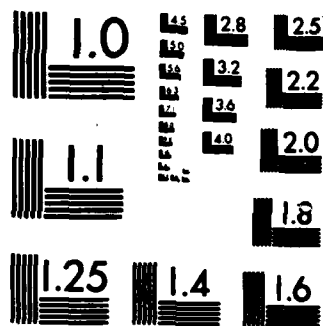


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STUDIES OF PHLEBOTOMINE SAND FLIES

ANNUAL REPORT

by

David G. Young

May 1981

Supported by

U.S. ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND  
Fort Detrick, Frederick, Maryland 21701-5012

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University of Florida  
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## SUMMARY

Studies of phlebotomine sand flies from Guatemala showed that 13 out of 25 total species have not been previously reported from that country. A review of these species is given here. It includes illustrations and a description of a new species. Other new Lutzomyia sand flies were discovered in Mexico and Ecuador. A species group of Lutzomyia, the microps group, is created and a review of the included species, including two new forms, is provided. Scanning electron microscope studies on the egg structure of some Lutzomyia species from the U.S.A. were begun. Significant advances were made in the laboratory colonization of sand flies; three species are being maintained in closed laboratory colonies and the biology of one species, L. anthophora, was studied in detail. A review of the North American Phlebotominae is in progress.

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## PROGRESS REPORT

### INTRODUCTION

→ Sand fly borne diseases, especially the various forms of leishmaniasis and arboviruses, continue to be important public health problems in many areas of the world. The Special Programme for Research and Training in Tropical Diseases (UNDP/World Bank/WHO) includes leishmaniasis among 6 tropical diseases that require special attention in the Programme.

The military importance of these diseases has been well documented in the Middle East where sand fly fever remains endemic. Outbreaks among nonimmune soldiers or other personnel can be predicted in some areas where the vector, P. papatasi, is common. The vectors of leishmaniasis in most endemic countries have not been identified. Those that are proven vectors have been little studied in terms of their behavior and habits, thus making it difficult or impossible to develop control strategies.

Because identification of sand flies is based largely on internal or genitalic structures, it is more difficult to identify these insects when compared to some other vector groups. A reference collection of Phlebotominae is indispensable for taxonomic studies and the one being expanded, with the support of this contract, at the University of Florida is one of the best in the world in terms of diversity of species.

### OBJECTIVES

1. To prepare keys, illustrations and other aids to identification both by geographic areas and by taxonomic groups.
2. To arrive at a more satisfactory classification of the subfamily Phlebotominae.
3. To build a reference collection on a worldwide basis.

4. To maintain one or more species in laboratory colonies to provide material for taxonomic and disease studies.

## RESULTS

Recent sand fly collections in Guatemala by Dr. C.H. Porter, who was also able to send the PI type material from the private collection of the late Dr. deLeon, revealed 13 species that had not previously been reported in that country. A preliminary review of this fauna is given in Appendix I. The following species are anthropophilic: L. cruciata, L. diabolica, L. shannoni, L. volcanensis, L. edentula, L. longipalpis, L. olmeca, L. ylephiletor and L. panamensis. The recent discovery of Leishmania braziliensis in Belize in humans suggests that this parasite may also occur in Guatemala in the Petén with Leish. mexicana which has been known in the country for many years and which is transmitted to humans by L. olmeca olmeca and possibly L. cruciata.

A review of the Microps group of Lutzomyia was completed (Appendix II). This is a newly created group equivalent to a subgenus in rank. All of the included species, including the two undescribed forms, occur in South America. They are rarely collected and essentially nothing is known about their biting habits or possible relationship with disease.

Additional species were added to the reference collection from Mexico, Brazil and Ecuador. Among these are two new species that were illustrated and which will be included in the handbook of neotropical Lutzomyia, a work which is in preparation.

Significant advances in the rearing of phlebotomines in the laboratory were made during this time period. A "techniques" paper is in preparation, the final draft to be completed following the PI's return from Kenya in August 1981. At present, L. shannoni, L. cruciata and L. anthophora are being maintained in closed colonies in our laboratory. It is expected that L. vexator

from Florida will be added to this list by the end of the summer (1981). Eggs from these species are being studied with the aid of a scanning electron microscope to detect possible species differences. Results will be given in the next annual report.

A draft paper on the laboratory biology of L. anthophora is given in Appendix III and will be submitted for publication as soon as possible.

The development of simple rearing procedures for phlebotomines should prove to be of great help in taxonomic studies, especially those involving the immatures and sibling species.

Work was begun on a review of the North American phlebotominae. The completed paper will be included in next year's annual report. Distributional data, taxonomy with identification keys, illustrations and a review of the literature will be given for each species.

A taxonomic review of the anthropophilic species of the Lutzomyia davis complex (South American) was completed and accepted for publication (Abonnenc et al. 1981).

## APPENDIX I

### Sand Flies of Guatemala. I. Additions to the Fauna, Redescriptions and a New Synonym (Diptera: Psychodidae)<sup>1</sup>

C.H. Porter

Medical Entomology Research and Training Unit/Guatemala

c/o American Embassy--Guatemala

APD Miami, Florida 34024

D.G. Young

Department of Entomology and Nematology

University of Florida

Gainesville, Florida 32611

**Abstract:** The phlebotomine sand fly fauna of Guatemala presently includes 25 species of which 13 are newly recorded here. Lutzomyia guatemalensis Porter and Young n.sp., a member of the shannoni group, is described from both sexes. L. tikalensis (de León) is a junior synonym of L. permira (Fchld. and Hertig). L. piedraferroi (de León), L. atalupai (de León) and L. edentula (de León) are redescribed from type material. The female of L. piedraferroi is described for the first time.

**Introduction:** Mr. H.S. Barber (1907) was the first investigator to report phlebotomine sand flies from Guatemala. He and E.A. Schwarz collected man-biting females at Cacao, Tres Aguas. These flies were named Phlebotomus cruciatus by Coquillett in 1907. Fairchild

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<sup>1</sup>Research supported by U.S. Army Medical Research and Development Command under contract no. DADA 17-72-C-2139.

and Hertig (1959) added 5 species--P. cgyennensis maciasi Fchld. and Hertig, P. evansi Nunez-Tovar, P. undulatus Fchld. and Hertig--all from roadside locations between Esquintla and San Jose), P. longipalpis Lutz and Neiva from El Jicarillo, Progreso and P. deleoni Fchld. and Hertig from Canchacan, Peten. P. olmecus olmecus Vargas and Diaz-Nájera, the probable vector of cutaneous leishmaniasis in the Peten, was added to the list by Fairchild and Theodor (1971). The same year, de León described 4 species from Guatemala--P. atalupai, P. piedraferroi, P. edentulous and P. tikalensis.

Here we provide additional records and information on Guatemalan sand flies from recent collections by the senior author (C.H.P.) and from study of 500 slide-mounted specimens in the collection of the late Dr. J.R. de León. This material was kindly loaned to us by Sra. de León to whom we are greatly indebted. We obtained further data from specimens in the University of Florida sand fly collection (UF).

Classification follows Lewis et al. (1977). Measurements are in millimeters.

#### Taxonomic Notes and Locality Records for Some Species

##### Genus Brumptomyia

1. B. galindoi (Fchld. and Hertig). Guatemala (C.H.P. collections).

1 ♂, Tikal, Peten, light trap, 6-VII-1980. 1 ♂, 2 ♀♀, same data but 3-IX-1980. 4 ♂♂, 1 ♀, Finca el Zapote, Peten, light traps, 8-IX-1980.

These specimens agree with the description of B. mesai (Sherlock, 1962), a smaller apparently conspecific form of B. galindoi.

2. B. hamata (Fchld. and Hertig). Guatemala (C.H.P. Collections). 1 ♂, 1 ♀, Tikal, Peten, light trap, 3-IX-1980. 4 ♂♂, 3 ♀♀, Finca el Zapote, Peten, light traps and on tree trunk, 8-IX-1980.

Genus Lutzomyia

subgenus Lutzomyia

3. L. cruciata (Coq.). Guatemala. 3 ♂♂, 22 km S of San Francisco, tree trunk, 5-VII-1980, C.H.P. 1 ♀, Finca el Zapote, Peten, light trap, 8-IX-1980, C.H.P. 1 ♀, S. Basilio, Sololá, Morales (UF).
4. L. diabolica (Hall). Guatemala. 1 ♂ (no. 688), Chaquiton, Esquipulas, IV-1950, de León coll.

This is a provisional identification. The pleura are as heavily pigmented as those of diabolica from Mexico and Texas but females are required to confirm the record. L. diabolica, believed to be conspecific with cruciata by Disney (1966), will be discussed in detail in a forthcoming review of the North American Phlebotominae (Young, in preparation).

Verrucarum Group

5. L. nuneztovari (Ortiz). Guatemala. 1 ♂ (no. 426), km 81, XI-1949, de León, no other data. Honduras. 2 ♂♂, Lancetilla Valley, Tela, tree trunks, 26-VI-1953, Hils (UF). Panama. 1 ♂, Santa Clara, Volcan de Chiriqui, tree trunk in coffee plantation, 11-IV-1955, Hartmann (UF).

Previous distribution records for nuneztovari include Colombia and Venezuela (Young, 1979). The male resembles that of L. evansi but its genital filaments are shorter than 4X the pump length and the style lacks a subterminal bristle, a character state unique among the known verrucarum group males.

6. L. odax (Fchld. and Hertig). Guatemala. 1 ♂, Sabana, 11 km from Esperanza, tree trunk, 7-IX-1980, C.H.P.

Vespertilionis Group

7. L. beltrani (Vargas and Díaz Nájera). Guatemala. 2 ♂♂, 3 ♀♀, Coop Tanhoc, Popton, 1-VI-1981, C.H.P. 1 , S. Luis, Peten, I-1945, de León.

The males agree with the description of L. beltrani (Belize form) given by Williams (1976). The large median spine of the style is inserted at 0.75 of the segment; the style is nearly as long as the coxite, and the lateral lobe is markedly inflated, its length being 3.5X maximum width. The male from Coop Tanhoc appears to have a thinner lateral lobe but this is evidently due to shrinkage during mounting.

We continue to use the informal name, L. beltrani (Belize form) until more specimens from different localities become available for study.

8. L. deleoni (Fchld. and Hertig). Guatemala. 2 ♀♀, 3 km from Caoba, light trap, 1-VII-1980, C.H.P. 7 ♂♂, 10 ♀♀, Finca el Zapote, Peten, light traps and tree trunks, 8-IX-1980, C.H.P.

Delpozoi Group

9. L. piedraferroi (de León) Figs. 1-9. Guatemala. 1 ♂ (no. 205), Piedra de los Eierras, IX-1948, de León (holotype). 20 ♂♂, 15 ♀♀, Finca Santa Isabel, Suchitepequez, elev. 1300 m a.s.l., tree trunks, V-VI-1980 and 11-II-1981, C.H.P.

♂ holotype. Wing length 2.16; width 0.56. Most of thorax and abdomen missing. Flagellomere I 0.36 long, length of II + III = 0.33; ascoids simple, those on II reaching to middle of flagellomere, on all flagellomeres except last. Labrum 0.24 long. Lengths of

palpal segments: 1, 0.04; 2, 0.15; 3, 0.18; 4, 0.12; 5, 0.36; palpal sensilla (about 9) scattered over distal 2/3rds of palp 3. Lengths of wing vein sections: alpha 0.43, beta 0.30, delta 0.17, gamma 0.40. Genitalia dissected and flattened. Style 0.16 long, median long spine at 0.7 of segment, with 2 large subterminal and 1 large terminal spines and a small subterminal bristle. Coxite 0.29 long with a tuft of 8-9 curving setae at base all of which arise from a common, heavily pigmented stalk. Paramere about 0.22 long, ventral margin with acute projection. Aedeagus sub-triangular with pointed tip. Genital pump 0.13 long, each filament 0.37 long or 2.8X length of pump, filament tips widened. Lateral lobe 0.34 long.

♀ (n = 3; from Finca Isabel). Wing length 2.28-2.52; width 0.69-0.78. Whole insect lightly pigmented, pleura but slightly paler than mesonotum. Head height 0.41-0.44; width 0.33-0.35. Eyes separated by 0.15 or by distance = to 7.7 facet diameters. Flagellomere I 0.31-0.33 long, combined length of II + III = 0.22-0.26; ascoids on II nearly reaching end of flagellomere, on all flagellomeres except last one (XIV). Labrum 0.25-0.28 long. Lengths of palpal segments: 1, 0.04; 2, 0.15; 3, 0.16-0.18; 4, 0.12-0.13; 5, 0.32-0.44; palp 2 with 2-4 sensilla at end, palp 3 with about 10 sensilla on distal 2/3rds of segment. Cibarium with 2 blade-like horizontal teeth, numerous inner-directed lateral and vertical teeth as shown; cibarial arch well developed, complete; pigment patch prominent. Pharynx without spines, 0.17-0.20 long. Pleura with 7-11 upper and 4-5 lower episternal setae. Lengths of wing vein sections: alpha 0.60-0.75, beta 0.24-0.31, delta 0.28-0.40,



gamma 0.38-0.41. Lengths of femora, tibiae and basitarsi: fore-leg, 0.76-0.86, 0.83-0.93, 0.47-0.54; midleg, 0.78-0.86, 1.02-1.12, 0.56-0.61; hindleg, 0.86-0.95, 1.20-1.34, 0.66-0.74. Spermathecae sac-like, ducts not visible.

It seems quite likely that L. piedraferroi is a junior synonym of L. delpozoi (Vargas and Díaz Nájera 1953:42-44) (♂, ♀, Mariscal, Chiapas, Mexico) but without Mexican material referable to that species, we treat them as separate species. The paramere of delpozoi, as illustrated by Vargas and Díaz Nájera (1953), does not show an acute ventral projection, so conspicuous in the piedraferroi holotype and males from Finca Santa Isabel. The females appear to be indistinguishable.

The holotype of L. piedraferroi has 4 major spines on the style rather than 3 as illustrated by de León (1971, fig. 5).

#### Subgenus Dampfomyia

10. L. atalupai (de León). Figs. 9-19. ♂ holotype (no. 504), La Presa, Esquipulas, III-1950, de León. ♀ allotype (no. 500), La Planta, Esquipulas, III-1950, de León. 1 ♂, 1 ♀, Tuxtla Gutierrez, Chiapas, Mexico, 23-III-1951, Fairchild and Hartmann.

♂ holotype. Wing length 1.34; width 0.35. Mesonotum and halteres well pigmented, pleura paler. Flagellomere I 0.14 long, length of II + III = 0.16; ascoids simple, on all flagellomeres except last (XIV); tip of those on II reaching to end of flag. Labrum 0.13 long. Lengths of palpal segments: 1, 0.03; 2, 0.09; 3, 0.12; 4, 0.09; 5, 0.20; palpal sensilla not visible. Pleura with 4-5 lower and 10 upper episternal setae. Lengths of wing vein sections: alpha 0.19, beta 0.24, delta 0.05, gamma 0.25.

Femur without spines. Lengths of femora, tibiae and basitarsi: foreleg, 0.53, 0.49, 0.25; midleg, 0.56, 0.59, 0.31; hindleg, 0.66, 0.78, 0.39. Genitalia dissected. Style 0.13 long, with 3 strong spines and small subterminal bristle, basal spine inserted at 0.6 of segment, smaller than terminal and subterminal spines. Coxite 0.23 long, no persistent setae. Paramere (fig. 13) excessively flattened due to manner of slide preparation; dorsal arm arched with enlarged end bearing 20-24 slender setae having curved tips; ventral margin with acute moderately pigmented projection; dorsum with median group of about 7 setae, larger than other setae on structure. Aedeagus distorted.

♀ allotype. Wing length 1.50; width 0.45. Coloration as for ♂.

Flagellomere I 0.13 long, length of II + III = 0.14; ascoids on flag. I-XII (last 2 flag. missing), tips of those on II extending to end of flag. Labrum 0.24 long. Ventral maxillary teeth 11, lateral teeth 25. Length of palpal segments: 1, 0.04; 2, 0.11; 3, 0.13; 4, 0.10; 5, 0.21; 5 palpal sensilla at end of palp 2, about 8 at middle third of 3. Cibarium extremely flattened due to mounting, with 2 pairs of median horizontal teeth and 3-4 large lateral teeth on each side, all with pointed tips; 6 relative large vertical teeth anterior to median horizontal teeth and numerous small vertical teeth on each side; posterior part of pigment patch darker than more slender anterior part, shaped as shown; cibarial arch well developed throughout. Pharynx unarmed, 0.13 long. Pleura with 8 upper and 6 lower episternal setae. Lengths of wing vein sections: alpha 0.28, beta 0.25, delta 0.11, gamma 0.27. Length of femora, tibiae

and basitarsi: foreleg, 0.60, 0.51, 0.28; midleg, 0.61, 0.61, 0.32; hindleg, 0.74, 0.88, 0.44. Abdominal sternite 2 with median clear area. Spermathecae of Dampfomyia type but nearly invisible.

As with others in the de León collection, the holotype and allotype are not labelled as such, but figs. 1 and 2 and photographs 1 and 2 in his 1971 paper were of the specimens we examined. Both were unduly flattened when slide mounted years ago. We remounted the abdomen of the female but were unable to see details of the spermathecae.

The atalupai male, with the apically enlarged arm of the paramere, differs readily from L. dodgei (Vargas and Nájera 1953) which has a uniformly slender arm bearing setae from base to apex. The setae on the dorsal arm of the paramere of atalupai are restricted to the apically enlarged section. We believe that the "dodgei" discussed and illustrated by Fairchild and Hertig (1956) represents atalupai (de León) instead of dodgei (Vargas and Nájera). There are no significant differences between the Mexican and Guatemalan specimens when allowances are made for obvious distortion due to improper slide mounting technique. Fairchild and Hertig (loc. cit.) illustrated the spermathecae of the Mexican female.

11. L. permira (Fchld. and Hertig). Guatemala. 2 ♂♂ (nos. 829 and 830), Dos Lagunas, Peten, II-1957, de León.

Phlebotomus permirus Fchld. and Hertig 1956:312 (♀ holotype, Palenque, Chiapas, Mexico). Lewis and Garnham 1959:86 (♂ descript., Belize).

Phlebotomus tikalensis de Leon 1971:190-191 (♂, Dos Lagunas, Peten, Guatemala). NEW SYNONYM

The specimens described by de León as tikalensis and seen by us are morphologically indistinguishable from L. permira as carefully described by Lewis and Garnham (1959).

Shannoni Group

12. Lutzomyia guatemalensis Porter and Young n.sp. Figs. 20-29.

♂ (holotype no. 611). Guatemala. Las Cebollas, Esquipulas, 1400 m a.s.l., II-1953, de León. ♀ (allotype no. 3922), same locality and collector, no date (UF).

Holotype ♂. Wing length 2.7; width 0.83. Head, mesonotum and abdomen moderately pigmented, pleura paler. Flagellomere I 0.41 long, II + III = 0.37; ascoids on all flagellomeres except last 3 (XII-XIV), those on II ending at 0.64 of flagellomere, all with short posterior spurs. Labrum 0.26 long. Lengths of palpal segments: 1, 0.04; 2, 0.21; 3, 0.15; 4, 0.07; 5, 0.14 but partially shrunk; palpal sensilla (about 6) visible only on middle 1/3 of palp 3. Pharynx 0.17 long. Cibarium with 15 remnants of teeth; pigment patch similar to that of ♀ (fig. 25); cibarial arch complete, well defined. Interocular distance about 0.11 but head contracted due to condition of specimen. Eyes in fig. 29 drawn to presumed normal appearance. Pleura with 7 upper and 3 lower episternal setae. Lengths of wing vein sections: alpha 0.61, beta 0.41, delta 0.15, gamma 0.25. Lengths of femora, tibiae and basitarsi: foreleg, 1.07, 1.76, 1.05; midleg, 0.91, 1.83, 1.13; hindleg, 1.00, 2.13, 1.23. Genitalia. Style 0.28 long with 4 strong spines at different levels, no subterminal bristle. Coxite 0.51 long, without persistent setae.

Paramere 0.28 long, simple and slightly clubbed at one angle of view (fig. 20), apical dorsal setae curved at tips. Aedeagus subtriangular, well pigmented, 0.09 long. Genital pump 0.20 long, each filament 0.51 long or 2.55X pump length, filament tips oval, enlarged. Lateral lobe 0.50 long.

Allotype ♀. Wing length 2.7; width 0.9. Coloration as for ♂. Head flattened due to mounting; head height 0.43, width 0.44. Eyes large, separated by 0.14 or by distance = to 7 facet diameters. Flagellomere I 0.35 long, II + III = 0.31; ascoids on flagellomeres I-VII (rest missing), those on VII reaching to distal fifth, all with short pointed posterior spurs. Labrum 0.33 long. Lengths of palpal segments: 1, 0.04; 2, 0.15; 3, 0.16; 4, 0.08; 5, missing, palpal sensilla (ca. 21) on distal 2/3rds of palp 3, most near end of segment. Cibarium with 4 sharp horizontal teeth, about 20 vertical teeth in 2-3 irregular rows (2 of the horizontal teeth displaced due to mounting), cibarial arch complete; pigment patch broader at base and conspicuous. Pharynx 0.19 long, unarmed. Pleura with 6 upper and 2 lower episternal setae. Lengths of wing vein sections: alpha 0.66, beta 0.42, delta 0.15, gamma 0.28. Lengths of femora, tibiae and basitarsi: foreleg missing; midleg, 0.88, 1.70, 1.10; hindleg, 0.95, 1.94, 1.2. Spermatheca cylindrical with about 15 segments, some of those shrunken in the one available specimen; common sperm duct at least 3X length of individual duct.

The combination of characters of the palpi, antennal ascoids, genitalia and female cibarium of L. guatemalensis suggests that this species belongs in the shannoni group with L. shannoni, L. undulata,

L. punctigeniculata (Fchld. and Hertig) and others listed by Martins et al. (1978) in the subgenus Psathromyia Barretto. L. guatemalensis and L. punctigeniculata, however, are the only ones in this group that have short posterior spurs of the antennal ascoids. The others have relatively long spurs, often reaching backwards to the preceding flagellomere. The structure of the male and female genitalia, including the nonsegmented spermathecae, of L. punctigeniculata readily distinguishes this species from guatemalensis.

Other Lutzomyia spp. with short, but conspicuous, posterior spurs and which lack persistent coxite setae include those in the aragaoi group. L. carpenteri, L. barrettoi, L. texana and others are members. The females of most of these species have 6 or more horizontal teeth in the cibarium. Those that have only 4 such teeth possess spermathecae and ducts which differ greatly from those of guatemalensis. The aragaoi group males, unlike that of guatemalensis, have the genital filament tips twisted or markedly inflated and pointed or simple and pointed. Often there is a dorsobasal hump of the paramere which is absent in the guatemalensis male.

13. L. shannoni (Dyar). Guatemala (all C.H.P.). 2 ♂♂ W of Las Cruces, km 100, tree trunks, 4-VII-1980. 5 ♂♂, 2 ♀♀, 22 km S of San Francisco, tree trunks, 5-VII-1980. 1 ♀, Sabana, 11 km from Esperanza, tree trunk, 7-IX-1980. 10 ♂♂, 2 ♀♀, Finca el Zapote, Peten, tree trunks and light traps, 8-IX-1980.
14. L. volcanensis (Fchld. and Hertig).

Aragaoi Group

15. L. carpenteri (Fchld. and Hertig). Guatemala (all C.H.P.). 2 ♂♂,  
3 km from Caoba, light trap, 1-VII-1980. 2 ♂♂, 1 ♀, Finca el Zapote,  
Peten, light trap, 8-IX-1980.

Subgenus Nyssomyia

16. L. edentula (de León).

17. L. olmeca olmeca (Vargas and Diaz Nájera). Guatemala (all C.H.P. in light traps). 1 ♂, 1 ♀, Tikal, Peten, 30-VI-1980. 2 ♀♀, same data but 6-VII-1980. 10 ♂♂, 6 ♀♀, 16 km S of San Francisco, Peten, 5-VII-1980.
18. L. ylephiletor (Fchld. and Hertig). Guatemala (all C.H.P.). 2 ♂♂, 2 ♀♀, W of Las Cruces, km 100, tree trunks, 4-VII-1980. 3 ♂♂, 2 ♀♀, 22 km S of San Francisco, tree trunks, 5-VII-1980. 1 ♂, 2 ♀♀, Tikal, Peten, light trap, 6-VII-1980. 4 ♂♂, Nueva Libertad, tree trunk, 4-IX-1980. 25 ♂♂, 10 ♀♀, Finca el Zapote, tree trunks and light traps, 8-IX-1980.

Subgenus Psychodopygus

19. L. panamensis (Shannon). Guatemala (all C.H.P. in light traps). 2 ♂♂, 27 ♀♀, Tikal, Peten, 30-VI-1980. 4 ♂♂, 3 ♀♀, 3 km from Caoba, 1-VII-1980. 1 ♂, 3 ♀♀, 16 km S of San Francisco, 5-VII-1980. 3 ♂♂, 33 ♀♀, Tikal, Peten, 6-VII-1980. 8 ♂♂, 7 ♀♀, same data but 3-IX-1980. 2 ♂♂, 7 ♀♀, Finca el Zapote, 8-IX-1980.

Cayennensis Group

20. L. cayennensis maciasi (Fchld. and Hertig). Guatemala. 1 ♂ (no. 330), La Encarnacion, IV-1949, de León. 1 ♀ (no. 855), Padre Miguel, Esquipulas, III-1964. 5 ♂♂, 2 ♀♀, San Esteban, Chiquim, various dates, III, VI and XII, 1948, 1957 and 1967, de León. 1 ♂, 22 km S of San Francisco, tree trunk, 5-VII-1980, C.H.P. 1 ♂, 1 ♀, Sabana, 11 km from Esperanza, tree trunk, 7-IX-1980, C.H.P.
21. L. chiapanensis (Dampf).



22. L. trinidadensis (Newstead). Guatemala (all C.H.P., tree trunks).  
4 ♂♂, 3 ♀♀, W of Las Cruces, km 100, 4-VII-1980. 23 ♂♂, 4 ♀♀, 22  
km S of San Francisco, 5-VII-1980. 16 ♂♂, 3 ♀♀, Sabana, 11 km from  
Esperanza, 7-IX-1980.

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### Figure Legends

Figs. 1-9. Lutzomyia piedraferroi (de León). 1. Male head. 2. Female wing. 3. Male wing. 4. Female cibarium. 5. Male flagellomere II. 6. Spermathecae and genital fork. 7. Male genitalia. 8. Female flagellomere II, same scale as fig. 5. 9. Female head. All figures drawn from specimen collected at Santa Isabel, Guatemala.

Figs. 10-20. Lutzomyia atalupai (de León). 10. Female head. 11. Female flagellomere II. 12. Female wing. 13. Male wing. 14. Paramere of holotype, flattened by coverslip. 15. Genital filaments and pump. 16. Male genitalia. 17. Different aspect of dorsal arm of paramere. 18. Genital filaments and pump of holotype. 19. Female cibarium. 20. Female cibarium of allotype, flattened and drawn to same scale as fig. 19.

Figs. 13-17 drawn to same scale. All figures from Mexican specimens except those of the Guatemalan holotype and allotype.

Figs. 21-30. Lutzomyia guatemalensis Porter and Young n.sp. 21. Paramere and genital filament tips. 22. Female wing. 23. Male wing. 24. Male genitalia. 25. Genital filaments and pump. 26. Female cibarium. 27. Spermathecae, in Canada balsam. 28. Female flagellomere VII. 29. Female pedicel, flagellomeres I and II and labrum. 30. Male head. All figures from holotype and allotype.

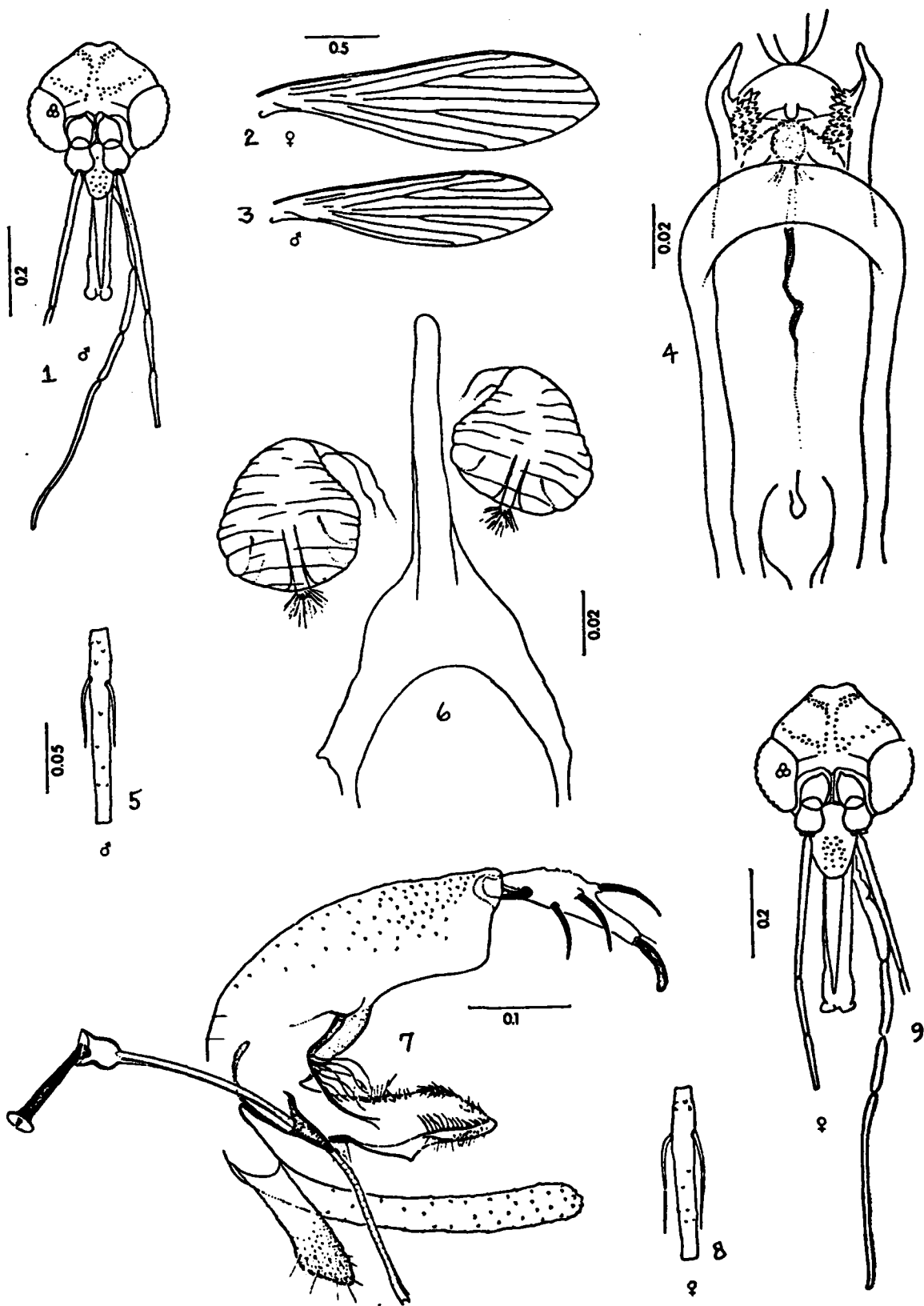
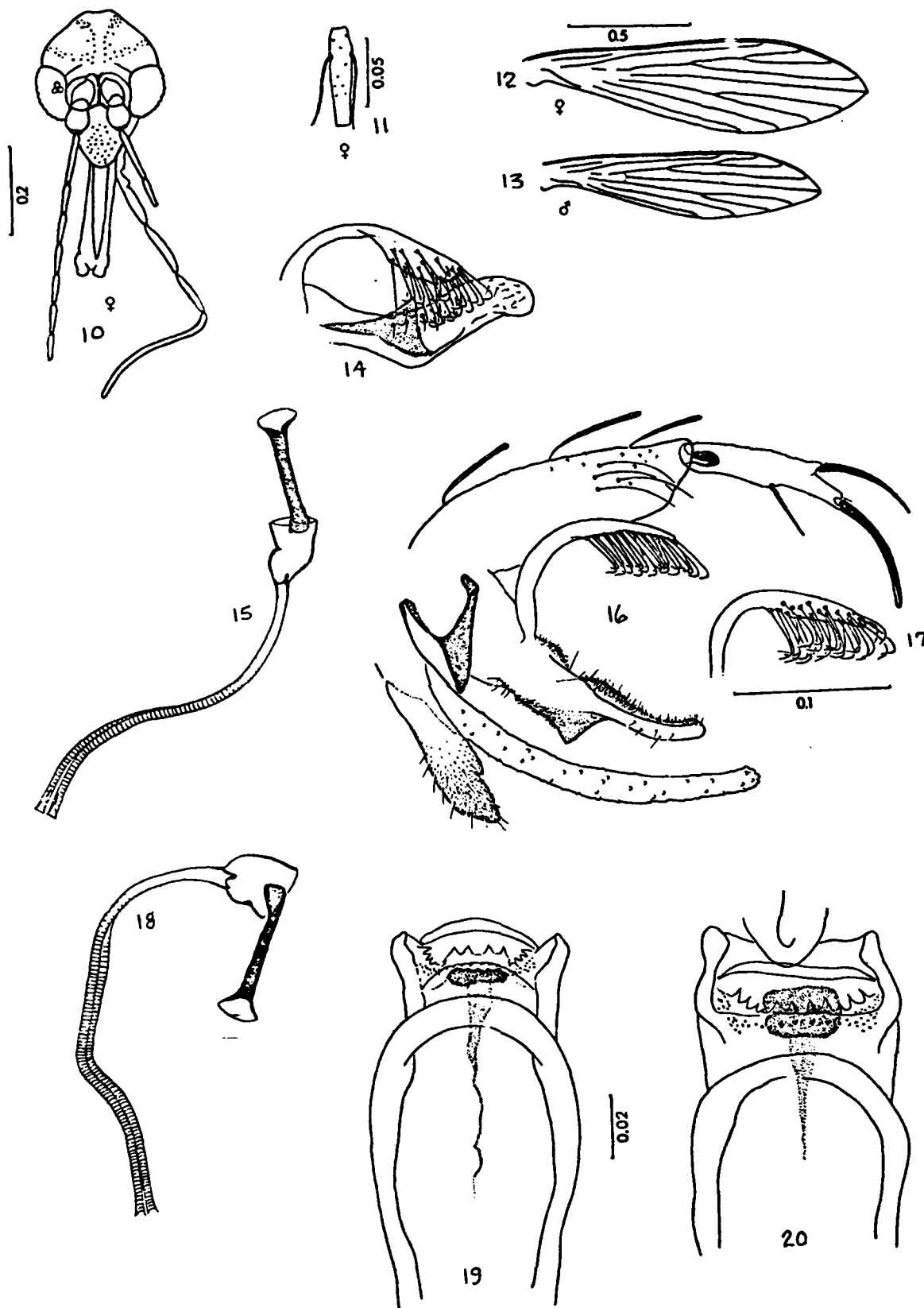


FIG. 1-9. Lutzomyia piedraferroi



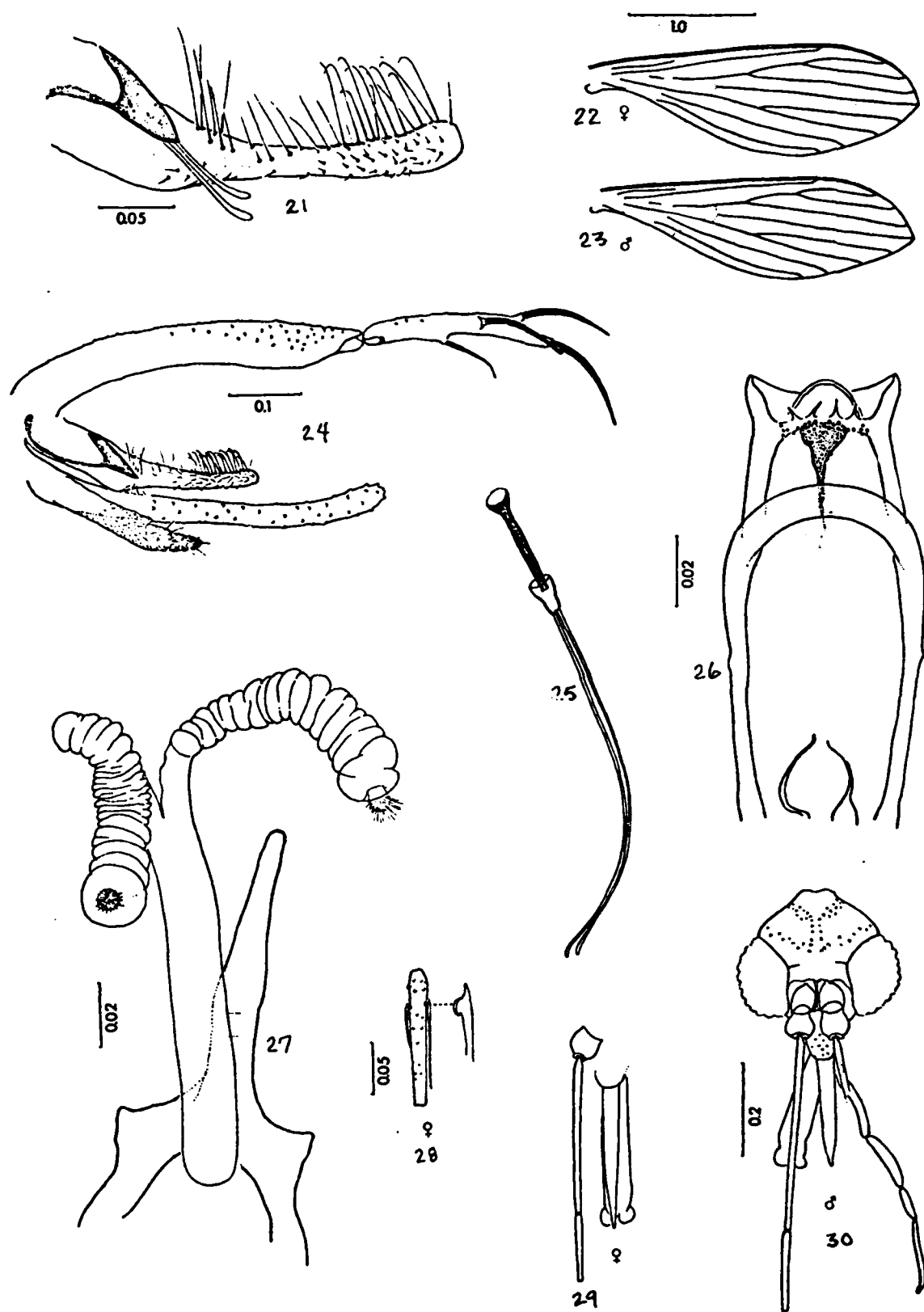


Fig. 21-30. *Lutzomyia guatemalensis* n. sp.

## APPENDIX II

### THE MICROPS GROUP OF Lutzomyia WITH DESCRIPTIONS OF TWO NEW SPECIES FROM SOUTH AMERICA (DIPTERA: PSYCHODIDAE: PHLEBOTOMINAE)<sup>1</sup>

D.G. Young<sup>2</sup> and J.R. Arias<sup>3</sup>

Abstract: Five species of phlebotomine sand flies in the genus Lutzomyia from South America are included in the microps group. References and illustrations of the species are given, including descriptions of two new forms--L. nematoducta n.sp., male and female from Brazil, and L. preclara n. sp. male from Colombia.

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The Lutzomyia sand flies considered here are known from South America in Colombia, French Guiana, Peru, Bolivia, and Brazil from relatively few specimens. Previously, L. microps (Mangabeira), L. fluviatilis (Floch & Abonnenc), and L. servulolimai (Damasceno & Causey) were treated as isolated species or as questionable members of the migonei group (Theodor 1965; Martins et al. 1978). Aside from the observation by Martins et al. (1975) that the females of L. microps and L. fluviatilis are structurally indistinguishable, there are no other reports suggesting a close relationship among the species. Forattini (1973) places 2 species in the genus Psychodopygus while retaining the other, L. servulolimai, in Lutzomyia.

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<sup>2</sup>Department of Entomology and Nematology, University of Florida, Gainesville, Florida 32611.

<sup>3</sup>INPA, C.P. 478, Manaus, 69000, Amazonas, Brazil.



It is apparent now that these 3 species and 2 others described here share a unique combination of characters. Accordingly, we propose to include them in the microps group, a new, informally named category equivalent in rank to other species groups of Lutzomyia (Lewis et al. 1978).

The species in the microps group are recognized by the following features. Color pale to light brown without contrasting dark mesonotum. Head broad with small eyes, short labrum and long to very long flagellomeres (unlike those spp. in the subgenus Trichophoromyia in the sense of Sherlock & Guitton 1970). Palp 5 shorter than or subequal to palps 3 + 4. Female cibarium with 4 horizontal teeth, inner pair separated by a wide gap and with few or no vertical teeth; pigment patch faintly infuscated or invisible; cibarial arch strongly developed only at sides. Wing venation with short beta, less than half alpha. Genitalia. Male style bearing 4 large spines, no subterminal setae. Inner coxite base with simple or blade-like setae usually inserted on a tubercle; paramere simple; genital filament tips pointed, unmodified. Female spermathecae cylindrical with incomplete or complete annuli, long to very long individual ducts and short common duct.

The inclusion of L. nordestina (Mangabeira) and an undescribed ally from northern Brazil (? only, Young 1979) in this group could be justified on the basis of most characters except that the nordestina male lacks a coxite tuft. This may or may not prove to be significant, but for the present we exclude the 2 species from the microps group.

The microps group males resemble those in the subgenus Lutzomyia having 4 spines on the style (series longipalpis and cruciata). Fairchild (1955), in fact, includes L. fluviatilis with the cruciata group species but it, and others in the microps group, have relatively long fifth palpal segments. Males in the series longipalpis also have a subterminal bristle on each

style, absent in those of the microps group. Nonsexual characters of the females, notably the broad heads, long antennae, short labrums, are especially useful in distinguishing the microps group females from others with similar cibarial armatures and spermathecae (e.g. vexator group spp.). The feeding habits of the species in the microps group remain unknown.

Microps group species.

1. Lutzomyia microps (Mangabeira). Fig. 1-4.

Phlebotomus microps Mangabeira 1942:169 (♂, Fazenda do Surdo, Municíp. de Nova Iguaçu, Rio de Janeiro, Brazil).

Lutzomyia microps: Theodor 1965:182 (listed). Martins et al. 1975: 259-261 (♀ descript., distrib., figs.). Martins et al. 1978:163 (distrib.).

Psychodopygus microps: Forattini 1973:473-474 (♂ fig., brief redescript.).

Distribution: Brazil (Bahia, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Santa Catarina).

Material examined: Brazil. 2♂♂ Serra do Cuiabá, Municíp. Sabará, Minas Gerais, 4-I-1958, A.V. Martins.

Remarks: This species is poorly known. Its geographic distribution is apparently restricted to southeastern Brazil where specimens were found in small numbers in rock crevices near small streams (Martins et al. 1975).

2. Lutzomyia servulolimai (Damasceno & Causey). Fig. 5-8.

Phlebotomus servulolimai Damasceno & Causey 1945:635 (♂, Bom Jesus, São Domingo, Pará, Brazil).

Lutzomyia servulolimai: Theodor 1965:182 (listed). Martins et al. 1965:3 (Rondonia Territory, Brazil, ?? captured). Llanos 1973:29 et seq. (♂, Peru, figs.). Forattini 1973:348 et seq. (brief re-descript. ♂, fig.). Martins et al. 1978:167-168 (distrib.).

Distribution: Brazil (Amazonas, Pará, Rondonia). Peru (Loreto), Bolivia (Beni).

Material examined: Brazil. ♂ holotype (USNM), 1♂, Br 19 at km 275, Amazonas, 18-X-1979, light trap, J.R. Arias. Bolivia. Guayaramerin, Beni, tree trunk, J. Velasco.

Remarks: Aside from the longer and slightly thicker coxite setae of the males from Amazonas, Brazil, and Beni, Bolivia, the specimens closely resemble the servulolimai holotype.

A female sand fly from Cumariana, Vichada, Colombia, in the collection of the Instituto Nacional de Salud, Bogotá, clearly belongs in the microps group. Its specific identity remains uncertain although it may represent the undescribed female of servulolimai or, less likely, that of L. preclara n.sp. which probably has longer sperm ducts.

Some measurements and observations of the partly damaged female (no. 648) are as follows. Wing length 1.69; width 0.49 (wing wrinkled). Color pale. Cibarium (Fig. 9) with 4 horizontal teeth, a few ill-defined vertical teeth as shown; cibarial arch prominent at sides, diffuse in middle; pigment patch barely visible. Pharynx unarmed. Eyes small (like L. nordestina). Length of flagellomere I, 0.35; II, 0.16; III, 0.17. Labrum 0.16 long. Length of palpal segments: 1, 0.03; 2, 0.78; 3, 0.96; 4, 0.07; 5, 0.13. Length of wing vein sections: alpha, 0.47; beta, 0.17; delta, 0.15; gamma, 0.29. Legs missing. Spermathecae as shown.

3. Lutzomyia fluviatilis (Floch & Abonnenc). Figs. 11-19.

Phlebotomus fluviatilis Floch & Abonnenc 1944a:7 (♂, Canori, French Guiana); 1955b:1 (♀ descript.).

Lutzomyia fluviatilis: Theodor 1965:196 (listed). Lewis 1975:503 et seq. (mouthpart morphol., keyed). Leger et al. 1977:218, 227 (collection data, French Guiana). Martins et al. 1978:163 (distrib.).

Psychodopygus fluviatilis: Forattini 1971:105 (listed); 1974:416 et seq. (♂,♀ figs., brief redescript.).

Distribution: French Guiana.

Material examined: French Guiana. 1♂, 2♀♀, Maripasoula, III-1973, light traps, N. Leger. 1♂, Paramana, 24-X-1975, light trap, N. Leger.

Remarks: There seems to be little doubt about the correct association of the fluviatilis sexes. Similar morphology, color, and recent collecting data in French Guiana provide enough evidence to support the association.

We did not observe a dark pigment patch of the cibarium in either of the 2 females examined. In fact, the pigment patch was barely visible, similar to that of L. microps, described by Martins et al. (1975), and L. nematoducta n.sp. The individual sperm ducts of fluviatilis, observed in liquid phenol, become narrow towards the base of the spermathecae (Fig. 19).

4. Lutzomyia nematoducta Young & Arias n.sp. (Fig. 20-29).

Holotype ♂. Measurements in millimeters. Wing length 1.83; width 0.51. Color pale except for moderately infuscated external genitalia. Head height from vertex to tip of clypeus 0.34;

width 0.31. Eyes small, separated by 0.12 or by distance = to 6.7 facet diameters. Flagellomere I very long, 0.45; II + III = 0.45; ascoids on II ending before apex of flagellomere; present on I-X (XI-XIV missing). Labrum 0.15 long. Length of palpal segments: 1, 0.037; 2, 0.075; 3, 0.116; 4, 0.073; 5, 0.136; palpal sensilla (6-8) at apical third of segment 3. Cibarium without teeth; pigment patch slender, nearly invisible; cibarial arch conspicuous at sides, diffuse in middle. Pharynx 0.14 long, unarmed. Pleura with 13-14 upper and 1-2 lower episternal setae. Length of wing vein sections: alpha, 0.44; beta, 0.16; delta, 0.11; gamma, 0.31. Length of femora, tibiae and basitarsi: foreleg, 0.85, 1.07, 0.69; midleg, 0.83, 1.30, 0.73; hindleg, 0.90, 1.50, 0.83. Genitalia. Style 0.25 long with 4 major spines, isolated spine at 0.76 of segment, no subterminal bristle. Coxite 0.37 long with a basal tuft of 12-14 blade-like setae on a well marked tubercle. Paramere simple with 3-4 curved dorsobasal setae distinct from others. Aedeagus 0.12 long, subtriangular with pointed tip, well sclerotized. Genital pump 0.18 long, each filament 1.14 long or 6.3X length of pump. Lateral lobe 0.37 long.

Allotype ♀. Wing length 1.91; width 0.56. Coloration as for ♂.

Head height 0.35; width 0.31. Eyes separated by 0.13 or by distance = to 7.1 facet diameters. Flagellomere I 0.39 long; II + III = 0.41; ascoids on II longer than for ♂ but not reaching end of flagellomere, on all flagellomeres except last (XIV). Labrum 0.18 long. Length of palpal segments: 1, 0.037; 2, 0.076; 3, 0.126; 4, 0.076; 5, 0.13; palpal sensilla (7) at

distal third of segment 3. Cibarium with 4 inwardly pointed horizontal teeth with a wide gap between inner pair, 2-3 small vertical teeth, nearly invisible, in 2 groups just anterior of inner pair of horizontal teeth; subtriangular pigment patch slightly pigmented; arch prominent at sides, diffuse in middle. Pharynx 0.15 long, unarmed. Pleura with 16-19 upper and 1-2 lower episternal setae. Length of wing vein sections: alpha, 0.52; beta, 0.15; delta, 0.20; gamma, 0.30. Length of femora, tibiae and basitarsi: foreleg, 0.88, 1.05, 0.66; midleg, 0.86, 1.22, 0.74; hindleg, 0.88, 1.40, 0.82. Spermathecae slender with about 20 annulations, middle third wider than basal or distal thirds; common duct apparently shorter than spermathecae but basal opening invisible; individual ducts exceedingly long, at least 12X length of spermathecae or common duct.

Type Data: Holotype ♂. 26 km E of Manaus, Amazonas, Brazil, at Reserva Ducke, 17-18-III-1979, flight trap in forest, D. Young. Allotype ♀. Same data except 43 km N of Manaus, light trap, 23-III-1979. Paratypes. 1♂, 1♀, same data as for holotype but ♂ in light trap. 1♀, 245 km E of Manaus near Rio Urubu, 13-III-1979, flight trap, J. Arias & D. Young. 20♂♂, Reserva Ducke, various dates in 1977-78, Light Traps, J. Arias, R. Freitas and J. Vidal.

Holotype and allotype to be deposited in the Museu de Zoologia Universidade de São Paulo, Brazil. Paratypes in collections at INPA, Manaus; U.S. National Museum (Nat. Hist.), Washington, E.C., and Florida State Collection of Arthropods, Gainesville, Florida.

Discussion: The male of L. nematoducta resembles that of fluviatilis but several features are strikingly different. The brush-like coxite tuft of nematoducta consists of about 12 thick setae inserted on a broad tubercle; whereas there are only 2 thin setae on a small tubercle in the other male. The parameres of the 2 males are quite similar in shape but the curved dorsal setae at the base of nematoducta are more strongly developed. The genital filaments of fluviatilis are relatively short, about 4X the length of the pump. Those of L. nematoducta and L. preclara, a species with different parameres, are longer than 6X the pump.

Some of the males in the subgenus Lutzomyia, series longipalpis, may be confused with the nematoducta male but they have a subterminal bristle on each style and the fifth palpal segment is relatively long.

From the female of L. fluviatilis, that of nematoducta differs in having thinner and longer sperm ducts and more slender spermathecae. These species and L. microps apparently have allopatric distributions.

5. Lutzomyia preclara Young & Arias n.sp. Fig. 30-34.

Holotype ♂. Wing length 1.67; width 0.47. Color pale except for

faintly pigmented external genitalia. Head height 0.32; width 0.30. Eyes separated by 0.12 or by distance = to 6.7 facet diameters. Flagellomere I 0.35 long, II = 0.16, remainder missing; ascoids on II simple as shown, 2 smaller ascoid-like structures visible near end of flagellomere II. Labrum 0.15 long. Length of palpal segments: 1, 0.03; 2, 0.06; 3, 0.11; 4, 0.07; 5, lost after drawing but about 0.12 mm; palpal sensilla (about 10) on middle third of palp 3. Cibarium without teeth or pigment patch; arch nearly complete, diffuse in middle. Pharynx 0.13 long, unarmed. Pleura with 10 upper and 2 lower episternal setae. Length of wing vein sections: alpha, 0.39; beta, 0.13; delta, 0.10; gamma, 0.30. Length of femora, tibiae and basitarsi: foreleg missing; midleg, 0.68, 1.10, 0.63; hindleg, 0.80, 1.27, 0.68. Genitalia. Style 0.20 long with 4 major spines, basal spine isolated, no subterminal bristle. Coxite 0.24 long with about 20 long pointed setae, the lower ones thicker than dorsal ones, all inserted on broad, well-pigmented tubercle. Paramere simple with all dorsal setae straight and pointed, ventral margin concave, tip rounded and slightly upturned. Aedeagus pointed downwards, slender towards tip, well-pigmented throughout. Genital pump 0.17 long, very dark; each filament 1.15 long or 6.7X length of pump, heavily infuscated especially section near pump. Lateral lobe 0.27 long.

Type Data: Holotype ♂. 9 km N of Leticia, Amazonas, Colombia, 3-5-VI-1979, flight trap, R.C. Wilkerson. Holotype to be deposited in U.S. National Museum (Nat. Hist.). The species name refers to the Latin word meaning very beautiful or splendid.



Discussion: The shape of the parameres of L. preclara readily distinguishes this species from males of fluviatilis and nemato-ducta. L. microps and servulolimai have fewer, thinner setae at the base of the coxite. The relatively short fifth palpal segment of preclara serves to separate it from L. gomezi (Nitz.), L. marinkellei Young and other species in the subgenus Lutzomyia, series cruciata.

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## Figure Legend

Fig. 1-4. Lutzomyia microps ♂, Serra do Cuiabá, Minas Gerais, Brazil.

1, genitalia, lateral view; 2, head; 3, wing; 4, genital filaments and pump.

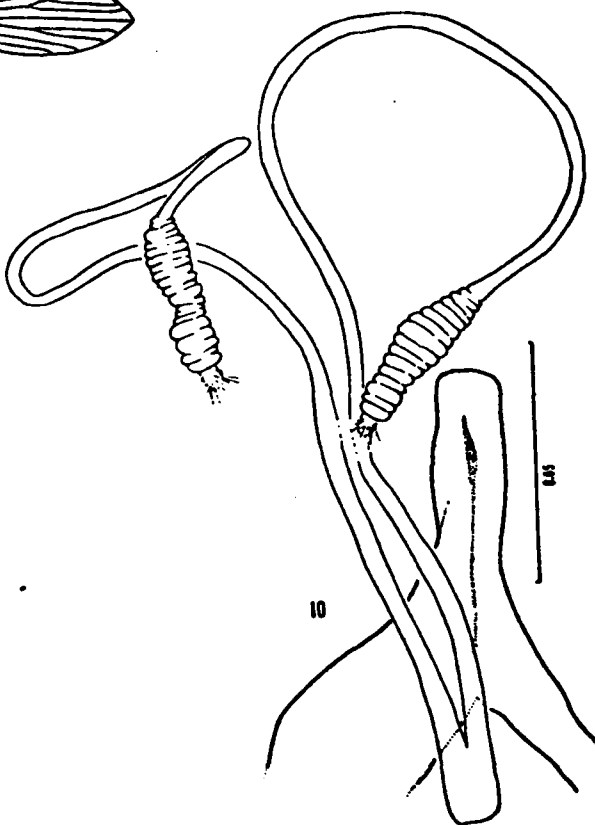
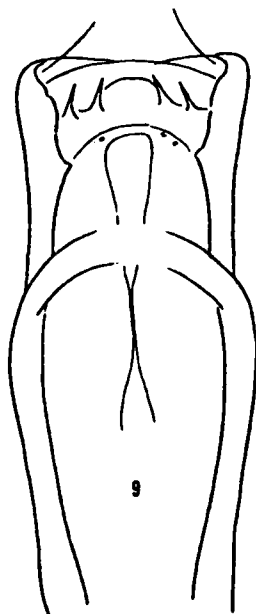
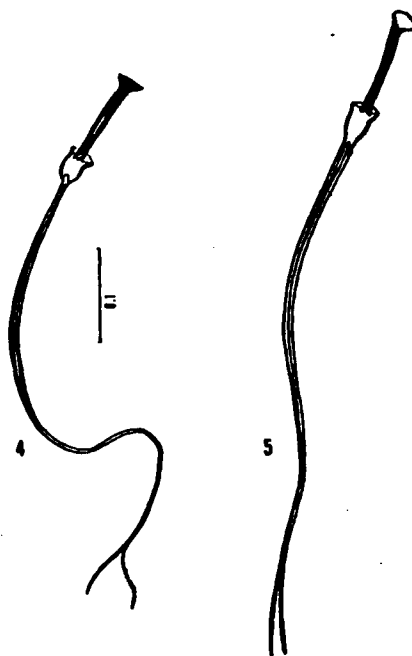
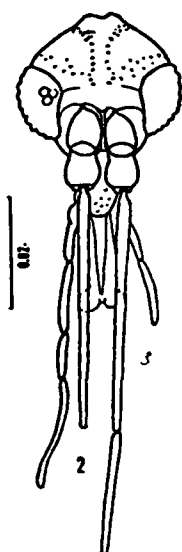
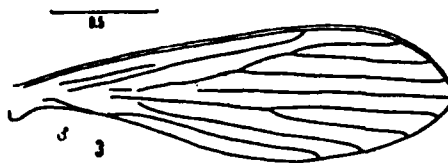
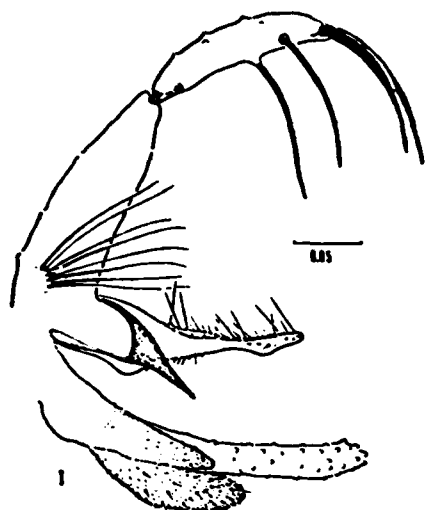
Fig. 5-8. Lutzomyia servulolimai ♂ holotype, sketched at U.S. National Museum, not drawn to same scale as others. 5, genital filaments and pump; 6, genitalia; 7, wing; 8, antenna base and palpi.

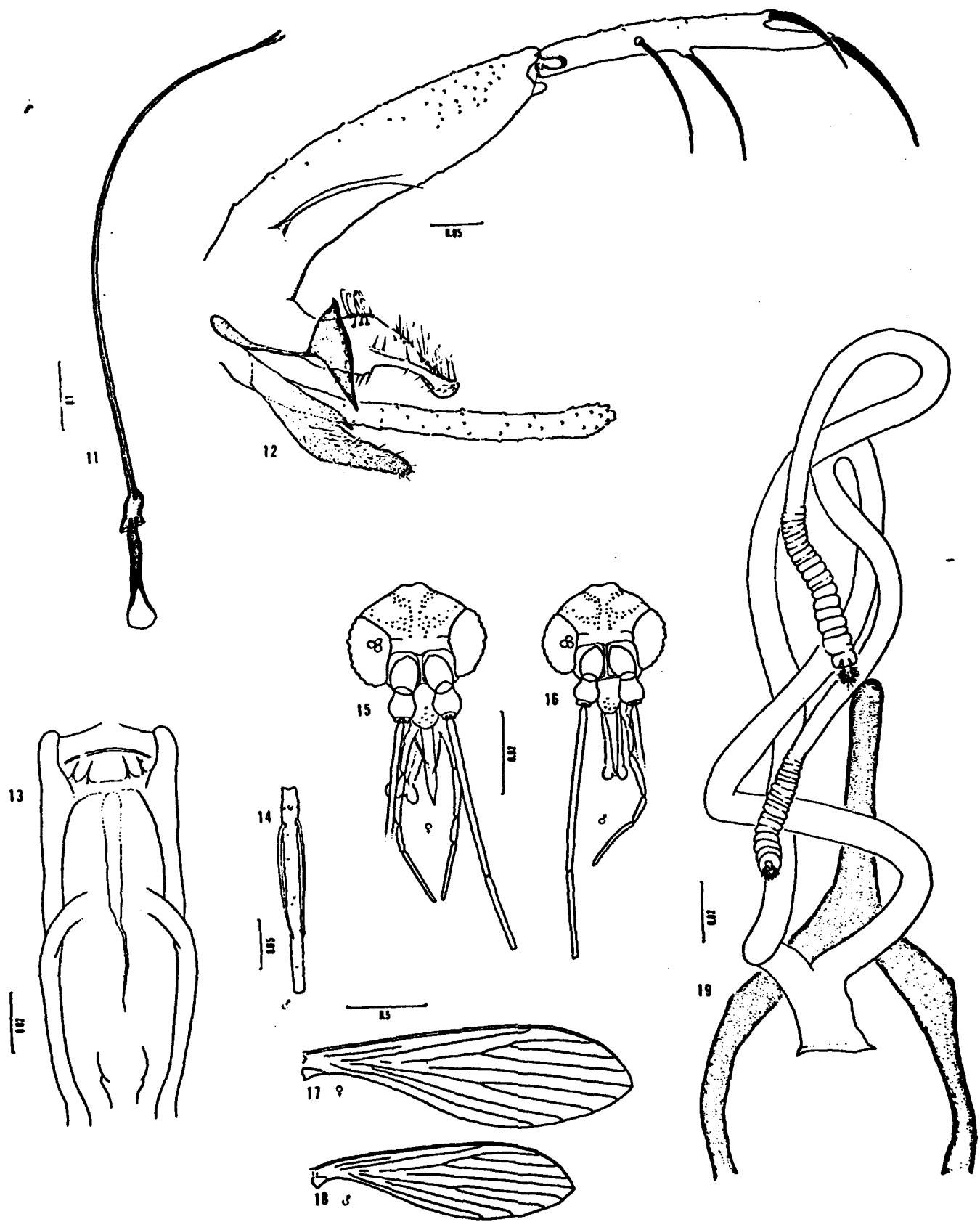
Fig. 9-10. Lutzomyia sp. ♀, Vichada, Colombia. 9, cibarium, same scale as Fig. 10; 10, spermathecae.

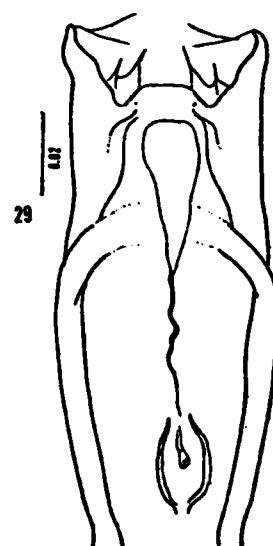
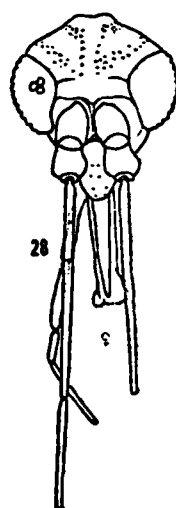
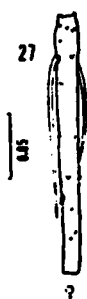
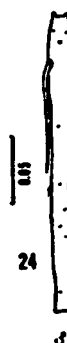
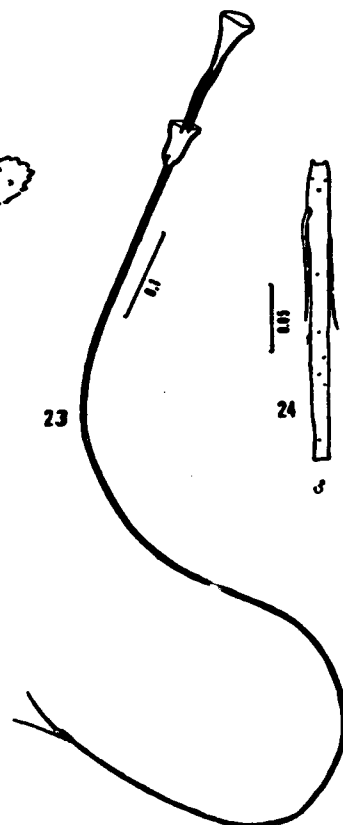
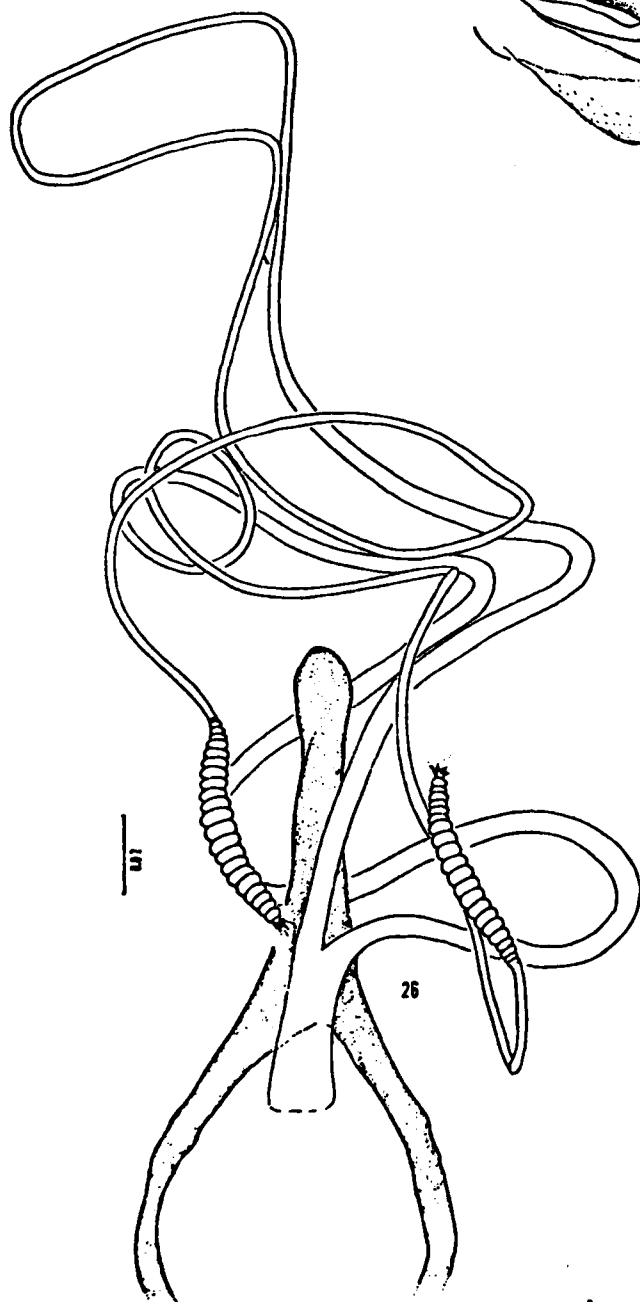
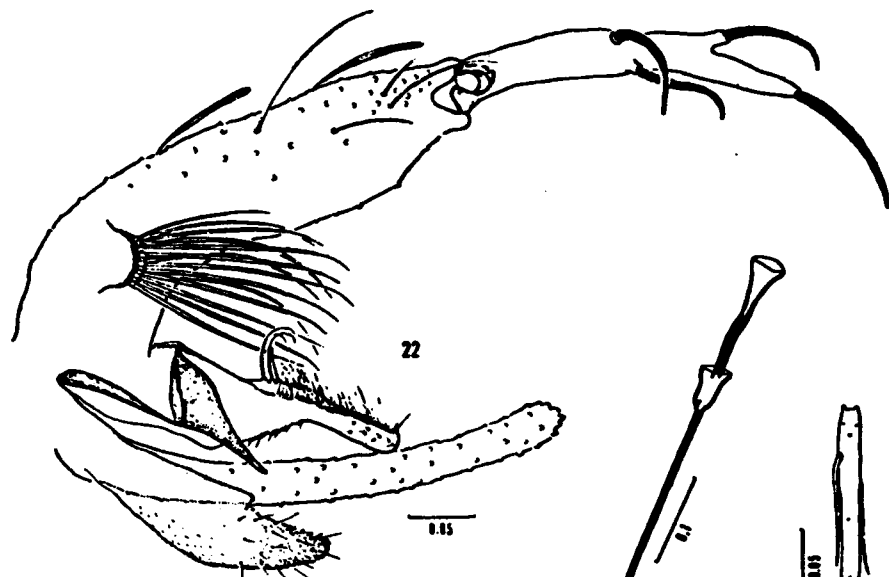
Fig. 11-19. Lutzomyia fluviatilis ♂, Paramana, Fr. Guiana; ♀, Maripasoula, Fr. Guiana. 11, genital filaments and pump; 12, genitalia; 13, ♀ cibarium; 14, ♂ flagellomere II; 15, ♀ head; 16, ♂ head; 17, ♀ wing; 18, ♂ wing; 19, spermathecae.

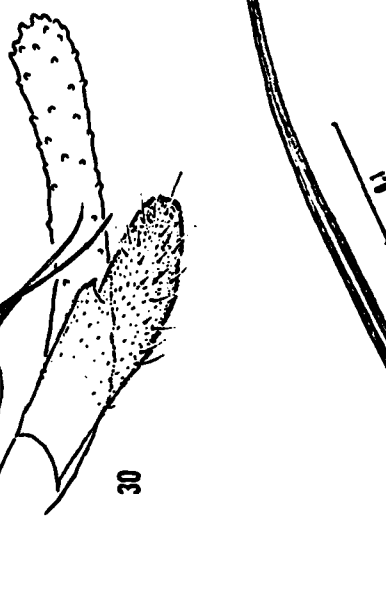
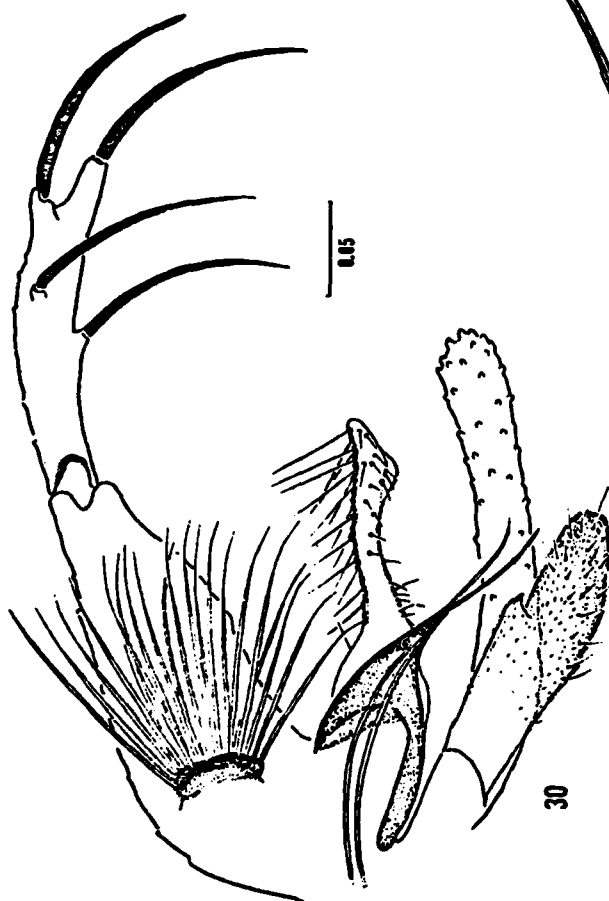
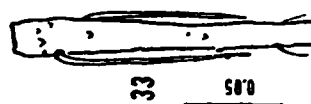
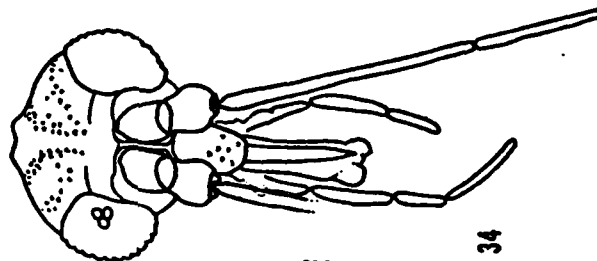
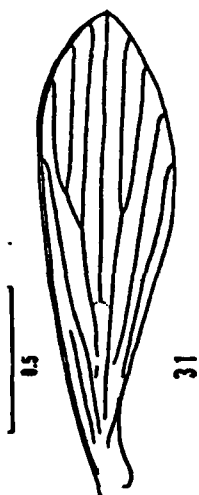
Fig. 20-29. Lutzomyia nematoducta n.sp. ♂ and ♀, Amazonas, Brazil. 20, ♀ wing; 21, ♂ wing; 22, genitalia; 23, genital pump and filaments; 24, ♂ flagellomere II; 25, ♂ head; 26, spermathecae; 27, ♀ flagellomere II; 28, ♀ head; 29, ♀ cibarium.

Fig. 30-34. Lutzomyia preclara n.sp. ♂, Leticia, Colombia. 30, genitalia; 31, wing; 32, genital filaments and pump; 33, flagellomere II; 34, head.









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### APPENDIX III

#### The Laboratory Biology of the Sand Fly

Lutzomyia anthophora (Ciptera: Psychodidae)

#### ADDENDUM

Appendix III has now been published in the open literature and has been deleted from this report. See Endris, R.G., D.G. Young, and J.F. Butler. 1984. The Laboratory Biology of the Sand Fly *Lutzomyia anthophora* Diptera Psychodidae. J. Med. Entomol. 21(6):656-664.

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PERSONNEL SUPPORTED ON PROJECT

D.G. Young, Ph.D., Assistant Research Scientist, Dept. of Entomology and Nematology, University of Florida.

S.S. Haney, Technician, Dept. of Entomology and Nematology, University of Florida.

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