Collection Areas and Techniques. Most of the material used for this study was borrowed from the institutions listed above. Additional specimens were collected by the author during visits to the area around Kaw Mountain in French Guiana (04°33'58"N 52°12'43"W); near Cardona, state of Soriano, Uruguay (33°52'60"S 37°22'60"W) and various areas around San Jose, Costa Rica in San Jose and Heredia Provinces in cooperation with researchers at INBIO. Flies were collected with bait traps baited with fish or chicken flesh and entrails. Baumgartner & Greenberg (1985) noted that blow flies showed a strong preference for fish. In this study, spoiled fish was very effective bait, see Whitworth (2010) and the website blowflies.net for details about traps and trapping techniques. For this project, the "Pop-up Butterfly Bait Trap" from BugDorm Store (<http://bugdorm.megaview.com.tw/pop-up-butter-fly-bait-trap-cone-type-pack-of-6-p-143.html>) was used to collect blow flies.

Identification. The treatment of each species varies herein, for well known species; the reader is referred to other publications for detailed descriptions. Poorly known species are usually fully redescribed and holotypes and/or paratypes were examined if possible. For some species, in depth study was not done. For example, for the three endemic Galápagos species, few good specimens were available and a recent publication (Tantawi & Sinclair 2013) addressed the current state of knowledge for these species.

The key was written for the identification of dry, pinned specimens. For specimens pinned from liquids, like alcohol, soaking in ethyl acetate or xylene before drying helped restore cuticle colors and "liven up" matted setae. Specimens were sometimes allowed to air dry, but better results were obtained by drying them with a hot lamp.

The key to species includes some character states that can be difficult to interpret. Many of the specimens examined for this study came from a tropical environment and were exposed to high heat and humidity. Others were stored in liquids before being pinned. As a result, characters were sometimes distorted or discolored making identification difficult for some specimens. The key herein is based only on specimens in fair to good condition, poor specimens can be difficult to identify accurately. Cuticle colors in *Lucilia* are too variable to be useful for species distinctions in many species. Color of setae on gena is useful to separate several species, but it can be difficult to see clearly. Angle of view and good lighting is very important, it usually is best to view the gena from below to see color of setae on gena. Care must be taken not to confuse pale setae found on the postgena with those on the gena when judging if the gena has pale setae. The postgena is just behind the gena and usually appears as a sunken area (Figs. 1, 2). In many species the postgena is completely covered with pale setae, in some species, the anterior edge has dark setae and the remainder has pale setae. For species with pale setae on the gena, the pale setae extend forward from the postgena in a narrow strip to a broad band toward the anterior edge of the gena (Fig. 1). In specimens with pale setae on the gena, the gena will also have dark setae. Sometimes only a few pale setae may be visible on the gena, that condition would still be "pale setae present". Calypter colors are important, depending on species or sex; they range from whitish to tan to brown or dark brown. The upper and lower calypters may be different colors and the color combination may vary with the sex of the specimen (Table 2). Calypter color refers to the color of the disc or central portion of the calypter. In some specimens with a pale disc, the rim may be tan or brown, but the calypter would still be considered pale. Pale calypters may darken if specimens are placed in liquid or are exposed to high humidity; it is best to look at several specimens before concluding calypter color. The condition of the setae on the back of the head directly below and behind the stout, black postocular row is also an important key character. Some species have one or more rows of stout dark setae below and behind the postocular row (Fig. 4), while others have only weak, pale setae (Fig. 3). Patterns of microtomentum on the cuticle of the thorax and abdomen can be very useful to help distinguish some species. When microtomentum (also called tomentum, pubescence or pollinosity) is present, the cuticle has a "ground color" while microtomentum is a fine dust like covering over the cuticle, usually pale whitish to light tan in color. In some cases microtomentum is so dense, the ground color underneath is not visible. Microtomentum patterns are usually best observed by viewing the specimen from the rear at a low angle.

Some proportional measures are included, see Whitworth (2006, figs. 23, 24) for how to measure the frons to head ratio. The expression "frons 0.10 (0.09–0.11/4) of head width at narrowest" means the frons averages one-tenth of head width measured at narrowest frons width in five specimens. Usually the male frons is narrowest midway on the frons and the female frons is narrowest at the vertex, but in some females, it is narrowest midway

too. In each species the female frons is broader than in males. Measurements were made with an ocular micrometer in a microscope. In males, the size and shape of the genitalia including the epandrium, surstyli and cerci are useful to distinguish species. Other useful male characters include the shape and condition of the phallus, ejaculatory sclerites, pre- and postgonites, hypandrium and sternites. In females, the shape of sclerites and setal pattern on the ovipositor and the appearance of spermathecae can be useful to distinguish species.

Another character state which can aid in the separation of species is eye facet size. Several authors have commented on the enlarged facets seen in male *L. purpurascens* along the anterior margin of the eye (Shannon 1926, under *L. ocellaris*; Aubertin 1933; Hall 1948), but no one actually measured them. In this study, this variation in facet size was studied in 11 species and it was found to vary between species and sexes. In species with enlarged facets, the largest facets were normally on the anterior portion of the eye along the frons, and the smallest were along the posterior edge of the eye. The difference is obvious in male *L. purpurascens* (Fig. 6), much less in male *L. ochricornis* (Fig. 5). A single eye facet is so small and difficult to measure that instead a row of 10 like-sized facets comparing the total length of a row of 10 anterior facets to 10 posterior facets was measured. To facilitate facet measurement, the section of the eye under study was photographed at high magnification (112.5x), and each photo was printed at identical settings. Then facets were measured on the printed photo with a ruler to get relative size for large and small facets, these measurements were then converted to actual lengths in mm. Facet length can also be determined with an objective micrometer by measuring the eye directly, but this is difficult to do accurately. Since the facet measurement is a length of 10 facets, not a single facet, it is actually the facet and any space between facets, which may vary slightly between species. As long as each length of facets is measured in the same way in each specimen, the results produce proportional information which is comparable. These measures are not used in the key, but they are included in the species descriptions to help characterize species differences (see Table 1).

In an effort to further clarify species identity, data for selected specimens was uploaded to the Barcode of Life Database (BOLD; www.boldsystems.org) (Ratnasingham & Herbert 2007). Then a right rear leg of each specimen was removed and submitted to the Canadian Centre for DNA Barcoding (CCDB; www.ccdb.ca) at the Biodiversity Institute of Ontario to perform DNA barcoding from the mitochondrial gene CO1 using standard high throughput methods (Ivanova *et al.* 2006). All laboratory analysis was completed at CCDB. This method required relatively new material, usually no more than about 20 years old for high success. Specimens exposed to excessive heat or humidity or to certain fluids (like formaldehyde) did not produce good DNA data. The results usually supported identification based on morphology, but in some cases, where the barcode indicated a possible problem, specimens were re-examined, rekeyed, and if necessary, the identification changed. In other instances barcode data did not corroborate identifications, though morphological characters provided clear species distinctions. See the discussion of this problem under *L. eximia* and *L. mexicana*. Also see Whitworth *et al.* (2007) for a discussion of factors which can make barcode data unreliable for species distinctions. Another example of problems with use of DNA to distinguish species of *Lucilia* is found in DeBry *et al.* (2013). DNA analysis was used to separate Nearctic species and the authors noted that *L. coeruleiviridis* and *L. mexicana* were indistinguishable based on DNA, but the species are clearly separate based on morphological characters. This result was also found in this study (Fig. 161). For barcoded specimens included in Fig. 161, unique identifiers are given in the form “[BNNR01–191]” (with BNNR standing for Blow flies of the Nearctic and Neotropical Regions) in the text under “specimens examined” or “specimens barcoded”. Barcode data produced in this project is available to researchers who can access it by going to the BOLD site at Boldsystems.org.

Subfamily Luciliinae

There are five genera in the Luciliinae worldwide, including *Blepharicnema* Macquart, 1844; *Dyscritomyia* Grimshaw, 1901; *Hemipyrellia* Townsend, 1918; *Hypopygiopsis* Townsend, 1916a and *Lucilia* but only two, *Lucilia* and *Blepharicnema* are found in the New World. See Amat *et al.* (2008) and Vargas & Wood (2010) for keys to subfamilies and genera.

Genus *Lucilia* Robineau-Desvoidy

Lucilia Robineau-Desvoidy, 1830: 452. Type species: *Musca caesar* Linnaeus, 1758, by subsequent designation of Macquart (1834: 162).

Phaenicia Robineau-Desvoidy, 1863: 750. Type species: *Phaenicia concinna* Robineau-Desvoidy, 1863, by subsequent designation of Townsend (1916b: 8).

BufoLucilia Townsend, 1919b: 542. Type species: *Lucilia bufonivora* Moniez, 1876, by original designation.

Francilia Shannon, 1924: 74. Type species: *Francilia alaskensis* Shannon, 1924, by monotypy.

Viridinsula Shannon, 1926: 131 (as a subgenus of *Lucilia* Robineau-Desvoidy, 1830). Type species: *Musca pionia* Walker, 1849, by original designation. Shannon (1926) erected the subgenus *Viridinsula* for *L. pionia* based on the anteroventral expansion of the head seen in male specimens. Curran (1934b) elevated Shannon's subgenus to full genus level for both *L. pionia* and *L. deceptor*. James (1966) concluded Curran's elevation of *Viridinsula* to full genus status was not warranted and retained it as a subgenus and applied it to all three species endemic to the Galápagos. Rognes (1991) did not recognize subgenera and listed *Viridinsula* as a synonym of *Lucilia*.

Diagnosis. The genus can be distinguished by a bare stem vein above; presence of a sclerite on the suprasquamal ridge with a conspicuous cluster of setae near the base of the scutellum and the lower calypter bare above (Whitworth 2006, fig. 14). It also normally has a metallic, shining body color. Other families (Muscidae, Sarcophagidae, and Tachinidae) have species with shining body color which may be encountered in the region, see the key to families in Whitworth (2006: 693) and the discussion in Vargas & Wood (2010) to distinguish them.

Discussion. This study provides a key to the 23 *Lucilia* species known to occur in the Neotropical Region. See Tables 1 and 2 for a comparison of important character states used to identify these species. Twelve species were selected for detailed study, including six new species. The five species of *Lucilia* endemic to the West Indies, and *L. cluvia* will not be discussed in detail herein because they were addressed in Whitworth (2010). Three species, *L. deceptor*, *L. pionia* (Walker), and *L. setosa* (James) are found in the Ecuadorean Galápagos Islands. *Lucilia deceptor* is also found in the Costa Rican Cocos Islands. James (1966) provided descriptions and figures of male genitalia for each of these species, but they were not studied in detail. Tantawi & Sinclair (2013) conducted a more detailed study of the Galápagos species providing illustrations of male genitalia and frons of both sexes. The cosmopolitan species *L. cuprina* and *L. sericata* are also not detailed herein since they have been described by numerous authors (Hall 1948, Whitworth 2006). The Nearctic species *L. coeruleiviridis* Macquart, *L. illustris* (Meigen), and *L. silvarum* (Meigen) which likely occur in Mexico (James 1970) are not included in this key; these species may be keyed using Whitworth (2006: 718). *Lucilia coeruleiviridis* was listed as a species found in the Neotropical Region by Whitworth (2010) following Townsend (1908) who recorded it from Cuba (as *L. oculata*). Whitworth (2010) listed *L. coeruleiviridis* in Guatemala, based on a single specimen examined. The listing by Kosmann *et al.* (2013) of this species in the Neotropical Region appears to be based on Whitworth (2010). Since that study, the Guatemala specimen was re-examined and it was determined to be a discolored and nontypical specimen of *L. eximia*. *Lucilia coeruleiviridis* has been excluded from the key since I have not found it in the Neotropical Region and I have been unable to verify its presence in Cuba. A search of Townsend material in USNM revealed no paratypes of *L. oculata*, and no USNM specimens of *L. coeruleiviridis* from Cuba were found (Norman Woodley, pers. comm.). The record of *L. oculata*, and hence *L. coeruleiviridis*, from Cuba is assumed to have been based on a misidentified specimen. *Lucilia coeruleiviridis* can be determined using the key to *Lucilia* in Whitworth (2006) if its presence is suspected. However, it is included in the barcode diagram to show its relationship to other *Lucilia* (Fig. 161).

Despite the paucity of good distinguishing characters in Neotropical *Lucilia*, this study has revealed six new species, which are described herein. The status of three species, *L. japuhybensis*, *L. ochricornis*, and *L. purpurascens* has been clarified herein.

Head Characters. The ratio of frons to head width measured at the narrowest area of the frons is a useful character to help separate many species, especially for males. Six species have males with exceptionally broad frons (0.115–0.23); four have frons of medium width (0.05–0.06) and thirteen have narrow frons (0.01–0.04) (Table 1). In the species studied, the female frons is always wider than the male (0.21–0.39) frons; widths in females tend to be less distinctive than in males, but can be useful to help separate some species (Table 1). Seven species have some pale setae on the gena along with dark setae (as in Fig. 1). When pale setae are present on the gena, they may be limited to the posterodorsal corner of the gena or extend forward and downward to cover almost all of the gena. Species with this character state include *L. albofusca*, *L. cluvia*, *L. deceptor*, *L. nitida*, *L. pulverulenta*, *L. rica* and *L. rognesi*, while the remaining 16 species have only dark setae on the gena (as in Fig. 2). Occasional specimens in the group with dark seta on the gena may have a few pale setae that occur just above the junction of the postgena with the gena; specimens with this condition should still be considered to have dark setae on the gena.

Fourteen species have pale, weak setae below and behind the postocular row (as in Fig. 3), eight species have stout dark setae, the condition of these setae in *L. problematica* was not determined (Table 1). Some species with weak setae, behind the postocular row, like *L. eximia*, and *L. woodi*, have a few stout dark setae behind the posteroventral corner of the eye, but the setae behind the rest of the postocular row are weak. These specimens are considered to have weak setae below and behind the postocular row of setae.

Eye facet size was measured in 11 selected species to help separate poorly known species. See the methods section for an explanation of how facet diameters were measured. See Table 1, for a comparison of facet size by species and sex. Males of six species have anterior facets that are relatively large, ranging from 0.55mm–0.68mm (as in Fig. 6). Males of the remaining five species studied have smaller anterior facets ranging from 0.40mm–0.49mm (as in Fig. 5). Anterior facets in *L. woodi* are twice the size of posterior facets in both sexes. In *L. purpurascens* the anterior facets in males are twice the diameter of the posterior facets (0.64mm/0.32mm) (Fig. 6), while in females the anterior and posterior facets are much smaller and more similar in size (0.45mm/0.34mm).

Thorax and Abdomen Characters. Chaetotaxy patterns on the thorax are similar in most species of Neotropical *Lucilia*, and this character is not mentioned unless the pattern varies. Exceptions are two cosmopolitan species of *Lucilia*, *L. cuprina* and *L. sericata*, which have three postsutural acrostichal setae, while the remaining 21 species have two postsutural acrostichals. In the Galápagos species *L. deceptor*, the presutural intra-alar is sometimes much reduced or absent, while it is usually stronger in all other species. Color of upper and lower calypter disc and rim are also important characters that vary with species and in some cases, by sex. Some species have upper and lower calypters pale in both sexes, *L. cluvia*, *L. cuprina*, *L. deceptor*, *L. pionia*, *L. sericata*, *L. setosa*, in others, calypters are pale except lower calypter faintly tan to brown in males only, *L. eximia*, *L. ibis*, *L. mexicana*, *L. rica*, *L. ochricornis*, and *L. retroversa* to both upper and lower calypters dark in both sexes, *L. fayeae*, *L. nitida*, *L. pulverulenta*, *L. purpurascens*, *L. vulgata*, *L. woodi*, *L. japuhybensis*, *L. rognesi* (Fig. 8), to upper and lower dark in males and upper pale and lower dark in females, *L. problematica*, to upper calypter pale and lower dark in both sexes, *L. albofusca* (Fig. 9), *L. lucigerens*. Basicosta color is dark brown to tan in most species (Fig. 11); only *L. cluvia*, *L. cuprina*, *L. deceptor*, *L. problematica*, *L. retroversa* and *L. sericata* have whitish to orange colored basicostas (Fig. 10). The presence or absence of the coxopleural streak can help distinguish species (Table 2). When present, it is a suture-like depression between the katepimeron and meron (see Rognes 1991, fig. 6 or Whitworth 2006, fig. 16). The streak is often paler in color and distinct, when there is no color difference, the suture can be hard to see. On the mainland of Central and South America, species with pale setae on the gena lack the streak, except it is present in *L. cluvia*, which occurs in Central America. In the Galápagos, Cocos and West Indies islands, *L. deceptor* (Galápagos and Cocos) has pale setae and lacks the streak, while *L. rica* (West Indies) has both pale setae and the streak. Again on the mainland, all species with dark setae on the gena have the streak present, except *L. purpurascens* and *L. woodi*. The island species of *L. pionia* and *L. setosa* (Galápagos) and *L. retroversa* (West Indies) have dark setae on the gena, and lack the streak; in *L. fayeae* (West Indies) the streak is variable, it is distinct in some specimens and absent in others.

Microtomentum patterns on the thorax and abdomen provide useful characters; see Table 2 for a comparison between species. The thorax may be covered with microtomentum (as in Fig. 12), limited to the presutural area (as in Fig. 13), small patches (as in Fig. 14) or the whole thorax may be polished (as in Fig. 15). In most species, the abdomen has T1+2 dark greenish or bluish black T1+2 and T3 usually have microtomentum, while some or all of segments T4 and T5 are polished. The posterior edges of T3 and T4 have black bands in the three endemic Galápagos species. Faint bands can sometimes be seen in the same area on other *Lucilia* species. Generally body color cannot be relied on for species distinctions, with a few exceptions. Two Neotropical species lack the bright, shining body color, the West Indies *L. problematica*, and the Galápagos and Cocos Islands *L. deceptor* (Curran) are dull colored with dense microtomentum and only faint underlying metallic blackish-green color. For *L. ibis*, the very distinctive violet-pink body color is a useful character (Fig. 21), as is the bright aeneous coloration on T5 in most *L. lucigerens*.

Males. Frons width in males tends to be very consistent within species and is an important key character for many species. See Table 1 for a comparison of frons to head ratios for each species. The shape of surstyli and cerci tends to be very similar between species, but in lateral view, they fall into a few more or less distinct groups: surstylus short broad, parallel sided (digitate), *L. cuprina* (Hall 1948, figs. K, L), *L. ibis*, *L. ochricornis*, *L. sericata* (Hall 1948, figs. F, G), *L. vulgata* (Figs. 43, 44; 51, 52, 59, 60 respectively); surstylus a little longer, narrower, parallel sided, *L. woodi* (Fig. 61, 62); surstylus medium length, digitate, gradually expanded toward distal end of

surstylus, *L. nitida* (Fig. 49, 50); surstylus medium length, curved forward with distal end expanded, *L. purpurascens* (Figs. 55, 56), *L. lucigerens* (Whitworth 2010, figs. 46, 47), *L. retroversa* (Whitworth 2010, figs. 48, 49); surstylus medium length, parallel sided, *L. albofusca* (Figs. 39, 40), *L. problematica* (Hall 1948, p. 423, A, B), *L. pulverulenta* (Figs. 53, 54), *L. rica* (Whitworth 2010, figs. 50, 51), *L. rognesi* (Figs. 57, 58); surstylus with distal end narrower, and curved slightly forward, *L. chuvia* (figs. 38, 39, Whitworth 2010), *L. eximia* (Figs. 41, 42), *L. pionia* (James 1966, fig. 2; Tantawi & Sinclair 2013, figs. 3G, H); surstylus medium length, narrower at base, distal half expanded, *L. fayeae* (Whitworth 2010, figs. 44, 45); surstylus in lateral view medium length, slightly curved forward, slender and parallel sided; in posterior view the cerci and surstyli are about equal in length, *L. setosa* (James 1966, figs. 7, 8; Tantawi & Sinclair 2013, figs. 2E, F); surstylus longer, slender, curved forward, parallel sided, *L. mexicana* (Figs. 47, 48) and *L. japyhybensis* (Figs. 45, 46). *Lucilia mexicana* also has distinctive upside down Y-shaped cerci in the posterior view, and tip of cercus with distinct hook (Figs. 47, 48). *Lucilia japyhybensis* surstyli and cerci are exceptionally long, and in lateral view, the tip of the cercus is hooked like *L. mexicana*. *Lucilia deceptor* cerci are long and slender, much longer than surstyli; tips of cerci diverge in posterior view, in lateral view, the tip of the surstylus is enlarged and extends posteriorly (James 1966 figs. 4, 5; Tantawi & Sinclair 2013, figs 1E, F. Phalli of the 12 species studied in detail herein (Figs. 63–86) are very similar to those illustrated in Whitworth (2010), figs. 52–63. The epiphallus is broad and cupped and the distal end curves forward, tip angling more or less sharply downward. The epiphallus originates near posterior end of basiphallus in most species; it is slightly farther forward in *L. mexicana* and *L. japyhybensis*. The venter of hypophallus is serrated; tip of paraphallus curves down and usually slightly to the rear; acrophallus similar in all species, anterior end with posterior pointing denticles. Shape of hypandria is more or less distinctive in each species although variation is minimal between species; width of distal end tends to be narrower in species such as *L. japyhybensis* and *L. woodi*, while broader in species like *L. mexicana*, *L. ochricornis*, *L. purpurascens*, and *L. vulgata*. The pre- and postgonites of all species are similar, the pregonite has 3–4 setae, including one on the tip, while the postgonite has a single long seta originating from near the base. The ejaculatory sclerites are similar, broader in *L. mexicana* and *L. nitida*, while narrower in the remaining species. See Figs. 87–122 for photos of hypandria, pre- and postgonites, and ejaculatory sclerites. The sternites are also similar, though the exact shape and size of each sternite varies between species, especially in segments ST2 and ST4–5 (Figs. 123–134).

Females. Females share many characters with males, but they consistently differ in several ways. In the 23 species studied, frons width was broader than males, (0.21–0.39 of head width at narrowest) (see Table 1 for a comparison of species), with one latero-clinate and two proclinate orbital setae. Typically the frontal vitta and fronto-orbitals are much broader in females than males and the frontal setae extend the full length of the fronto-orbital plate, while in most males, they do not. Normally the pattern of microtomentum on the thorax does not vary significantly between sexes, but in some species the pattern on the abdomen may vary. If it is significant, it is mentioned in the species discussion. The most extreme example is in *L. mexicana* where females have all but the front edge of T5 polished, while in males, only the rear half of T5 is polished. For some species, calypter color of the upper and lower calypters differs between sexes (Table 2). See Whitworth (2010) for a discussion of ovipositor characters of four species endemic to the West Indies, and *L. chuvia*. *Lucilia problematica* females were not dissected. The female genitalia of Galápagos species *L. deceptor*, *L. pionia*, and *L. setosa* also were not dissected in this study and their condition is unknown. In the 12 species studied in detail, female genitalia were dissected and ovipositors and spermathecae were illustrated (Figs. 135–158). Tergites and sternites 6–8 of the ovipositor exhibited some variation between species. In 9 species, the cuticle on the anterior margin of T6 is weakened and translucent, in 2 species, *L. mexicana* and *L. rognesi*, only the anterolateral corners are weakened, and in one species, *L. eximia*, there is no weakening. ST6 of most species have lateral margins weakened and ST 6–7 has a posterior digit-like prolongation into the intersegmental membrane. This digit-like extension is found in 11 of the 12 species studied herein; only *L. purpurascens* lacks these extensions (Fig. 143). When the ovipositors of West Indies *Lucilia* were studied (Whitworth 2010) these structures were not noted, but upon re-examination the projections are present to some degree in all. Rognes (1991) also found these extensions in some species of *Lucilia* he studied in Fennoscandia and Denmark. The central portion of T7 is at least partially divided by weakened, translucent cuticle and/or membrane in all 12 species. The pattern of cuticular weakening extends the full length of the tergite in *L. eximia*, *L. ibis*, *L. ochricornis*, *L. nitida*, *L. purpurascens*, and *L. woodi*; in the remaining species the division of the tergite ends just short of the posterior margin. The weakened cuticle is further separated by membrane in all species, ranging from a tiny area of membrane at the anterior edge in *L. ochricornis* to the anterior

two-thirds of the segment in *L. albofusca*, *L. eximia*, *L. nitida*, *L. purpurascens*, *L. rognesi*, *L. vulgata*, and *L. woodi*. T8 is composed of two tergites broadly separated by membrane, in some species the tergites join at the posterior edge of the segment. In *L. ibis*, *L. japyhybensis*, *L. purpurascens*, and *L. vulgata* the posterior edge of the tergite is more or less connected by a narrow strip of cuticle. The shape of ST8 is somewhat variable among species. The shape of the epiproct and hypoproct are similar between species though they exhibit some variation in shape (Figs. 135–158). The spermathecae of all 12 species are similar as well (Figs. 147–158).

Distribution. Some species have very limited distributions so range information can be used to narrow down species identity. For example, endemic species in the West Indies and Galápagos Islands are not found on the mainland. *Lucilia mexicana* is known only from Mexico, Guatemala, and Honduras in the Neotropics while *L. ibis* is known only from the eastern slope of the Andes in Argentina, Bolivia, and Peru. When distribution data helps distinguish species, it is included in the key.

DNA Analysis. Samples of specimens for selected species were submitted to the BOLD project at the University of Guelph in an effort to increase information needed to distinguish valid species. See details of this project under Methods. CO1 barcodes were generated for 14 species of Neotropical *Lucilia*. See the barcode diagram showing the clusters of species analyzed (Fig. 161). Details of barcoding results, when available, are given under each species.

Key to the Species of Neotropical *Lucilia*

See Tables 1, 2 for a comparison of important key characters in each species.

- 1 Three postsutural acrostichal setae; basicosta orange (as in Fig. 10); abdomen usually with apparent mesal division in which one half is microtomentose, the other half shining when viewed from a sharp angle laterally 2
- Two postsutural acrostichal setae; basicosta usually tan to dark brown (Fig. 11) (except basicosta orange in *L. cluvia*, two West Indies species and one Galápagos species); abdomen usually uniformly metallic or microtomentose 3
- 2 Central occipital area with single seta just below inner vertical seta (Whitworth 2006, fig. 73); abdomen dull coppery; humeral callus with 2–3 small setulae along posterior margin (Whitworth 2006, fig. 74); metasternum bare; frons of male broad, much broader than width of parafacial at level of lunule, 0.20 (0.19–0.21/7) of head width; male genitalia (as *Phaenicia pallescens*) as in Hall (1948, fig. 24, J–M); widespread in the Neotropical Region 3. *L. cuprina*
- Central occipital area with 2–5 setae below inner vertical seta (Whitworth 2006, fig. 73); abdomen usually bright green, occasionally shining coppery; humeral callus with 6–8 small setulae along posterior margin (Whitworth 2006, fig. 74); metasternum setose; frons of male narrower, about equal to width of parafacial at level of lunule, 0.13 (0.12–0.14/6) of head width; male and female genitalia as in Rognes (1991, figs. 455–465); common near many larger cities and developed areas in the Neotropical Region 20. *L. sericata*
- 3 Two species known only from the Galápagos Islands, and one species, *L. deceptor*, known from the Galápagos Islands and Cocos Island off the west coast of Costa Rica (where it coexists with some mainland species). *Lucilia deceptor* is distinct from the mainland species of *Lucilia* in having the thorax and abdomen dull blackish to blackish green with dense whitish microtomentum on thorax and all abdominal segments; frons of male very broad, 0.10 head of width or more, only male *L. cluvia* among species with two posterior acrostichals has such a wide frons (about 0.12 of head width) 21
- Not known from the Galápagos or Cocos Islands (except *L. eximia*); male frons narrower, 0.075 of head width or less 4
- 4 Body color violet-pink with aeneous highlights (Fig. 21); face bright yellow to gold from above, including lower fronto-orbital, parafacial, and gena; all abdominal tergites microtomentose; upper calypters white, both sexes, lower calypter light tan in male, white in female; basicosta brown; fifth tergite aeneous in some; male frons broad, at narrowest, 0.05 (0.04–0.06/5) of head width, slightly narrower than the width of first flagellomere; female frons, at narrowest, 0.26 (0.25–0.27/5) of head width, known primarily from Peru, Junin Region near Chuquisunca, San Felix, San Ramon and Cusco Province near Huadquina and Huancabamba (Baumgartner & Greenberg 1985), also Santa Cruz, Bolivia and Rio Tapia, Tucuman Province, Argentina 7. *L. ibis*
- Body color combination not as above; face usually darker; usually part or all of T4 and T5 polished; male frons width variable 5
- 5 Known only from Jamaica, fifth abdominal tergite coppery or aeneous (not always obvious in some females); intrapostocular area golden; body color dark blue sometimes with purple highlights; upper calypter white, lower calypter tan in both sexes. See Whitworth (2010) for more information 9. *L. lucigerens*
- not as above 6
- 6 Known only from Bermuda. Body color metallic-tan; basicosta pale orange; all abdominal tergites microtomentose; known only from six specimens, probably extinct. See Whitworth (2010) for more information 14. *L. problematica*
- Body color normally shining metallic green, blue, or purple 7
- 7 Gena with, at least, some pale setae mixed with dark setae on the posterior edge, anterior to the postgena. In some species the pale setae extends forward to midway on the gena or beyond (Fig. 1) 8

- Gena with dark setae only (Fig. 2) (note the postgena has some pale setae in all species). Rarely a few pale setae may be found just ahead of the postgena in specimens with dark setae, but they are not found beyond the edge of the postgena 13
- 8 Basicosta pale whitish to yellow or orange, rarely light tan; both calypters pale in both sexes; rear of T4 and all of T5 polished (fig. 37, Whitworth, 2010). Male frons exceptionally broad, 0.10–0.12 of head width, at narrowest, broader than the width of the first flagellomere; female frons, at narrowest, 0.29 (0.28–0.30/4) of head width; known from Mexico, Guatemala, Honduras, Costa Rica, and West Indies 2. *L. cluvia*
- Basicosta light brown to dark brown; lower calypters dark in both sexes except for *L. rica* which is known only from the West Indies; condition of T4 and T5 variable; male frons narrower, 0.01–0.035 of head width; female frons narrower, 0.21–0.26 of head width 9
- 9 Known only from the West Indies; upper calypter pale both sexes, lower calypter dark in male, pale in female. Rear edge of T3, all of T4 and T5 polished when viewed from rear (fig. 36, Whitworth, 2010); anterior edge of presutural area of thorax microtomentose 18. *L. rica*
- Known only from Central and South America. Upper and lower calypters brown in both sexes (except upper pale and lower brown in both sexes of *L. albofusca*); only rear one-third to two-thirds of T4 and T5 polished; microtomentum on presutural area of thorax variable from a broad band to absent. 10
- 10 Upper calypter pale in both sexes (sometimes light tan, in poor specimens or in low light), lower calypter dark in both sexes (Fig. 9); face pale yellow-gold from above, orange from below; anterior edge of gena often orange; dorsum of thorax all polished; male frons narrow, 0.02 (0.01–0.02/5) of head width, about equal to width of anterior ocellus; female frons narrow, 0.21 (0.20–0.22/5) of head width. Known from Brazil, Colombia, Ecuador, French Guyana, Guyana (British Guiana), Panama, Peru, and Venezuela (Figs. 159, 160) 1. *L. albofusca*
- Upper calypter light tan to darker brown, lower calypter brown to dark brown (as in Fig. 8); face and edge of gena darker; thorax microtomentum variable; frons width variable. 11
- 11 Presutural area of thorax with broad band of whitish microtomentum (as in Fig. 13); male, surstylus digitate, medium length, parallel sided (Fig. 53); male frons very narrow, 0.018 (0.015–0.02/5) of head width at narrowest, narrower than the width of the medium ocellus; female frons, at narrowest, 0.24 (0.23–0.25/5) of head width. Known from Colombia, Costa Rica, Ecuador, Honduras and Panama (Figs. 159, 160) 15. *L. pulverulenta*
- Presutural area of thorax all polished (Fig. 15), or at most only a few small patches of microtomentum (as in Fig. 14); male genitalia variable; male frons 0.015–0.03 of head width; female frons 0.21–0.24 of head width 12
- 12 Presutural area of thorax all polished (as in Fig. 15); male surstylus digitate, medium length, gradually expanding toward distal end, cercus about equal in length to surstylus (Figs. 49, 50); known from northern South America, Brazil, Peru, and Venezuela (Fig. 160); male frons narrow, 0.02, (0.015–0.03/6) of head width at narrowest, about equal to the width of median ocellus; female frons, at narrowest, 0.23 (0.21–0.24/6) of head width 11. *L. nitida*
- Presutural area of thorax mostly polished with microtomentose streak between acrostichal and dorsocentral setae and a whitish patch between dorsocentral seta and humeral callus; surstylus medium length, parallel sided, cercus shorter and broader at base (Figs. 57, 58) known from Central America, Costa Rica, Honduras and Panama (Fig. 159); male frons, at narrowest, 0.02 (0.015–0.025/4) of head width, about equal to width of medium ocellus; female frons, at narrowest, 0.23 (0.23/4) of head width at narrowest 19. *L. rognesi*
- 13 Basicosta pale yellow to orange (Fig. 10); upper calypter pale in both sexes, lower calypter tan in male, pale in female; known only from the West Indies (see Whitworth 2010 for details) 17. *L. retroversa*
- Basicosta brown (rarely a few *L. ochricornis* are seen with an orange basicosta); not known from the West Indies, except for *L. fayeae* and *L. eximia* 14
- 14 Disc of upper calypter usually pale in both sexes, from whitish to yellowish, rim may be tan, clearly lighter than lower calypter in male; lower calypter pale in female, light tan to brown in male; coxopleural streak present (see this character in Whitworth 2006, fig. 16); anterior one-third to one-half of gena orange in two of three species, silvery in *L. mexicana* 15
- Disc of upper and lower calypters light tan to dark brown in both sexes; gena normally dark silvery to brown; coxopleural streak absent in all but two species (*L. fayeae*, *L. vulgata*). 17
- 15 One or more rows of stout dark setae below and behind strong postocular row (as in Fig. 4); T4 with, at most, the rear edge polished to only rear half of T5 polished; male frons broad, about the width of the first flagellomere (0.05–0.07 of head width); female frons 0.26–0.28 of head width 16
- Setae below and behind strong postocular row pale whitish or yellow and usually weak, except a few stronger setae can be found near the posteroventral corner of the eye (Fig. 3); polished area larger on abdomen with rear half to one-third of T4, and all of T5 polished (in West Indies specimens most or all of T4 is polished); male frons narrow, less than the width of fifth flagellomere, 0.04 (0.03–0.05/19) of head width, at narrowest; female frons 0.25 (0.24–0.28/11); widespread from the southern United States through Central and South America 5. *L. eximia*
- 16 Lower parafacial and anterior half or more of gena orange; usually rear edge of T4 and all of T5 polished; proepisternal depression usually with pale setae; male frons, at narrowest, 0.06 (0.05–0.075/5) of head width, about equal to the width of the parafacial; female frons, at narrowest, 0.26 (0.24–0.26/5) of head width; cerci in male genitalia nearly parallel when viewed from rear (Fig. 52); first flagellomere in male is usually narrower than parafacial; rarely with an orange basicosta. Known from Argentina, Brazil, Paraguay, Peru and Uruguay (Fig. 160) *L. ochricornis* . . . (12)
- Parafacial and gena dark silvery; in males, only rear half T5 of abdomen polished, in females, all of T5, or all but front edge of T5 polished; proepisternal depression usually with dark setae; male cerci in the shape of an inverted Y when viewed from the rear (Fig. 48); in male, first flagellomere usually wider than parafacial; male frons, at narrowest, 0.055 (0.05–0.06/8) of head width, slightly narrower than the width of the parafacial; female frons, at narrowest, 0.28 (0.26–0.30/6) of head width. Known from the southern United States south through Mexico into Guatemala and Honduras 10. *L. mexicana*

- 17 Known only from the West Indies. Setae below and behind strong postocular row pale and weak. Presutural area of thorax with heavy microtomentum; rear one-half to two-thirds of T4 and all of T5 polished; see Whitworth (2010) for more information. 6. *L. faveae*
- Not as above 18
- 18 Entire dorsum of thorax covered with heavy whitish microtomentum when viewed from rear (Fig. 12); T4 and T5 usually entirely polished; calypters very dark brown; usually a strong row of brown setae below and behind the postocular row, some setae may be weaker; male frons extremely narrow, 0.01/5 of head width at narrowest, eyes almost touch, a thin line midway, narrower than width of a single adjacent eye facet; surstylus in lateral view short, curved forward, with distal end expanded (Fig. 55); in male, anterior thoracic spiracle much enlarged, about equal to humeral callus; anterior eye facets much larger than posterior facets (Fig. 6); female frons broad, at narrowest, 0.28 (0.27–0.29/4) of head width. Known from Argentina, Bolivia, Costa Rica, Colombia, Ecuador, Guatemala, Mexico, Panama, Peru, and Venezuela 16. *L. purpurascens*
- Only presutural area of thorax with microtomentum (Fig. 13) or whole thorax bare and shining (Fig. 15); abdomen with, at least, some microtomentum on T4; calypters not dark brown; condition of setae below and behind postocular row variable; male frons wider, 0.03–0.07 of head width, in two species, similar in one (*L. woodi*); surstylus not as above; anterior thoracic spiracle smaller; anterior eye facets smaller (except similar in *L. woodi*); female frons 0.23–0.25 of head width, except up to 0.28 in *L. japuhybensis* which is known only from southern Brazil 19
- 19 Setae below and behind strong postocular row pale and weaker (some strong setae may occur behind the posteroventral corner of the eye); rear one-third to two-thirds of T4 on abdomen polished; coxopleural streak absent; calypters darker brown; postgena either all pale setae or anterior quarter with dark setae; male frons usually 0.017–0.03 of head width 20
- Row of stout dark setae behind and below the strong postocular row (Fig. 4); anterior edge of presutural area with heavy microtomentum (as in Fig. 13); only rear edge of T4 polished; coxopleural streak present; calypters lighter tan; anterior half of postgena with dark setae, remainder pale; surstylus in male digitate, medium length, gradually expanding toward distal end (Fig. 59); male frons wide, 0.05 (0.045–0.07/7) of head width at narrowest, slightly narrower than width of parafacial at lunule. Known from Argentina, Bolivia, Brazil, Colombia, Peru, and Venezuela (Fig. 160). 22. *L. vulgata*
- 20 Presutural area of thorax usually all polished with little or no microtomentum (as in Fig. 15); only rear third T4 of abdomen polished; proepisternal depression usually with dark setae (rarely pale); anterior fourth of postgena with dark setae, remainder pale; surstylus long and curved to rear (Figs. 45, 46); male frons broader, at narrowest, 0.03 (0.02–0.04/5) of head width, about two-thirds the width of the parafacial at lunule; female frons, at narrowest, 0.25 (0.23–0.28/5) of head width; known only from Brazil (Fig. 160) 8. *L. japuhybensis*
- Front edge of presutural area normally with a broad band of whitish microtomentum (Fig. 13), some specimens with only patchy microtomentum on the anterior edge of the presutural area (as in Fig. 14); T4 polished except for anterolateral corners in males, all polished in females; proepisternal depression usually with pale setae; all setae on postgena pale; male surstylus short and digitate (Figs. 61, 62); known from Costa Rica, Honduras and Panama (Fig. 160); male frons narrower, 0.017 (0.01–0.02/5) of head width, about equal to width of median ocellus; female frons, at narrowest 0.24 (0.22–0.25/5) of head width 23. *L. woodi*
- 21 Thorax and abdomen dull blackish to greenish black with heavy tan to whitish microtomentum; basicosta pale orange; gena with pale setae on posteroventral area; setae below and behind postocular row pale and weak; ST5 is deeply incised with elongate lobes, as in Tantawi & Sinclair (2013, fig. 1G); Male frons broad, 0.23 (0.21–0.24/5) of head width at narrowest, almost twice the width of the parafacial at narrowest; female frons about 0.35 (0.35/1) of head width at narrowest; genitalia are distinctive, cercus is slender and much longer than surstylus, the tips of the cerci diverge in posterior view, in lateral view, the tip of the surstylus is enlarged and projects posteriorly (Tantawi & Sinclair 2013, figs. 1E, F) 4. *L. deceptor*
- Thorax and abdomen with areas of shining blue green, or coppery cuticle with whitish or brown microtomentum; basicosta brown; gena with only dark setae; setae below and behind postocular row strong; ST5 not deeply incised as in Tantawi & Sinclair (2013, fig. 3I); male frons narrower, 0.12–0.18 of head width at narrowest; genitalia not as above; female frons narrower (0.31–0.33 of head width) 22
- 22 Lower gena and parafacial expanded anteroventrally as in Tantawi & Sinclair (2013, fig. 3C) (except see discussion of variant found on the island of Española, Tantawi & Sinclair 2013); thorax and abdomen shining bright metallic green to coppery with weak microtomentum (tends to be stronger in males than females); in females, disc of T5 without stout, black setae; presutural intra-alar seta often weak or absent (variable, seen in four of six female specimens); male frons narrower, 0.115 (0.10–0.13/2) of head width at narrowest, slightly narrower than width of parafacial at narrowest; male genitalia as in Tantawi & Sinclair (2013, figs. 3G, H); female frons 0.31 (0.30–0.32/3) of head width at narrowest 13. *L. pionia*
- Lower gena and parafacial not expanded anteroventrally as in Tantawi & Sinclair (2013, fig. 1C); thorax and abdomen shining green showing through heavy whitish microtomentum; disc of T5 with stout black setae; presutural seta present; male frons broader, 0.17 (0.16–0.18/3) of head width, about 1.25x the width of parafacial at narrowest; male genitalia as in Tantawi & Sinclair (2013, figs. 2E, F); female frons 0.33 (0.33–0.34/3) of head width at narrowest 21. *L. setosa*

TABLE 1. Comparison of head character states for species of Neotropical *Lucilia*

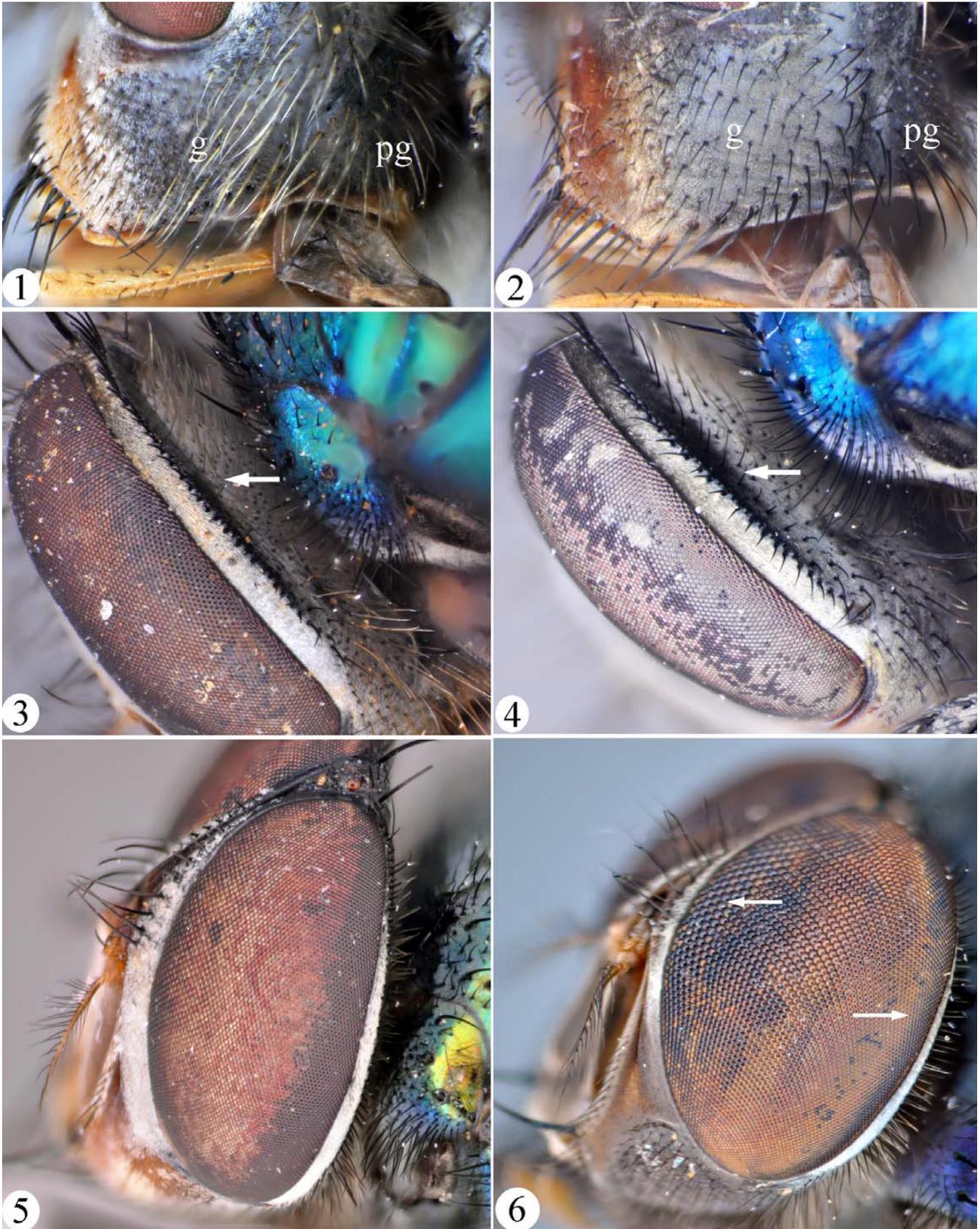
<i>Lucilia</i> species	Male frons width at narrowest	Female frons width at narrowest	Vestiture color lower parafacial & anterior edge gena ¹	Color of setae on lower gena ¹ postgena ²	Pattern of pale setae on postgena ²	Diameter anterior/posterior eye facets in male (mm)	Diameter anterior/posterior eye facets in female (mm)	Condition of setae below and behind postocular row
<i>albofusca</i>	0.02 (0.01–0.02/5)	0.21 (0.20–0.22/5)	orange	pale	all pale	0.60/0.40	0.55/0.28	pale, weak
<i>cluvia</i>	0.12 (0.10–0.13/13)	0.29 (0.28–0.30/4)	orange	pale	all pale	not measured	not measured	pale, weak
<i>cuprina</i>	0.20 (0.19–0.21/7)	0.39 (0.38–0.40/5)	bright silvery	dark	lower ¼	not measured	not measured	stout, black
<i>deceptor</i>	0.23 (0.21–0.24/5)	0.35/1	dark silvery	pale	all pale	not measured	not measured	pale, weak
<i>eximia</i>	0.04 (0.03–0.05/19)	0.25 (0.24–0.28/11)	orange	dark	lower ⅔	0.40/0.27	0.48/0.27	pale, weak
<i>fayeeae</i>	0.02 (0.02–0.03/16)	0.25 (0.22–0.27/16)	dark silvery	dark	all pale	not measured	not measured	pale, weak
<i>ibis</i>	0.05 (0.04–0.06/5)	0.26 (0.25–0.27/5)	golden-orange	dark	all pale	0.48/0.29	0.43/0.26	tan, weak
<i>japuthybensis</i>	0.03 (0.02–0.04/5)	0.26 (0.23–0.28/5)	dark silvery	dark	lower ¾	0.55/0.33	0.41/0.29	pale, weak
<i>lucigerens</i>	0.02 (0.02–0.03/5)	0.24 (0.24–0.25/5)	orange	dark	all pale	not measured	not measured	pale, weak
<i>mexicana</i>	0.055 (0.05–0.06/8)	0.28 (0.26–0.30/6)	dark silvery	dark	lower ½	not measured	not measured	stout, black
<i>nitida</i>	0.02 (0.015–0.03/6)	0.23 (0.21–0.24/6)	dark silvery	pale	all pale	0.63/0.36	0.58/0.30	pale, weak
<i>ochricornis</i>	0.06 (0.05–0.075/5)	0.26 (0.24–0.26/5)	orange	dark	lower ¾	0.42/0.24	0.46/0.31	stout, black
<i>ponia</i>	0.115 (10–13/2)	0.31 (0.30–0.32/3)	pale gray	dark	all pale	not measured	not measured	stout, black
<i>problematica</i>	0.02/1	0.30 (0.29–0.31/2)	unknown	dark	unknown	not measured	not measured	unknown
<i>pulverulenta</i>	0.018 (0.015–0.02/5)	0.24 (0.23–0.25/5)	dark silvery	pale	all pale	0.68/0.44	0.52/0.30	pale, weak
<i>purpurascens</i>	0.01/5	0.28 (0.27–0.29/4)	dark silvery	dark	lower ½	0.64/0.32	0.45/0.34	stout, black
<i>retroversa</i>	0.025 (0.02–0.03/7)	0.26 (0.24–0.28/10)	dark silvery	dark	all pale	not measured	not measured	pale, weak
<i>rica</i>	0.026 (0.02–0.04/14)	0.25 (0.24–0.26/5)	dark silvery	pale	all pale	not measured	not measured	pale, weak
<i>rognesi</i>	0.02 (0.015–0.025/4)	0.23 (0.23/4)	dark silvery	pale	all pale	0.49/0.32	0.51/0.31	pale, weak
<i>sericata</i>	0.13 (0.12–0.14/6)	0.37 (0.35–0.40/8)	bright silvery	dark	lower ¼	not measured	not measured	stout, black
<i>setosa</i>	0.17 (0.17–0.19/5)	0.33 (0.33–0.34/3)	pale orange	dark	all pale	not measured	not measured	stout, black
<i>vulgata</i>	0.05 (0.045–0.07/7)	0.25 (0.24–0.27/4)	orange	dark	lower ½	0.43/0.24	0.43/0.30	stout, black
<i>woodi</i>	0.017 (0.01–0.02/5)	0.24 (0.22–0.25/5)	dark silvery	dark	all pale	0.67/0.28	0.59/0.29	pale, weak

¹Note, all species in this study have some or all of the postgena with pale setae. ²If some of the setae are pale, the remainder are black.

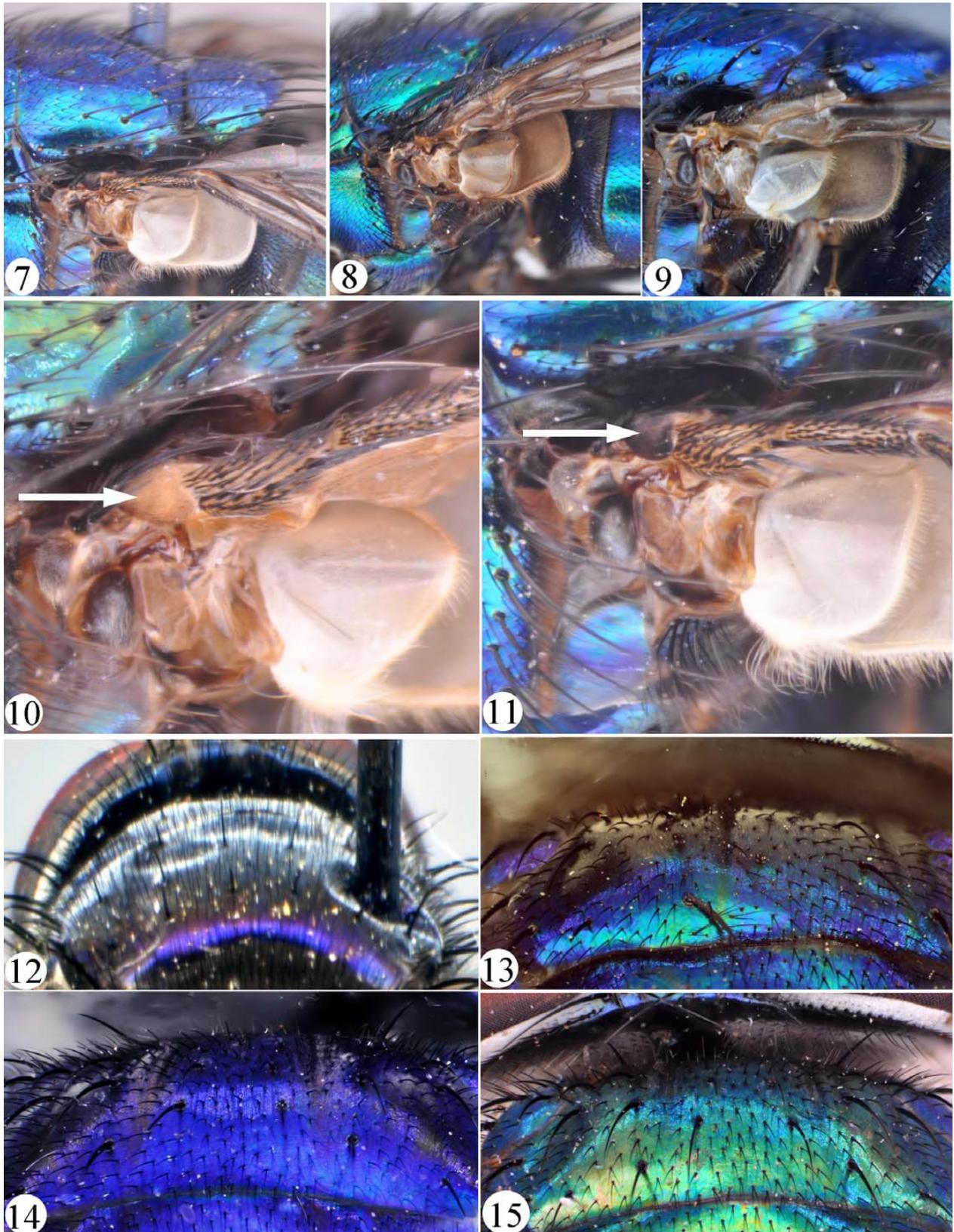
TABLE 2. Comparison of thorax and abdomen character states for species of Neotropical *Lucilia*.

<i>Lucilia</i> species	Male calypter color upper/lower	Female calypter color upper/lower	Basicosta color	Thorax with microtomentum present on presutural area	Abdominal segments polished, lacking microtomentum	Coxopleural streak	Color of seta on proepisternal depression	Specimens barcoded	Species distribution ¹
<i>albofusca</i>	pale/dark	pale/dark	brown	absent, polished	rear $\frac{1}{5}$ – $\frac{2}{3}$ T4, all of T5	no	pale	1 only	CA, NSA
<i>cluvia</i>	both pale	both pale	pale orange	yes, heavy	rear $\frac{1}{5}$ – $\frac{2}{3}$ T4, all of T5	yes	pale	4 grouped	CA, WI
<i>cuprina</i>	both pale	both pale	pale orange	yes, heavy	no segments polished	yes	dark	none	widespread
<i>deceptor</i>	both pale	both pale	pale orange	yes, heavy	no segments polished	no	pale	none	Galápagos
<i>eximia</i>	pale/dark	both pale	brown	yes, heavy	rear $\frac{1}{5}$ – $\frac{2}{3}$ T4, all of T5	yes	pale	35 variable	Widespread
<i>fayeeae</i>	both dark	both dark	brown	yes, heavy	rear $\frac{3}{4}$ T4, all of T5	variable	pale	2 groups	WI
<i>ibis</i>	pale/light tan	both pale	brown	yes, heavy	no segments polished	yes	pale	none	Andes mts.
<i>japulybensis</i>	both dark	both dark	brown	absent, polished	rear $\frac{1}{5}$ T4, all of T5	no	dark	none	Brazil
<i>lucigerens</i>	pale/dark	pale/dark	brown	yes, heavy	rear $\frac{3}{4}$ T4, all of T5	yes	pale	none	WI
<i>mexicana</i>	pale/light tan	both pale	brown	yes, heavy	rear $\frac{1}{2}$ to all T5 polished	yes	dark	4 variable	CA, Mexico
<i>nitida</i>	both dark	both dark	brown	absent, polished	rear $\frac{2}{5}$ T4, all of T5	no	pale	none	NSA
<i>ochricornis</i>	pale/light tan	both pale	brown	yes, heavy	rear $\frac{1}{4}$ T4, all of T5	yes	pale	13 grouped	SSA
<i>ponia</i>	both pale	both pale	brown	yes, heavy	no segments polished	no	pale	none	Galápagos
<i>problematica</i>	both dark	pale/dark	pale orange	yes, heavy	no segments polished	?	?	none	WI
<i>pulvertenta</i>	both dark	both dark	brown	yes, heavy	rear $\frac{1}{5}$ T4, all of T5	no	pale	5 variable	CA, NSA
<i>purpurascens</i>	both dark	both dark	brown	yes, heavy	rear $\frac{1}{5}$ T4, all of T5	no	pale	5 grouped	CA, NSA
<i>retroversa</i>	pale/light tan	both pale	pale orange	yes, heavy	rear $\frac{1}{5}$ – $\frac{2}{3}$ T4, all of T5	no	pale	none	WI
<i>rica</i>	pale/light tan	both pale	brown	yes, heavy	rear edge T3, all of T4, T5	yes	pale	none	WI
<i>rognesi</i>	light tan/dark	light tan/dark	brown	Small patches only	most of T4, all T5	no	pale	1 only	CA
<i>sericata</i>	both pale	both pale	pale orange	yes, heavy	no segments polished	yes	dark	none	Widespread
<i>setosa</i>	both pale	both pale	brown	yes, heavy	no segments polished	no	pale	none	Galápagos
<i>vulgata</i>	Light tan/tan	Light tan/tan	brown	yes, heavy	rear $\frac{1}{5}$ T4, all of T5	yes	dark	5 grouped	SA
<i>woodi</i>	both dark	both dark	brown	yes, heavy	rear $\frac{3}{4}$ T4, all of T5	no	pale	2 not grouped	CA, NSA

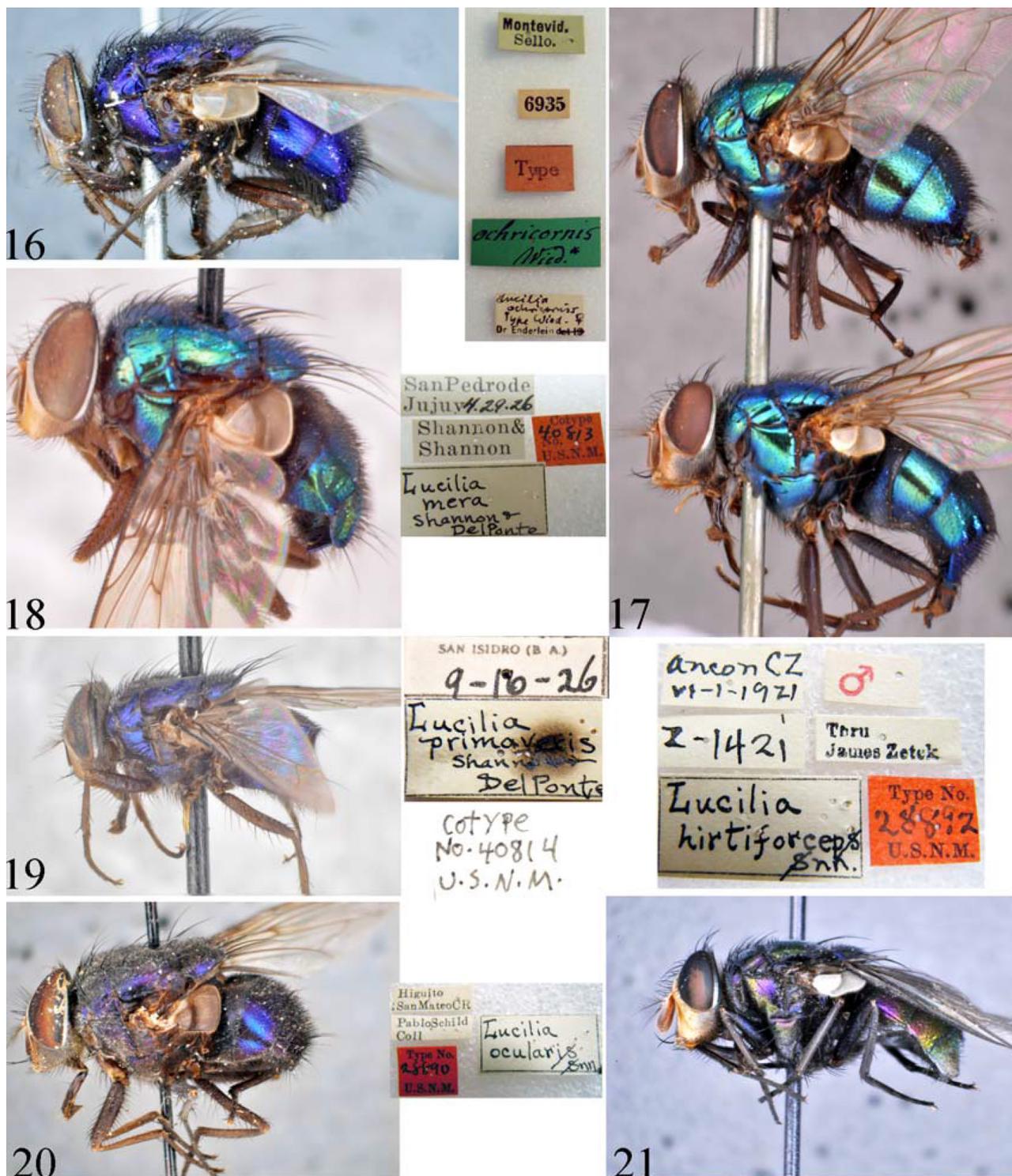
¹CA=Central America, NSA=northern South America, SSA=southern South America, WI=West Indies.



FIGURES 1–6. 1–2. Left lateral view of gena=g and postgena=pg showing color of setae on gena. 1. *L. cluvia*, setae pale. 2. *L. eximia*, setae dark. Left lateral view of head showing condition of setae below and behind postocular row on occiput (white arrow). 3. *L. albofusca* female, setae pale and weak. 4. *L. ochricornis* female, setae stout and dark. Left lateral view of eye facet size, see white arrows 5. *L. ochricornis* male, anterior and posterior facets very small. 6. *L. purpurascens* male, anterior facets twice the diameter of posterior facets.



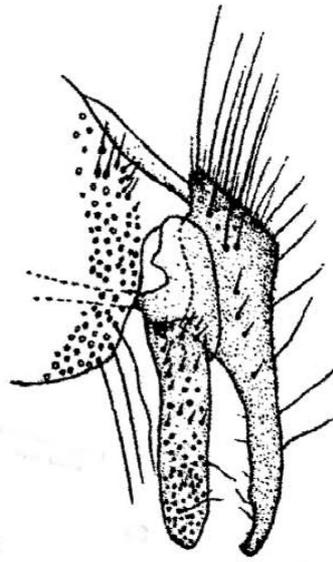
FIGURES 7–15. 7–9. Upper and lower calypter color. 7. *L. eximia* female, both pale. 8. *L. japuhybensis* female both dark, both sexes. 9. *L. albofusca* female, upper pale, lower dark, both sexes. 10–11. Basicosta color left lateral view. 10. *L. cluvia* female, basicosta orange. 11. *L. eximia* female, basicosta brown. 12–15. Pattern of microtomentum on thorax viewed from the rear. 12. *L. purpurascens* female, heavy on whole dorsum of thorax. 13. *L. woodi* female, broad band on presutural area of thorax. 14. *L. rognesi* female, patches on presutural area of thorax. 15. *L. nitida* female, microtomentum absent, presutural area of thorax all polished.



FIGURES 16–21. Photos of adults and labels. 16–20. Adult types and labels. 16. *L. ochricornis* (Wiedemann) (lectotype male of *Musca ochricornis* Wiedemann). 17. *L. eximia* (Wiedemann) (holotype male and paratype female of *L. hirtiforceps* Shannon, *in copula*). 18. *L. ochricornis* (Wiedemann) (cotype male of *Lucilia mera* Shannon & Del Ponte). 19. *L. ochricornis* (Wiedemann) (cotype male of *L. primaveris* Shannon & Del Ponte). 20. *L. purpurascens* (Walker) (holotype male of *L. ocularis* Shannon). 21. *L. ibis*, left lateral view of non-type female from San Ramon, Peru.



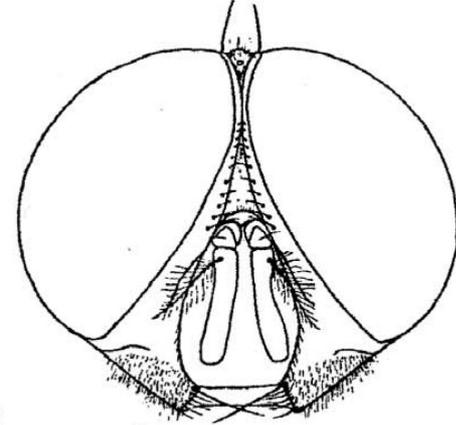
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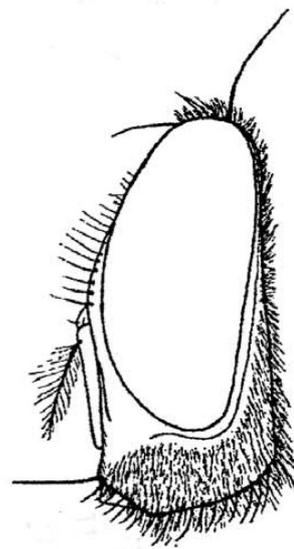
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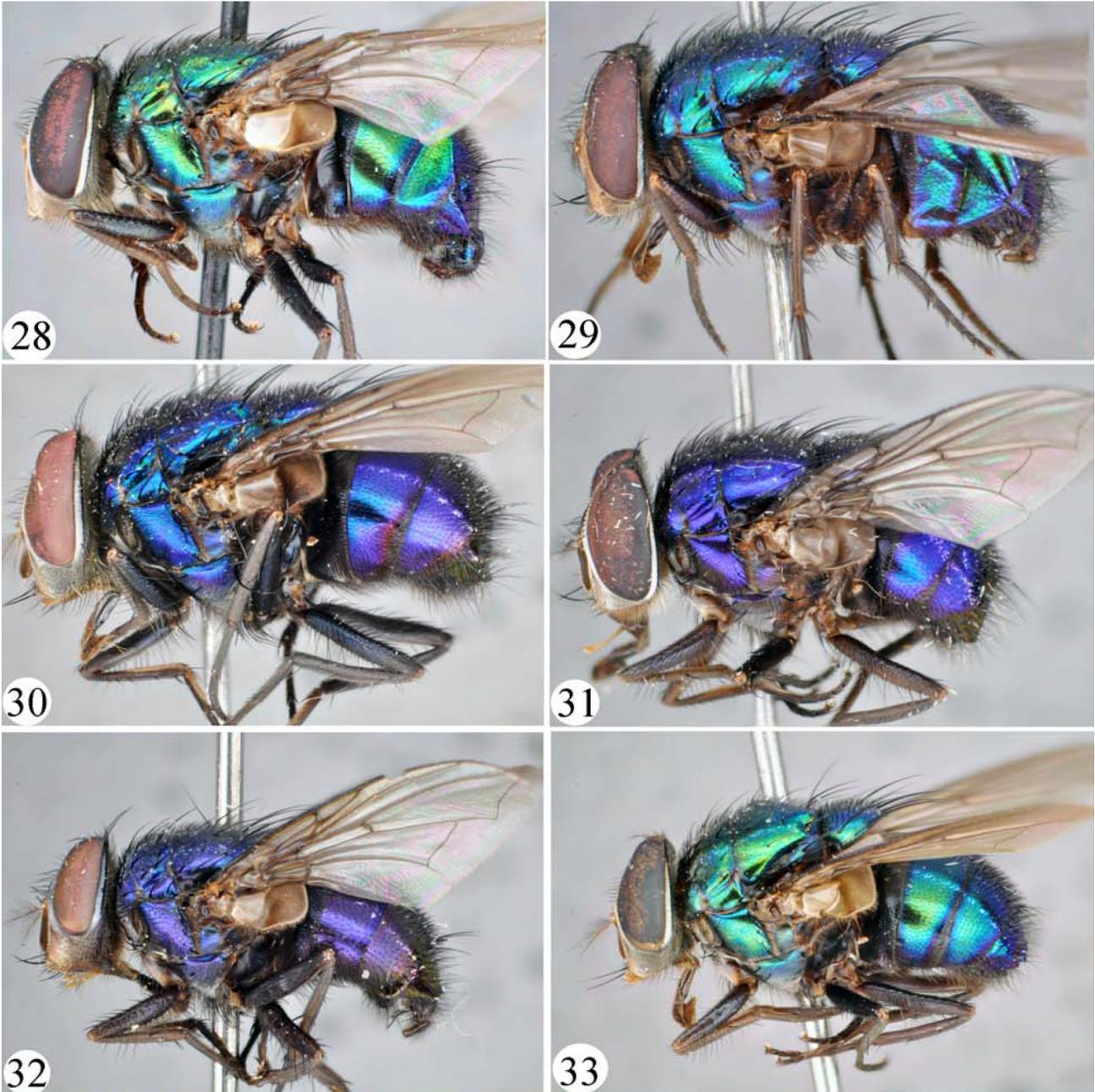


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FIGURES 22–27. Photos of male specimen by author compared to figures of male *L. japyhybensis* by Mello (1961: 275) (figures reproduced with permission from the journal *Memorias do Instituto Oswaldo Cruz*). **22, 23.** Left lateral view of genitalia, **22.** Author's photo. **23.** Mello's figure. **24, 25.** Anterior view of head. **24.** Author's photo. **25.** Mello's figure. **26, 27.** Left lateral view of head. **26.** Author's photo. **27.** Mello's figure.



HOLOTYPE <i>Lucilia albofusca</i> T.L. Whitworth	HOLOTYPE <i>Lucilia nitida</i> T.L. Whitworth	HOLOTYPE <i>Lucilia pulverulenta</i> T.L. Whitworth
HOLOTYPE <i>Lucilia rognesi</i> T.L. Whitworth	HOLOTYPE <i>Lucilia vulgata</i> T.L. Whitworth	HOLOTYPE <i>Lucilia woodi</i> T.L. Whitworth

FIGURES 28–34. 28. *L. albofusca* holotype male. 29. *L. nitida* holotype male. 30. *L. pulverulenta* holotype male. 31. *L. rognesi* holotype male. 32. *L. vulgata* holotype male. 33. *L. woodi* holotype male. 34. Holotype labels for the above species.



FIGURES 35–38. 35–37. Holotype female of *Musca purpurascens* Walker. 35. Dorsal view. 36. Type labels. 37. Left lateral view. 38. Left lateral view of female *Lucilia purpurascens* matching the concept of *purpurascens* of Aubertin (1933) and Hall (1948).

Species descriptions

Tables 1 and 2 provide a comparison of important morphological characters for all 23 species.

1. *Lucilia albofusca* sp. nov.

Figs. 3, 9, 28, 34, 39, 40 63, 64, 87–89, 123, 135, 147, 159–161, Tables 1, 2

Diagnosis. Gena with pale setae extending from the posterior edge about halfway forward, pale setae on the gena is a character state found in only 7 of the 23 Neotropical *Lucilia* species. Disc and rim of upper calypter pale whitish; disc and rim of lower calypter tan to brown in both sexes (Fig. 9); this combination is found only in one other species in the neotropics, *L. lucigerens* (West Indies-Jamaica only), though upper calypter pale and lower dark is found in males of several species in the area (*L. eximia*, *L. deceptor*, *L. ibis*, *L. mexicana*, *L. ochricornis*, *L. retroversa*, *L. rica*). Other species with pale setae on gena have both upper and lower calypters brown, except *L. rica* which is known only from the West Indies and Bermuda. Vestiture of parafacial and gena is usually bright yellow-gold when viewed from above, orange when viewed from below. Dorsum of thorax polished when viewed from rear, little or no microtomentum on dorsum of thorax. Setae below and behind strong postocular row pale and weak.

Description. Male. Frons narrow, 0.02 (0.01–0.02/5) of head width at narrowest, narrower than the width of median ocellus. Anterior eye facets 1.5x posterior facets (60mm, 0.40mm), see Table 1 for comparison with other species (see methods section for explanation of how facets are measured). Fronto-orbital plate, parafacial and gena vestiture pale gold from above, orange from below; lower frontal vitta reddish, narrowed upper portion of frontal vitta obliterated as frons narrows; pedicel of antenna reddish brown, first flagellomere broader than parafacial, base orange, remainder pale yellow; occiput below and behind stout postocular row with dense, weak pale gold to silver

setae; setae on facial ridge ascending about halfway up toward vertex. Anterior and posterior thoracic spiracles medium sized, brown in color; proepisternal depression usually with pale setae. Disc and rim of upper calypter pale, whitish; disc and rim of lower calypter tan to brown. Presutural area on thorax polished, with no microtomentum. Tegula black, basicosta brown. Abdomen, T3 and anterior third to half of T4 with whitish microtomentum, remainder of T4 and T5 polished.

Surstylus is digitate; medium in length and parallel sided in lateral view (Fig. 39). In posterior view, surstyli curve slightly inward and cerci are about equal in length (Fig. 40). The phallus is similar to other species, but the acrophallus and paraphallus are more slender than most (Figs. 63, 64). The hypandrium, pre- and postgonites, ejaculatory sclerites and sternites are as in Figs. 87–89, 123.

Female. Similar to male, except frons 0.21 (0.20–0.22/5) of head width, unusually narrow for female Neotropical *Lucilia* (Table 1). Diameter of anterior eye facets, almost as large as males (0.60mm vs. 0.55mm), but the posterior facets in females are much smaller than those in males (0.28mm vs. 0.40mm). Frontal vitta is broad, mostly dark brown with the lower portion reddish. In bright light, the upper disc and rim of the calypter are all white, lower is brown; in low light the upper calypter may appear light tan, but the upper calypter is much lighter than the lower calypter. The ovipositor and spermathecae are as in Figs. 135, 147.

Type material. Holotype male from Panama, Canal Zone, Barro Colorado Island, May 13, 1956, no. 1782, collected over a swarm raid of *Eciton burchelli* (*Eciton* army ant), C.W. and W.E. Bettenmeyer (USNM) (Figs. 28, 34). Allotype female, same location as holotype, June 28, 1968, Malaise trap, Roger E. Akre (USNM). The holotype and allotype were originally in WSUP but permission has been granted to deposit them in USNM.

Paratypes. (5 males, 176 females). **Brazil** (6 females): 4 females, Belém, state of Pará, April, 1969, D.J. Lewis (BMNH); 1 female, State of Amazonas, Manaus, Reserva Ducke, July 31, 1981, flight trap, G.B. Fairchild (FSCA); 1 female, State of Pará, 60km S Altmira, Rio Xingu Camp, 52°22'W 3°39'S, Oct. 2–8, 1986, Malaise trap, P. Spangler, O. Flint (USNM). **Colombia**: 2 males, 4 females, Chocó Department, Teresita, various dates in 1967, Aug. 11, Oct. 7, 8, 20, Dec. 3, one no date, no collector given on any, a label states M.T. James Det. 1968 (FSCA). **Ecuador** (7 females): 2 females [BNNR088], Apo Prov., Yasuni Res. Sta., 0°40'566'S 23°851'W, Sept. 30–Oct. 11, 2002, 250m, C. Brammer (LACM); 1 female, Napo Prov., Coca, Napo River, April 12–May 30, 1965, 250m, L.Pena (CNC); 1 female, Napo, Misahualli, nr. Tena, Aug. 26–Sept. 2, 2000, Steven and Paul Keller (LACM); 2 females, Napo Province, Rio Saragaco, Jan. 29, 1997, J.Skartveit (RC); 1 female, Orellana Prov., Yasuni Natl. Pk., Yasuni Res. Sta., 0°40.566'S 76°23.851'W, 250m, April 28–May 8, 2009, L. Hewitt (UG); **French Guiana**: 72 females, Kaw Mt., 04°33'58"N 52°12'43"W, 310m, Feb. 8, 2008, bait trap, T.L. Whitworth (TW); **Guyana** (British Guiana): 27 females, Essequibo River, Moraballi Creek, Aug. 27, 1929, Oxf. Univ. Expeden. BM, 1929–485 (BMNH); **Panama** (3 males, 47 females): 1 male Canal Zone, Barro Colorado Is., April 6, 1956, Carl W. and Mirian F. Bettenmeyer, no. 1615 (WSUP); 6 females same data except collected over a swarm raid by *Eciton* army ants (*Eciton burchellii*), Feb. 16, 1956, no. 1172, March 8, no. 1414, March 8, no. 1411, March 27, no. 1574, May 11, no. 1755, July 25, no. 2178; 2 males, Barro Colorado Is., March 17, 1981, R.B. and L.S. Kimsey (UCDC); 6 females, Canal Zone, B.C.I., Nov. 1, 2, 1975, rat carrion trap, O.P. Young (USNM); 5 females, Canal Zone, Barro Colorado Is., Malaise trap, 1968, various dates July 15, 18, 19, 29, 30, Roger D. Akre (WSUP); 1 female, same information except July 17, Richard Torgenson; 6 females, Canal Zone, Barro Colorado Is., various dates in 1967: 1 female, Feb. 16, 2 females Feb. 23, 1 female Feb. 25, 2 females March 2, 1967, Roger Akre (WSUP); 7 females, Darien Province, Santa Fe, 1967, various dates, Jan. 7, May 11, May 25, Sept. 2, Oct. 1, Nov. 3, one has no date, no collector given (FSCA); 1 female, Darién Prov., Mortí River, June 22, 1967, no collector (FSCA); 3 females, San Blas Province, June 29, 1967, no collector (FSCA); 1 female, Darién Province, Yavisa, April 19, 1991, F.D. Parker (LACM); 1 female, Canal Zone, Barro Colorado Is., April 17, 1967, Roger D. Akre; 1 female, Canal Zone, Cerro Galera, July 1, 1958, W.J. Hanson (LACM); 1 female, Potrerillos, Jan. 17, 1934, D.V. Brown (USNM); 1 female, Canal Zone, Gamboa, Pipeline Road, July, 1967, Malaise trap, W.W. Wirth (USNM); 1 female, Gamboa, Aug. 14–17, 1986, Malaise trap, Riley Nelson (BYU). **Peru** (9 females): 1 female, Boqueron, Loreto, 550m, July 9, 1965, J. Schunke (LACM); 1 female, Avispas, Madre de Dios, Oct. 1–15, 1962, 400m, L. Pena (CNC); 1 female, Pucallpa, Loreto, Oct.21–31, 1964, 200m, J. Schunke (LACM); 1 female, Previsto, April 6, 1965, 700m, J. Schunke (BMNH); 5 females, Pasco Province, 3 km N Puerto Bermudez, June 27, 1980, 200m, D. Baumgartner, B. Greenberg (BG). **Suriname**: 1 female, Afobaka, Jan. 10, 1972, F. Scott (CNC). **Venezuela** (3 females): 1 female, T.F. Amaz. Cerro de la Neblina base camp, 0°50'N 66°10'W, 140m, Feb. 4–12, 1984, D. Davis, T. McCabe (USNM); 1 female, T.F. Amaz. Cerro de la Neblina base camp, 0°50'N 66°10'W, Jan. 21–31, 1985, flight intercept

trap, P.J. and P.M. Spangler, R.A. Faitoute, W.E. Steiner (USNM); 1 female, T.F. Amaz., Puerto Ayacucho (40 km S) El Tobogán, Cano Coromoto, Jan. 26, 1989, Malaise trap, P.J. Spangler, R.A. Faitoute, C.B. Barr (USNM).

Distribution. Brazil, Colombia, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname, Venezuela (Figs. 159, 160).

Discussion. Males are very rarely collected, over 100 specimens of this species were collected in French Guiana with carrion bait traps, but no males were caught. Of 182 specimens examined only 6 males were found. Only a single specimen from Ecuador produced a full barcode of 658 base pairs, it grouped near *L. pulverulenta* (Fig. 161).

Ecology and biology. Found primarily in the tropics. It was the most common species of *Lucilia* collected near Kaw Mountain, French Guiana in early February 2008. The holotype male and six females were collected over a swarm raid by the *Eciton* army ant in Panama, see data under holotype and paratypes.

Etymology. The species name is a combination of the words *albus* and *fuscus* which refers to the pale upper and dark lower calypters in both sexes, this is a distinctive character for this species.

2. *Lucilia cluvia* (Walker, 1849)

Figs. 1, 10, 161, Tables 1, 2

Musca cluvia Walker, 1849: 885. Holotype female (BMNH, examined). Type locality: West Indies (as “West India. From Mr. Children’s collection”). Note: The holotype is intact and in reasonably good condition; it is typical for the female of the species.

Lucilia cluvia: Shannon 1926: 133; Aubertin 1933: 418; Curran 1934: 472, likely a misidentification, see discussion below; Whitworth 2006: 720; Amat *et al.* 2008: 234; Whitworth 2010: 20; Kosmann *et al.* 2013: 77.

Phaenicia cluvia: Hall 1948: 236; James 1970: 10; Mariluis *et al.* 1994: 30 (misidentification, see discussion section below); Mariluis 2002: 99 (misidentification); Mariluis & Mulieri 2003: 87 (misidentification); Centeno *et al.* 2004: 388 (misidentification).

Lucilia pilatei Hough, 1899: 287. Syntypes, 5 males and 17 females (“Type, male” in FMNH according to Hall 1948: 236; no syntypes examined). Type locality: United States, Georgia, Tifton.

Lucilia pilatei: Townsend 1908: 122; Shannon 1924: 80.

Notes on synonymy. Both Aubertin (1933) and Hall (1948) synonymized *L. pilatei* with *L. cluvia*. Hough (1899) noted this species has a “white beard”; only one species of *Lucilia* in the Nearctic Region is known to have pale setae on the gena and this is *L. cluvia*.

Diagnosis. One of seven species in the Neotropical Region with pale setae on the gena. *Lucilia cluvia* is the only species in the region that has the combination of pale setae on gena and basicosta pale orange (Figs. 1, 10). The pale orange basicosta is also found in five other species in the region, including two species with three postacrostichals (*L. cuprina* and *L. sericata*), two species known only from the West Indies (*L. problematica* and *L. retroversa*), and one species (*L. deceptor*) known only from the Galápagos and Cocos Islands. Both calypters are pale in both sexes, a condition found in only six species in the region (Table 2). Males of *L. cluvia* have an exceptionally wide frons, 0.12 (0.10–13/13) of head width at narrowest, which readily distinguishes this species from other similar species. The broad frons in males is unique to this species with two postacrostichals on the mainland in the Neotropics. The males of the three species with two postacrostichals in the Galápagos also have a very broad frons, as do the two species with three postacrostichals in the Neotropics. *Lucilia cluvia* is known only from Central America, the West Indies, and the Nearctic Region.

Description. See Whitworth (2010) for details of characters and figures of species character states.

Specimens examined. (11 males, 17 females). **Costa Rica** (3 males, 1 female): **Guanacaste.** 2 males [BNNR186], 14km S Cañas, July 11–20, 1991, F.D. Parker (LACM); 1 male [BNNR187], same data except July 21–31, 1991, F.D. Parker; same data except July 28, 1991; 1 female, 3 mi SE R. Naranjo, July 29–31, 1993, F.D. Parker. **Guatemala.** 1 female, San Jose, May 1943, D.G. Hall (USNM). **Honduras.** 7 females, Rio Grande, July, 1935, J.J. White (BMNH). **Mexico** (3 males, 3 females): **Campeche.** 1 male, 1 female, Ciudad del Carmen, Aug. 5, 1964, Paul J. Spangler (USNM). **Chiapas.** 1 male, Puerto Madero, June 6, 1969, B.V. Peterson (CNC); **Nayarit.** 1 male, San Blas, Dec. 30, 1969, D.L. Briggs (FSCA). **Oxaca.** 1 female, Mitla, April 9, 1953, R.C. Bechtel, E.I. Schlinger (EMEC). **Vera Cruz.** 1 female, Catemaco, Sept. 6, 1974, W. Hanson, G. Bohart (LACM). **West Indies.** **Martinique:** 1 female, Aug., 1957, J.W. Boyes (CNC). **Puerto Rico.** 5 males, 4 females: 1 male, Joyuda,

Mayaguez, Dec. 8, 1981, Walter Vasquez (UPR). 4 males, 2 females, San Juan, Carolina Bosque de Piñones, May 5–9, 1990, flight trap in mangroves, G.B. Fairchild (FSCA); 1 female [BNNR185], Quebradillas, 6.3 km SSE La Casa de Piedra, east side of Lago Guajataca, 18°22'24"N 66°54'22"W, June 15, 1996, C. Young *et al.* (CMNH); 1 female [BNNR050], Mayaguez, UPRM Campus, Bosque Colegio Ciencias Agrícolas, July 14, 2008, S. Yusseff (UPR).

Distribution. Widespread, though rare throughout the southeastern United States, Mexico, Costa Rica, Guatemala, Honduras, and the West Indies.

Discussion. Curran (1934a) listed *L. chuvia* from Guyana (as British Guiana), this is almost certainly a misidentification as this species has not otherwise been found in South America. *Lucilia albofusca* also has pale setae on the gena (like *L. chuvia*), it is a common species in Guyana and French Guiana and is likely what he was seeing. Mariluis *et al.* (1994) recorded this species from Argentina, Colombia, Ecuador, Mexico, Paraguay, Peru and Venezuela and described three forms of this species. They distinguished *L. eximia* and *L. chuvia* based, in part, on the color of setae on the gena (jowls). They described the gena of *L. eximia* with white pilosity and the gena of *L. chuvia* without white pilosity. The authors listed *L. rica* and *L. ibis* as synonyms of *L. chuvia*, this was a mistake, both are valid species. The discussion of *L. chuvia* was repeated in Mariluis (2002). In fact, the reverse condition exists; *L. chuvia* has pale setae on the gena while *L. eximia* has dark setae on the gena. *Lucilia chuvia* is the only mainland species with the combination of a pale yellow to orange basicosta and pale setae on the gena in the region. The frons width of male *L. chuvia* is distinctive, 0.12 (0.10–0.13) of head width at narrowest; it is broader than any other mainland Neotropical *Lucilia* with two postsutural acrostichals (*Lucilia* males of three species in the Galápagos have a broader frons). Mariluis & Mulieri (2003) recorded this species from Argentina, Brazil and Uruguay and several authors appear to have followed their identification. I believe all records of this species from South America are likely an error. Amat *et al.* (2008) provided a key to species of Colombia, the characters given in the key appear to be for *L. chuvia*, but the authors do not indicate they collected it there and there is no evidence this species occurs there.

Barcodes for four specimens were obtained; two specimens from Puerto Rico and two from Costa Rica and they formed a distinct group (Fig. 161).

3. *Lucilia cuprina* (Wiedemann, 1830)

Tables 1, 2

Musca cuprina Wiedemann, 1830: 654. Type(s), unspecified sex (ZMUC, not examined). Type locality: China.

Lucilia cuprina: Shannon 1926: 131; Aubertin 1933: 412; Curran 1934a: 472; James 1970: 10; Woodley & Hilburn 1994: 12; Carvalho & Riberio 2000: 170; Whitworth 2006: 720; Amat *et al.* 2008: 234; Carvahlo & Mello-Patiu 2008: 398; Whitworth 2010: 21; Kosmann *et al.* 2013: 77.

Phaenicia cuprina: James 1970: 10; Greenberg & Szyska 1984: 495; Baumgartner & Greenberg 1985: 583; Mariluis *et al.* 1994: 28; Mariluis 2002: 99; Mariluis & Mulieri 2003: 88.

Lucilia pallescens Shannon, 1924: 78. Holotype male (USNM, not examined). Type locality: United States, North Carolina, Wilmington.

Phaenicia pallescens: Hall 1948: 247; Mello 1961: 265.

Lucilia pseudosericata Gaminara, 1930: 1267. Type(s), male (not located). Type locality: "Uruguay".

Diagnosis. Three postsutural acrostichal setae, a character shared only with *L. sericata* in the region. The following is a comparison of *L. cuprina* with *L. sericata*: Central occipital area with a single seta just below inner vertical seta vs. a group of 2–5 setae (Whitworth 2006, fig. 73); abdomen dull coppery vs. shining green to gold or brighter coppery; humeral callus with two or three small setulae along posterior margin vs. 6–8 setulae (Whitworth 2006, fig. 74); metasternum bare vs. setose; frons of male broad, 0.20 (0.19–0.21) of head width much broader than width of parafacial at level of lunule, vs. frons narrower, 0.13/6 (0.12–0.14), about equal to width of parafacial; see figure of male genitalia (under *Phaenicia pallescens*) in Hall (1948, fig. 24, J–M). This is a cosmopolitan species, widespread in the Neotropical Region.

Specimens examined. (4 males, 19 females). **Argentina:** 1 male, Entre Rios, Liebig (Rio Uruguay), April, 1977, S. Bolle (CNC); **Brazil:** 2 females, 20km n. São João da' Aliança, Go., April 28, 1956, F.S. Truxal (LACM); **Colombia:** 1 female, 18km w. Cali, Rd. to Buenaventura, Oct. 2–8, 1978, Mac A. Tidwell (FSCA); 1 female, Pto. Conejoe, R. San Miguel, 76°53'W 0°15'N, Ap. 1–3, 1963, Pena (CNC); **Costa Rica:** 1 male, 1 female, S.J., Escazu,

July 22, 1989, F.D. Parker (LACM); 2 males, 12 females, Heredia, Santo Domingo, Jan. 10, 2011, T.L. Whitworth (TW); **Mexico**: 1 female, St. of Veracruz, Fortin de las Flores, Sumidero, Ap 26–28, 1965, 2500–3000 ft., H.V. Weeks (FSCA); **Peru**: 1 male, Boquerón, Loreto, July 7–14, 1965, 500m, J. Schunke (LACM); **Uruguay**: 1 female, State of Soriano, Cardona, May 20, 2008, T.L. Whitworth (TW).

Distribution. James (1970) noted this species is almost worldwide in the tropics and warmer climates. In the New World, it is found from southern United States to Uruguay and northern Argentina. Baumgartner & Greenberg (1985) found it in Peru. Mariluis *et al.* (1994) found it in Argentina, Colombia, and Paraguay. Woodley and Hilburn (1994) found it in Bermuda. Whitworth (2010) recorded it in the West Indies, Cuba, Haiti, Jamaica, Puerto Rico, Trinidad, and Virgin Islands.

4. *Lucilia deceptor* (Curran, 1934b)

Tables 1, 2

Viridinsula deceptor Curran, 1934b: 166. Holotype male (CAS, not examined). Type locality: Ecuador, Galápagos Islands, North Seymour Island.

Phaenicia deceptor: James 1966: 479; James 1970: 11.

Lucilia deceptor: Kosmann *et al.* 2013: 77; Tantawi & Sinclair 2013: 238.

Diagnosis. Specimens are dull colored, blackish to greenish-black, unusual for calliphorids; the color is reminiscent of the West Indies species *L. problematica*. The thorax is faintly metallic, covered with heavy brownish microtomentum while the abdomen is subshining with an olivaceous luster and heavy whitish microtomentum. The basicosta is pale orange (as in Fig. 10) with pale setae on rear of gena (as in Fig. 1). Setae below and behind postocular row are mostly pale and weak with a few stronger setae near the vertex. The male frons is extremely broad, 0.23 (0.21–24/5) of head width at narrowest, only *L. cuprina* in the New World has such a broad frons. In males, both calypters are pale; the genitalia are distinctive, the cerci are much longer than surstyli and the tip of the surstylus is enlarged and directed posteriorly, (Tantawi & Sinclair 2013: figs. 1 E, F). ST5 is deeply incised with elongate lobes, (Tantawi & Sinclair 2013: fig. 1 G).

Specimens examined. (3 males, 2 females). **Ecuador**: Galápagos Islands. 1 male, 1 female, Narborough Is., Jan. 26, 1899 (WSUP); 2 males, Hood Is., May 18, 1899 (WSUP); 1 female, Española, Punta Juarez, Feb. 10–12, 1967, Ira L. Wiggins (WSUP).

Distribution. Specimens were examined from Hood and Española Islands. James (1966) listed it from the Ecuadorian Galápagos Islands including Albemarle, Española, Fernandina, Floreana, Hood, North Seymour, as well as the Costa Rican island Cocos, off the west coast. Tantawi & Sinclair (2013) examined specimens from the islands of Bartolomé, Caamaño, Española, Fenandina, Isabela, Marchena, Santa Cruz, Santa Fe, and Seymour Norte.

5. *Lucilia eximia* (Wiedemann, 1819)

Figs. 2, 7, 11, 17, 41, 42, 65, 66, 90–92, 124, 136, 148, 161, Tables 1, 2

Musca eximia Wiedemann, 1819: 53. Type(s), unspecified sex (“unique type is a female” in NMW according to Aubertin 1933: 424; not examined). Type locality: Brazil.

Lucilia eximia: Aubertin 1933: 423; Carvalho & Riberio 2000: 170; Silva *et al.* 2003: 2; Whitworth 2006: 720; Giao & Godoy 2006: 753; Amat *et al.* 2008: 235; Carvahlo & Mello-Patiu 2008: 398; Whitworth 2010: 21; Giraldo, *et al.* 2011: 273; Kosmann *et al.* 2013: 77; Tantawi & Sinclair 2013: 238.

Phaenicia eximia: Hall 1948: 239; Mello 1961: 270; James 1970: 10; Greenberg & Szyska 1984: 496; Baumgartner & Greenberg 1985: 583; Mariluis *et al.* 1994: 30; Mariluis 2002: 99; Mariluis & Mulieri 2003: 88.

Lucilia hirtiforceps Shannon, 1926: 133. Holotype male (USNM, examined, Fig. 17). Type locality: Panama, Canal Zone.

Lucilia hirtiforceps: Curran 1934a: 471.

Lucilia littoralis Blanchard, 1938: 380. Syntypes, unspecified number of males (MACN, not examined). Type locality: Argentina. **Syn. nov.**

Lucilia littoralis: unplaced Calliphoridae: James 1970: 15.

New synonymy. Based on Blanchard’s (1938) description and figures of the male genitalia of his new species *Lucilia littoralis*, this nominal species is synonymized with *Musca eximia* Wiedemann, 1819, **syn. nov.**

Diagnosis. A widespread and somewhat variable species found from the southern United States to southern South America. One of six species where the upper calypter is white and the lower brown in males while both the upper and lower calypters are white in females. Where ranges overlap in southern South America, it may be confused with *L. ochricornis*. To separate them, *L. eximia* has pale and weak setae below and behind the strong postocular row (as in Fig. 3) vs. setae dark and stout (as in Fig. 4); male frons narrower, averaging 0.04 (0.03–0.05/19) of head width at narrowest vs. broader, averaging 0.06 (0.05–0.075/5) of head width; male genitalia are distinctive in lateral view the surstylus is of medium length, narrower at the base with distal half expanded (Fig. 41).

Description. In male, anterior and posterior facets both small, anterior facets 1.8x posterior facets (0.40mm, 0.27mm); females eye facets very similar to males except anterior facets are slightly larger (0.48mm, 0.27mm). See Hall (1948) and other authors listed above for more characters for this species. See Whitworth (2010) for a detailed discussion of characters and character states for this species. See Figs 41, 42, 65, 66, 90–92, 124 herein for views of male genitalia, phallus, hypandrium, ejaculatory sclerite and sternite; see Figs. 136, 148 for views of ovipositor and spermathecae.

Specimens examined. (280 males, 690 females). **Argentina** (16 males, 22 females): 4 males, 1 female, no location given, April 10, 1927, R.C. Shannon (USNM); 2 females, Iguazu, Oct. 4–10, R.C. & E.M. Shannon (USNM); 9 males, 14 females, Entre Rios Liebig (Rio Uruguay), April, 1977, S. Bolle (CNC); 1 male, Buenos Aires, Rio Lujan, S. Bolle (CNC); 1 female, La Plata, Punta Lara, Jan. 13, 1970, Malaise trap, Vardy & Arguinguey (BMNH); 1 female, Tuc. Horco Molle, 12km W Tucuman, 700m, Malaise trap, March 22–24, 1974, C.R. Vardy (BMNH); 2 males, 1 female, Bemberg, Alto Parana Misiones, March 7–21, 1934, K.J. Hayward (BMNH); 2 females, Catamarca, Ao. El Pintado, S. La Vina. 650m, Sept. 27, 28, 1969, Pena (BMNH). **Belize:** 1 male, 5 miles N San Ignacio, Nov. 22–30, 1988, F.D. Parker (LACM); 1 female [BNNR111], Bel.District, UCR Campus, March 17, 2011, J.S. Kirkley. **Bolivia** (5 males, 10 females): 5 males, 4 females, Sta. Cruz, 24km S Camin; March 5, 1999, M. Irwin, F. Parker (LACM); 2 females, Sta. Barbara, N. Coroico Yungas, Jan. 4, 5, 1976, 1100m, L.E. Pena (CNC); 1 female, Andres Ibanez Prov., Potrello del Guenda, Oct. 9, 1993, J.A. Aramayo, P. Bettella, M.J.R. Hall (BMNH); 1 female [BNNR110], Sta. Cruz, Camin, March 5, 1999, Irwin & Parker (LACM); 1 female [BNNR112], Sta. Cruz, Samapeta, Feb. 18, 1999, F. Parker (LACM); 1 female [BNNR036], La Paz, Chulumani, March 10, 2003, F.D. Parker (LACM). **Brazil** (39 males, 103 females): 29 males, 55 females, Tocantis, Porto Nacional, Feb. 1–4, 2003, D.J. Carvan (BYU); 1 male, 2 females, Dist. Fed. Planaltina, 1000m, cerrado, Malaise trap, Sept. 24–Oct., 1985, Scott E. Miller; 3 males, 5 females, Bahai, Rock Found., May, 1929, Shannon Lab, (USNM); 1 male, São Paulo Prov., Mogi Guaca Campininha, Oct. 23–28, 1970, J.W. Boyes (CNC); 1 male, Cupary Trail near Boa Vista Fordlandia, R. Tapajós, July 6, 1906, C.H.T. Townsend (USNM); 1 male, Tabocal, R. Tapajós, June, 1920, C.H.T. Townsend (USNM); 1 male, Rio de Janeiro Prov., Guanabara, July 23, 1960, N. Marston (WSUP); 1 female, Min. Ger., near Timote, April 1–15, 1999, Eurico (LACM); 1 male, same data except Sept. 30, 1999; 1 female, same data except Oct., 1997; 1 female, same data except July 10–18, 1999; 2 females, 24km E Formoso, Go. May 23, 1956, F.S. Truxal (LACM); 1 female, same data except E.Y. Dawson (LACM); 10 females, Rio de Janeiro, Aug. 1938, Yell. Feb. Serv. MES, (USNM); 2 females Mato Grosso, Maracaju, July, 1937, Yell. Feb. Serv. MES (USNM); 6 females, Rio de Janeiro D.F., Aug. 1938, Yell. Feb. Serv. MES, (USNM); 2 females, Nova Teutonia, 27°11'S 52°23'W, 300–500m, no date, Fritz Plaumann (FSCA); 3 females, Serra Grande, Oct. 21–30, 1992, D.W. Davis (LACM); 2 females, Rondonia, 62km SW Ariquemes, near Fzda. Rancho Grande, Dec. 6–15, 1990, D.A. Rider, J.E. Eger (FSCA); 1 male, 1 female, Ceara, Diaz Da Roche, April 1936 (USNM); 1 female, Amapa, Santanure, May 1966, T. CH. (BMNH); 1 female, Para, Rio Iriri Camp Altamira (ca 100km S), 52°40'W 3°50'S, Oct. 17, 18, 1986, Malaise trap, P. Spangler, O. Flint (USNM); 1 female, Petropolis, Dec. 1970, J. Maldonado (USNM); 4 females [BNNR102–105], Porto Nacional, Feb. 4, 2003, D.J. Cavan (BYU); 1 female [BNNR035], Brazilo, March 7, 1999, M. Irwin (LACM); 1 female [BNNR037], Tocantins, April 11, 2003, D.J. Cavan (LACM). **Colombia** (11 males, 4 females): 7 males, Anchicaya, 70km E B'ventura, Feb. 17–20, 1970, 400m, D.M. Wood (CNC); 1 male, 1 female, Rio Jamundi, 10km S Cali, Valle, Feb. 25, 1970, 1000m, D.M. Wood (CNC); 1 male, Dept. Valle, Ginebra, July 13, 14, 1979, Mac A. Tidwell (FSCA); 1 female, Cartagena, Oct. 3, 1971, G.E. Bohart (LACM); 1 female, Antioq., Medellin, Oct 2, 1971, G.E. Bohart (LACM); 1 female, Tol. Amero, Jan. 30, 1977 Malaise trap, E.L. Peyton (USNM); 2 males, Buena Ventura, July 19, 1930 (USNM); **Costa Rica** (78 males, 227 females): 33 males, 94 females, Heredia, Santo Domingo, Jan. 10, 2011, T.L. Whitworth (TW); 28 males, 84 females, Guanica, 3 km SE Naranjo, numerous dates May–Aug., 1993, F.D. Parker (LACM); 15 males,

31 females, San Jose, Escazu, numerous dates, Feb., 1987-July, 1988, F.D. Parker (LACM); 2 females, San Jose, July 25, 1962, M.T. James (WSUP); 3 females, San Jose, June 5, 1963, C.L. Hogue (LACM); 1 male, 10 females, Cartago, Turrialba, July 24, 1952 W.W. Neel (USNM); 10 females, same data except May-June, 1976, Malaise trap, M. Wasbauer (EMEC); 1 male [BNNR096], 4 females [BNNR98-101], Heredia, Santo Domingo, T.L. Whitworth (TW); 3 females [BNNR158], Guanica, Navanjo, June 14, 1993 (LACM); same data except [BNNR159], July 21, 1993; data same except [BNNR160], Aug. 8, 1993. **Ecuador** (27 males, 22 females): 3 males, 3 females, Past., Puyo, various dates Jan.-June, 1976, Malaise trap, R. Spangler *et al.* (USNM); 3 males, 3 females, same data except May 18, 1977; 5 males, 2 females, Zam. Chin., Zamora, June, 1976, A. Langley *et al.* (USNM); 1 male, Napo, Misahualli, June 25, 1976, P.M. Turner (USNM); 3 males, Taguando R., NW Ibarra, June 9, 1965, 1650-1900m, L. Pena (CNC); 4 males, 7 females, Pompeya, Napo R., Pastaza, May 14-22, 1965, L. Pena (CNC); 2 males, Coca, Napo R., Napo, April 12-30, 1965, L. Pena (CNC); 1 male, 1 female, Balao Chico, April 23-25, 1963, L.E. Pena (CNC); 3 males, 2 females, Rio Frio, Chico, April 26-30, 1963, Pena; 1 male, 1 female, El Triunfo, Guayas, March 4, 1965, L. Pena (CNC); 1 male, Guayaquil, 1935, G. Von Buchwald, (LACM); 1 female, Rio Ayampe, July 26, 1976, J. Cohen (USNM); 1 female, Pich. E. Santo Domingo, May 8-14, 1988, Hanson, Bohart (LACM); 1 female, Canar, El Valle de Cochanca on Rd. to El Tamto, Feb. 13, 1966, 280m, R.H. Arnett, E.J. Gerberg (FSCA). **El Salvador** (4 males, 1 female): 1 male, San Salvador, May 18, 1958, O.L. Cartwright (USNM); 3 males, Santa Tecla, 900m, July 2, 1970, S.&L. Steinhauser (FSCA); 1 female, 3 miles E La Libertad, Aug. 30, 1972, G.F. & S. Hevel (USNM). **French Guiana**: 1 male, 3 females, Kaw Mt., 04°33'58"N 52°12'43"W, 310m, bait trap, Feb. 8, 2008, T.L. Whitworth (TW). **Guatemala** (15 females): 1 female, Guatemala, Colonia Las Victorias, April 11, 1999, Jose Monzon (UVGC); 1 female, Suchite Pequez, Cocales, Finca San Antonia, March 5, 2008, C. Bran (UVGC); 1 female, El Progreso, Senarate, Llanos de Morales, Feb. 1, 1992, H. Castaneda (UVGC); 1 female, Guatemala, km 34 Carr Amatitlan, March 9, 2005, Maria Jose Aldana (UVGC); 1 female, Guatemala, 1500m, May, 2000, L. Perez (UVGC); 1 female, Alta Verapaz, Senahu, Fca. El Volcan, July 17, 1986, Lab de Ecol. (USNM); 6 females, Guatemala, 1937, Bishopp # 27566 (USNM); 1 female, Quetzal Tenango, Aug. 1, 1949, E.G. Smyth (LACM); 1 female, S. Antonio Such., July 6, 1965, Malaise trap, Paul J. Spangler (USNM); 1 female, Sta. Lucia, Cotz, May 2-11, 1988, F.D. Parker (LACM). **Guyana** (2 males, 8 females): 6 females, Mazaruni, second growth low forest, Sept. 24, 1937, Richards & Smart Coll., (BMNH); 1 female, Villavicencio, Quatquia River, Dec., 1914, Wellcome Coll. (BMNH); 1 male, Kartabo, Sept., 1922, M.D. Haviland (BMNH); 1 male, Georgetown, Aug., 1929 (BMNH); 1 female, Demerara, Wismar, Aug. 1, 1923, L.D. Cleare, Jr. (USNM). **Honduras** (6 males, 16 females): 8 females, Tegucigalpa, Escuela Agricola Pan America, Nov. 26, 1983, John Dick (FSCA); 1 male, 3 females, same data except Dec. 5, 1983; 1 male, Tegucigalpa, Sept., 13, 1917, F.J. Dyer (USNM); 1 male, Zamorano, Dec. 16, 1946, W.P. Cockerell, (WSUP); 1 female, Zamorano, Feb. 7, 1946, T.D.A. Cockerell (USNM); 1 male, 1 female, Roatan Is., Feb. 27, 1979, G.E. Bohart (LACM); 1 male, 1 female, Siguatepeque, Aug. 26, 1978, J.A. Chemak, E.G., J.M. Linsley (EMEC); 1 male, Tegucigalpa, July 29, 1918, F.J. Dyer (USNM); 1 female, S. Marcos Crol., July 29, 1958, Neff and Matthews (CNC); 1 female [BNNR107], Santa Lucia, Feb. 11, 2003, Wilson & Lizard (LACM). **Mexico** (21 males, 111 females): **State of Campeche**. 2 males, 2 females, Ciudad del Carmen, Aug. 5, 1964, Paul J. Spangler (USNM); 1 female, Campeche, June 30, 1968, Malaise trap, M.W. McFadden (LACM). **State of Chiapas**. 1 female, 15 mi SW Tapachula, June 30, 1965, A. Raske, C. Slobodchikoff (EMEC); 1 female, 20-25 mi N Huixtla, 3000ft, June 5, 1969, B.V. Peterson (CNC); 1 male, Ocozocuaulta, Sept. 14, 1974, W. Hanson, G. Bohart (LACM). **State of Guerrero**. 2 females, Cuernavaca, Nov. 10-12, 1987, F.D. Parker (LACM); 1 female, 12 km S Ixateopan, Sept. 13, 1982, 1530m, J.A. Powell, J.A. Chemsak (EMEC). **State of Jalisco**. 3 females, Careyes, Feb. 12-March 19, 1997, F.D. Parker (LACM); 9 females, Chamela, Sept. 26-Oct. 8, 1985, Parker and Griswold (LACM); 5 females, Chamela, Oct. 4, 1985, Malaise, (LACM); 4 females, Chamela, July 13, 1986, M. Sanchez-M.T. (LACM); 5 females, Puerto Vallarta, Jan. 25, 1984, G.E. Bohart (LACM); 1 female, same data except Dec. 15, 1987; 1 male, 2 females, Chamela, July 23-31, 1990, Chemsak (EMEC). **State of Mexico**. 1 male, Chapingo, Aug. 29, 1980, J.B. Karren (LACM). **State of Michoacan**. 1 female, Cotija, Sept. 14, 1975, B. Villegas (UCDC). **State of Morleos**. 2 males, Tequesquito, July 7, 1956, K. H. Janzen (EMEC); 1 male, Cuernavaca, July, 1959, Krauss (USNM); 1 female, 6 mi E Cuernavaca, Sept. 1, 1974, W. Hanson, G. Bohart (LACM); **State of Nuevo Leon**. 3 females, 5 mi. S Monterrey, May 8, 1968, Malaise trap, M.W. McFadden (WSUP); 1 female, Cola de Caballo, June 18, 1976, M. Grant (FSCA). **State of Oaxaca**. 1 male, 3 females, Temascal, Oct. 15, 1963, D.H. Hanson (EMEC); 3 females, same data except Oct. 19, 1963; 3 females, Puerto Escondido, Jan. 2-7, 1995, Lars Ove Hanson (KR). **State of Quintana Roo**. 3 females, Felipe Carrillo, pto,

Oct. 10–14, 1986, Malaise trap (LACM). **State of San Luis Potosi.** 2 males, 1 female, El Narandjo, June 29, 1965, Paul J. Spangler (USNM); **State of Sinaloa.** 4 males, 7 females, 2.5 mi N Mazatlan, Aug. 11, 1970, Malaise trap, M. Washbauer (EMEC). **State of Sonora.** 1 male, 5 females, Alamos, Sept. 6, 1970, W.J. Hanson, T.L. Whitworth (LACM). **State of Tamaulipas.** 1 male, 28 females, Villa de Casas, 41 mi E Cd. Victoria, June 15–30, 1986, carrion trap, R. Trevino, R. Jones (TAMU); **State of Veracruz.** 1 male, Fortin de las Flores, May 20–23, 1965, Malaise trap, H.V. Weems (FSCA); 1 female, Cordoba, July 20, 1966, J.S. Buckett (LACM); 1 male, 1 female, Lake Catemaco, June 17, 1969, B.B. Peterson (CNC); 1 female, 2km NW Alazan, Jan. 22–23, 1970, 20m, Richard K. Laval (TAMU); 2 males, 1 female, Catemaco, Sept. 6, 1974, G. Bohart, W. Hanson (LACM); 14 females, Yanga, Jan. 28, 1975, 1500 ft, bait trap, A.B. Broce (FSCA). **Nicaragua:** 1 male, 31 miles N Esteli, Aug. 22, 1972, G.F. & S. Hevel (USNM). **Panama** (10 males, 29 females): 1 female, Ft. Kolbe, Aug. 3, 1967, B.F. Eldridge (FSCA); 3 males, 9 females, Ft. Kolbe, Aug. 18, 1967, B.F. Eldridge (FSCA); 2 females, Panama City, July 8–9, 1962, M.T. James (WSUP); 1 female, Barro Colorado, Feb. 17, 1967, Malaise trap, R.D. Akre (WSUP); 1 female, same data except April 13, 1967; 1 female, Las Cumbres, Aug. 26, 1982, Malaise trap, Henk Wolda (UCDC); 1 female, same data except Oct. 10, 1982; 1 female, same data except Oct. 20, 1982; 1 female, same data except Nov. 1, 1982; 1 female, same data except Oct. 2, 1982; 3 females, Potrerillos, Feb. 14, 1934, D.V. Brown (USNM); 1 male, Concepcion, Oct. 1959, N.L.H. Krauss (USNM); 2 males, Jacque River, July 26, 1962, F.S. Blanton (USNM); 1 male, Camaron, Ft. Kobbe, June 17, 1952, F.S. Blanton (USNM); 1 male, Boquette, Dec. 1946, N.L. Krauss (USNM); 2 females, Cristobal, May 1960, S.G. Breeland (FSCA); 1 male, 1 female, Colon, Oct. 1959, N.L.H. Krauss (USNM); 1 female, Darien province, April 14, 1967 (FSCA); 1 female, Cerro Campana, April 10, 1963, Roger D. Akre (WSUP); 1 female, same data except Aug. 1, 1970, 2900 ft., J.M. Campbell (CNC); 1 male, El Cermeno, Dec. 1939, Zetek (USNM); 1 female, Los Cumbres, July 2, 1971, M. Daykin (UCDC). **Paraguay** (22 males, 61 females): 19 males, 51 females, Villarrica, numerous dates from March–June, 1936–1939, F. Schade (USNM); 1 female, Sa. Trinidad, Aug. 19, 1913, no collector (USNM); 1 female, same data, except Aug. 13; 1 male, 2 females, same data, except June 19, 1914; 2 males, 6 females, Asuncion, Oct. 6–Nov. 5, 1980, D.C. Lowry (USNM). **Peru** (25 males, 28 females): 21 males, 15 females, Loreto, 200m, 21–31 Oct., 1984, J. Schunke (LACM); 3 males 5 females, Junin Prov., reared in San Ramon, 1000m, July 26, 1980, D. Baumgartner (BG); 1 male, 1 female, Tarma, San Ramon, Dec. 10, 1977, J. Kunich (BG); 1 female, Huanuco, Tingo Maria N.P., 660m, April 16, 1987, W.J. Hanson (LACM); 3 females, Pasco Prov., Puerto Bermudez, 200m, June 28, 1980, D. Goodwin (BG); 1 female, Pan de Azucar, San Ramon, 1000m, June 21, 1980, D. Goodwin, B. Greenberg (BH); 1 female, Pucalla, Loreto, 200m, Dec. 3–5, 1984, J. Schunke (LACM); 1 female, same data, except Aug. 1–9, 1985. **Suriname:** 3 males, 2 females, Paramaribec, Sept., 1943, David G. Hall (USNM). **United States, Louisiana:** 2 females [BNNR040, 041], EBR, Oct. 29, 2008, Parish, L. Pharr (TW). **Texas:** 1 female [BNNR096], Rockport, Feb. 20, 2011, T.L. Whitworth (TW). **Uruguay:** 1 female, State of Soriano, Cardona, May 20, 2008, T.L. Whitworth (TW). **Venezuela** (5 males, 19 females): 1 male, Maracay, Aug. 29, 1943, D.G. Hall (USNM); 1 female, Barrancas Obispos, Barinas, July 6, 1979, R.W. Brooks *et al.* (UCDC); 1 male, 1 female, same data except Quibor, Jimenez, July 8, 1979; 2 males, 1 female, T.F. Amaz., Cerro de la Neblina Basecamp, 0°50'N 66°9'W, 140m, March 1–10, 1984, D. Davis, T. McCabe (USNM); 1 female, Zuila, 31km SW Machiques, April 14, 1981, A.S. Menke, L. Hollenberg (USNM); 1 male, Aragua, 2km N Ocumare de la Costa, June 21, 1976, A.S. Menke, D. Vincent (USNM); 2 females, same data except March 31, 1981, A.S. Menke, L. Hollenberg; 1 female, same data except Puerto de Cata, June 10, 1976; 2 females, Portg. 10 km N Biscucuy, April 9, 1981, A.S. Menke, L. Hollenberg (USNM); 3 females, Merida, Libertador, July 3, 1979, R.W. Brooks *et al.* (UCDC); 1 female, San Esteban, Nov. 26, 1939, Pablo Anduze (USNM); 1 female, La Mesa, Trujillo, Sept. 11, 1973, B. Villegas (UCDC); 1 female, La Florida, April 20, 1938, on palm flowers, C.H. Ballows (USNM); 1 female, Caracas, 1938, Br. Anthonius (USNM); 1 female, Caracas, Sept. 1941, Col. O. Hect (WSUP); 1 female [BNNR108], Meredia, May 17, 1996, W.C. Pitt (LACM); 1 female [BNNR109], Bolivar, Rio Hacha; Dec. 6, 1995, P. Kung (LACM). **West Indies, Dominica:** 4 females [BNNR113–116], St Andrew Parish, near Calibishe, 15°35'28"N 61°20'09"W, March 17, 2009, trap baited with dead fish, T.L. Whitworth (TW). **Puerto Rico:** 3 males [BNNR119–121], 4 females [BNNR30, 31, 117, 118], Mayaguez, Univ. of Puerto Rico campus, 18°13'16"N 67°08'74"W, 3 March, 2009, T.L. Whitworth (TW).

Distribution. Widespread from the southern United States through Central America to southern South America, including Argentina, Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Honduras, Guatemala, Guyana, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay,

Venezuela, and the West Indies. Tantawi & Sinclair (2013) recorded this species for the first time from four Galápagos Islands.

Discussion. This species was common in many areas and somewhat variable, it has been described as different species by numerous authors, see synonyms above. Mello (1961) listed *Phaenicia ochricornis*, *P. mera*, and *P. primavera* as synonyms of *L. eximia*, these were misidentifications. This species was the most frequently encountered species of *Lucilia* in most of the Neotropical Region and it occurs over a large geographical area. It is likely found in every country through Central and South America from Argentina north.

Barcodes for 28 specimens of this species were obtained from Belize, Bolivia, Brazil, Costa Rica, Dominica, Honduras, Puerto Rico, Venezuela, and from the United States (Louisiana and Texas). Specimens grouped into several discrete clusters, widely separated (Fig. 161). This raised the possibility that some of these groups are cryptic species. A study of specimens within groups revealed some variation in morphology, but, in my opinion, none of the differences merited the description of separate species. See Whitworth (2010) for a discussion of differences seen between West Indies and mainland *L. eximia*. A possible explanation for the variation in barcodes for this species is that isolated populations widely separated evolved at different rates. They slowly grew more different, but genes may change faster than the observable physical characteristics that mirror these changes. Further study of the various populations may reveal groups that merit species distinctions. It is possible that *L. eximia* is a species complex based on the CO1 data, but it is beyond the scope of the present work to sort this out.

6. *Lucilia fayeae* Whitworth, 2010

Fig. 161, Tables 1, 2

Lucilia fayeae Whitworth, 2010: 22. Holotype male (USNM, examined) Type locality: West Indies, Dominica, St Andrew Parish, near Calibishe, 15°35'28"N 61°20'09"W.

Lucilia fayeae: Kosmann *et al.* 2013: 77.

Diagnosis. Known only from four islands in the West Indies. Setae below and behind strong postocular row pale and weak. Presutural area of thorax with heavy microtomentum. Rear one-third to half of T4 and all of T5 of abdomen polished. Male, surstylus medium length, narrower at base with distal half expanded (Whitworth 2010, figs. 44, 45).

Description. See Whitworth (2010) for details of characters and figures of character states for this species.

Specimens barcoded. 9 females [BNNR032, 034, 057, 058, 129–133], Dominica, West Indies: St Andrew Parish, near Calibishe, 15°35'28"N 61°20'09"W, March 17, 2009, trap baited with dead fish, T.L. Whitworth (TW). 5 females [BNNR060, 061, 126–128], Puerto Rico, Mayaguez, Univ. of Puerto Rico campus, 18°13' 16"N 67° 08' 74"W, 3 March, 2009, T.L. Whitworth (TW).

Distribution. Known only from Dominica, Puerto Rico, Saint Vincent, and Saint Lucia in the West Indies. Likely occurs on some other islands in the region.

Discussion. Fourteen specimens were barcoded from the West Indies islands of Dominica and Puerto Rico. Interestingly, the Dominica specimens grouped with two separate *L. eximia* clusters, while five specimens from Puerto Rico formed a discreet group separate from *L. eximia*. A few other specimens of *L. fayeae* were scattered in a variety of locations in the tree. (Table 3). The Dominica specimens were re-examined and they are clearly *L. fayeae* and distinct from *L. eximia*. The most obvious difference is the upper and lower calypters are dark in both sexes of *L. fayeae*, while in *L. eximia* the upper calypter is pale in both sexes, the lower calypter is dark in males and pale in females. Male genitalia are also distinctly different, see figs. 42–45 Whitworth (2010).

7. *Lucilia ibis* Shannon, 1926

Figs. 21, 43, 44, 67, 68, 93–95, 125, 137, 149, 160, Tables 1, 2

Lucilia ibis Shannon, 1926: 132. Syntypes, 2 males (USNM, not examined). Type locality: Huadquina, Peru.

Lucilia ibis: Aubertin 1933: 424; Kosmann *et al.* 2013: 77.

Phaenicia ibis: James 1970: 10; Greenberg & Szyaska 1984: 498; Baumgartner & Greenberg 1985: 584.

Diagnosis. A distinctive species, body color violet-pink with aeneous highlights and a bright yellow face, including fronto-orbital, parafacial, antenna and gena (Fig. 21). All abdominal tergites with microtomentum. The male surstylus is short, broad and digitate (Figs. 43, 44). Known only from the east slopes of the Andes Mountains in Peru, Bolivia, and Argentina.

Description. Male. Frons broad, 0.05 (0.04–0.055/5) of head width at narrowest; anterior facets 1.38x larger than posterior facets (0.40 mm, 0.29mm) this difference is small compared to most other species. Fronto-orbital plate, parafacial, and anterior half of gena yellow-gold in color; remainder of gena gradually darkening posteriorly, gena with dark setae; postgena dark silvery with pale setae. Frontal vitta dull orange, obliterated above; fronto-orbital plates broad, meeting midway up frons; upper parafacial broad, equal in width to first flagellomere. Ocellar triangle medium sized anterior ocellus twice the diameter of posterior ocelli, anterior ocellar setae short and stout, no distinct postocellar setae, small dark setae on the rest of the triangle. Frontal setae ascend to about two-thirds of way to vertex; supravibrissal setae ascending about one-third of way up facial ridge. Intrapostocular area bright silvery; setae behind and below stout black row of postocular setae pale and weak; upper edge of occiput black, shining, the remainder covered with pale setae and whitish microtomentum. Thorax color variable, usually purple with pink highlights, but ranging from blue to purple; presutural area of thorax with heavy whitish microtomentum, remainder of thorax and scutellum with weak whitish microtomentum. Thoracic spiracles small, dark brown in color; setae on proepisternal depression usually with pale setae, a few specimens with tan setae. Upper calypter white, lower calypter variable, from white to light tan; basicosta brown, tegula black, veins in wing base darkened, legs dark brown. Surstylus is short, broad, and parallel sided, cerci are short and stout (Figs. 43, 44); phallus as in Fig. 67, 68, hypandrium, pre- and postgonites, ejaculatory sclerite, and sternites as in Figs. 93–95, 125.

Female. Characters like male except frons 0.26 (0.25–0.27/5) of head width at narrowest; eye facets slightly smaller than males, anterior facets 1.65x posterior facets (0.43mm, 0.26mm). Upper and lower calypters white. Ovipositor and spermathecae as in Figs. 137, 149.

Specimens examined. (20 males, 40 females). **Argentina:** 1 female, Tuc., Rio Tapia, Oct. 12, 1926, R.C. Shannon (USNM). **Bolivia:** 1 male, Santa Cruz, Sept. 28, 1972, G.E. Bohart (LACM). **Ecuador:** 1 female, Nayón Pichincha, 00°10.579S 78°25.668W, Oct. 18, 2013, S. Aguirre (CNC). **Peru: Junín Province.** (19 males, 38 females): 1 male, 5 females, 18km W San Ramon, May 7, 1980, hemisynanthropic, D. Baumgartner, B. Greenberg (BG); 3 females, 8km W San Ramon, 1220m, June 21, 1980, hemisynanthropic, B. Greenberg (BG); 2 males, 11 km W San Ramon, June 22, 1980, hemisynanthropic, B. Greenberg, D. Baumgartner (BG); 1 male, 1 female, 11 km W San Ramon, 1433m, June 21, 1980, M. Szyska, B. Greenberg (BG); 1 female, 11 km W San Ramon, June 23, 1980, M. Szyska (BG); 1 female, 11 km W San Ramon, 1000m, June 22, 1980, D. Goodwin (BG); 8 females, Tarma, Dec. 9, 1977, B. Greenberg (BG); 3 females, 20km SW San Ramon, Dec. 9, 1977, D. Baumgartner; 2 females, 16 km W San Ramon, 1433m, June 21, 1980, asynanthropic, M. Szyska, B. Greenberg (BG); 1 female, same data except May 7, 1980; 1 male, 7 females, same data except 23 km W San Ramon, Jan. 7, 1980; 7 males, 4 females, lab strain F₁ reared in San Ramon, 1000m, eclosed July 16, 1980, M. Szyska (BG); 5 males, 1 female, Chuquisunca, 1882m, June 1980, eusynanthropic, B. Greenberg (BG); 1 male, Huadaquina, Aug. 1, 1911, Yale Peru Exp., paratype # 28891(USNM); 1 female, Huancabamaba, 4000 ft., no other data (USNM); 1 male, Huancabamaba, Aug. 13, 1945, P.A. Berry (USNM).

Distribution. Specimens were examined from Peru, Junin Region near Chuquisunca, San Felix, San Ramon and Cusco Province near Huadaquina and Huancabamba, as well as from Rio Tapia, Tucuman Province, Argentina, Santa Cruz, Bolivia and Nayón Pichincha, Ecuador (Fig. 160). Baumgartner & Greenberg (1985) discussed the distribution of this species in detail.

Discussion. The species is quite distinctive and only known from higher elevations of the Andes Mountains. Aubertin (1933) provided a description of this species. Identified material from the Bernard Greenberg collection (BG) was relied on to confirm this species.

8. *Lucilia japuhybensis* (Mello, 1961)

Figs. 8, 22–27, 45, 46, 69, 70, 96–98, 126, 138, 150, 160, Tables 1, 2

Phaenicia japuhybensis Mello, 1961: 274. Holotype male (FIOC, only genitalia remaining; not examined). Type locality: Brazil, State of Rio de Janeiro, Angra dos Reis, Japuhyba.

Lucilia japuhybensis: Kosmann *et al.* 2013: 77.

Phaenicia japuhybensis: James 1970: 10; Mariluis *et al.* 1994: 28.

Type information. The status of *L. japyhybensis* (Mello) has been uncertain since this species was described on the basis of a single male (Mello 1961). In the process of studying a possible new species of *Lucilia* found in southeastern Brazil, male genitalia photos taken were compared to Mello's figures (Mello 1961, p. 275, figs. 45–49) as well as other characters detailed in his description. A comparison of the characters shown in Mello's figures of the possible new species are given in Figs. 22–27. The male genitalia in lateral view are exceptionally long, slender, and curved forward, unlike those of any other *Lucilia* in the region. Mello's anterior view of the head is very close to my photo and an average frons width of 0.03 at narrowest of head width is a match for my specimens. This frons width is distinctive; other species occurring in the area have either a narrower or wider average frons width (0.02 or 0.05). In an effort to examine the holotype, I contacted Márcio Felix, Coleção Entomológica do Instituto Oswaldo Cruz who spoke with the author of this species, R.P. de Mello (pers. comm.). He said the body of the specimen was destroyed in a 1960s military insurrection; however a slide of the holotype genitalia survived and is in FIOC. The slide was not available for loan. However, Mello's (1961) figure of the genitalia was adequate to compare to my material. Based on the comparison of these features, I have concluded that the Mello species and my material belong to the same taxon. Most of the specimens of this species examined are 30–60 years old, its current distribution is uncertain.

Diagnosis. Setae on gena are dark; both sexes have brown upper and lower calypters; setae below and behind postocular row are pale and weak, and the presutural area of thorax is shining, usually with no microtomentum. Males have an exceptionally long, slender surstylus and cercus, the tip of the cercus is hooked forward (Figs. 45, 46). This species is known primarily from a small area of southeastern Brazil.

Description. Male. Frons 0.031 (0.025–0.04/5) of head width at narrowest; anterior eye facets 1.67x larger than posterior (0.55mm, 0.33mm). Fronto-orbital plate silver-tan from above, dull orange from below; parafacial silvery-orange from above, dull orange from below; gena dark silvery with dark setae, genal groove orange, postgena dark silvery, anterior third with dark setae, remainder with pale setae; frontal vitta dull orange, extending only one-fourth up from pedicel bases, upper three-fourths obliterated where fronto-orbitals touch; pedicel orange-brown; first flagellomere long and slender, base faint orange, the remainder grey in color. Ocellar triangle small, anterior ocellus about 2x posterior ocelli, preocellar area orange, two distinct ocellar setae, other setae small and short. Frontal setae ascend about halfway up toward vertex; supravibrissal setae ascend about one-third of way up facial ridge. Intrapostocular area bright silvery, area below and behind postocular row with pale, weak setae. Upper edge of occiput shining black, remainder with whitish microtomentum with pale setae. In known specimens, thorax is usually bright green; in a few specimens it's blue or coppery. The spiracles are brown and medium in size; legs are brown; proepisternal depression usually with brown setae; rim and disc of upper and lower calypters brown; base of wing with dark brown veins, some cells in the basal area partially darkened, remainder of wing hyaline; basicosta and tegula brown to black; subcostal sclerite orange-brown with fine pubescence; dorsum of thorax shining, with little or no microtomentum. Abdomen with rear one-third of T4 and all of T5 polished. Surstylus and cercus are long and slender and curved forward, the tip of the cercus is hook-like (Figs. 45, 46). The phallus is as in Figs. 69, 70, the hypandrium, pre- and postgonite, ejaculatory sclerite and sternites of this species are as in Figs. 96–98, 126.

Female. Characters similar to males except frons 0.26 (0.23–28/5) of head width at narrowest; anterior eye facets much smaller than those in males (0.41mm vs. 0.55mm), anterior facets 1.41x larger than posterior facets (0.41mm vs. 0.29mm). The ovipositor and spermathecae are as in Figs. 138, 150.

Specimens examined. (29 males, 30 females). **Brazil: Rio de Janeiro Federal District.** 7 males, 5 females, Yellow Fever Service, MES, Oct. 1937, R.C. Shannon (USNM); 2 females, same data except Dec. 1937; 9 males, same data except Oct. 1937–Jan. 1938; 1 female, same data except April 1938; 3 males, same data except June 1938; 2 males, 2 females, same data except July 1938; 2 males, 3 females, same data except Aug. 1938; 7 females, same data except Sept. 1938; 2 males, 3 females, same data except Oct. 1938; 2 females, same data except Jan. 1939; **Santa Catarina.** 1 female, Nova Teutonia, 27°11'S 52°23'W, Oct. 30, 1936, Fritz Plaumann (BMNH); 1 male, same data except 300–500m, April 25; 1 female, same data except April 4, 1938. **São Paulo.** 2 males, São Paulo, Nov. 14, 1972, G.E. Bohart, (LACM); **Paraná.** 1 male, Alto Paraná, Curitiba, April 1940, Claret (USNM); 1 female, São Paulo, Casa Grande, Boraceia Field Station, grid 23 KMP 092837, Feb. 2, 1975, Thomas E. Rogers (FSCA); **Rondônia.** 1 female, 62km SE Ariquemes, Nov. 5–16, 1996, W.J. Hanson (LACM); **Rio de Janeiro.** 1 female, near Desenyano State Park; 21.87°S 41.80°W, May 5, 1999, 200 feet, Malaise trap, B.V. Brown (USNM).

Distribution. Primarily known from southeastern Brazil, with one record further west in the state of Rondônia (Fig. 160).

Discussion. No specimens of this species were barcoded.

9. *Lucilia lucigerens* (James, 1971)

Fig. 161, Tables 1, 2

Phaenicia lucigerens James, 1971: 384. Holotype male (USNM, not examined). Type locality: Jamaica, Portland.

Phaenicia lucigerens: Mariluis *et al.* 1994: 26.

Lucilia lucigerens: Whitworth 2010: 24; Kosmann *et al.* 2013: 77.

Type information. Several paratypes in WSUP were examined; this species was clearly defined by James (1971).

Diagnosis. One of only two species in the Neotropical Region with the upper calypter white and the lower dark in both sexes (also found in *L. albofusca*). Fifth tergite coppery to aeneous in both sexes.

Specimen barcoded. 1 male [BNNR056], West Indies, Jamaica, March 17, 2009, W. Cranston (WSUP)

Discussion. See Whitworth (2010) for a detailed description of this species. Barcode data was obtained for only one specimen (Fig. 161).

Distribution. Known only from Jamaica.

10. *Lucilia mexicana* Macquart, 1844

Figs. 47, 48, 71, 72, 99–101, 127, 139, 151, 161, Tables 1, 2.

Lucilia mexicana Macquart, 1844: 300. Holotype male (MNHN, not examined). Type locality: Mexico.

Lucilia mexicana: Aubertin 1933: 422; Whitworth 2006: 721; Kosmann *et al.* 2013: 77.

Phaenicia mexicana: Hall 1948: 243; Mello 1961: 268; James 1970: 11; Mariluis *et al.* 1994: 29.

Lucilia unicolor Townsend, 1908: 121. Holotype: female (USNM, not examined). Type locality: United States, New Mexico, Mesilla.

Lucilia unicolor: Shannon 1926: 133.

Lucilia infuscata Townsend, 1908: 123. Holotype: male (USNM, not examined). Type locality: United States, New Mexico, Organ Mountains.

Diagnosis. Known from the US (primarily the Southwest), Mexico, Guatemala and Honduras. It superficially resembles *L. eximia*, but strong, black setae behind and below the postocular row (as in Fig. 4) in *L. mexicana* vs. pale and weak setae in *L. eximia* (as in Fig. 3) separates them. It also has a dark face and gena, while *L. eximia* tends to have an orange face and gena. The male genitalia of the former have distinctive inverted Y-shaped cerci when viewed from the rear (Fig. 47), while cerci are nearly parallel in the latter (Fig. 42). The distributions of the two species overlap throughout the range of *L. mexicana*. This species also resembles *L. ochricornis*, but the former is known only from Mexico and Central America, while the latter is only known from South America.

Description. Male. Frons is wide, 0.055 (0.05–0.06/8) of head width at narrowest. Fronto-orbital plate bright silvery from above, darker from below, frontal setae ascend from antennal bases to vertex; fronto-orbital plates broad and nearly touch midway; gena and genal groove dark silvery with dark setae; postgena also dark silvery, anterior one-third to one-half with dark setae, the remainder with pale setae; frontal vitta brown to dark orange, nearly obliterated by broad fronto-orbitals midway; pedicel grey, apical edge orange, first flagellomere grey, about equal in width to parafacial. Ocellar triangle medium size, anterior ocellus about twice the diameter of posterior ocelli, usually with a shining black preocellar area, a small pair of stout ocellar setae, the remaining setae short and weaker. Supravibrissal setae ascend about one-third of way up facial ridge. Intrapostocular area with bright silvery microtomentum; usually two rows of stout black setae below and behind strong postocular row, the remaining setae on the occiput are pale and weak. The thorax and abdomen of most species are bright green, rarely coppery or bluish. The upper and lower thoracic spiracles dark brown to black; legs brown; proepisternal depression with dark setae; tegula black, basicosta dark brown; subcostal sclerite dark orange with pubescence. Upper calypter and rim pale, lower calypter light tan, rim usually pale. Anterior edge of presutural area of thorax with white microtomentum, the remainder of the thorax polished. Abdomen with T1–4 and anterior third to half of T5 with whitish microtomentum. The surstylus is long, slender, curved forward, and parallel-sided. It also has distinctive upside down Y-shaped cerci visible in the posterior view, and the tip of the cercus with a distinct hook (Figs. 47, 48). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in 71, 72, 99–101, 127 respectively.

Female. Characters similar to male except frons width averages 0.28 (0.26–0.30/6) of head width. Both upper

and lower calypters pale. T1–4 with whitish microtomentum, anterior edge of T5 with microtomentum or all polished. The ovipositor and spermathecae as in Figs. 139, 151.

Specimens examined. (32 males, 81 females). **Guatemala:** (6 males, 18 females) **Chimaltenango Dept.** 1 male, Chimaltenango, Oct. 6, 1979, E. Aguilar (USDC). **Guatemala Dept.** 2 males, 1 female, Guatemala City, May 30, 1990, J. Monzon (UVGC); 1 female, same data except San Lazro, March, 1997, M. Monzon; 2 females, same data except July 17, 1986, P. Mayorga; 1 female, same data except May 27, 1986, G. Robles; 1 female, same data except June 15, 1986, Juan Perez; 1 female, same data, May 10, 1996, E. Kepfer; 1 female, same data except April 20, 2010, J. Moran (WSUP); 1 female, Guatemala City, Zona 5, April 23, 1996, J. Rodas (WSUP); 1 male, Guatemala City, Zona 15, Feb. 12, 2000, C.A. Samayoa (UVGC); 1 female, Guatemala City, Zona 15, May 5, 2002, K. Morales (UVGC); 1 female, Guatemala City, Aug. 31, 1979, E. Aguilar (UCDC); 1 female, Guatemala City, July 16, 1989, K.S. Bloem (UCDC); 1 female, Guatemala City, April 19, 2001, Lis Lima (WSUP); 1 female, Mixco, las Hojarascas, Feb. 2, 2002, S. Melgar (WSUP); 1 male, San Jose, Pinula, April 1, 1992, L.F. Cocores (WSUP); 1 female, Guatemala Sta., Catarina Pinula, Piedra Parada, Aug. 24, 2009, J.C. Schuster (WSUP); 1 male, Casa Jack, April 18–25, 2009, Jack Schuster (WSUP); 1 female, Villa Nueva, Fca. Paraiso, Feb. 12, 1991, Clara I. (WSUP). 1 male, Catarina Pinula, Fca. Munbal, May 3, 2001, Omar Rgalaado (WSUP); 1 female, same data except March, 2010, A.F. Barillas (WSUP). **Verapaz Dept.** 1 female, Union Barrios, May 2, 2004, A. Estrada (WSUP). **Honduras:** 3 females, S. Macos Chol., July 29, 1958, Neff and Matthews (CNC). **Mexico** (26 males, 54 females): **State of Baja California.** 1 male, Sur las Barracas, 30km E Santiago, Oct. 15, 1982, Paul DeBach (EMEC); **State of Chiapas.** 1 male, Cristoba de las Casas, May 24, 1969; 1 male, San Cristobal, San Felipe, June 30, 1991, 7200 ft. (TAMU); 1 male, Yerba Buena, Hwy. 195, June 10, 1969, B.V. Peterson (CNC). **State of Chihuahua.** 1 male, Cuiteco, Sept. 1, 1969, T.A. Sears, R.C. Gordon, C.S. Glaser (LACM). **State of Coahuila.** 4 males, 2 females, Saltillo, July 12, 2010, C. Nunez-Vazquez (TW); 3 males, 5 females, Torreon, 2007, Teresa Perezgasga (TW). **State of Durango.** 1 male, Durango, June 22, 1964, L.A. Kelton (CNC); 1 male, 1.8 mi. W Durango, July 31, 1964, J. Powell (EMEC). **State of Jalisco.** 1 male, Autlan, Aug. 22, 1970, Malaise trap, J.S. Wasbauer (EMEC); 1 male, Teocaltiche, Aug. 22, 1970, B. Villegas (UCDC); 1 male, 6 mi N Chapala, Sept. 7, 1980, J.B. Karren (LACM). **State of Michoacan.** 6 males, Catija, Aug. 23, 1970, B. Villegas (UCDC); **State of Morelos.** 1 female, Cuernavaca, Nov. 10–12, 1987, F.D. Parker (LACM). **State of Neuvo Leon.** 1 male, San Juanito, Sept. 22, 1976, 7200 ft., J.A. Chemsak, M. Michelbacher (EMEC). **State of Oaxaca.** 1 female, Monte Alban, June 28, 1973, Howard Weems (FSCA). **State of Puebla.** 1 female, 2 mi NW Tehuacan, April 25, 1953, B.C. Bechtel, E.I. Schillinger (EMEC). **State of Zacatecas.** 2 males, 4 females, Nochistlan, Aug. 23, 1970, E. Villegas (EMEC); 2 females, same data except Aug. 23, 1970, 6400 ft.; 38 females, same data except Aug. 26, 1979. **United States, New Mexico,** 5 females [BNNR062–66], Grant.CO, Cherry Creek, Aug. 15, 2007, T.L. Whitworth (TW).

Distribution. Southwestern US, Mexico, Guatemala, and Honduras.

Discussion. Hall (1948, p. 204) used the condition of setae below and behind the postocular row in his key to separate *L. mexicana* from other *Lucilia*. However, he described the additional dark setae in this species as a second row of postocular setae. The single postocular row of setae is actually much stronger than the setae below and behind it. I do not consider these as extra rows of postoculars; rather they are stout, dark setae below and behind the postocular row. Hall's key indicated only *L. mexicana* had this character, while *L. purpurascens* and *L. coeruleiviridis* lacked it. In my studies, I found both *L. purpurascens* and *L. coeruleiviridis* actually share this character with *L. mexicana*.

Five specimens were barcoded; they formed a group along with *L. coeruleiviridis* though morphologically they are easily distinguished from each other (Fig. 161). DeBry *et al.* (2013) also noted that DNA analysis did not distinguish these two species. Two specimens of *L. eximia* from East Baton Rouge, LA also grouped with these specimens, though upon re-examination they proved to be typical for *L. eximia*. Oddly, none of the many other *L. eximia* barcoded grouped near this species. As mentioned under the discussion of *L. eximia*, barcodes did a poor job of distinguishing this species.

11. *Lucilia nitida* sp. nov.

Figs. 15, 29, 34, 49, 50, 73, 74, 102–104, 128, 140, 152, 160, Tables 1, 2

Diagnosis. One of only seven species in the Neotropical Region with pale setae on the gena, this species is unique

in that its thorax is wholly polished with no microtomentum. Only *L. rognesi* is close to this species, but the presutural area of thorax has a few patches of microtomentum. Furthermore, the distribution of these two species does not overlap; the former is known from Brazil, Peru, and Venezuela, while the latter is known from Costa Rica, Honduras and Panama.

Description. Male. Frons narrow 0.02 (0.015–0.03/6) of head width at narrowest; anterior eye facets are 1.75x posterior facets (0.63mm and 0.36mm). Fronto-orbital plates silvery to silvery-gold from above, orange to orange-brown from below, plates meet one-quarter way up frons; frontal setae ascend about three-fourths of the way up toward antennal bases; frontal vitta very short, color varies from brown to dark orange, ending one-quarter up the frons; parafacial orange to silvery-orange; gena light gray with a mixture of pale and dark setae, more pale setae to rear, genal groove varies from gray to orange; postgena like gena except all setae pale; pedicel and first flagellomere mostly gray to tan, except junction of pedicel and first flagellomere orange, width of first flagellomere about equal to width of parafacial; ocellar triangle small, black, preocellar area with small brown to black shining streak, median ocellus about twice the diameter of posterior ocelli. Supravibrissal setae ascend about one-third of way up facial ridge. Intrapostocular area with bright white microtomentum; setae below and behind strong postocular row and, on the rest of occiput, pale and weak. The thorax and abdomen of most specimens examined are bright green, in a few specimens, they are bright blue. Front and rear spiracles brown; proepisternal depression with pale setae; legs brown to reddish brown. Base of wing, veins and some cells more or less darkened; basicosta brown, tegula black; subcostal sclerite reddish-brown with pubescence. Upper calypter brown with brown rim, lower calypter with darker disc and almost black rim. Dorsum of thorax all polished, T1–3 and anterior third of T4 of abdomen with microtomentum, the remainder polished. Surstylus medium length, digitate, gradually expanding toward distal end, cercus with gentle curve forward (Figs. 49, 50). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in 73, 74, 102–104, 128 respectively.

Female. Characters similar to males except frons 0.23 (0.21–0.24/6) of head width at narrowest. Anterior facets about twice the size of posterior ones (0.58mm and 0.30mm). The ovipositor and spermathecae as in Figs. 140, 152.

Type material. Holotype male from Brazil, Federal District, Rio de Janeiro, ServicoFebre Amarela, October, 1937, M.E.S. Bras, no collector given (USNM) (Figs. 29, 34). Allotype female same data as male (USNM).

Paratypes. (13 males, 61 females). **Brazil** (12 males, 52 females): 1 female, Federal District, Rio de Janeiro, ServicoFebre Amarela, July, 1938, M.E.S. Bras, no collector given (USNM); 3 females, same data except Aug., 1938–Feb., 1939; 1 male, same data except Brazil, Federal District, Rio de Janeiro, ServicoFebre Amarela, Dec., 1937, M.E.S. Bras, no collector given (USNM); 3 females, same data except July, 1938; 1 male, same data except May, 1937; 5 females, same data except Sept., 1938; 3 males, 4 females, same data except Oct., 1938; 1 male, same data except Aug, 1938; 2 females, same data except Terezopolis, April, 1938; 2 females, same data except Maracaju, Mato Grosso, July, 1938; 1 male, 13 females, Rio de Janeiro, Oct.–Nov, 1937–1938, R.C. Shannon (USNM); 1 female, Rio de Janeiro, Mage, Jan., 1940, R.C. Shannon Collection (USNM); 2 females, Jan., 1939, YellFevServ, MESBrazil (USNM); 1 male, 2 females, Aug., 1938; 2 females, YellFevServ, MESBrazil (USNM); 7 females, Sept., 1938, YellFevServ, MESBrazil (USNM); 3 males, 5 females, Oct., 1938, YellFevServ, MESBrazil (USNM); 1 male, S. Catarina, Nov., 1900 (BMNH). **Peru** (1 male, 7 females): 3 females, Cuzco, Quincemil, Nov. 1–15 1962, 700m, L. Pena (CNC); 1 female, Upper Amazonas, Yahuas Terr., July 16–Aug. 13, 1948, J. Mounsey (BMNH); 1 female, Junin Dept., Chanchamayo, July 19, 1948, Jose M. Schunke (USNM); 1 female, Previsto, May 2, 1965, 750m, J. Shunke, BM 1965-529 (BMNH); 1 female, Previsto, June 2, 1965, 850m, J. Shunke, BM 1965-529 (BMNH); 1 male, Meshagua, Sept. 29, 1903, Urubambafl (USNM). **Venezuela:** (2 females): 1 female, 11 km N. Rancho Grande, Edo. Aragua, Feb. 25, 1971, G. and M. Wood (CNC); 1 female, no location given, B-10, 1952, Via P. Cova Garcia (WSUP).

Distribution. Brazil, Peru, and Venezuela (Fig. 160).

Etymology. The species name is taken from the Latin, *nitidus*, which means “shining” and is the condition of the presutural area of thorax which is an important character state in this species.

12. *Lucilia ochricornis* (Wiedemann, 1830)

Figs. 4, 5, 16, 18, 19, 51, 52, 75, 76, 105–107, 129, 141, 153, 160, 161, Tables 1, 2

Musca ochricornis Wiedemann, 1830: 408. Lectotype male (ZMHB), by present designation (see below). Type locality: Uruguay, Montevideo.

Lucilia ochricornis: Gaminara 1930: 1267; Aubertin 1933: 425; Kosmann *et al.* 2013: 77.

Phaenicia ochricornis: Baumgartner & Greenberg 1985: 584. These authors relied on Aubertin's (1933) key to identify this species; her concept of this species appears to have been mistaken, so their identification may have been incorrect. However, this species is found in Peru where their research was conducted.

Lucilia mera Shannon & Del Ponte, 1926: 586. Lectotype male (USNM), by present designation (see below). Type locality: Argentina, San Pedro de Jujuy. **Syn. nov.**

Lucilia primavera Shannon & Del Ponte, 1926: 586. Lectotype male (USNM), by present designation. Type locality: Argentina, Buenos Aires, San Isidro. **Syn. nov.**

Phaenicia eximia: Hall 1948: 239; James, 1970: 10. Misidentifications, not *eximia* (Wiedemann)

Type information. *Musca ochricornis* Wiedemann, 1830.

Described from 2 males and 4 females from Montevideo, Uruguay. The specimens are syntypes, no type specimen was chosen. One male and 2 females from ZMHB were examined, they are all in excellent condition and they are conspecific. The male specimen was selected as the lectotype; the female specimens were labeled paralectotypes.

Lectotype male (ZMHB) in good condition, completely intact, see Fig. 16 for the figure of specimen and specimen labels. The labels say Montevideo, Sello., # 6935. The collection location was Montevideo, Uruguay, the collector was Sello. It appears the label *Lucilia ochricornis* was added by Dr. Enderlein. According to Joachim Ziegler, curator of Diptera at ZMHB (pers. comm.), Wiedemann wrote "Aus Brasilien" (from Brazil) in his description, but Ziegler notes that Montevideo (Uruguay) was a province of Brazil until 1828. Wiedemann likely was not aware of the change at the time of his publication.

Aubertin's (1933) description leaves one uncertain of what she was seeing. She stated "squamae dark in both sexes". In fact the upper calypter is pale in both sexes; the lower is dark in the male and pale in the female. She also stated the male frons width ranges from half the width to equal to the width of the first flagellomere. Such a large range of variation in male frons would be very unusual, and leaves one wondering if she was looking at more than one species. This species has a broad frons about equal to the width of the first flagellomere. Aubertin stated that she examined the male type of the series from the Vienna Museum (NMW) and that there were two males and a series of females in the Berlin Museum (ZMHB). In the process of discussing Wiedemann types, Pont (1997) searched NMW for syntypes of this species and could not find any specimens. Later, a dusty, squashed male specimen was found by another researcher and Pont concluded this was the specimen Aubertin examined. He stated that she had designated it as the lectotype by inference. He also noted that, at that time, this species was considered a synonym of *L. eximia* (James 1970). To resolve the identity of this species, I contacted NMW and asked that they try to locate this specimen, or other specimens under this name. In a search of NMW by curator Peter Sehnaal, he found no evidence of any specimens labeled *L. ochricornis*, nor were there any calliphorids with this species name under any other genus names (pers. comm.). He concluded that it was not present in their museum and was either lost or had been sent elsewhere. Therefore I contacted Joachim Ziegler at ZMHB who stated that he had two males and four females from Wiedemann's original series which are detailed above.

I contacted Pont (pers. comm.) and he agreed that in Aubertin's statement regarding the Vienna specimen being "the male type of the series", she was most probably not saying that this was "the type male". Thus it was not a lectotype designation, but a reference to the fact that this specimen, like the rest of Wiedemann's series, was labeled "type". In any event the specimen could not be located and it seemed prudent to designate a lectotype for this species to finally resolve the identity of this name.

Baumgartner & Greenberg (1985) listed this species from their collections in Peru. However they relied on Aubertin's key to identify this species; her concept of this species appears to have been mistaken, so their identification may have been incorrect.

Lucilia mera Shannon & Del Ponte, 1926

Described from 3 males and 2 females. One male and 1 female each have the USNM number 40813. Two males and 2 females are from San Pedro de Jujuy, Argentina. One male is from Concepción, Tucumán, Argentina. The specimens are syntypes, no holotype was selected. Two males and 2 females were examined from this series, they are conspecific, 1 male from San Pedro was not located. One male examined (from San Pedro) was labeled cotype, the other male (from Concepción) and 2 females were labeled syntypes. The male labeled cotype was

selected as the lectotype; the other specimens were labeled paralectotypes.

Lectotype male (USNM) in good condition, see Fig. 18 for a figure of the specimen and the specimen labels. Though not given on the labels, the authors stated that this specimen was collected April 28, 1926, by Shannon and Shannon. This nominal species is a synonym for *Lucilia ochricornis*.

Lucilia primaveris Shannon & Del Ponte, 1926

Described from 7 males and 9 females from San Isidro, Buenos Aires, Argentina. One male and one female were examined, the male was labeled cotype, the female was labeled syntype, each specimen was labeled USNM# 40814. The two specimens are conspecific. The specimens are syntypes, no holotype was selected. The male specimen was selected as the lectotype; the female specimen was labeled paralectotype.

Lectotype male (USNM) is in fairly good condition, the dorsum of T4 and T5 have been cut out in the process of extracting the genitalia which are in a vial under the specimen. The dissected genitalia are in good condition. T3 has some damage from the pin, both midlegs are missing. See figure of specimen and specimen labels, Fig. 19. Though not on the label, the authors state these specimens were collected September 16, 1926 by R.C. Shannon. This nominal species is a synonym for *Lucilia ochricornis*.

I have concluded that both *L. mera* and *L. primaveris* represent a single species. The *L. mera* type specimens are bright green while the *L. primaveris* types are purple. The green coloration appears to be most common, the purple variant, though less common, was seen regularly (a total of over 100 specimens were examined). This sort of color variation occurs with many other *Lucilia* species as well. The authors further separated these species based on the number of posterodorsal setae on midtibia, they stated that *L. mera* has one seta and *L. primaveris* has two setae. A careful examination of both color variants (as well as several blue colored specimens) showed this character was unreliable. Furthermore, specimens of these species were virtually identical in every other way, including male and female genitalia. I was prepared to use *L. mera* as the valid name for this species until I examined the types for *L. ochricornis*. They clearly all belong to the same species and *L. ochricornis* has precedence, making both names synonyms.

Diagnosis. *Lucilia ochricornis* can be distinguished by the following characters: the upper calypter is white in both sexes, the lower is tan; in males, in females both calypters are white, this combination is as in *L. eximia* and *L. mexicana*. Both sexes have one or more strong rows of stout dark setae below the postocular row of strong setae. They also usually have an orange parafacial with the anterior third or more of gena orange.

Identification. This species shares many characters with *L. vulgata* and ranges can overlap. In good specimens, upper calypters of *L. ochricornis* are usually bright white in color in both sexes, and the lower calypter is bright white in females, and light tan in males. In specimens exposed to high humidity or stored in liquids, calypters may darken, causing them to key to *L. vulgata*. In *L. ochricornis*, normally most of the parafacial and the anterior third of the gena are orange; in *L. vulgata*, usually only the antero-ventral edge of the parafacial is orange and the gena is tan. Male genitalia are very similar, but T7 of the ovipositor in *L. ochricornis* is fully divided vertically midway by weak cuticle (Fig. 141); while in *L. vulgata*, the anterior two-thirds is divided by membrane (Fig. 145). This species was found only in southern South America, in Argentina, Brazil, Paraguay, Peru and Uruguay, where its range overlapped with *L. vulgata*. However, *L. vulgata* is more widespread, ranging from Argentina to Venezuela.

Lucilia ochricornis shares a row of stout dark setae behind and below the postocular row with *L. mexicana* (Fig. 4). It can be separated from *L. mexicana* with the following characters: *L. ochricornis* vs. *L. mexicana*, lower parafacial and anterior half or more of gena orange to yellow vs. parafacial and gena dark silvery; T1–T4 with microtomentum, except rear edge of T4 and T5 polished vs. only rear half of T5 polished in males, all but front edge of T5 polished in females; males have a broad frons to head ratio, a character shared with *L. mexicana* (0.05–0.07) which separates both species from *L. eximia* (0.03); in males, cerci almost parallel in posterior view (Fig. 52) vs., cerci, upside down Y-shape in posterior view (Fig. 48); known only from the southern half of South America vs. known only from Central America and the Nearctic Region.

Description. Male. Frons 0.06 (0.05–0.075/5) of head width at narrowest; eye facets small, anterior facets 1.48x posterior facets (0.46mm, 0.31mm), see Table 1. Fronto-orbital plates bright silvery, broad and touching two-thirds of way up toward vertex, obliterating frontal vitta; frontal vitta reddish brown; upper parafacial silvery, lower parafacial orange which extends onto the anterior half to two-thirds of the gena, the remainder of gena dark silvery, gena with dark setae only; postgena dark silvery, the anterior edge with dark setae, the remainder with pale setae;

pedicel and first flagellomere light to dark orange with light gray microtomentum, width of first flagellomere about equal to width of parafacial. Ocellar triangle small and black with a pair of small ocellar setae, anterior ocellus about 2x posterior ocelli; frontal setae ascend to just below ocellar triangle. Intrapostocular area is silvery; with one or more irregular rows of stout, black setae below and behind postocular row (Fig. 4), remaining setae on occiput pale and weak; upper quarter of occiput shining black, remainder covered with whitish microtomentum. Color of thorax and abdomen is variable, green, blue or purple. Thoracic spiracles medium sized, brown in color; leg coloration brown to reddish brown; proepisternal depression usually with pale setae, occasionally tan; disc of upper calypter pale, rim light tan, disc and rim of the lower calypter tan; base of wing with darker veins and parts of some cells darkened, remainder of wing hyaline; basicosta dark brown, except note that occasional specimens have been found with orange basicostas (see discussion later); tegula black; subcostal sclerite pubescent orange-brown; presutural area of the thorax with whitish microtomentum, remainder of thorax shining. Abdomen with rear edge of T4 and all of T5 polished. Surstylus digitate, short and broad, cerci short and stout (Fig. 51, 52). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in 75, 76, 105–107, 129 respectively.

Female. Characters similar to males except frons 0.26 (0.24–0.26/5) of head width at narrowest; anterior eye facets 1.5x posterior facets (0.46mm and 0.31mm). Upper and lower calypters white with white rims, occasional specimens are seen with some darkening of lower calypter. The ovipositor and spermathecae as in Figs. 141, 153.

Specimens Examined. (67 males, 104 females). **Argentina** (6 males, 20 females): 3 males, 9 females, Entre Rios, Liebig (Rio Uruguay), April, 1977, S. Bolle (CNC); 1 male, La Plata, Punta Lara, Jan. 13, 1970, Malaise trap, Vardy, Arguin-deguy (BMNH); 2 females, same data except Jan. 1, 1970; 1 female, Tuc., Horco Molle, c. 12 km W Tucuman, March 18–21, 1974, 700m, Malaise trap, C.R. Vardy (BMNH); 1 female, Alto Parana, Bemberg, March 13, 14, 1934, K.J. Hayward (BMNH); 2 females, Mis., Iguazu, Oct. 4–10, 1927, R.C. & E.M. Shannon (USNM); 1 female, Iguazu Nat. Park, hosteria, Hoppe, April 10, 11, 1974, c. 140m, Malaise trap, C.R. Vardy (BMNH); 1 female, Jujuy, April 10, 1927, R.C. Shannon (USNM); 1 female, Jujuy, Agua Caliente, NE Guemes, Oct. 18, 19, 1968, 110m, Pena (CNC); 1 female, Delta, April 6, 1927, (USNM); 1 female, Oct. 6, 1926, H.E. Box (USNM); 1 male, B. Ayres, Bigot Coll., B.M. 1960-539 (BMNH); 1 male, Catamarca, Andalgalá, Oct. 25, 1972, G.E. Bohart (LACM). **Bolivia:** 1 female, Chipiriri, Dec. 1964, T. Steinbeck (CNC). **Brazil** (3 males, 12 females): 1 male, São Paulo, Guarulhos, Jan. 29, 2003, D.J. Cavan (LACM); 1 female, São Paulo, Nov. 14, 1972, G.E. Bohart (LACM); 1 female, Maua, Oct. 20, 1961, N.L.H. Krauss (USNM); 1 male, 1 female, Mato Grosso, YellowFeverService, MES, May 1937 (USNM); 2 females, Alto Para, Curitiba, April, 1940, Claret (USNM); 1 female, same data except Jan. 3, 1961, N. Marston (WSU); 1 male, UFPR Campus, April 16, 1996, feces trap, Pont (BMNH); 5 females [BNNR155–159], R.G.S., Fed. Univ. Pelotas campus, May 26, 1992, liver trap, M.J.R. Hall (BMNH); 1 female, same data except Nov. 30, 1963, C.M. Biezanko (BMNH); 1 female, Tocantins Porto Nacional, Feb. 1, 2003, D.J. Cavan (BYU); 1 female, Pelotas, Oct. 31, 1959, C.M. Biezanko (BMNH); 1 female, same data except Oct. 30, 1963. **Paraguay** (1 male, 3 females): 1 male, Villarrica, Oct. 1936, F. Schade (USNM); 1 female same data except Dec. 1936; 2 females, same data except Aug. 1938. **Peru** (1 male, 1 female): 1 male, San Martin, 8–13 km from Tarapoto Urimaguas, Dec. 10, 1991, 650–800m, John R. MacDonald (MEM); 1 female, Pasco, Puerto Bermudez, June 28, 1980, 200m, fruit bait, D. Goodwin (BG); **Uruguay** (56 males, 64 females): 2 females, Montevideo, H.L. Parker (USNM); 1 female, Paras Lab, Oct. 23, 1942, Parker (USNM); 56 males [BNNR184], 61 females [BNNR72, 73, 75, 76 180–183] Soriano, Cardona, 33°52'60"S 57°22'60"W, May 20, 2008, T.W. Whitworth (TW).

Distribution. Known from Argentina, Bolivia, Brazil, Paraguay, Peru and Uruguay (Fig. 160).

Discussion. *Lucilia ochricornis* is similar to *L. eximia*, which explains why many authors synonymized it with that species; however, it is clearly distinct. About 5% of the specimens examined had orange basicostas. Initially they were thought to be a different species from the majority of specimens with brown basicostas. The genitalia of both sexes with orange and brown basicostas were dissected and only the basicosta color was different, otherwise those with orange basicostas appeared to be identical to the species with brown basicostas. Normally in *Lucilia*, basicosta color is a consistently reliable character state to help distinguish species. Barcodes were obtained for 14 specimens of this species and they formed a distinct cluster distinct from other species (Fig. 161). Of these specimens, one male and four females had orange basicostas. The fact that they grouped tightly based on barcodes, and no other differences were found between them led to the conclusion that this was intraspecific variation. The barcode results supported the conclusion, based on morphology, that this species is distinct from *L. vulgata*.

13. *Lucilia pionia* (Walker, 1849)

Table 1, 2

Musca pionia Walker, 1849: 880. Holotype male (BMNH, not examined). Type locality: Galápagos Islands.

Lucilia pionia: Shannon 1926: 129; Aubertin 1933: 399; Kosmann *et al.* 2013: 77; Tantawi & Sinclair 2013: 239.

Viridinsula pionia: Curran 1934b: 166.

Phaenicia pionia: James 1966: 477; James 1970: 11.

Diagnosis. Lower parafacial and gena extends significantly downward and forward (Tantawi & Sinclair 2013, fig. 3c); thorax and abdomen metallic greenish to coppery with whitish microtomentum; presutural seta weak or absent; male frons about 0.13 of head width, at narrowest.

Specimens examined. Ecuador: Galápagos Islands. Typical *L. pionia*-3 females, Pinta Playa Ibbetson, 40m, March 13–22, 1992, Malaise trap, S. Peck; 1 female, same data except 200m, March 14–22, 1992; 2 females, Fernandina, 5km ne Cabo Hammond, 110m, May 4–11, 1991, Malaise, S. and J. Peck. Near *L. pionia*-1 male, 1 female, Española, Bahía Manzanilla, June 8–10, 1985, S. and J. Peck; 1 male, 1 female, same data, except June 5–10.

Discussion. This species was described in detail by James (1966). Tantawi & Sinclair (2013) studied specimens of *L. pionia* and found that *L. pionia*-like specimens from the island of Española lack the typical forward and downward extension of the head. The specimens from Española are in poor condition, Tantawi and Sinclair (2013) have stated in their key that good quality male specimens of typical *L. pionia* are needed to assess the size of setae on T5. Some other differences were noted, but the male genitalia appeared identical. They suggested the status of identity of the specimens on Española that are close to *L. pionia* should be re-evaluated once better specimens are available. They found typical *L. pionia* on other Galápagos Islands.

Distribution. Ecuador, Galápagos Islands. James (1966) listed Walker's type specimen as from Santa María Island (Floreana). He also lists it from Santa Cruz Island and Genovesa (Tower) Island. Tantawi & Sinclair (2013) listed it from the islands of Fernandina, Marchena, Pinta, and Santiago. They listed *Lucilia* sp. near *L. pionia* from the island of Española.

14. *Lucilia problematica* Johnson, 1913

Tables 1, 2

Lucilia problematica Johnson, 1913: 448. Holotype male (USNM, not examined). Type locality: Bermuda.

Lucilia problematica: Woodley & Hilburn 1994: 13; Whitworth 2010: 25; Kosmann *et al.* 2013: 77.

Phaenicia problematica: Hall 1948: 253; James 1970: 11.

Diagnosis. This species appears nontypical for the genus, the body color is metallic-tan and specimens look somewhat teneral, the coloration resembles the Galápagos species *L. deceptor*. They share similar body color, an orange to yellow basicosta and all abdominal tergites with microtomentum, but the male frons in *L. problematica* is only 0.02 of head width at narrowest in males while *L. deceptor* males have a wide frons, about 0.23 of head width at narrowest.

Description. See Whitworth (2010) for details of this species characters.

Distribution. Only six specimens are known, from the island of Bermuda, it was last collected in 1934. On a collecting trip to the island Woodley and Hilburn (1994) looked for this species and did not find it. They concluded it is likely extinct.

Discussion. Two females from the Melander Collection (USNM) were examined (Whitworth 2010).

15. *Lucilia pulverulenta* sp. nov.

Figs. 30, 34, 53, 54, 77, 78, 108–110, 130, 142, 154, 159–161, Tables 1, 2

Diagnosis. Setae on gena pale (as in Fig. 1); basicosta brown, upper and lower calypters brown; anterior edge of presutural area of the thorax with a strong band of whitish microtomentum (as in Fig. 13). Known from Colombia, Costa Rica, Ecuador, Honduras, and Panama. Very similar to *L. woodi*, see comments under that species.

Description. Male. Frons 0.018 (0.015–0.02/5) of head width at narrowest; anterior eye facets very large, 1.55x larger than posterior facets, (0.68mm, 0.44mm). Fronto-orbital plates bright silvery, plates meet midway up frons, eyes almost touch; frontal vitta dull orange, extending only about one-fourth of the way up the frons, obliterated by fronto-orbital plates; frontal setae ascend about half way up toward the vertex. Parafacial bright silvery except a small area of orange on the anteroventral corner; gena bright silvery with mostly black setae, except pale setae extend up from the postgena along the ventral edge. Antenna with pedicel brown, lower edge orange and first flagellomere silvery-gray, about one-third broader than parafacial; ocellar triangle medium size, black in color, anterior ocellus slightly larger than posterior ocelli. Intrapostocular area bright silvery; area behind and below postocular row pale and weak (as in Fig. 3); occiput, upper edge and upper midsection shining black, the remainder with whitish microtomentum. Body color variable, most specimens bright blue or green, but some are purple and a few coppery.

Thoracic spiracles brown, relatively large; legs brown to dark brown; proepisternal depression usually with pale setae; rim and disc of upper and lower calypters brown; base of wing with veins and cells dark brown, rest of wing hyaline; basicosta and tegula brown and black respectively; subcostal sclerite brown with brown pubescence; presutural area of the thorax with heavy whitish microtomentum, remainder of thorax polished (as in Fig. 13). Abdomen, rear third of T4 and all of T5 polished; surstylus medium length, parallel sided (Figs. 53, 54). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in 77, 78, 108–110, 130 respectively.

Female. Characters similar to males except frons 0.24 (0.23–0.25/5) of head width at narrowest; anterior eye facets fairly large about 1.7x posterior facets (0.52mm and 0.30mm). The ovipositor and spermathecae are as in Figs. 142, 154.

Type material. Holotype male, Costa Rica, Guanacaste Province, 9 km S Sta. Cecilia, P.N., L_N_330200_380200, March 21–April 6, 1993, 700m, C. Moraga (INBIO) (Figs. 30, 34). Allotype female, Ecuador, Rio Palenque, 0°35'S 79°22'W, Feb. 22–26, 1976, 150m, G. and M. Wood (CNC). **Paratypes.** (40 males, 124 females). **Colombia:** 1 female, Choco Dept., Aug. 8, 1967, B-2195 (USNM). **Costa Rica** (37 males, 78 females): **Alajuela Province.** 1 female, 2km S Pital, Sept. 5–28, 1988, F.D. Parker; 1 female 20km S Upala, Aug. , 7–9, 1990, F.D. Parker (LACM); 1 female, same data except Aug. 28–30, 1990; 1 female, same data except Sept. 17, 1990; 1 female [BNNR176], same data except March 20–26, 1991; 1 female, same data except March 27–31, 1991; 1 female, same data except April 1–10, 1991; 1 male, same data except April 21–30, 1991; 1 male, same data except June 17, 1991; 1 male, same data except Oct. 1–10, 1991; 1 female [BNNR080], PN Volcán Tenorio, Est. El Pilon, L_N_298212_427913, #85038; 700–800m, Oct. 19–22, 2005, Tp amarilla, J.A. Azofeifa (INBIO); 1 female [BNNR083], San Carlos, Laguna Lagarto Lodge, L_N_296095_516714 #76554, 100m, Feb. 23–27, 2004, B. Hernandez (INBIO). **Cartago Province.** 1 female, Pejibaye, Estación Biológica Copal, Sendero Tigre, L_N_196286_563684; 1090m, Ap 6, 2005, J.P. Azofeifa (INBIO); **Guanacaste Province.** 1 female, 9km S Santa Cecilia, Estac. Pitilla, L_N_330200_380200, 700m, Oct., 1989, C. Moraga, P. Rios (INBIO); 1 female, Estac. Cacao, SW side Vulcan Cacao, 1000–1400m, Nov.–Dec., 1989, R. Blanco, C. Chavez (INBIO); 1 male, Guanacaste NP, Estac. Pitilla, 9km S Santa Cecilia, L_N_330200_380200, 700m, Oct. 8–18, 1991, C. Moraga (INBIO); 1 male same data except Dec., 1994; 1 male same data except Aug., 1995; 1 female, same as data except Aug., 1991, P. Rios (INBIO); 2 females, same as previous except C. Moraga (INBIO); 1 female, same data except Oct. 3–18, 1991; 1 male, 3 females same data except March 2–19, 1992, P. Rios; 2 males, same data except Sept. 22–Oct. 14, 1992; 1 female, same data except C. Moraga; 1 female, 3km SE R. Naranjo, May, 1992, F.D. Parker (LACM); 1 female, same data except April, 1992; 1 female, same data except May, 1992; 1 female, same data except July 22–24, 1992; 1 female, same data except Oct. 21–31, 1992; 1 female, same data except June 14–16, 1993; 1 female, same data except Aug. 14–20, 1993. **Limón Province.** 1 male, Sector Cerro Cocori, Fca. de Rojas, L_N_286000_567500, 150m, March, 1993, E. Rojas (INBIO); 1 male, NP Tortuguero, Cerro Tortuguero, L_N_285000_588000; 100m, Dec., 1989; J. Solano (INBIO); 1 male [BNNR150], R.B. Hitoy Cerere, Send. Espavel, L_S_401200_569800, 560m, March 10, 2003, W. Arana, F. Rojas, B. Gamboa (INBIO); 1 male [BNNR151], same data except June 20–July 9, 2003; 1 female, Talamanca, San Miguel, Albergue CASACODE, Send Chonta, L_S_391000_612000, 10–30m, Feb. 23–26, 1999, M. Alfaro (INBIO); 1 female, 16km W Guápiles, 400m, Aug–Sept, 1989, Paul Hanson (INBIO). **Puntarenas Province.** 3 females, Península de Osa, Rancho Quemado, L_S_292500_511000, 200m, July, 1991, F. Quesada (INBIO); 1 female, same data except Aug.; 1 female, same data except Sept., 1992, A. Marin; 3 females, same data except March 12–31, 1993, A. Gutiérrez; 1 female, same data except May 12–24, 1993; 1 female, same data except Dec. 1–20, 1993, A. Marin; 1 female, A.C.

Osa, Corcovado NP, Est. Sirena, L_S_270500_508300, 1–100m, Jan. 1994, G. Fonseca (INBIO); 1 male, Corcovado NP, Est. Sirena, L_S_270500_508300, 1–100m, Dec., 1989, G. Fonseca (INBIO); 1 male, same data except Dec., 1990; 1 male, same data except June, 1991; 2 males, same data except July, 1991; 2 males, same data except Sept., 1991; 3 males, same data except Jan., 1992; 2 males, same data except Sept., 1993; 1 male, same data except Sept., 1995; 2 males, Corcovado NP, Sector Los Planes, Entrada a la Estac. L_S_288200_500300, 100–200m, July 25, 2002, K. Caballero (INBIO); 1 male, 1 female, Sector Tigre, 1 km de estacion, L_S_277313_531805, 100m, Nov. 24, 2002, K. Caballero (INBIO); 1 female, Isla del Coco NP, Cerro Yglesias, 05°04'47"N 87°04'47"W, 600m, March 21, 2002, B. Hernandez (INBIO); 1 female, Golfito, Corcovado NP, Est. Sirena, Send. Corcovado, L_S_270500_508300, 10m, Nov. 15, 2001, K. Caballero (INBIO); 1 female, Golfito, Corcovado NP, Est. Sirena, Send. Olla, L_S_270572_508258, 10M, Nov. 20, 2001, K. Caballero (INBIO); 1 male [BNNR149], Golfito, Jiménez, Corcovado NP, Estac. Los Patos, Send. a Mirador, L_S_279950_516975, 190m, March 15, 2002, K. Caballero (INBIO); 1 female, Golfito, Jiménez, Corcovado NP, Cno a Sirena, Send. Alred. Río Cederal, L_S_280655_517000, 86m, Oct. 10, 2001, K. Caballero (INBIO); 1 male [BNNR148], Jiménez, Corcovado NP, Estac. Los Patos, Send. Vaco, L_S_280700_515500, 160m, April 13, 2002, K. Caballero (INBIO); 1 female, Res. Biol. Carara, Est. Queb. Bonita, L_N_194500_469850, Oct. 18–29, 1992, A. Guzman (INBIO); 2 female, same data except Nov. 6–27, 1992; 1 female, same data except Jan.4–26, 1993; 2 males, Sendero Zamia, Est. Agujas, L_S_276750_526550, 300m, Nov. 26–30, 1995, A. Azofeifa, (INBIO); 4 females, same data except Aug. 24–31, 1996; 1 female [BNNR081], Corcovado NP, Cerro Puma, Intersection #4, L_S_267700_518900, 100–300m, June 19–July 8, 2003, M. Moraga, A. Azofeifa, K. Caballero, (INBIO); 1 female, Corcovado NP, Sector La Leona, Cerro Puma, Tp Intersection, L_S_267700_518900, 100–302m, June 23–July 7, 2003, K. Caballero, (INBIO); 1 female, Est. Sirena, Sendero Ollas (ACOSA), L_S_272100_509400, 150m, April 20, 1995, A. Picado, (INBIO); 1 male, Est. Agujas, Sendero Ajo, L_S_276750_526550, 400m, Aug. 14–24, 1996, A. Azofeifa, (INBIO); 1 female, Manuel Antonio NP, Quepos, L_S_370900_448800, 80m, April, 1991, G. Varela, (INBIO); 1 female, Pen. Osa, Cerro La Torre, Fca. La Purruja, Fila Matahambre, L_N_277000_527000, 200m, May 4–9, 1994, M. Segura, (INBIO). 1 female, Monteverde, June 20–24, 1986, W. Hanson, G. Bohart (LACM); 1 female, Golfito, June 29, 1976, Malaise trap, M. Wasbauer, (EMEC); 2 females, Golfito-United Fruit Company, June 28, 1976, M. Wasbauer, (EMEC); 1 female, same data except July 1, 1976; 1 male, 12 females, 5.6km SW Rincon, Aug. 5–15, 1970, R.W. Merritt, (WSUP). **Heredia Province.** 2 males 1 female, Braulio Carrillo NP, Est. El Ceibo, L_N_256500_527700, 400–600m, Feb, 1990, C. Chaves, (INBIO); 1 female, same data except Oct., 1989, R. Aguilar, M. Zumbado (INBIO). **San Jose Province.** 1 female [BNNR169], Tarrazu, Reserva Ríos Pariso, Alvergue Pecarí, L_S_390500_449600, 405m, May 1, 2, 2006, B. Gamboa, M. Moraga, J.A. Azofeifa, Tp Veleta (INBIO). **Ecuador** (2 males, 3 females): 2 males, 2 females, Balao Chico, Rio Frio, April 26–30, 1963, Pena (CNC); 1 female, Rio Palenque, 0°35'S 79°22'W, 150m, G. M. Wood (CNC). **Honduras** (32 females): 23 females, Atlantida, 13km E La Ceiba, July, 1996, 150m, flight intercept trap in plantation, R. Lehman (TAMU); 9 females, Atlantida, 15km W La Ceiba, June 20–July 20, 1996, 175m, Malaise trap, tropical rain forest, R. Lehman, (TAMU). **Panama** (1 male, 10 females): 1 male, Canal Zone, Barro Colorado I., Aug. 17, 1956, from over swarm raid of *Eciton burchelli*, C.W., M.E. Bettenmeyer (WSUP); 2 females, Canal Zone, Barro Colorado I., May 13, 1967, Roger D. Akre (WSUP); 1 female same data except July 17, 1968, Richard L. Torgenson, (WSUP); 1 female, Canal Zone, Gamboa Pipeline Rd., July, 1967, Malaise trap, W.W. Wirth (USNM); 3 females, Pacora, May 14, 1953, no collector name, (USNM); 1 female, Darien Prov., Morti River, no collector name or date (WSUP); 1 female, San Blas Prov., no collector name or date (FSCA); 1 female, Bocas del Toro Prov., Almirante, Yellow Fever Camp, June 11, 1952, Shannon trap.

Other Material Examined. Material examined, but not labeled paratypes included 296 females (INBIO), as follows: Alajuela Province, 2; Cartago Province, 1; Guanacaste Province, 97; Heredia Province, 2; Limon Province, 10; Puntarenas Province, 178; San Jose Province, 6.

Distribution. Known from Colombia, Costa Rica, Ecuador, Honduras and Panama (Figs. 159, 160).

Discussion. The setae on the gena are very fine and it can be hard to see the pale setae mixed with dark setae. If they are missed, specimens will key to *L. vulgata*. The specimens from Colombia and Ecuador are distant from where most specimens were found, but they still appear to be *L. pulverulenta*. Barcode data was obtained for nine specimens, all from Costa Rica. The barcodes for six of these specimens placed them in a distinct group (Fig. 161). It would be useful to get barcode data for specimens from Colombia, Ecuador or other areas to see if they match the Costa Rican species.

Etymology. The name is taken from the Latin *pulvis* meaning “dust” which refers to the heavy dusting on this species in the presutural area of the thorax

16. *Lucilia purpurascens* (Walker, 1836)

Figs. 6, 12, 20, 35–38, 55, 56, 79, 80, 111–113, 131, 143, 155, 161, Tables 1, 2

Musca purpurascens Walker, 1836: 355. Holotype female (BMNH, examined). Type locality: Brazil, Santa Catarina. See Nomenclature section below.

Lucilia purpurascens: Aubertin 1933: 426 (see Nomenclature section below); Carvalho & Riberio 2000: 170 (name spelled correctly in key but incorrectly as “*purpurescens*” in summary).

Phaenicia purpurescens: Hall 1948: 254 (the species name was misspelled as “*purpurescens*” and most subsequent authors followed this incorrect spelling); James 1970: 11; Baumgartner & Greenberg 1985: 584; Mariluis 1989: 75, larval description.

Lucilia purpurescens: Kosmann *et al.* 2013: 77.

Lucilia ocellaris Shannon, 1926: 132. Holotype male (USNM, examined) (Fig. 20). Type locality: Costa Rica, San Mateo, Higuito. There are two original spellings for this species, *L. ocellaris* (pp. 130, 131) and *L. ocellatis* (p. 132). The correct original spelling was selected as *L. ocellaris* by James (1970: 11), as the First Reviser (Article 24.2.4 of ICZN 1999).

Lucilia ocellaris: Shannon & Del Ponte 1926: 585.

Lucilia peruviana: Amat *et al.* 2008: 234. Most authors using *peruviana* were referring to *L. purpurascens*, but given the characters used in the key, it is unclear what species Amat *et al.* were referring to. Misidentification, not *Lucilia peruviana* Robineau-Desvoidy, 1830. See further comments on this species name under entry below for *Phaenicia peruviana*.

Phaenicia peruviana: Mariluis *et al.* 1994: 29; Mariluis 2002: 99; Mariluis & Mulieri 2003: 88. See appendix by Rognes and Whitworth in Whitworth (2012) for an explanation of the status of the name *Lucilia peruviana* Robineau-Desvoidy, 1830: 455.

Nomenclature. Aubertin (1933) was the first author to provide a detailed description of both sexes of *L. purpurascens* and included a figure of the phallus and male genitalia (figs. 30 a, b). Aubertin noted “this is a striking and easily recognizable species”, the male genitalia for this species are distinctive (Aubertin 1933: fig. 30 b). Hall (1948) provided an even more detailed description and figures of this species (fig. 25 C, D) following Aubertin. Aubertin also stated she examined specimens of Shannon’s (1926) *L. ocellaris* identified by Aldrich and that they match Walker’s type. I have examined the holotype male and a paratype male of Shannon’s *L. ocellaris* and they match the nominal species that Aubertin and Hall described as *L. purpurascens*. The Walker holotype is intact, but has a heavy layer of dust adhering to the cuticle which could not be cleaned off without risking destruction. It was difficult to be certain about the exact microtomentum patterns on the thorax and abdomen which are important to confirm species identity. Unfortunately, Aubertin’s description does not match the holotype of *L. purpurascens*. A comparison of females of Aubertin’s (Fig. 38) concept of *L. purpurascens* with Walker’s holotype female (Figs. 35–37) reveals significant differences, as follows: for species described by Aubertin, frons width averaged 0.28 of head width, at narrowest vs. frons 0.25 of head width at narrowest on the holotype; dorsum of thorax with heavy whitish microtomentum (Fig. 12) vs. only the anterior edge of pronotum with whitish microtomentum; T4 mostly polished or only anterior edge with microtomentum vs. most of T4 with microtomentum; gena all dark brown vs. anterior edge of gena orange; upper and lower calypters dark brown with dark brown rims vs. upper and lower calypters light tan, rim of upper calypter brown, rim of lower calypter pale. Other less obvious differences were noted as well. Finally, perhaps the most significant difference noted is the specimen was collected from Santa Catarina, in southeast Brazil. It is not clear if this was from the nearby island with that name or somewhere else in the state of Santa Catarina, but the species matching Aubertin’s description has not been found anywhere near this location (see range information below). Subsequently, all authors have followed Aubertin’s concept of the species, see listings in the synonymy above. Walker’s specimen is a *Lucilia*, but is not identifiable to species; characters which might reveal this species’ actual identity are obscured. Repeated efforts to confirm this specimen’s identity with certainty have failed. Even with good specimens, a lone female *Lucilia* without matched males in the Neotropical Region can be difficult to positively identify. Because the species defined by Aubertin is what taxonomists currently consider *L. purpurascens* to be and the actual identity of the holotype is in serious doubt, I consider it a *nomen dubium*. I plan to apply to the ICZN to conserve prevailing usage by designating a neotype and to set aside the existing name-bearing type in accordance with ICZN Article 75.5. Thus all photos and descriptions herein are based on *L. purpurascens sensu* Aubertin (1933) and Hall (1948).

Diagnosis. Dark setae on gena; basicosta brown; both calypters, including rims and discs dark brown; normally stout black to brown setae behind and below postocular row; entire dorsum of thorax with heavy whitish microtomentum; T4–T5 usually both polished. Normally an exceptionally large *Lucilia*, body colors usually a distinctive bluish-purple.

Description. Male. Frons narrow 0.01(0.01/5) of head width at narrowest; anterior eye facets much enlarged, twice the diameter of the rear facets (0.64mm and 0.32mm, Fig. 6). Fronto-orbital plates slender, silvery color with frontal setae ascending about one-third of way to vertex; parafacial mostly silvery, with lower third to half more or less orange; gena dark silvery with dark setae, postgena also dark silvery, anterior third with dark setae, remainder with pale setae; frontal vitta dark orange, very short, about one-quarter of the way up the frons, fronto-orbital plates meet obliterating upper three-fourths of vitta; antenna with pedicel orange, first flagellomere gray, about one-third broader than width of parafacial; ocellar triangle black, medium ocellus about one-third larger than posterior ocelli, ocellar setae short. Supravibrissal setae extend about halfway up facial ridge. Intrapostocular area bright silvery; one or more irregular rows of stout black to brown setae below and behind postocular row, the remainder of the occiput with pale setae; upper edge of occiput shining black, also a shining black central vertical stripe, remainder of occiput with whitish microtomentum.

Thorax and abdomen purple to bluish-purple dorsum of thorax with heavy whitish microtomentum (Fig. 12). The anterior thoracic spiracles are dark brown and much enlarged, about equal to the size of the humeral callus; proepisternal depression usually with long and pale setae, sometimes tan; rim and disc of upper and lower calypters dark brown. Base of wing, cells and veins darkened, rest of wing hyaline; basicosta brown, tegula black; subcostal sclerite orange with pubescence. Abdomen, T1–3 with whitish tomentum, normally all the T4–5 are polished. Surstylus medium length, curved forward with distal end expanded, cercus medium length and slender (Figs. 55, 56). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in 79, 80, 111–113, 131.

Female. Characters similar to male except frons 0.28 (0.27–0.29/4) of head width at narrowest; anterior facet diameter much smaller than males (0.45mm vs. 0.64mm), posterior facets about equal to those in males (0.34mm vs. 0.32mm). Ovipositor and spermathecae as in Figs. 143, 155.

Specimens examined. (94 males, 134 females). **Argentina:** 1 male, Tucuman, Oct. 19, 1992, G.E. Bohart (LACM); 1 male, Tucuman, Horco Molle, c. 12km w Tucuman, 700m, Malaise trap, March 18–21, 1974, C.R. Vardy (BMNH). **Bolivia** (4 males, 10 females): 1 male, Cochabamba Chapare, Alto Palmar, 1100m, Sept. 1960, F.H. Walz (WSUP); 2 males, 2 females, Cochabamba, El Limbo, Nov. 1962, 2000m, F.H. Walz (WSUP); 2 females, La Paz, Caranavi, 10km NW rd. to Entel Tower, 15°46'35"S 67°35'48"W, 1400m, April 13, 2001, S.A. Marshall (UGG); 2 females, La Paz, Coroico, Cerro Echumachi, 16°12'43"S 67°42'49"W, 2550m, April 5, 2001, S.A. Marshall (UGG); 1 female, La Paz, Sud Yungas, Punta Villa Hotel, Tamampaya, 4300ft., May 19–24, 1989, J.E. Eger (FSCA); 1 female, El Limbo, 17°07'S 65°36'W, 2200m, Nov. 1963, F. Steinbach (CNC); 1 female, El Chapare, Youngas, Feb. 1–3, 1976, 2200m, L.E. Pena (CNC); 1 male, 1 female, Cbba Chapare, Villa Tunari, Cochabamba Rd., km358, 1300m, March 23, 1995, Puritt and Wood (CNC). **Colombia** (1 male, 7 females): 2 females, Magdalena, Cerro San Lorenzo, 2100m, July 9, 1970, B. Malkin (BMNH); 1 female, 15mi S La Union Narino, 2150m, March 4, 1955, E.I. Schlinger, E.S. Ross (WSUP); 1 female, Valle, km19, hwy to Buenaventura, Aug. 12, 1979, Manowell (FSCA); 1 male, 2 females, Valle Saladito, Feb. 17, 1970, D.M. Wood (CNC); 1 female, 20km w Silva Cauca, Feb. 22, 1970, 2000m, D.M. Wood (CNC). **Costa Rica** (49 males, 55 females): **Alajuela Province.** 1 male, Volcan Poas, 1800m, Nov. 15, 1987, D.M. Wood (CNC); 1 female, R.F. Grecia, Bosque del Naio, Send. Catarata, 1900–2000m, June 26–29, 2007, R. Gonzales, M. Morgana, E. Navarro (INBIO); 2 females, 20km S Upala, June 3, 1991, F.D. Parker (LACM); **Cartago Province.** 2 males, 1 female, Pejibaye, Est. Biol. Copal, Sendero Garvula, L_N_196286_563684, 1090m, April 8, 2005, D. Briceno (INBIO); 2 females, P.N. Campamento, 1200m, L_N_213371_600782, May 5–9, 2005, D. Briceno, M. Morgan (INBIO); 1 female, La Union, C. Campintera, 1840m, L_N207300_539000, July 22–25, 2008, Malaise trap, Azofeifa, Hernandez, Moraga, Zumbado (INBIO). **Guanacaste Province.** 6 males, 1 female, Est. Cacao, lado so Vol. Cacao PN, 800–1600m, L_S_323300_375700, July 12–17, 1993, F.A. Quesada (INBIO); 2 females, Est. Cacao, SW alde Volcan Cacao, L_S_323300_375700, 1000–1400m, Nov.–Dec., 1989, URCC, R. Blanco, C. Chavez (INBIO); 1 male, Macizo Miravalles, Est. Cabro Muco., 1100m, L_N-299769_411243, June 20–July 8, 2003, J.D. Gutierrez (INBIO). **Heredia Province.** 1 female, La Selva Biol. Stat., May 18, 1989, R.L. Huber (LACM); **Limon Province.** 1 female, Tortuguero, Tortuguero NP, L_N_285000_588000, 0–120m, R. Delgado (INBIO). **Puntarenas Province.** 1 female, Monteverde, 1970, H.M. Powell (UCDC); 4 males, Monteverde, Feb. 24–29, 1980, 1500m, G.

and M. Wood (CNC); 2 males, 5 females, Monteverde, June 20–24, 1986, W. Hanson, G. Bohart (LACM); 3 males, 3 females, Monteverde, July 18–24, 1987, G. and M. Wood (CNC); 1 male, Monteverde, Nov. 20, 1987, D.M. Wood (CNC); 1 female, Monteverde, Feb. 18, 1999, 1800m, D.M. Wood (CNC); 1 male, Monteverde, July 20, 1991, 1799m, D.M. Wood (CNC); 5 males, 3 females, Monteverde, July 20–23, 1991, 1500m, D.M. Wood (CNC); 2 males, 1 female, same data except Feb. 17–20, 1992; 1 male, same data except July 25–30, 1997, 1500m; 1 female, Coton Las Alturas, Nov. 28, 1994, D.M. Wood (CNC); 4 males, same data except 1400m, Sept. 5, 1991, P. Devries, M. Wood (CNC); 1 male, 3 females, Monteverde, 1500m, Feb. 24–29, 1980, G. and M. Wood (CNC); 3 males, E St. Pittier, 1670m, L_S_330900_577400, Jan. 5–18, 1995, E. Navaro (INBIO); 1 male, same data except June 28–July 3, 1995, E. Zumbado (INBIO); 2 males, same data except Aug. 23–Sept. 13, 1995, E. Navaro; 1 male, same data except Oct. 24–Nov. 1, 1995, M. Moraga; 1 female, Las Alturas, Cato Brus., 1500m, L_S_822500_591300, Nov., 1991, M.A. Zumbado (INBIO); 2 females, Buen Amigo, San Luis Monteverde; L_N_250850_449250, April, 1995, Z. Fuentes (INBIO); 2 males, 1 female, P.I. La Amistad E St. Altamira, Sendero Gigantes del Bosque, L_S_331300_571600, 1300m, Oct. 6–Nov. 1, 2005, R. Gonzales (INBIO). **San Jose Province.** 1 female, Escazu, July 25, 1988, F.D. Parker (LACM); 1 female, San Isidro del Gen., Jan. 2, 1989, F.D. Parker (LACM); 2 males, 9 females, Monteverde, Hdwts. Rio Guacimal, July 23–27, 1964, C.L. Hogue (LACM); 1 male, Escazu, Feb. 8, 1987, G.E. Bohart (LACM); 3 females, San Jose, Dec. 26, 1987, F.D. Parker (LACM); 1 female, Santa Elena, Send. La Bota, L_S_373400_507300, Ap. 25, 1996, A. Alfaro (INBIO); 1 male, Calle Tornillal, L_N_224500_537350, 1500m, May 11, 1997, F. Alvarado (INBIO); 1 male, Tarrazni, Cerro Cura, L_S_395350_450300, 1750m, Feb. 16, 17, 2003, M.A. Zumbado (INBIO); 1 female, Est. Zurqui, antes de Tunel, Sept.–Oct., 1990, G. Maass (INBIO); 1 female, F. Cementerio de la Maquina, PN Chirripio, L_S_378700_512500, 2100–2500m, F. Quesada, M. Segura (INBIO); 1 male, Cascajal de Coronado, Bajo La Rosa, May 3, 1995, Baumann, Houseman (BYU); 4 females [BNNR122–125], San Jose, Tres de Junio, Jan. 16, 2011, T.L. Whitworth (TW). **Ecuador** (9 males, 13 females): 1 male, 2 females, Napo, 7 km S Bacza, 2000m, Feb. 20–25, 1979, G. and M. Wood (CNC); 1 male, Cuenca rd., Canar, March 4, 1965, L. Pena (CNC); 6 males, 11 females, Tandapi, 40 km SW Quito, 1300–1500m, June 15–21, 1965, Pena (CNC); 1 male [BNNR054], Napo, May 10, 2002, O. Lonsdale (UGG). **Guatemala** (12 males, 36 females): 3 males, 8 females, Suchitepequez Dept., Tepectuez Refugio del Quetzal, 1600m, July 21, 2011, Camposeco and Monzona (UVGC); 3 females, same data except July 21, 2011; 2 males, 3 females, same data except Univ. of Guatemala Res. Stat., June 10, 2011, F. Carillo (UVGC); 2 females, Zacapa fea Somta Claren, 2270m, July 6, 2011, Monzon and Sutton (UVGC); 2 females, San Marcos Bajoual, 1600m, July 2, 2011, F. Camoseco (UVGC); 2 females, Guatemala, Puerta Parada, 1900m, April 12–19, 2002, J.C. Schuster (UVGC); 1 female, same data except Aug. 12–18, 2002; 1 male, same data except Sept. 29–Oct. 6, 2002; 1 male, same data except Nov. 4–11, 2002; 1 female, same data except April 5, 2003; 1 female, same data except April 12, 2003; 1 male, 1 female, same data except April 26–May 3, 2003; 1 female, same data except Aug. 17, 2003; 1 female, same data except Oct. 4–12, 2003; 1 female, same data except March 22, 2004; 1 female, same data except April 24, 2004; 1 male, same data except May 15–22, 2004; 1 female, same data except Aug. 1–7, 2004; 1 male, 1 female, Escuintla, Sabana Grande, March 17, 2010, Edgar Arriaza (UVGC); 1 female, Guatemala, Puerta Parada, Aug. 12–18, 2002, Trampa Malaise, J.C. Schuster (UVGC); 1 female, Guatemala, Vista Hermosa, Zona 15, March 13, 2008, J.R. Galvez (UVGC); 1 female, Guatemala, Mixco, May 5–9, 2010, Castellanos (UVGC); 1 female, Guatemala, Catarina Pinula, San Jose Pinula, 1580m, March 10, 2007, J.C. Schuster (UVGC); 1 male, Guatemala, Puera Parada, March 31, 2007, J. Schuster (UVGC); 1 male, Guatemala, Universidad del Valle, May 19, 2009, R. Montenegro (UVGC); 1 female, Ciudad, Zona 15, Oct. 5, 2002, D. Ramirez (WSUP); 1 female [BNNR053], Zacapa, June 4, 2007, Sutton (WSUP).

Mexico (13 males): **State of Chiapas.** 1 male, 2.5 mi S Tuxtla, 8000–9000ft., Aug. 10, 1962, H.E. Milliron (CNC); 1 male, San Cristobal de Las Casas; 7087ft, June 18–25, 1969, B.V. Peterson (CNC); 1 male, Yerba Buena Hyw 195, June 24, 1969, B.V. Peterson (CNC); 1 male, 8 mi. W Navenchaue, April 1, 1953, R.C. Bechtel, E.I. Schlinger (EMEC); 1 male, 8.9km E Rayoh, 1500m, Sept. 19, 1991, D.M. Wood (CNC); 1 male, 6km SW Ocosingo, Sept. 20, 1991, 1400m, D.M. Wood (CNC); 2 males, 1 km NW San Cristobal, 2200 m, Sept. 23, 1991, D.M. Wood (CNC). **State of Morelos.** 1 male, Tetela del Volcan, Aug. 23, 1984, D.M. Wood (CNC). **State of Tamaulipas.** 3 males, El Canindo nr. Ejido San Jose, 7.5km W Gomez Farias, 1400m, July 19–21, 1994, E. Riley (TAMU). **State of Veracruz.** 1 male, Jalapa, Aug. 1–6, 1961, R. and K. Driesbach (CNC). **Panama:** 1 male, Chiriqui, Cerro Punta, 08°53'N 82°36'W, June 23, 1999, W. Reeves (KR). **Peru** (1 male, 7 females): 1 female, Machu Picchu ruins, 2000m, Aug. 13, 1971, C.M. Vardy (BMNH); 1 female, Junin Prov., 11km W San Ramon,

June 22, 1980, D. Baumgartner, B. Greenberg (BG); 1 female, same data except 23km W San Ramon, 1869m, July 1, 1980; 4 females, same data except 16km W San Ramon, 1433m, June 21, 1980; 1 male, Junin Prov., Chanchamayo, 1300m, May 17, 1918, Jose M. Schunke (BMNH). **Venezuela** (2 males, 6 females): 1 male, 11km N Rancho Grande, Edo. Argua, Feb. 25, 1971, G. and M. Wood (CNC); 1 female, Choroní Rd., Edo. Argua, Feb. 26, 1971, 1500m, G. and M. Wood (CNC); 1 female, Avila Mt., Carcas, Aug. 16, 1958, 6000ft., Arnold Menke (LACM); 1 female, T.F. Amaz., Cerro de la Neblina, Camp VII, 0°51'N 65°58'W, 1800m, Jan. 30–Feb. 10, 1985, Malaise trap, P.J. and P.M. Spangler, F.A. Faitoute (USNM); 1 female, Mira Los Teques, Nov. 16, 1972, G.E. Bohart (LACM); 1 male, 2 females, Merida, Libertador Merida, July 3, 1979, R.W. Brooks *et al.* (UCDC).

Distribution. Argentina, Bolivia, Costa Rica, Ecuador, Guatemala, Mexico, Panama, Peru, Venezuela (Figs. 159, 160). Mariluis & Mulieri 2003 listed this species from several locations in northern Argentina (under *Phaenicia*).

Discussion. Six specimens were barcoded and five formed a distinct group (Fig. 161). A specimen from Ecuador was separated from the group, but morphologically appeared identical. This is one of the most distinctive species of *Lucilia* in the Neotropical Region. Several species of Calliphoridae, belonging to *Mesembrinella* Gigliot-Tos and *Paralucilia* Brauer & Bergenstamm and some Muscidae were encountered that were superficially very similar to this species. Mariluis (1989) described the immature stages of this species and studied their life history (under *Phaenicia*).

17. *Lucilia retroversa* (James, 1971)

Fig. 161, Tables 1, 2

Phaenicia retroversa James, 1971: 382. Holotype male (USNM, not examined). Type locality: Bahamas, Grande Island.

Phaenicia retroversa: Mariluis *et al.* 1994: 26.

Lucilia retroversa: Whitworth 2010: 26; Kosmann *et al.* 2013: 77.

Type information. The type series includes the holotype, an allotype, 5 male and 8 female paratypes. Two male paratypes were examined.

Diagnosis. Known only from the West Indies, where this species and *L. cluvia* are the only *Lucilia* with a pale orange basicosta (*L. sericata* also has this character, but this species is only known from Bermuda near the West Indies). This species has dark setae on the gena to separate it from *L. cluvia*. See Whitworth (2010) for more details on this species.

Specimens barcoded. 2 females [BNNR183, 184], Grand Bahama Island, Freeport, West Indies, June 20, 1987, W.E. Steiner, M.J. & R. Molineaux (USNM). 1 male [BNNR048], 1 female [BNNR047], Dominican Republic, La Vega Cordillera Central, 4.1 km SW El Convento, May 31, 2003, J. Rawlins, *et al.* (CMNH).

Discussion. James (1971) described this species from the Bahamas and Cuba. Whitworth (2010) studied a long series of specimens from the Dominican Republic that were similar to this species, but some differences were noted. It was originally thought these specimens belonged to a separate species, but detailed studies of specimens from each group led to the conclusion that differences were intraspecific variation. Four specimens were barcoded, two from the Dominican Republic, and two from the Bahamas (Fig. 161). The barcode data supports the finding, though they are not identical, the two groups are very similar.

Distribution. Bahamas, Grand, New Providence, San Salvador; Cayman Islands, Cuba, Dominican Republic and Puerto Rico.

18. *Lucilia rica* Shannon, 1926

Fig. 161, Tables 1, 2

Lucilia rica Shannon, 1926: 132. Holotype male (USNM, examined). Type locality: West Indies, Antigua.

Lucilia rica: Curran 1934a: 471 (misidentification?; see comments below); Woodley & Hilburn 1994: 13; Whitworth 2010: 30; Kosmann *et al.* 2013: 77.

Phaenicia rica: Hall 1948: 257; James 1970: 11.

Type information. The holotype, allotype, and one paratype of this species were examined (USNM). The labels for the holotype male say “*Lucilia rica* Shannon”, the allotype female and a paratype have labels with the same data. The holotype has been dissected and the genitalia are in a vial on the pin, all specimens are in good condition.

Diagnosis. This species is known only from the West Indies. It has pale setae on the gena, a character shared only with *L. cluvia* in that region. To separate the two, *L. rica* has a tan basicosta and males have a narrow frons (0.026) of head width at narrowest, while *L. cluvia* has a pale orange basicosta and broad frons to head ratio, about 0.12 of head width at narrowest in males.

Description. For details on this species see Whitworth (2010).

Specimens barcoded. West Indies, Antigua: 4 females [BNNR042–44, 046], 17°01'98"N 61°50'22", March 17, 2009, T.L. Whitworth (TW).

Discussion. Curran (1934a) listed *L. rica* from Guyana (as British Guiana), this is almost certainly a misidentification. This species is known only from the West Indies. *Lucilia albofusca* is found in Guyana and has pale setae on the gena like *L. rica*; this may be the species he was seeing. Four specimens from Antigua were barcoded and they formed a distinct group (Fig. 161). It would be interesting to compare barcodes of this species from Antigua to those found in Bermuda, morphologically they appear very similar.

19. *Lucilia rognesi* sp. nov.

Figs. 14, 31, 34, 57, 58, 81, 82, 114–116, 132, 144, 156, 159, 161, Tables 1, 2

Diagnosis. Lower gena with pale setae; basicosta brown; upper calypter light tan and lower calypter brown both sexes; presutural area mostly polished with microtomentose streak between acrostichal and dorsocentral setae and a whitish patch between dorsocentral seta and humeral callus; (Fig. 14). Known only from Costa Rica, Honduras and Panama (Fig. 159).

Description. Male. Frons 0.02 (0.015–0.025/4) of head width at narrowest; anterior eye facets are 1.53x larger than posterior facets (0.49mm vs. 0.32mm). The relative size of both anterior and posterior facets is almost identical for both sexes (see Table 1). Fronto-orbital plate silvery, plates touching midway up frons, frontal setae ascend to about midway up toward vertex; parafacial silvery except silvery-orange in anteroventral corner; gena with silvery-brown microtomentum, posteroventral corner with pale setae; pale setae extending up from postgena about one-fourth of way up gena; frontal vitta a small, dull orange triangle on the lower frons; antenna with brown pedicel, lower edge of pedicel and upper edge of first flagellomere red, remainder with gray microtomentum. Ocellar triangle small, black with short setae, anterior ocellus about 2x posterior ocelli. Supravibrissal setae extend about one-third of way up facial ridge. Intrapostocular area bright silvery, setae below and behind postocular row pale and weak; upper edge of occiput shining black, also a vertical black shining stripe midway, the remainder with pale microtomentum and pale setae. Color of thorax and abdomen blue, green or purple. Thoracic spiracles are medium sized and brown in color; legs are brown to reddish brown; proepisternal depression with pale setae; rim and disc of upper calypter light brown, lower calypter darker brown; veins and cells in wing base darkened, remainder of wing hyaline; basicosta brown, tegula dark brown; subcostal sclerite orange-brown with pubescence; dorsum of thorax shining, with little microtomentum (Fig. 14). Abdomen with all but anterolateral corners T4 and all of T5 polished. Surstylus medium length, parallel sided, cercus tapers to a slender point (Figs. 57, 58). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in 81, 82, 114–116, 132 respectively.

Female. Characters similar to males except frons 0.23 (0.23/4) of head width at narrowest; facets almost identical to males (anterior facets 0.51mm, posterior facets 0.31). The ovipositor and spermathecae as in Figs. 144, 156.

Type material. Holotype male from Costa Rica, Alajuela Province, Sector Colonia Palmareña, L_N_245900_475900, 700m, April 3–22, 1995, E. Fletes (INBIO) (Figs. 31, 34). Allotype female, Guanacaste Province, Guanacaste NP, 9km S Sta. Cecilia, Est. Pitilla, L_N_330200_880200, 700m, March 2–19, 1992, P. Rios (INBIO).

Paratypes. (8 males, 78 females). **Costa Rica** (8 males, 73 females): **Alajuela Province.** 1 female, 20km S Upala, June 1990, F.D Parker (LACM); 1 female, R.B. San Ramón, L_N_244100_470100, 800m, Nov. 1994, G. Carballo (INBIO); **Cartago Province.** 1 male, La Suiza, 1923, Pablo Schild (USNM), 1 female, Tapantí, Q. Segunda, L_N_194000_559800, 1300m, Oct. 1993, G. Mora (INBIO); 1 female, Guayabo National Monument,

L_N_217400_570000, 1100m, Oct. 1994, G. Fonseca (INBIO); 1 female, Barbilla, Send. Principal A Rio Barbilla, L_N_216110_597123, 500m, Jan. 12, 2003, E. Rojas (INBIO). **Guanacaste Province.** 1 female [BNNR177], 3km SE R. Naranjo, Nov. 8, 1991, F.D. Parker (LACM); 1 female, same data except Feb. 3–7, 1992; 2 females, same data except June 1–5, 1992; 2 females, Rincón de la Vieja NP, Send. a las aguas termales, L_N_305843_392970, 900–1000m, Nov. 5–7, 2001, D. Briceflo (INBIO); 1 female, Tenorio Z.P., Tierras Morenas, Rio San Lorenzo, L_N_287800_427600, 1050m, March 28–April 21, 1992, A. Marin (INBIO); 1 female, same data except Dec. 1992; 1 male, 3km SE R. Naranjo, Dec. 21–28, 1992, F.D. Parker (LACM); 1 female, same data except June 5, 1993; 2 females, same data except June 8–12, 1993; 1 female, same data except June 12, 1993; 1 female, same data except June 14–16, 1993; 1 female, same data except June 18–23, 1993; 1 female, ACG, Estación Meugo, Volcan Cacao, Bosque Primario, L_N_322740_375198, 1000m, April 6–30, 1988, Espinoza (INBIO); 1 female, Estac. Cacao, SW side Volcan Cacao, L_N_323300_375700, 1000–1400m, Sept. 1989, URCG, R. Blanco, C. Chavez (INBIO); 2 females, same data except Oct. 1989; 1 female same data except Nov.–Dec. 1989; 1 female, Est. Cacao, SW side Volcan Cacao, L_N_323300_375700, June 1990 no collector (INBIO); 1 female, same data except May 21–28, 1992, C. Moraga, M.M. Chavarria (INBIO); 1 female, same data except 800–1660m, July 12–17, 1993, D.G. García (INBIO); 1 female, Est. Cacao, Send. Casa Fran, 2km W of Cerro Cacao, L_N_324100_376500, 1600m, Feb. 12, 1995, A.M. Maroto (INBIO); 1 female, Est. Cacao, 2km SW of Cerro Cacao, L_N_323100_375800, 1000–1400m, Feb. 12–14, 1995, S. Avila (INBIO); 1 male, same data except July 24–Aug. 3, M.A. Zumbado; 1 female, Estac. Pitilla, 9km S Santa Cecilia, 10°59'26"N 85°25'40"W, 700m, Nov. 1988, GNP Biodiversity Survey (INBIO); 1 female, Fca Pasmompa Est. Patilla, 5km SW Santa Cecilia, L_N_333500_380600, 400m, March 1989, GNP Biodiversity Survey (INBIO); 1 female, Guanacaste NP, Estac. Patilla, 9km S Santa Cecilia, 700m, May 1989, I. Gauld (INBIO); 1 male, Est Patilla, 9km S Sta. Cecilia, L_N_330200_380200, July 1991, P. Rios (INBIO); 1 female, same data except Aug., 1991; 4 females, same data except C. Moraga; 2 males, 12 females, same data except March 2–19, 1992, P. Rios; 3 females, same data except Sept 22–Oct. 14, 1992; 1 female, same data except Dec. 5–14, 1992, C. Moraga; 1 female, same data except Dec. 1992, C. Moraga (INBIO). **Limon Province.** 1 female, Est. Hitoy Cerere, R. Cerere, Res. Biol. Hitoy Cerere, L_N_184200_643300, 100m, Jan. 7–26, 1992, G. Garballo (INBIO); **Puntarenas Province.** 1 female, Estación Sirena, L_S_270500_508300, 1–100m, Sept. 1995, G. Fonseca (INBIO); 1 female, Buenos Aires, La Amistad NP, Est. Altamira, Send. a Casa Coca, L_S_331750_674400, 1700m, Aug. 13–Sept. 3, 2005, D. Rubi (INBIO); 1 female, Fila Cruces, Fca Luis Amador, L_S_304100_577015, 1400m, June 9, 1995, J.A. Chacon (INBIO); 4 females, Est. Queb. Bonita, Res. Biol. Carara, L_N_194500_469850, Oct. 18–29, 1992, R. Guzman (INBIO); 2 females, same data except Nov. 6–27, 1992; 1 female, Las Alturas Biol. Stat., 20km NE San Vito, Quarry, 1 km N Rio Bellavista, Aug. 14, 1995, C.R. Nelson (LACM); 1 female, Monteverde, 1300m, Aug. 18–24, 1987, G., M. Wood (CNC); 1 female, 5.6km SW Rincon, Aug. 5–15, 1970, R.W. Merritt (WSUP); 1 female, Rancho Quemado, Pen. de Osa, L_S_292500_511000, 200m, Oct. 8–28, 1993, A. Marin (INBIO); 1 female, Corcovado, Sector La Leona, Cerro Puma, L_S_267700_518900, 100–302m, June 21–July 7, 2003, K. Caballero (INBIO); 1 female, 6km S San Vito, 08°42'N 83°00'W, April 30, 1967, D.F. Veirs (INBIO); 1 male, Fca. Cafrosa, Est. Las Mellizas Amastad NP, L_S_316100_596100, 1300m, Oct. 1989, M. Ramirez, G. Mora (INBIO); 1 male, Isla del Coco NP, Bahía Chatan, 5°32'40"N 87°03'20"W, 1–100m, Oct. 1994, J.F. Quesada (INBIO). **San Jose Province.** 1 female, Est. Carrillo, Braulio Carrillo NP, L_N_236700_541800, 700m, Feb. 15–17, 1993 (INBIO); 1 female, Est. Santa Elena, Viejo, Santa Elena, Las Numbes, L_S_371750_507800, 1210m, Jan. 5–14, 1996, E. Alfaro (INBIO); 1 female, Est. Las Numbes de Santa Elena, 1.6km NW of the Est., L_S_370700_508800, 1500m, March 31, 1996, E. Alfaro, (INBIO). **Honduras:** 2 females, Atlantida Department, 15km W La Ciba, 175m, June 20–July 20, 1996, Malaise trap, R. Lehman (TAMU). **Panama:** 1 female [BNNR175], Coclé Province, 3km N El Valle La Mesa, 08°38'13"N 80°07'28"W, 3050 feet, July 21–28, 1999, Malaise trap, Gillogly, Woolley (TAMU). **Venezuela:** 2 females, Edo. Argua, PN Henri Pittier, Rancho Grande, 10°21'N 67°41'W, 1183m, Jan. 25, 2007, A. Martinez (YV)

Distribution. Known only from Costa Rica, Honduras, Panama and Venezuela (Fig. 159).

Discussion. Two specimens were barcoded, they were in a group nearest *L. woodi* (Fig. 161).

Etymology. This species name was chosen to honor Knut Rognes, a great mentor, teacher and calliphorid expert.

20. *Lucilia sericata* (Meigen, 1826)

Tables 1, 2

Musca sericata Meigen, 1826: 53. Syntypes, unspecified number of males and females (presumed lost).

Lucilia sericata: Hough 1899: 287; Shannon 1926: 131; Aubertin 1933: 411; Woodley &

Hilburn 1994: 13; Carvalho & Riberio 2000: 170; Whitworth 2006: 721; Amat *et al.* 2008: 234; Carvahlo & Mello-Patiu 2008: 398; Whitworth 2010: 32; Kosmann *et al.* 2013: 77.

Phaenicia sericata: Hall 1948: 259; Mello 1961: 261; James 1970: 11; Baumgartner &

Greenberg 1985: 584; Mariluis *et al.* 1994: 28; Mariluis 2002: 99; Mariluis & Mulieri 2003: 88; Centeno *et al.* 2004: 388; Mariluis *et al.* 2008: 109.

Diagnosis. See comparison of this species with *L. cuprina* under that species. See Rognes (1991) for a detailed description of this species and figures of male and female genitalia respectively (figs. 455–463 and figs. 464, 465).

Specimens examined. (14 males, 29 females). **Argentina** (14 males, 24 females): 9 males, 15 females, Entre Rios Liebig (Rio Uruguay), Apr. 1987, S. Bolle (CNC); 3 males, 8 females, El Bolson, Rio Negro, Nov. 1955–Dec. 1957, Andor Kovacs (LACM); 1 female, Catamarca, Andalgalá, Nov. 4, 1972, G.E. Bohart (LACM); 1 male, 5km S Alta Garcia Cordova PR, Nov. 18, 1975 (UCDC); 1 male, S. d. Estero Colonia Dora, Nov. 15–26, 1979, C., M. Vardy (BMNH). **Peru**: 1 female, 18km NE Cusco, April 17, 1983, 3000m, C., M. Vardy (BMNH). **Uruguay**: 4 females, State of Soriano, Cardona, May 20, 2008, T.L. Whitworth (TW).

Distribution. James (1970) listed as almost worldwide, from southern Canada to Argentina. Not found in many areas of the Neotropical Region. Not known from the West Indies proper (Whitworth 2010), though it was found in Bermuda (Woodley & Hilburn 1994) and in some areas of Central and South America, especially near bigger cities. Whitworth (2010) listed *L. sericata* in Costa Rica based on a single specimen examined. A re-examination of the specimen revealed it was intermediate between *L. sericata* and *L. cuprina*; I now believe it is likely an aberrant *L. cuprina*.

Discussion. See Hall (1948), Rognes (1991) or Whitworth (2006) for more information on this species.

21. *Lucilia setosa* (James, 1966)

Tables 1, 2

Phaenicia setosa James, 1966: 479. Holotype male (USNM, not examined). Type locality: Ecuador, Galápagos, Darwin Island.

Phaenicia setosa: James 1970: 11.

Lucilia setosa: Kosmann *et al.* 2013: 77; Tantawi & Sinclair 2013: 239.

Diagnosis. The lower portion of the head does not extend downward or forward. The thorax and abdomen are metallic bluish or green and covered with a heavy whitish microtomentum; disc of T5 with stout black setae. The male frons is broad in this species, 0.16–0.17 of head width at narrowest, like other Galápagos *Lucilia*. Male genitalia are illustrated in Tantawi & Sinclair (2013, figs. 2E, 2F).

Description. See Tantawi & Sinclair (2013) and James (1966) for more details on this species.

Specimens examined. (7 males, 7 females). **Ecuador: Galápagos Islands.** 5 male, 6 female paratypes, Isla Darwin, Jan. 29, 1964, D.G. Cavagnaro (WSUP); 1 female, same data except nonparatype; 2 males, Española at Punta Juarez, Feb. 10–12, 1967, Ira L. Wiggins (WSUP).

Discussion. Two nonparatype male specimens from Española and collected by Ira Wiggins were examined (above). They had been identified as *L. setosa* by James, but differ from the paratype specimens I examined. The former specimens have a narrower frons with a head to frons ratio of 0.13/2 of head width at narrowest, than the five paratype males listed above with broader frons 0.174(0.16–19/5). They shared the stout discal setae on T5 with the paratype specimens from Darwin Island, but they appeared different in body color and microtomentum patterns varied. More material is needed for study from Española to clarify the identity of both the *L. setosa*-like specimens and the *L. pionia*-like specimens. Tantawi and Sinclair (2013) have examined additional specimens from the same series collected by Ira Wiggins from Española and identified as *L. setosa* by James. They placed all the Española *Lucilia* specimens, other than *L. deceptor*, under *Lucilia* sp. near *L. pionia*.

Distribution. James (1966) listed from Ecuador, Galápagos Islands, Darwin Island (Culpepper) and Wolf Island, but is likely to occur on other islands.

22. *Lucilia vulgata* sp. nov.

Figs. 32, 34, 59, 60, 83, 84, 117–119, 133, 145, 157, 160, 161, Tables 1, 2

Diagnosis. Gena with dark setae only; basicosta brown; upper calypter light tan, lower dark brown in both sexes; one or more rows of stout setae below and behind postocular row; presutural area of thorax with heavy whitish microtomentum. This species can be confused with specimens of *L. ochricornis* with discolored and darkened calypters. See discussion in identification section under *L. ochricornis*.

Description. Male. Frons broad 0.05 (0.045–0.07/7) of head width at narrowest; both anterior and posterior facets are small; the anterior eye facets are 1.8x posterior facets (0.43mm vs. 0.24). The relative size of both anterior and posterior facets for both sexes is almost identical (0.43mm, 0.30mm in female) (Table 1), as in *L. rognesi*. Fronto-orbital plate bright silvery, relatively broad, frontal setae extend up to just below ocellar triangle; parafacial silvery from above with anteroventral corner orange, dull orange from below; gena with dark setae, anterior edge orange, remainder of gena dark silvery; postgena dark silvery, anterior half with dark setae, remainder with pale setae. Frontal vitta dull orange, extending half the way up frons to where fronto-orbital plates meet; antenna with upper pedicel orange-brown, apex orange, first flagellomere gray-orange. Ocellar triangle moderate size, black with short setae, anterior and posterior ocelli about equal in size. Supravibrissal setae ascend about one-third up facial ridge. Intrapostocular area bright silvery, one or more rows of stout, black setae below postocular row; upper edge of occiput and a vertical line in the center polished black, the remainder with whitish microtomentum and pale setae. Thoracic spiracles are brown and medium size; legs are reddish-brown; proepisternal depression usually with tan setae, but occasionally nearer pale; disc of upper calypter light tan with tan rim, disc of lower calypter brown with tan rim; base of wing with cells and veins darkened; basicosta dark brown and tegula black; subcostal sclerite orange with pale orange pubescence; dorsum of thorax with heavy microtomentum on presutural area, remainder polished. Abdomen usually with rear one-third of T4 and all of T5 polished. Surstylus short, broad and parallel-sided, cerci short, tapering to a point (Figs. 59, 60). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in Figs. 83, 84, 117–119, 133 respectively.

Female. Characters similar to males except frons 0.25 (0.24–0.27/4) of head width at narrowest; facets almost identical to males (anterior facets 0.43mm, posterior facets 0.30mm). The ovipositor and spermathecae as in Figs. 145, 157.

Type material. Holotype male, Brazil, São Paulo Province, São Paulo Guarulhos, Jan. 29, 2003, D.J. Cavan (USNM) (Figs. 32, 34). Allotype female, Brazil, Nova Teutonia, 27°11'S 52°23'W, 300–500m, Jan. 1965, Fritz Plaumann (CNC). The holotype was originally in BYU but permission has been granted to deposit it in USNM.

Paratypes. (15 males, 108 females). **Argentina** (12 males, 2 females): 3 males, Misiones Terr., Bonpland, Jan. 13–14, 1927, F.&M. Edwards (BMNH); 3 males, 1 female, Bemberg, Alto Parana, March 13–14, 1934, K.J. Hayward (BMNH); 1 male, Buenos Aires, Burzaco, Sea L., March 27, 1974, C.R. Vardy (BMNH); 1 male, Mis. Iguazu NP, hosteria Hoppe, 140m, Malaise trap, April 10, 11, 1974, C.R. Vardy (BMNH); 1 male, Tuc., Horco Molle, 12km W Tucuman, 700m, Malaise trap, March 18–21, 1974, C.R. Vardy (BMNH); 3 males, 1 female, Entre Rios, Liebig (Rio Uruguay), April, 1977, S. Bolle (CNC). **Bolivia** (1 male, 2 females): 1 male 1 female, Cochabamba, Cochabamba, Sept. 26, 1972, G.E. Bohart (LACM); 1 female, S. Inicua Riv. Alto Beni, Jan. 15–18, 1976, 1100m, L.E. Pena (CNC). **Brazil** (2 males, 91 females): 4 females, Nova Teutonia, 27°11' S 52°23'W, Fritz Plaumann (BMNH); 2 females, same data except 1960 (FSCA); 1 female same data except Feb., 1937 (BMNH); 1 female, same data except Nov. 16, 1936; 4 females, same data except Feb. 19, 1937; 1 female, same data except Oct. 24, 1937; 4 females, same data except Jan. 1937; 1 female, same data except Feb. 16, 1937; 1 female, same data except Oct. 11, 1937; 1 female, same data except June 6, 1937; 1 female, same data except Aug. 17, 1937; 1 female, same data except Aug. 12, 1937; 1 female same data except Feb. 18, 1938; 1 female same data except May 23, 1939; 1 female same data except June 6, 1939; 1 female same data except Nov. 14, 1939; 1 female, same data except Nov. 28, 1952; 3 females same data except Sept. 25, 1959 (CNC); 1 female same data except Nov. 31, 1959; 1 female same data except Nov. 2, 1959; 2 females, same data except April 22, 1966; 1 female, same data except Nov. 3, 1960; 2 females, same data except April 1966; 1 female, same data except April 25, 1966; 6 females, São Paulo, Itaquaquecetuba, Jan. 1929, C.H.T. Townsend (USNM); 2 females, same data except May 11, 1929; 6 females [BNNR038, BNNR068], São Paulo, São Paulo, Guarulhos, Jan. 29, 2003, D.J. Cavan (BYU); 6 females same data except Nov. 14, 1972, G.E. Bohart (LACM); 1 male, São Paulo, São Jose dos Campos, Jan. 7–21, 1999, Eurico R. DePaula (LACM); 2 females same data except Feb. 23–March 8, 1989; 1 female same data except Aug.

30–Sept. 6, 1997; 3 females same data except Aug. 15–22, 1997; 1 female [BNNR071], same data except April 1–15, 1999; 1 female same data except Aug. 29–Sept. 5, 1999; 2 females [BNNR162, 163] same data except Jan. 10–25, 1999; 1 male, 6 females, São Paulo, Est. Biol. Boraceia, Salesópolis, Oct. 14–18, 1970, J.W. Boyes, J.H. Guimaraes (CNC); 1 female, R.G.S., Pelotas, June 7, 1957, C.M. Biezanko (BMNH); 1 female, same data except June 15, 1959; 1 female same data except June 12, 1959; 1 female, same data except Nov. 3, 1961; 1 female, R.G.S., Fed. Univ. Pelotas campus, liver baited trap, May 26, 1992, M.J.R. Hall (BMNH); 1 female, Santa Catarina Chapeco, July 1960, F. Plaumann (CNC); 1 female, São Paulo, São Paulo, April 11, 1965, D. Heffern (UCDC); 1 female, São Paulo, Maua, Oct. 20, 1961, no collector (USNM); 1 female, São Paulo, São Paulo, Oct. 23, 1970, J.W. Boyes, J.H. Guimaraes (CNC); 1 female, São Paulo, Casa Grande, Boraceia Field Stat., Feb. 2, 1975, Thomas B. Rogers (FSCA); 1 female, Nova Teutonia, May 6, 1952, F. Plaumann (BMNH); 1 female, same data except June 6, 1952; 1 female, Rio de Janeiro, Yellow Fever, MES Brazil, Jan. 1939, R.C. Shannon (USNM); 1 female, Minas Gerais, Vicoso, Nov. 20, 1932, E.J. Hambleton (USNM); São Paulo, R. Claro, Adutora, Sept. 1940, no collector (USNM); 1 female, Espírito Santo, April 22, 1898, J. Michaelis (USNM); 1 female [BNNR165], R.G.S., Fed. Univ. Pelotas campus, May 28, 1992, liver trap, M.J.R. Hall (BMNH). **Colombia:** 1 female, La Reata, May, 1914, D. Balfour (BMNH). **Peru:** 1 female, Loreto, Pucallpa, 200m, Oct.21–31, 1964, J. Schunke (LACM); 1 female, Previsto, 700m, June 6, 1965, J. Schunke (BMNH). **Venezuela:** (10 females). 8 females, T.F. Amaz. Cerro de la Neblina, Camp X, 1690m, 0°54'N 60°02'W, 13 Feb. 1985, open meadow, W.E. Steiner (USNM); 1 female State of Merida, Merida, 17 Nov. 1972, G.E. Bohart (LACM); 1 female, Merida Libertador, Merida, 3 July 1979, R.W. Brooks, A.A. Grigarick, J. McLaughlin, R.O. Schuster (UCDC).

Distribution. Argentina, Bolivia, Brazil, Colombia, Peru, and Venezuela (Fig. 160).

Discussion. Males of this species can be confused with males of *L. ochricornis* based on color of upper calypter, see discussion under that species. Other species characters should be checked if species identity is uncertain. Six specimens of this species were barcoded; they occurred in a clearly defined group, separate from *L. ochricornis* (Fig. 161).

Etymology. The species name is from the Latin *vulgata*, one of its meanings is widespread. This species is widespread in South America from Venezuela to Argentina.

23. *Lucilia woodi* sp. nov.

Figs. 13, 33, 34, 61, 62, 85, 86, 120–122, 134, 146, 158, 159, 161 Tables 1, 2

Diagnosis. Gena with dark setae; upper and lower calypters dark in both sexes; basicosta brown; setae below and behind strong postocular row pale and weak; presutural area of thorax usually with a broad band of whitish microtomentum, in some specimens the microtomentum is patchy. This species shares many characters with *L. pulverulenta*, but the former has pale setae on the gena, while *L. woodi* has all dark setae on the gena. In lateral view, the surstylus of *L. woodi* (Fig. 61) is broader than in *L. pulverulenta* (Fig. 53).

Description. Male. Frons narrow, 0.017 (0.01–0.02/5) of head width at narrowest; anterior facets are 2.4x larger than posterior facets (anterior 0.67mm, posterior 0.28mm, Table 1); fronto-orbital plates are silvery-tan, plates converge midway up frons; frontal vitta dark red, extending about one-third up frons to where fronto-orbitals touch, frontal setae end about one-half way up frons; parafacial silvery-tan except anteroventral corner more or less orange; gena silvery with dark setae, postgena silvery with pale setae; pedicel dark orange with base of first flagellomere brighter orange, remainder pale orange; ocellar triangle tiny and black with short setae, ocelli about equal in size; supravibrissal setae ascend about 40% up frontal ridge; intrapostocular area bright silvery, setae below and behind postocular row pale and weak except for a small cluster of dark setae near the lower edge of the eye; upper edge of occiput and a vertical strip in the center shining black, remainder of occiput with whitish microtomentum. Presutural area of thorax with heavy microtomentum, remainder of thorax shining; spiracles brown and fairly large; proepisternal depression with pale setae; upper calypter light tan to brown, lower calypter brown to dark brown; base of wing with cells and veins darkened; basicosta dark brown, tegula black; subcostal sclerite orange with pubescence. T1-3 of abdomen and anterolateral corners of T4 with whitish microtomentum, with the remaining segments polished. Surstylus medium length, digitate, gradually expanding toward distal end, cercus tapers distally and gradually curving forward (Figs. 61, 62). Phallus, hypandrium, pre- and postgonite, ejaculatory sclerite, and sternites as in 85, 86, 120–122, 134 respectively.

Female. Characters very similar to male except frons 0.24 (0.22–0.25/5) of head width at narrowest; eye facet size very similar to those in male (anterior 0.59mm, posterior 0.29mm, Table 1). The ovipositor and spermathecae as in Figs. 146, 158.

Type material. Holotype male from Costa Rica, Puntarenas Province, Peninsula de Osa, Rancho Quemado, L_S_292500_511000, 200m, July 1992, A. Marin (INBIO) (Figs. 33, 34). Allotype female, Costa Rica, Guanacaste Province, Guanacaste NP, Est. Pitilla, 9km S St. Cecilia, L_N_330200_380200, Aug. 1991, 700m, C. Moraga (INBIO).

Paratypes. (57 males, 88 females) **Costa Rica** (56 males, 76 females): **Alajuela Province.** 1 female, 20km S Upala, April 11–20, 1991, F.D. Parker (LACM); 1 male, same data except June 17, 1971; 1 female, Bijagua, July 29, 1990, Malaise trap, W.F. Chamberlain (TAMU); 1 female, Bijagua, Alberge de Heliconias, Ridge Trail, 10°42'48"N 85°02'27"W, 1000–1100m, June 18, 2000, N.E. Woodley, (USNM); 1 female, San Carlos, Laguna Lagarto Lodge, L_N_296095_516714, 0–100m, Feb. 23–27, 2004, B. Hernandez (INBIO); 1 male, Volcan Tenorio NP, Est. el Pilon, 500m, Feb. 12–March 4, 2006, L_N_298212_427913, Malaise trap, J.A. Azofeifa (INBIO). **Cartago Province.** 1 female, Barbilla NP, Send. Principal a Rio Barilla, L_N_216110_597123, 500m, Jan. 2003, F. Rojas (INBIO). **Guanacaste Province.** 1 male, 1 female, Est. Pitilla, 9km S Santa Cecilia, 700m, L_N_330200_380200, Nov. 1989, C. Moraga, P. Rios (INBIO); 2 males, 4 females, same data except March 2–19, 1992, P. Rios; 2 males, same data except Sept. 22–Oct. 14, 1992; 1 male, same data except Dec. 1992; 2 females, same data except Aug. 1991; 2 females, Est. Pitilla, 9km S Santa Cecilia, 10°59'26"N 85°25'40"W, 700m, July 1988, G.N.P. Biodiversity Survey (INBIO); 1 female, Est. Cacao, SW side Volcan Cacao, L_N_323300_375700, 1000–1400m, Nov.–Dec. 1989, URCG, R. Blanco, C. Chavez (INBIO); 1 male, same data except Oct. 1989. 1 female, same data except May 21–29, 1992, D. Brenes; 1 female, 3km SE R. Naranjo, July 21–31, 1992, F.D. Parker (LACM); 3 females, Rincon de la Vieja NP, Send. a las aguas termales, L_N_305843_392770; 900–1000m, Nov. 5–7, 2001, D. Briceno (INBIO); 1 female, Rincon de la Vieja NP, Sect. Santa Maria, Send. Pailas Agua Fria, L_N_305475_392908, 800m, Nov. 10, 2001, D. Briceno (INBIO); 1 female, Sector Santa Maria, 25km NE Liberia, L_N_304700_393450, 790m, Feb. 15–24, 1997, D. Briceno (INBIO). **Limon Province.** 1 male, Cerro Tortuguero, Tortuguero NP, L_N_285000_588000, 0–120m, April 1993, R. Delgado (INBIO); 1 male same data except Feb. 1993; 1 female, Est. Hitoy Cerere, R.B. Hitoy Cerere, L_N_643400_184600, 100m, Nov. 1993, G. Carballo, (INBIO). **Puntarenas Province.** 1 male, Rancho Quemado, Pen. de Osa, L_S_292500_511000, 200m, July 1992, A. Marin (INBIO); 3 females, Rancho Quemado, Pen. de Osa, L_S_292500_511000, Dec. 1990, F. Quesada (INBIO); 1 female, same data except Jan. 1991; 6 females, same data except 200m, May 1991, J.C. Saborio (INBIO); 1 female, same data except F. Quesada; 1 female, same data except July 1991; 2 females, same data except Aug. 1991; 1 female, same data except Sept. 1992; 1 female, same data except March 12–31, 1993, A. Gutierrez; 1 female same data except May 12–24, 1993; 3 males, 1 female, Isla del Coco NP, Llano Palo Hierro, 05°32'59"N 87°03'35"W, 200–250m, March 10, 2002, B. Hernandez (INBIO); 2 females [BNNR085], Isla del Coco NP, Cerro Pelon, Bajando Hacia Wafer, 05°31'50"N 87°04'41"W, 520m, March 21, 2002, B. Hernandez (INBIO); 3 males, 1 female, Isla del Coco NP, Cerro Yglesias, 05°04'47"N 87°04'47"W, 600m, March 21, 2002, B. Hernandez (INBIO); 1 male, Est. Queb. Bonita, Res. Biol. Carara, 50m, L_N_194500_46850, July 1–29, 1992, R. Guzman (INBIO); 5 males, same data except Aug. 10–28, 1992; 1 female, same data except Oct. 18–29, 1992; 6 females, same data except Nov. 6–27, 1992; 1 male, same data except 100m, Jan. 1995; 3 males, Est. Agujas, L_S_276750_526550, 300m, Sept. 1996, A. Azofeifa (INBIO); 1 male, A.C. Osa, Corcovado NP, Alrededores de Rio Corcovado, L_S_279650_509700, 10–190m, Jan. 26–29, 2002, B. Hernandez (INBIO); 1 female, Corcovado NP, Sector La Leona, Cerro Puma, L_S_267700_518900, 100–300m, June 21–July 10, 2003, M. Moraga (INBIO); 2 females, Corcovado NP, Sector La Leona, Alto Cerro Rubio, L_S_269300_518350, 300–400m, July 19, 2002, K. Caballero (INBIO); 1 male, Est. Sirena, Corcovado NP, L_S_270500_508300, Dec. 1989, G. Fonseca (INBIO); 1 female, same data except Feb. 1990; 3 males, same data except June 1991; 7 males, 1 female same data except July 1991; 5 males, same data except Jan. 1992; 1 male same data except June 1990, F. Quesada, (INBIO); 3 males, 1 female, Est. Sirena, L_S_270500_508300, 1–100m, Sept 1993, G. Fonseca (INBIO); 1 female, same data except Oct. 1993; 1 female, same data except 0 meters, M. Segura; 3 males, 3 females, Est. Sirena, Corcovado NP, A.C. Osa, L_S_270500_508300, 1–100m, Jan. 1994, G. Fonseca (INBIO); 1 female, Golfito, Corcovado NP, Est. Sirena, Send. Corcovado, L_S_270500_508300, 10m, Oct. 17, 2001, K. Caballero (INBIO); 2 males, Corcovado NP, Sector Los Planes, entrada a la Estac., L_S_288200_500300, 100–200m, July 25, 2002, K. Caballero, (INBIO); 5 females, Est. Agujas, Send. Zamia, L_S_276750_526550, 300m, Aug. 24–31, 1996, A. Azofeifa; 1 female same data except Nov. 26–30, 1995; 2 males, Manuel Antonio NP, Quepos, L_S_370900_448800, 80m, May 1991, G.

Varela (INBIO); 1 female, Golfito, Jimenez, Corcovado NP, Cno. a Sirena, Send. Alred. Rio Cedral, L_S_280655_517000, 86m, Oct. 10, 2001, K. Caballero (INBIO); 1 female, Golfito, Corcovado NP, Est. Los Patos, Send. a Rio Rincon, L_S_281050_516800, 75m, Feb. 1, 2002, K. Caballero (INBIO); 1 female, Jimenez, Corcovado NP, Est. Los Patos, Send. Vaco, L_S_280700_515500, 160m, April 13, 2002, K. Cabellero (INBIO); 1 female, Est. Pittier, L_S_330900_577400, 1670m, Aug. 23–Sept. 13, 1995, E. Navarro (INBIO); 1 female, same data except Tablas, July 28–Aug. 7, 1995, M. Moraga; 1 female, 5.6km SW Rincon, Aug. 5–15, 1970, R.W. Merritt, (WSUP). 1 female, Coton, Las Alturas, 1400m, Sept. 5, 1991, P. DeVries, M. Wood (CNC). **San Jose Province.** 1 female, Est. Zurqui Tunel, L_N_226800_535200, 1600m, Sept. 26–Oct., 1990, G. Maass, (INBIO). **Honduras** (8 females): 2 females [BNNR166], Atlantida, 15km W La Ceiba, 175m, June 20–July 20, 1996, Malaise trap, R. Lehman (TAMU); 6 females, same data except 13km E La Ceiba. **Panama** (1 male, 4 females): 1 male, Canal Zone, Barro Colorado Is., May 13, 1956, C.W. & M.E. Rettenmeyer (WSUP); 1 female, same data except April 9, 1967, Roger D. Akre (WSUP); 1 female, Bocas Almirante, May 16, 1951, R. Dahl Coll. (BMNH); 1 female, Pacora, May 14, 1953 (USNM); 1 female, San Blas Prov., Cuadi River, April 3, 1967, no collector (FSCA).

Distribution. Costa Rica, Honduras, and Panama (Fig. 159).

Discussion. About 20% of the specimens that keyed to this species had patchy microtomentum on the presutural area of the thorax, not a solid band (similar to Fig. 14), all from Costa Rica. Originally, this was thought to be a separate species, but other characters for both sexes appeared to be very similar. For now, this condition is considered intraspecific variation. A few specimens of *Lucilia*, primarily from southeastern Brazil keyed to this species, but clearly are not, based on male genitalia. Not enough good material was available to determine if these specimens belong to an undescribed species, or if they are aberrant examples of an existing species. Two specimens that keyed to this species produced barcodes that were widely separated. This is either a variable species, or possibly a species complex. Further study is needed to explain the variation observed (Fig. 161).

Etymology. The species name was chosen to honor D. Monty Wood who encouraged me to work on the taxonomy of this difficult genus in the Neotropics and has been a dedicated student of Diptera for over half a century.

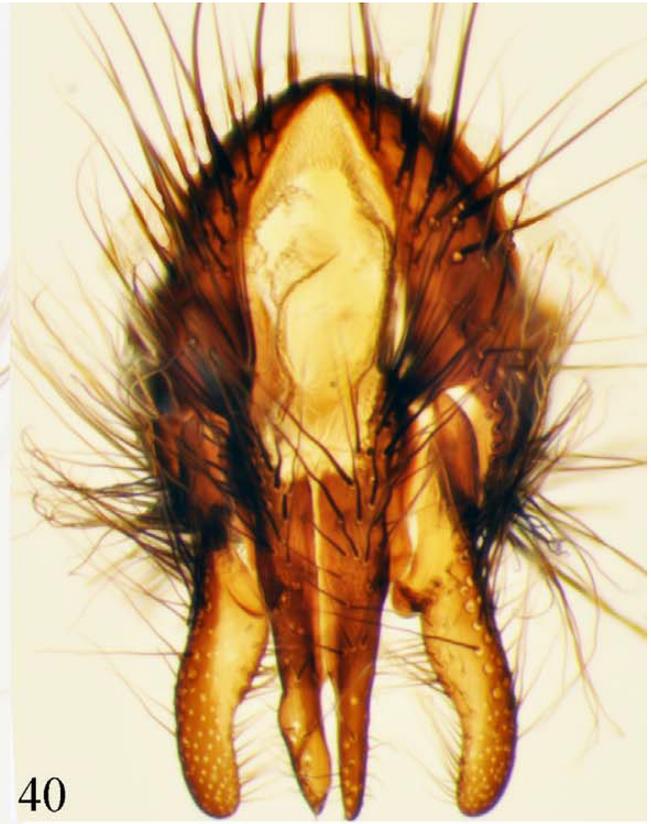
Erratum

In the Whitworth publication on calliphorids of the West Indies (2010: 10, 11), the author mistakenly labeled the proepimeral seta which is present or absent in some *Chrysomya* as “proepisternal seta”.

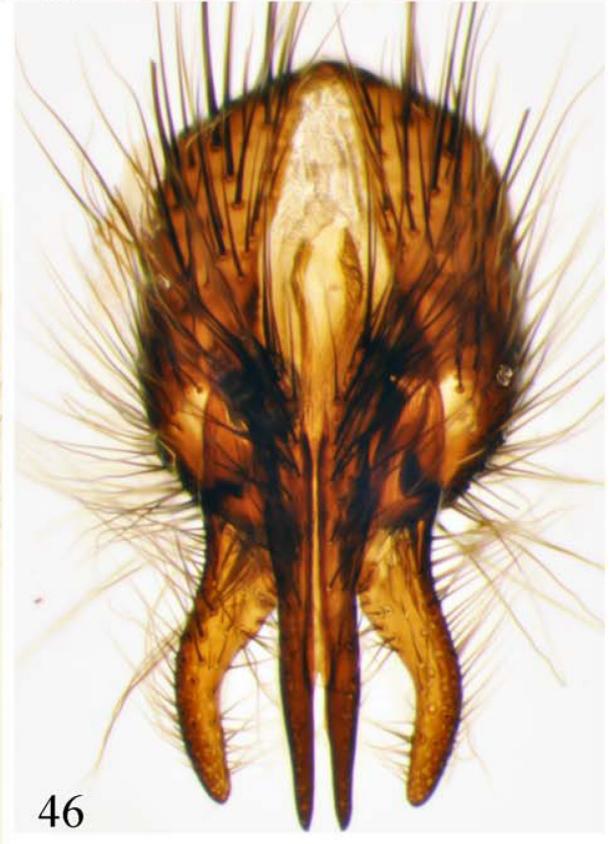
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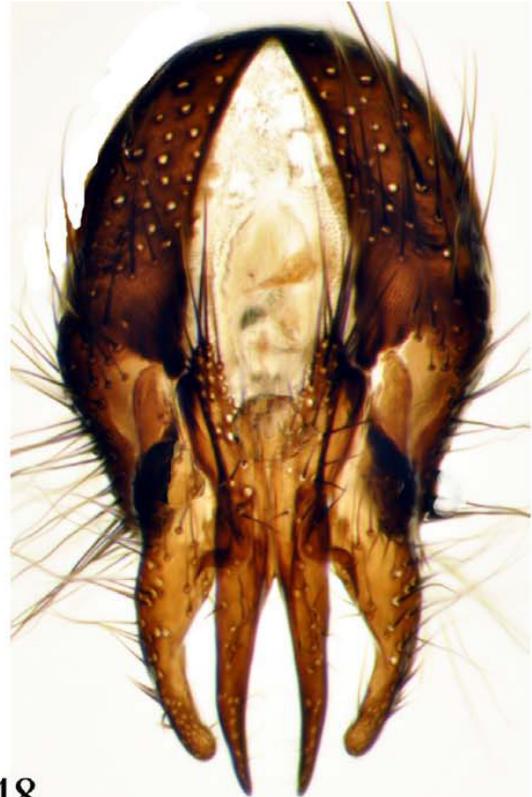
FIGURES 39–42. Left lateral and posterior views of male genitalia of *Lucilia* spp. **39, 40.** *L. albofusca*. **41, 42.** *L. eximia*.



FIGURES 43–46. Left lateral and posterior views of male genitalia of *Lucilia* spp. 43, 44. *L. ibis*. 45, 46. *L. japyhybensis*.



47



48

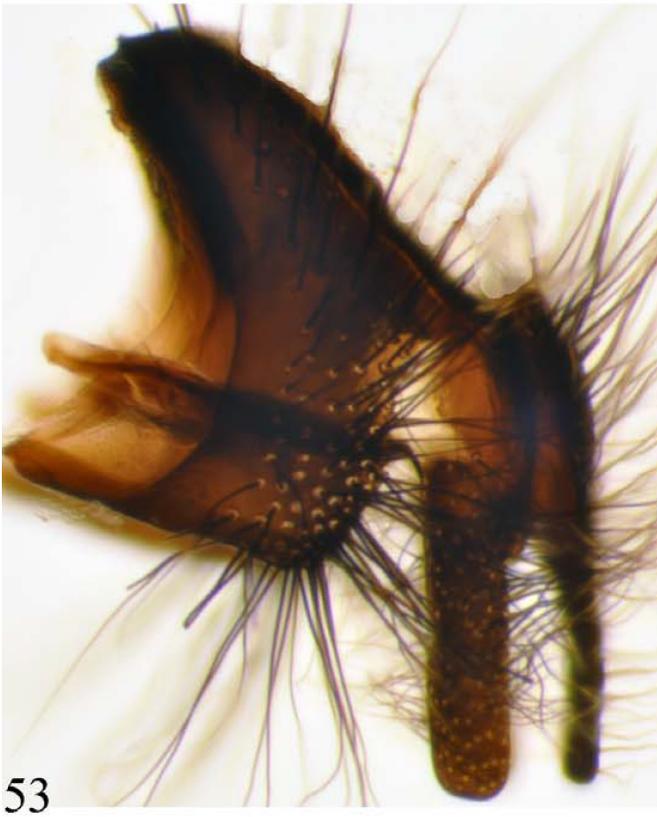


49



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FIGURES 47–50. Left lateral and posterior views of male genitalia of *Lucilia* spp. 47, 48. *L. mexicana*. 49, 50. *L. nitida*.



FIGURES 51–54. Left lateral and posterior views of male genitalia of *Lucilia* spp. **51, 52.** *L. ochricornis*. **53, 54.** *L. pulverulenta*.



FIGURES 55–58. Left lateral and posterior views of male genitalia of *Lucilia* spp. 55, 56. *L. purpurascens*. 57, 58. *L. rognesi*.



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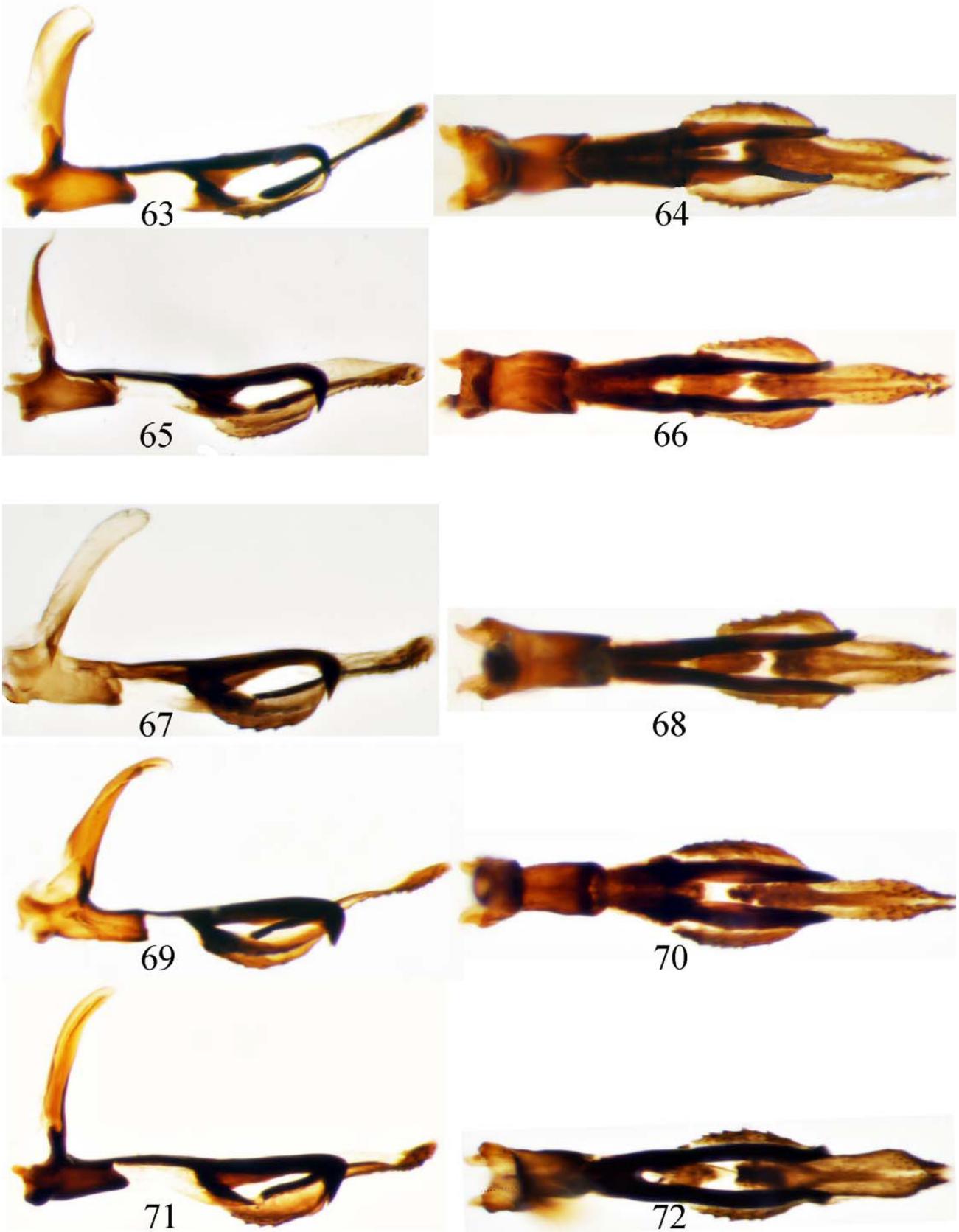


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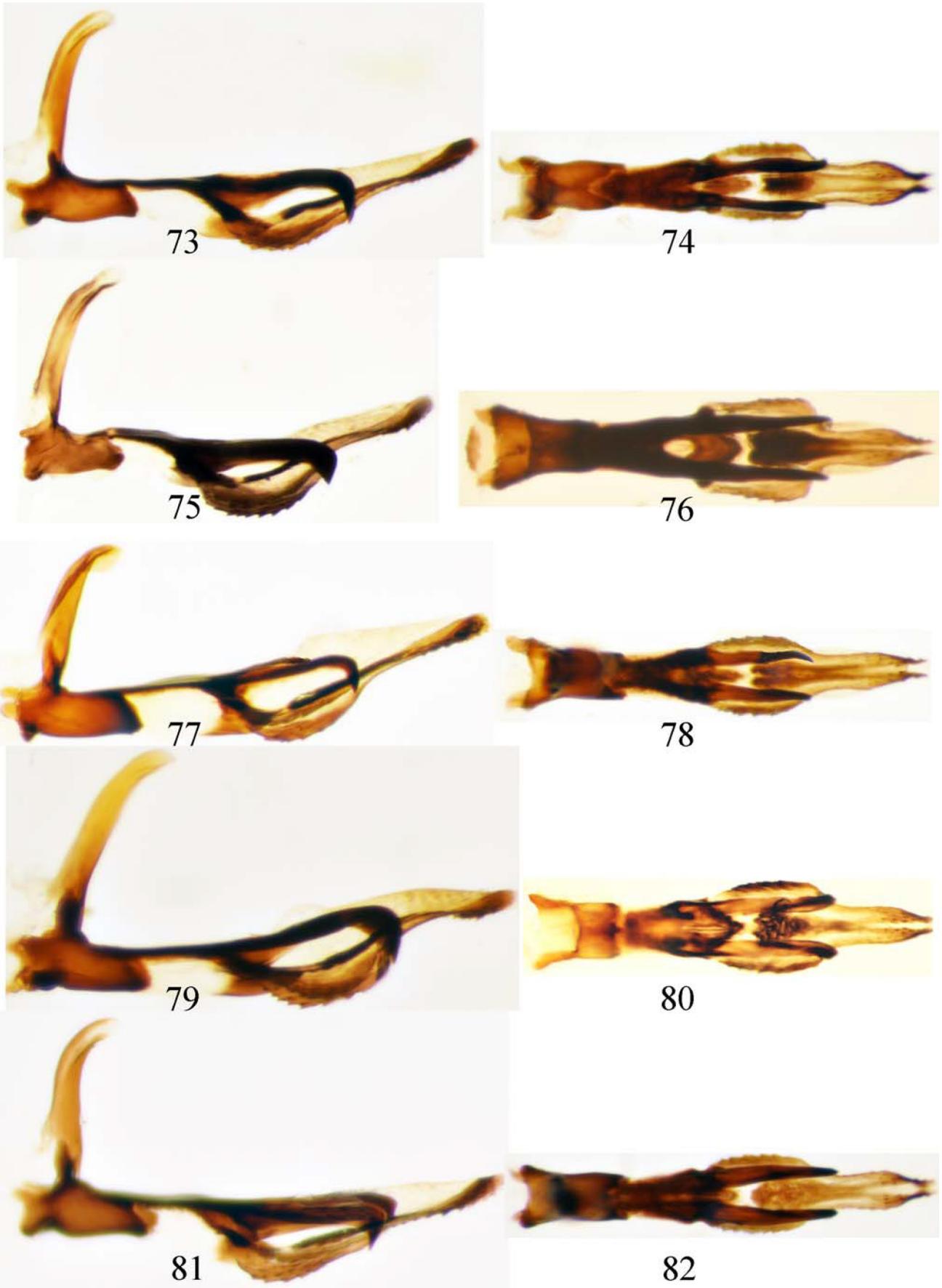


62

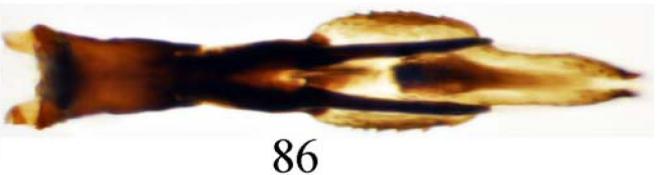
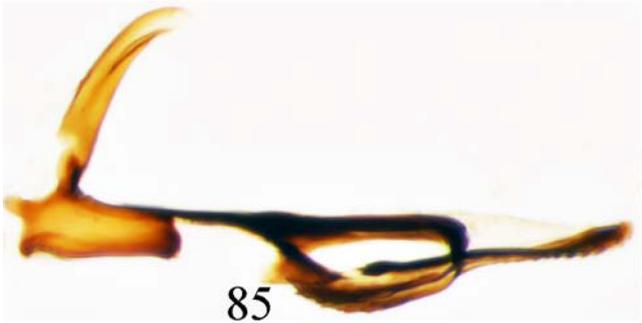
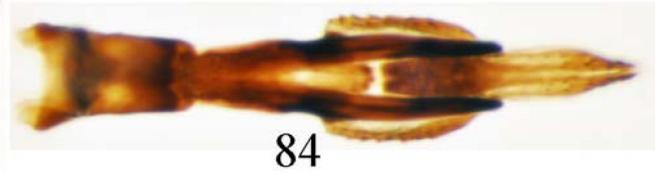
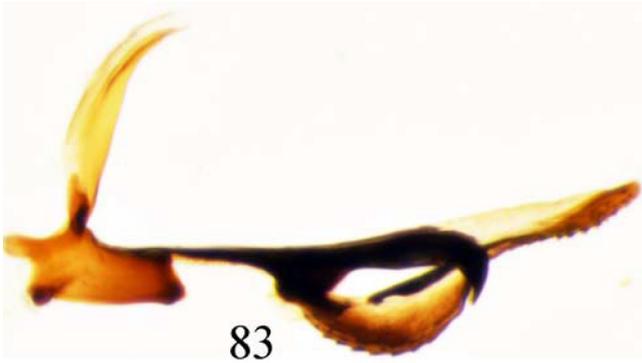
FIGURES 59–62. Left lateral and posterior views of male genitalia of *Lucilia* spp. 59, 60. *L. vulgata*. 61, 62. *L. woodi*.



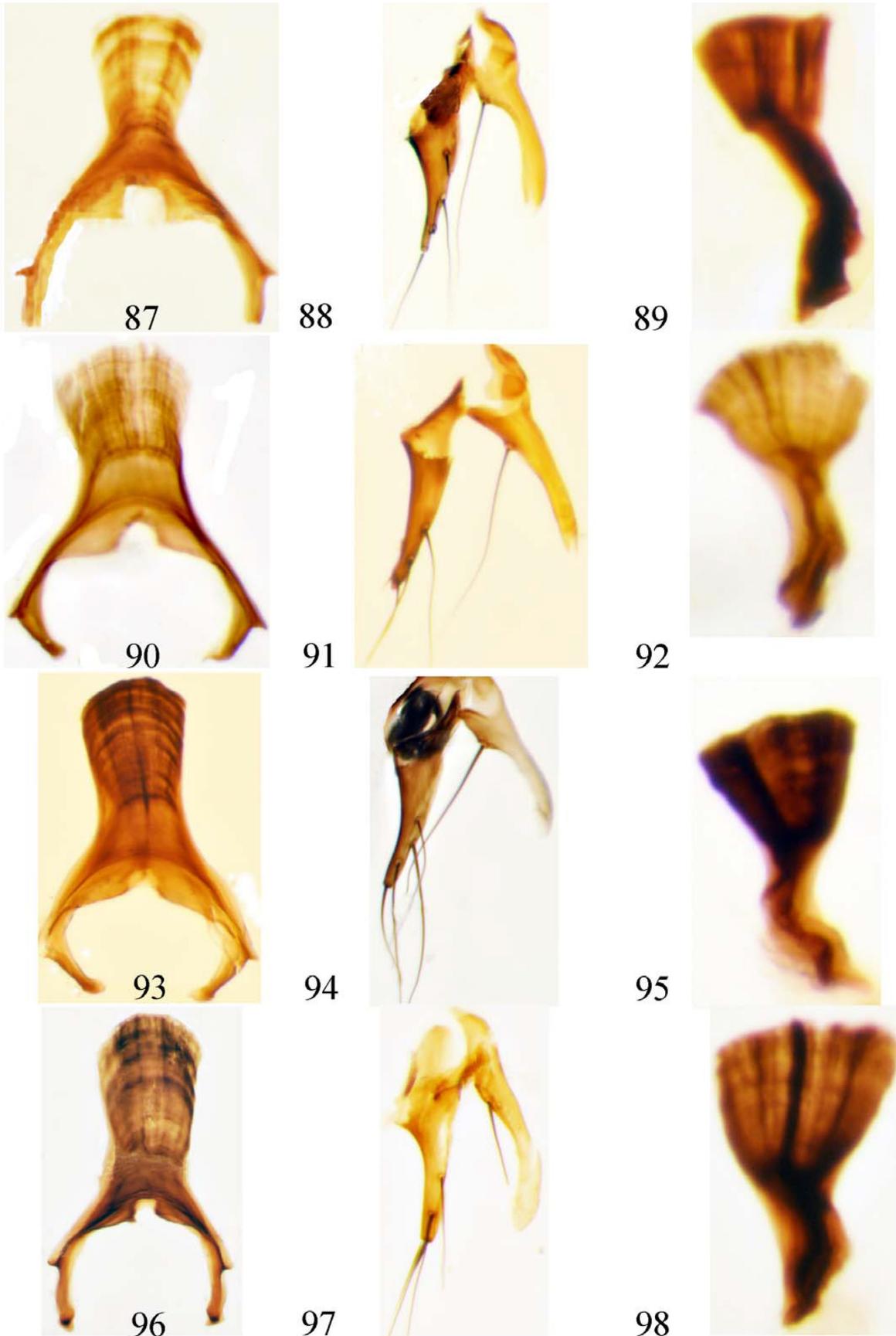
FIGURES 63–72. Phallus of male *Lucilia* in left lateral and dorsal views. **63, 64.** *L. albofusca*. **65, 66.** *L. eximia*. **67, 68.** *L. ibis*. **69, 70.** *L. japyhybensis*. **71, 72.** *L. mexicana*.



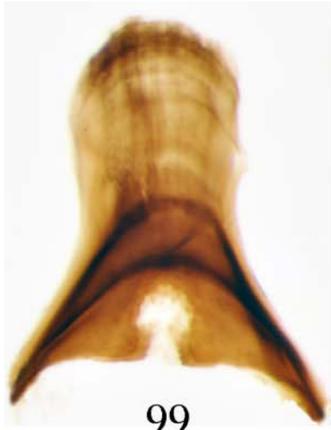
FIGURES 73–82. Phallus of male *Lucilia* in left lateral and dorsal views. **73, 74.** *L. nitida*. **75, 76.** *L. ochricornis*. **77, 78.** *L. pulverulenta*. **79, 80.** *L. purpurascens*. **81, 82.** *L. rognesi*.



FIGURES 83–86. Phallus of male *Lucilia* in left lateral and dorsal views. **83, 84.** *L. vulgata*. **85, 86.** *L. woodi*.



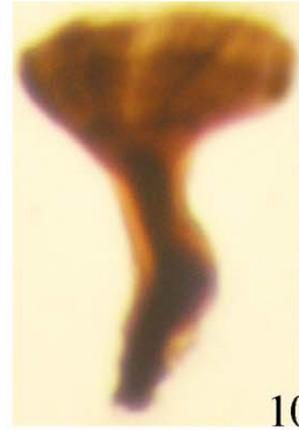
FIGURES 87–98. Hypandrium, pre- and postgonites, and ejaculatory sclerite of male *Lucilia*. **87–89.** *L. albofusca*. **90–92.** *L. eximia*. **93–95.** *L. ibis*. **96–98.** *L. japyhybensis*.



99



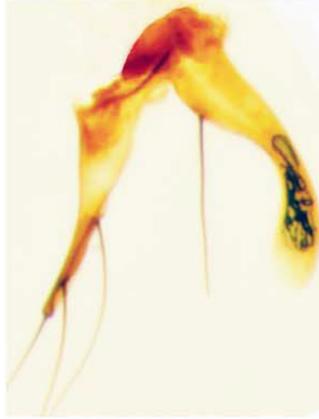
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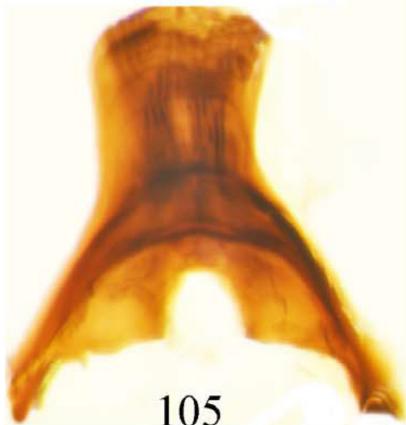
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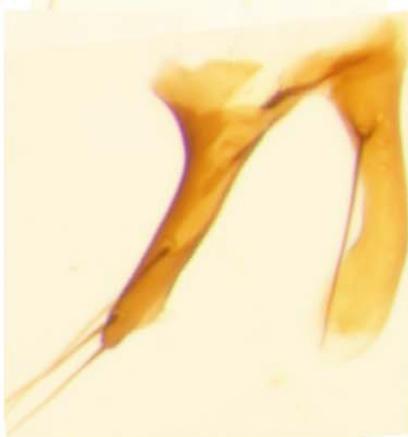
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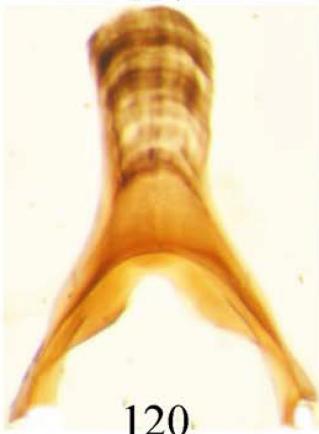
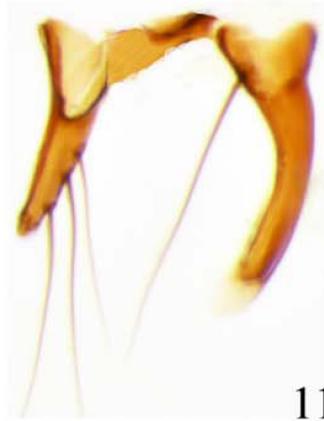
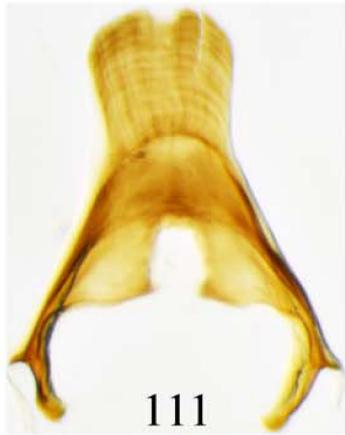


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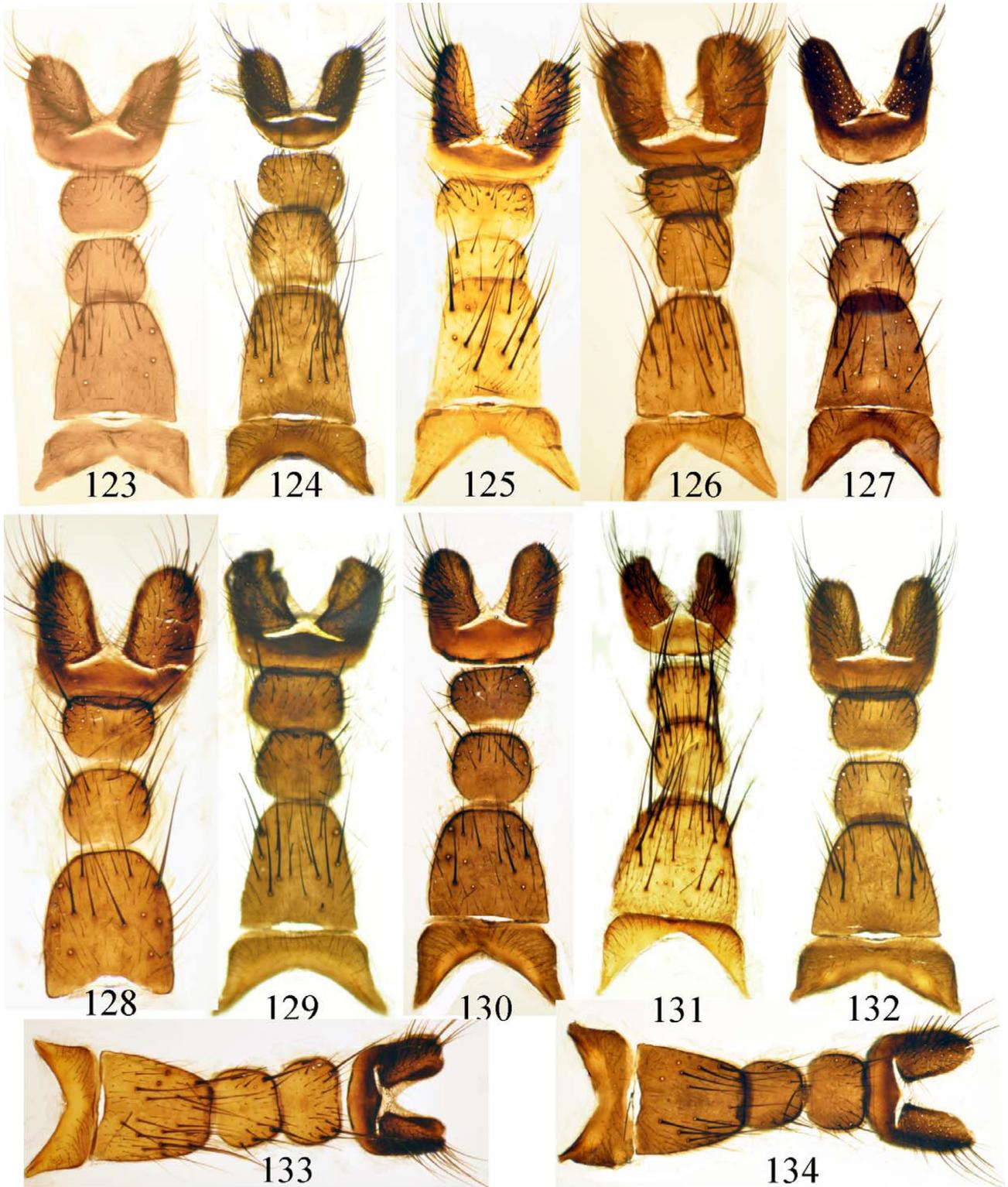


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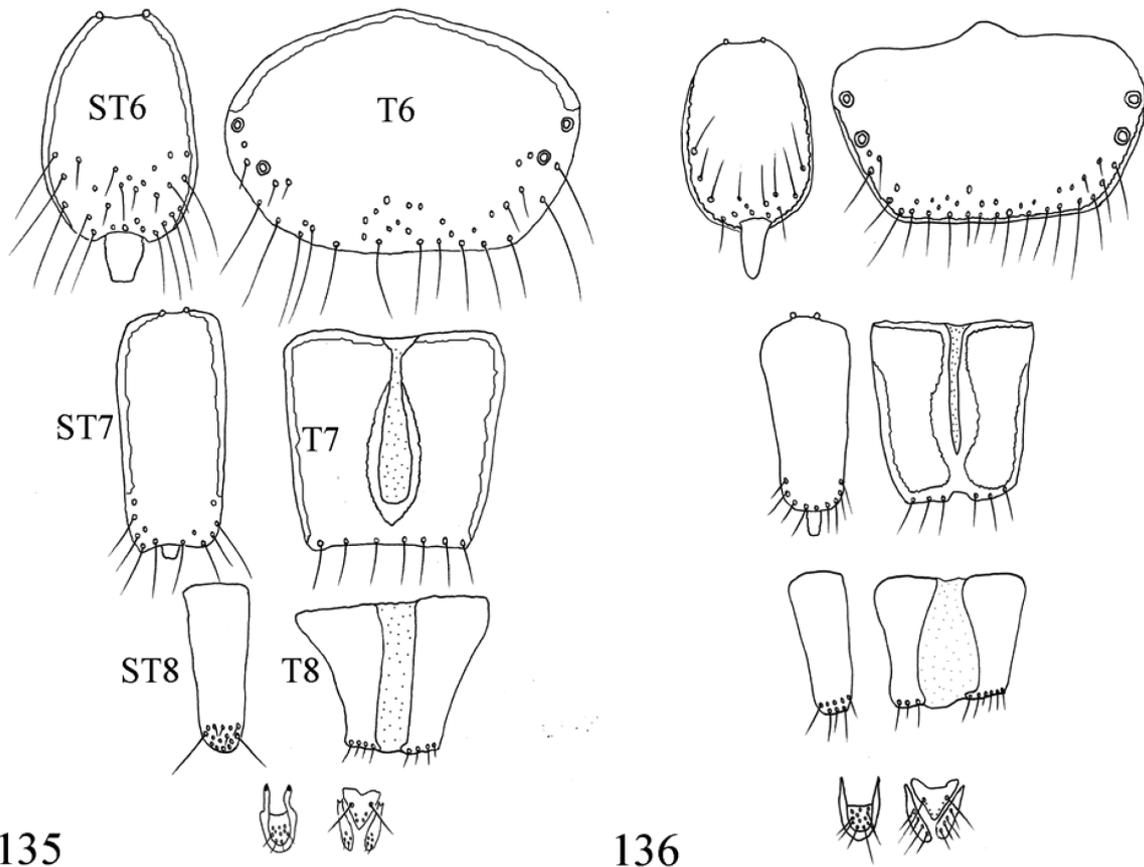
FIGURES 99–110. Hypandrium, pre- and postgonites, and ejaculatory sclerite of male *Lucilia*. **99–101.** *L. mexicana*. **102–104.** *L. nitida*. **105–107.** *L. ochricornis*. **108–110.** *L. pulverulenta*.



FIGURES 111–122. Hypandrium, pre- and postgonites, and ejaculatory sclerite of male *Lucilia*. 111–113. *L. purpurascens*. 114–116. *L. rognesi*. 117–119. *L. vulgata*. 120–122. *L. woodi*.

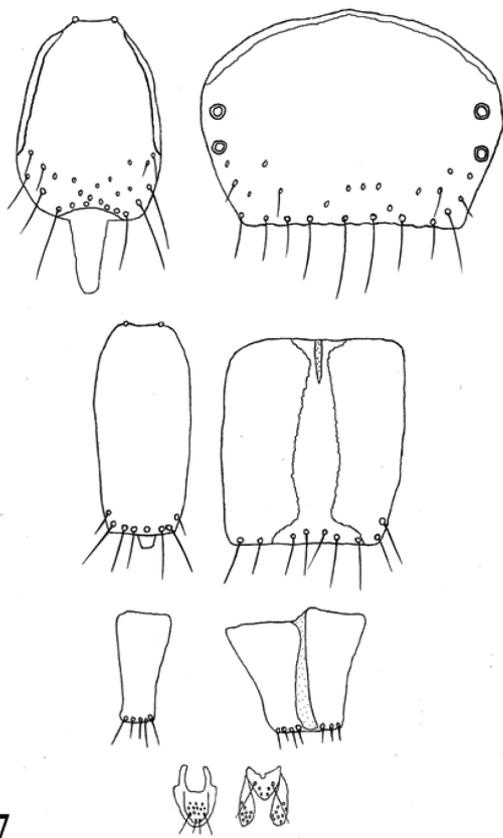


FIGURES 123–134. Male *Lucilia* abdominal sternites ST1–5. 123. *L. albofusca*. 124. *L. eximia*. 125. *L. ibis*. 126. *L. japuhybensis*. 127. *L. mexicana*. 128. *L. nitida* (ST1 is missing). 129. *L. ochricornis*. 130. *L. pulverulenta*. 131. *L. purpurascens*. 132. *L. rognesi*. 133. *L. vulgata*. 134. *L. woodi*.

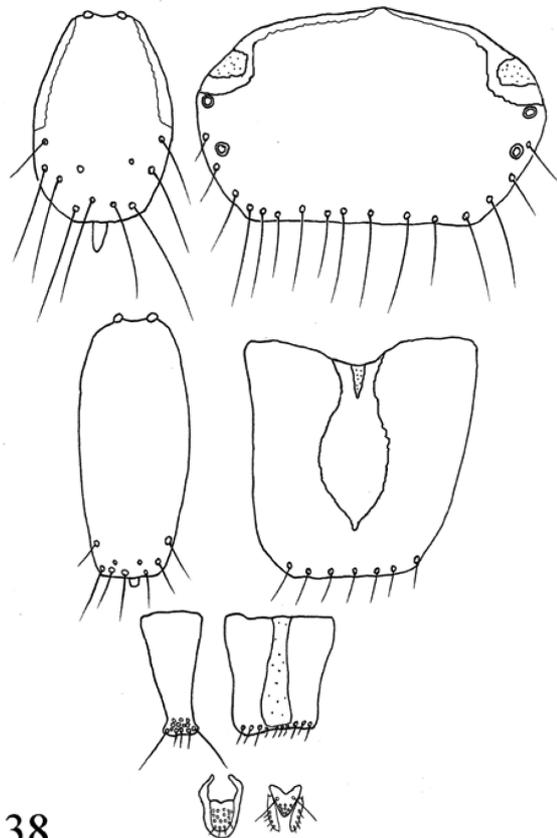


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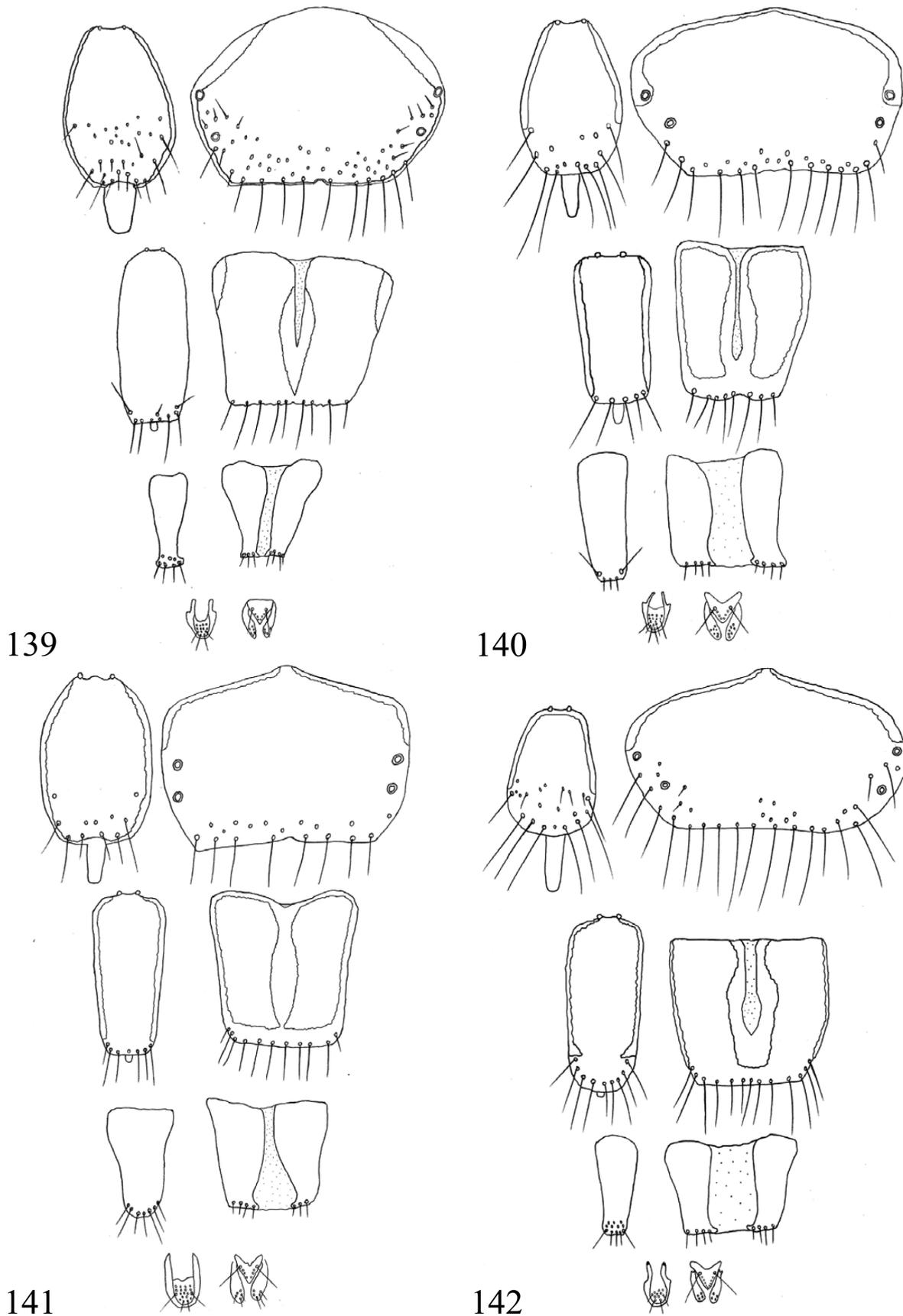


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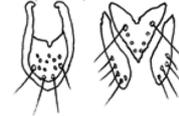
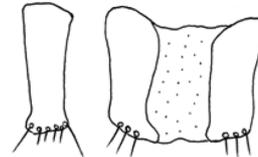
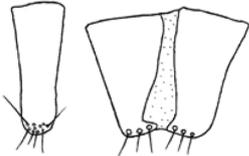
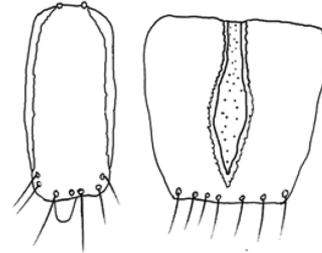
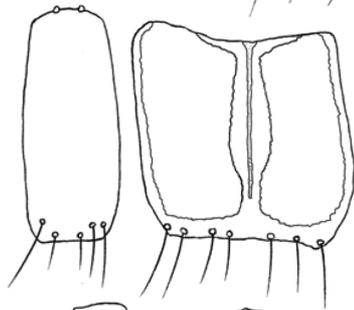
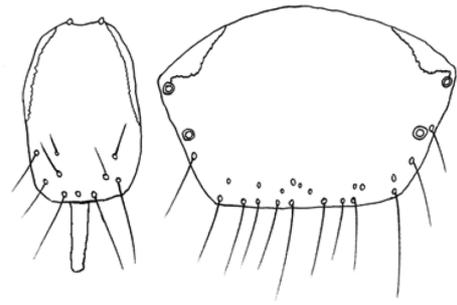
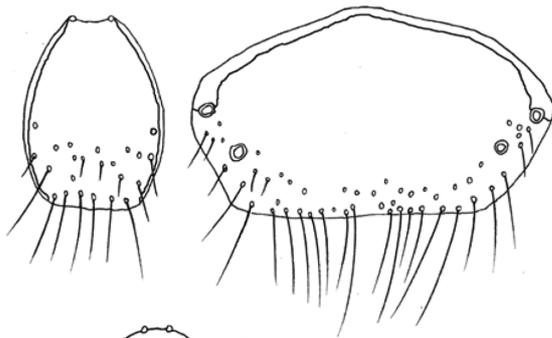


138

FIGURES 135–138. Ovipositors of *Lucilia*. 135. *L. albofusca*. 136. *L. eximia*. 137. *L. ibis*. 138. *L. japuhybensis*.

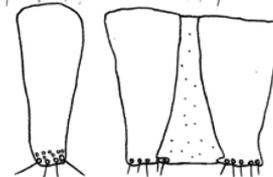
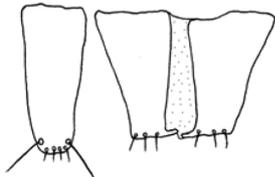
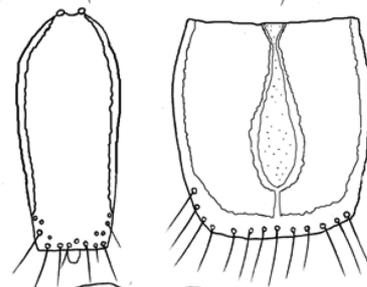
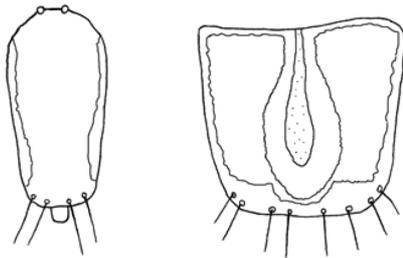
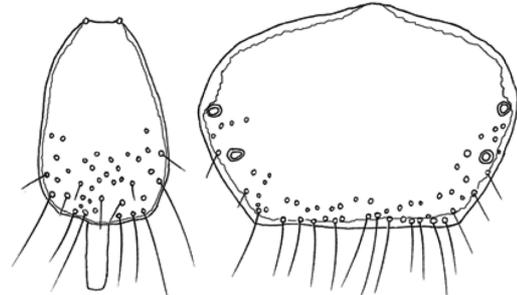
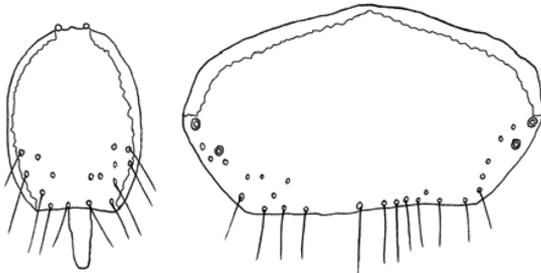


FIGURES 139–142. Ovipositors of *Lucilia*. 139. *L. mexicana*. 140. *L. nitida*. 141. *L. ochricornis*. 142. *L. pulverulenta*.



143

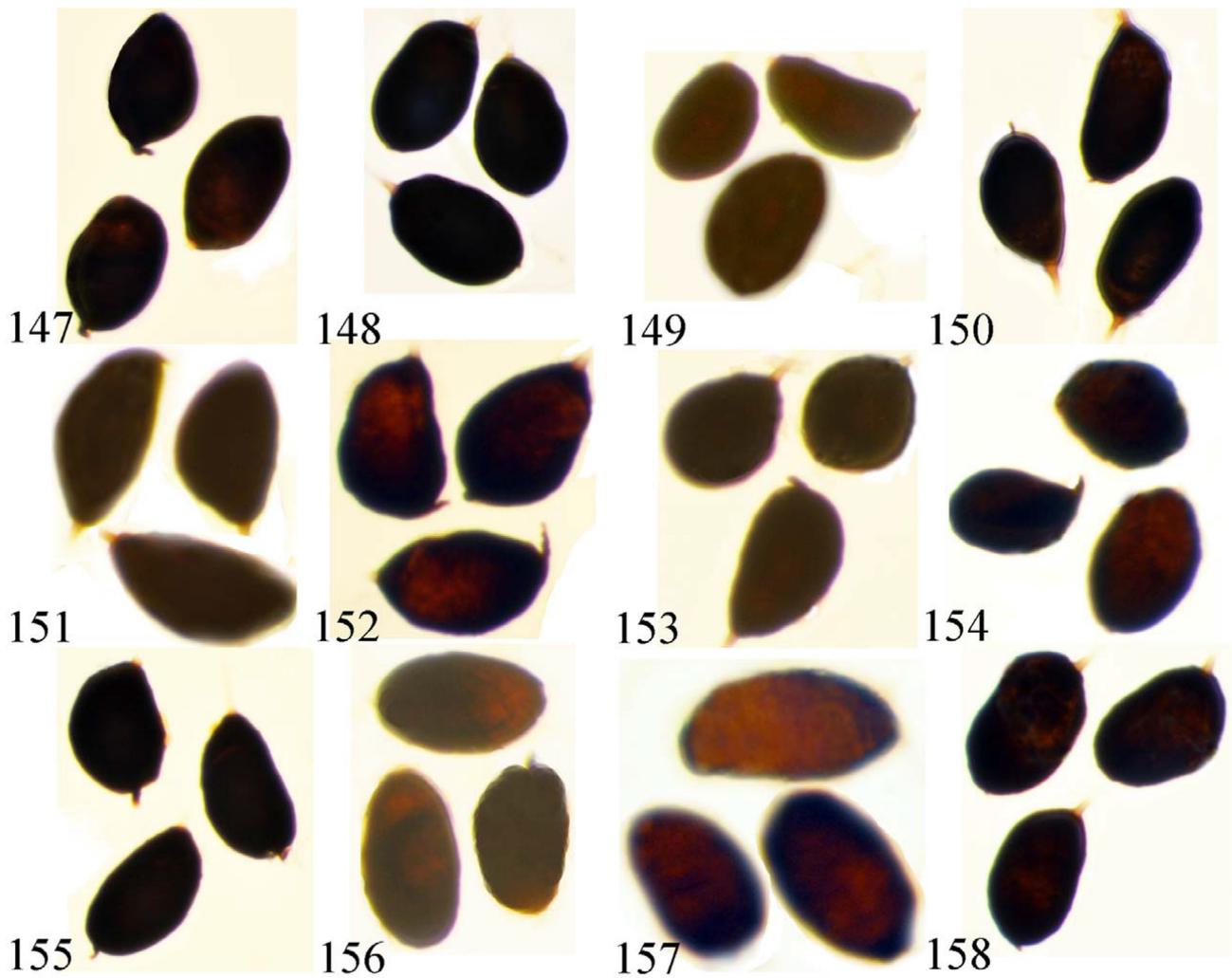
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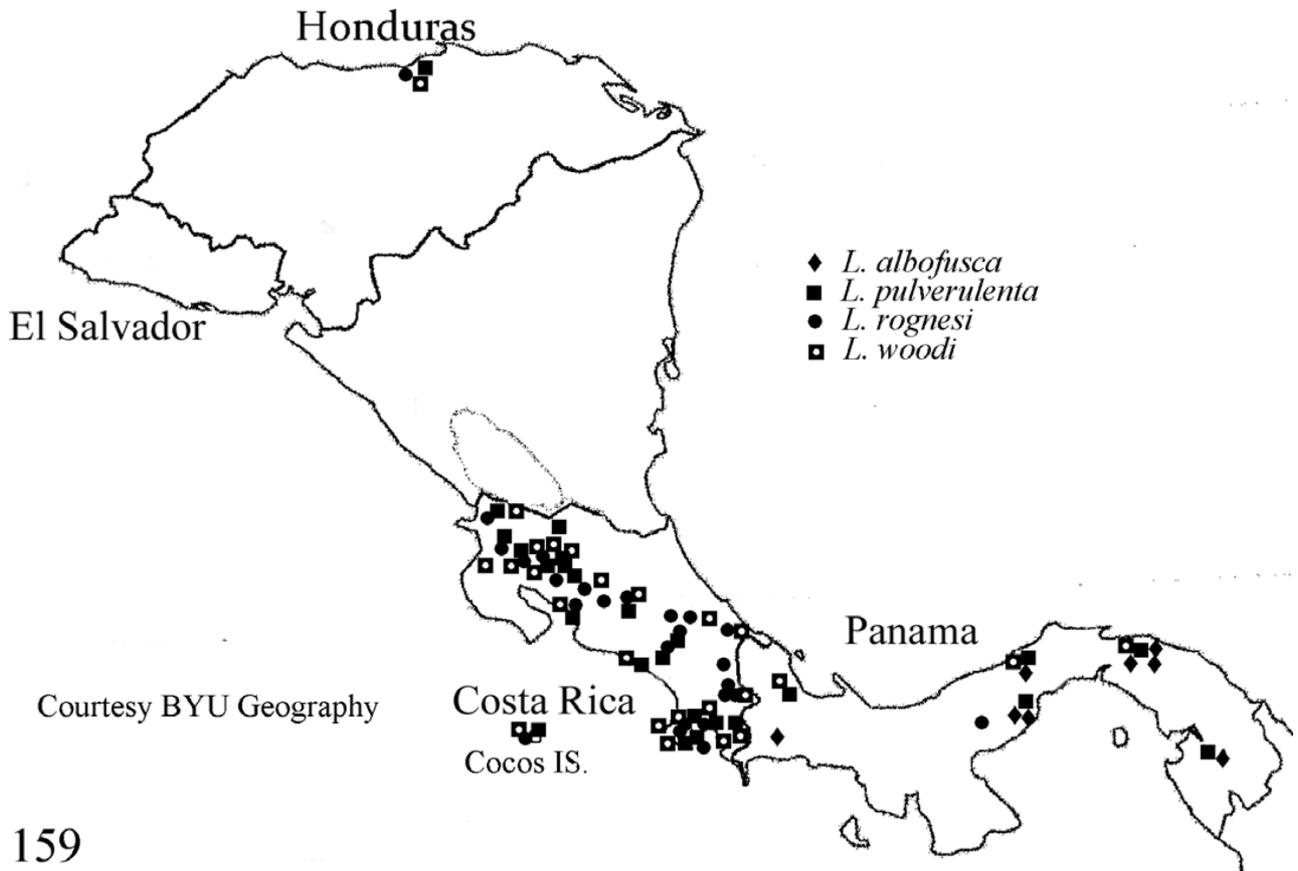
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146

FIGURES 143–146. Ovipositors of *Lucilia*. 143. *L. purpurascens*. 144. *L. rognesi*. 145. *L. vulgata*. 146. *L. woodi*.



FIGURES 147–158. Spermathecae of *Lucilia*. **147.** *L. albofusca*. **148.** *L. eximia*. **149.** *L. ibis*. **150.** *L. japuhybensis*. **151.** *L. mexicana*. **152.** *L. nitida*. **153.** *L. ochricornis*. **154.** *L. pulverulenta*. **155.** *L. purpurascens*. **156.** *L. rognesi*. **157.** *L. vulgata*. **158.** *L. woodi*.



159

FIGURE 159. Map of *Lucilia* species found in Central America.



FIGURE 160. Map of *Lucilia* species found in South America.

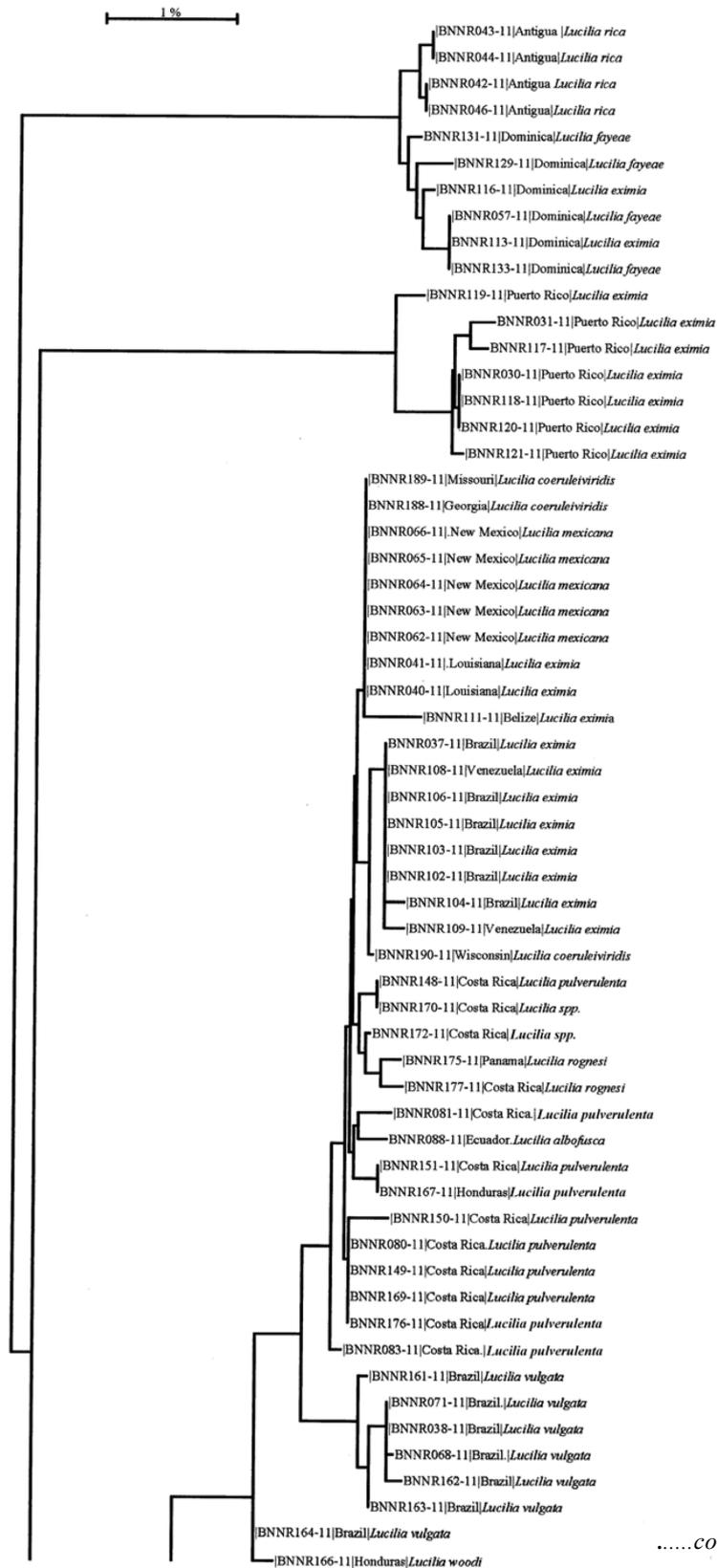
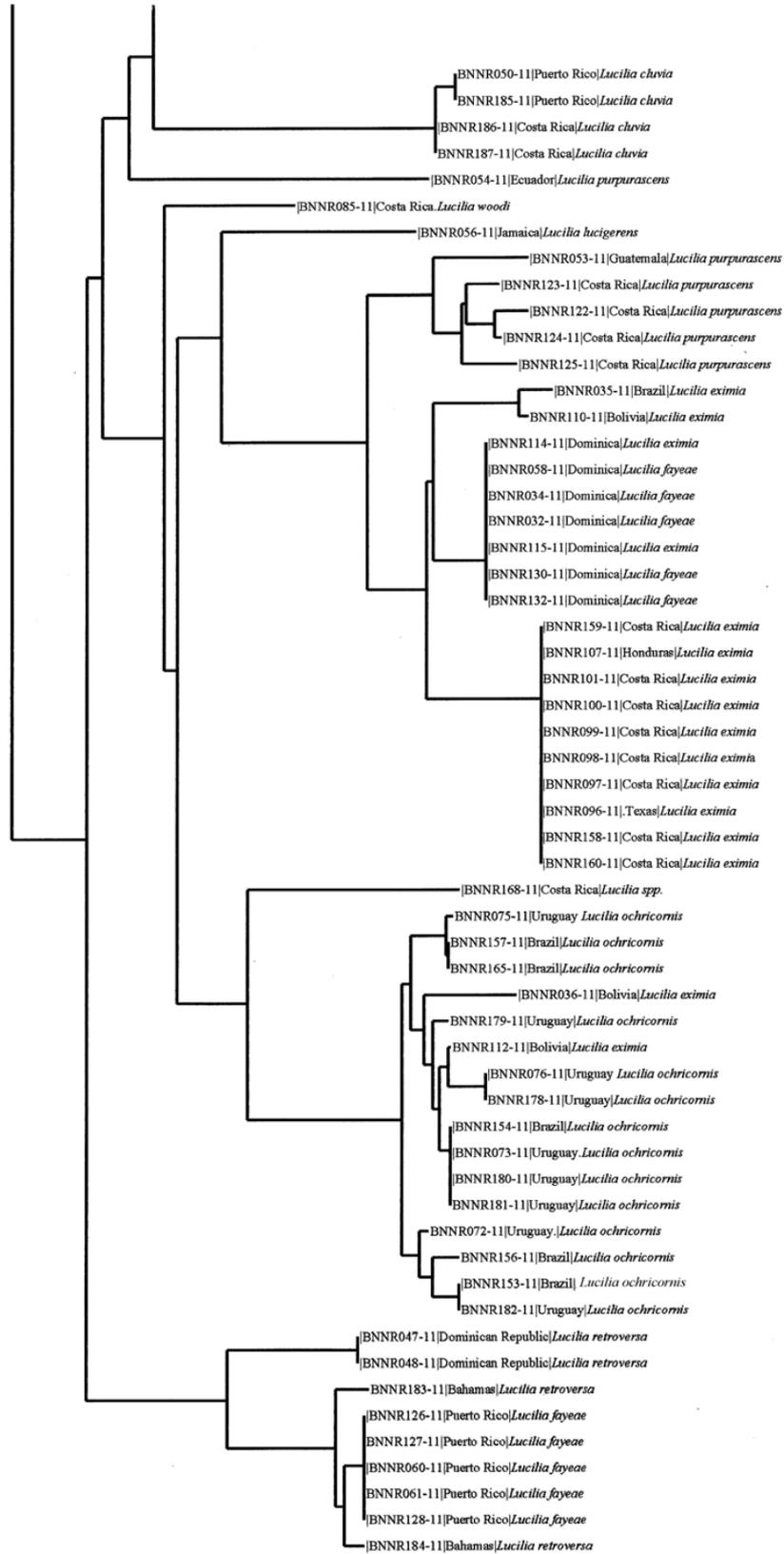


FIGURE 161. A neighbor joining tree of specimens and species of Neotropical *Lucilia* using CO1 DNA barcode, made with K2P distance and generated in BOLD.



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