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GUIDE TO THE IDENTIFICATION AND GEOGRAPHIC DISTRIBUTION OF *LUTZOMYIA* SAND FLIES IN MEXICO, THE WEST INDIES, CENTRAL AND SOUTH AMERICA (DIPTERA: PSYCHODIDAE)

By

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Monographic works on insects are published as Memoirs of the American Entomological Institute. Memoir No. 54 incorporates a taxonomic treatment of nearly 400 species and subspecies of phlebotomine sand flies belonging to the medically important genus *Lutzomyia* occurring in the New World. References to existing and new information on their geographic distributions, biology and disease relationships are included.

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Nearly 400 species and subspecies of phlebotomine sand flies in the medically important genus Lutzomyia are identified by taxanomic keys to the adults and by associatiated illustrations. References to existing and new information on thier geographic distribution(with maps), biology, and disease relationships are included. The following 9 new species in the genus are described: caminoi Young and Duncan, christenseni Young and Duncan, clitella Young & Perez, falcata Young, Morales, and Ferro, gibba Young & Arias, nemorosa Young & Perez reinerti Young and Duncan, sinuosa Young & Duncan, and torvida Young, Morales & Ferro. The previously unknown females of monticheti, omagua and pelloni are described. New junior synonyms include spinosa Floch & Abonnenc (=damascenoi Mangabeira) and tikalensis Leon (=permira Fairchild & Hertig). The status of nuneztovari anglesi Le Pont & Desjeux as a subspecies of n. nuneztovari is rejected. The subgenus Xiphomyia of Artemiev 1991 is a junior homonym of Xiphomyia of Alexander 1916. The subspecies name, cruzi of Gonzalez & Garcia-Avila 1981, is a junior homonym of cruzi of Mangabeira 1938. Lutzomyia paulwilliamsi Martins, Falcao & Silva is a junior synonym of Lutzomyia monticola (Costa Lima).

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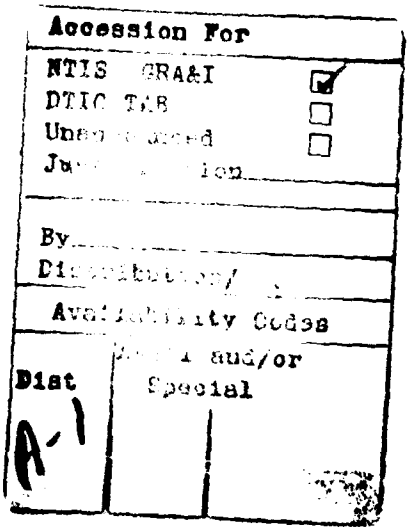

CONTENTS

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ABSTRACT. Nearly 400 species and subspecies of phlebotomine sand flies in the medically important genus *Lutzomyia* are identified by taxonomic keys to the adults and by associated illustrations. References to existing and new information on their geographic distributions (with maps), biology, and disease relationships are included. The following 9 new species in the genus are described: *caminoi* Young & Duncan, *christenseni* Young & Duncan, *clitella* Young & Pérez, *falcata* Young, Morales & Ferro, *gibba* Young & Arias, *nemorosa* Young & Pérez, *reinerti* Young & Duncan, *sinuosa* Young & Duncan, and *torvida* Young, Morales & Ferro. The previously unknown females of *moucheti*, *omagua* and *pelloni* are described. New junior synonyms include *spinosa* Floch & Abonnenc (= *damascenoi* Mangabeira) and *tikalensis* Leon (= *permira* Fairchild & Hertig). The status of *nuneztovari anglesi* Le Pont & Desjeux as a subspecies of *n. nuneztovari* is rejected. The subgenus *Xiphomyia* of Artemiev 1991 is a junior homonym of *Xiphomyia* of Alexander 1916. The subspecies name, *cruzi* of Gonzalez & Garcia-Avila 1981, is a junior homonym of *cruzi* of Mangabeira 1938. *Lutzomyia paulwilliamsi* Martins, Falcão & Silva is a junior synonym of *Lutzomyia monticola* (Costa Lima).

INTRODUCTION

The phlebotomine sand flies are notorious vectors of human diseases caused by *Leishmania* protozoa, *Bartonella* bacteria, and numerous arboviruses. The medically important species belong in two genera -- *Phlebotomus* Rondani & Berté (Old World) and *Lutzomyia* França (New World). Members of the former genus were reviewed by Lewis (1982), but there has been no comparable treatment of the *Lutzomyia* sand flies since Forattini (1973).

Accordingly, we felt that an up-to-date account of this genus might be useful to investigators interested in these hematophagous insects. Barretto (1947a) provided complete references to the species known at that time. Subsequent papers by Fairchild & Hertig (1947-1961), Forattini (1973), Martins et al. (1978) and Young (1979) contain additional citations. These sources, and others listed here, can be consulted for specific information on each taxon, including the immature stages which are not described and illustrated in the present publication. We also excluded five *Lutzomyia* species known to occur only within the continental boundaries of

Canada and the U.S.A. -- *L. californica* (Fairchild & Hertig), *L. apache* Young & Perkins, *L. aquilonia* (Fairchild & Harwood), *L. tanyopsis* Young & Perkins, *L. xerophila* Young, Brenner & Wargo, and the fossil species -- *L. paterna* (Quate) from Mexican amber and two undescribed *Lutzomyia* spp. from Dominican Republic amber (Young & Lawyer 1987). The North American sand fly fauna was reviewed recently by Young & Perkins (1984) with additional distributional, medical, and biological data provided by Corn et al. (1990), McHugh et al. (1990), McHugh (1991), Brinson et al. (1992), Comer et al. (1992), and McHugh & Grogl (1993).

Virtually all information on the systematics, biology and disease relationships of the American sand flies has accumulated during the present century, beginning in 1907 when Coquillett (1907) formally described two species - *Flebotomus cruciatus* and *Flebotomus vexator.* Little progress was subsequently made until the 1930s, shortly after Adler & Theodor (1926) and Theodor (1932) drew attention to the usefulness of the female cibarium and spermathecae as key taxonomic characters. At the same time, the role of sand flies as disease vectors became better known. Thus, many neotropical species were described and named from the late 1930s to 1960 by Mangabeira, Abonnenc (with H. Floch), Damasceno, Causey, Barretto and associates, Costa Lima, Fairchild and Hertig, Dampf, Vargas and Nájera. Concomittant with the increase in species descriptions, there was growing interest in the supraspecific classification of the American phlebotomines (Fairchild 1955, Barretto 1962, Theodor 1965, Forattini 1973, Lewis et al. 1977, Martins et al. 1978; Artemiev 1991).

Aside from brief remarks, our attention is not focused on this aspect of sand fly systematics. Rather, we emphasize identification of the *Lutzomyia* species and subspecies that occur in Mexico, the West Indies, Central and South America. The distribution maps were prepared from both published and unpublished information. The book on American sand flies by Martins et al. (1978) gives detailed locality information and has made our task of plotting the geographic ranges of many species much easier. Doubtful records are marked with a query. Each symbol on the map represents one or more specimens from, or near, a specific locality.

The majority of illustrations are original or were published previously by the senior author alone or with coauthors. It was necessary to adapt some figures of sand flies from the literature when specimens were not available. References to these illustrations are given where appropriate.

The search for new taxonomic characters has accelerated, especially as they relate to cryptic species which are inseparable in structure or coloration. For example, differences in cuticular hydrocarbons were noted between the structurally-similar females of *L. wellcomei* and *L. complexa* in Brazil (Ryan et al. 1986c). Earlier efforts to distinguish these cryptic females by multivariate discrimination were not completely reliable (Lane & Ready 1985). The increasing use of enzyme electrophoresis and other biochemical methods such as DNA probes (Ready et al.

1991 & Adamson et al. 1991) are expected to add much to our biosystematic knowledge of Phlebotominae but will not entirely replace existing diagnostic aids in the near future.

In the meantime, we hope that this review will serve as a guide to the biosystematics of one important genus in the subfamily.

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Special thanks are due J.R. Arias who allowed us to use his unpublished distribution records of many *Lutzomyia* species from the Amazon basin of Brazil. Alberto Morales and M.C. Ferro provided similar information on Colombian sand *flies. Ronald A. Ward, Willis W. Wirth, Jayson I. Glick, Phillip G. Lawyer* and Edelberto S. Dias painstakingly reviewed the manuscript and added valuable suggestions. David C. Miles, Walter Reed Army Institute of Research, spent many hours photographing and reducing original illustrations so that they were suitable for the format of this book. Barbara Hollien cheerfully typed the original manuscript

in 1988 and Debbie Boyd followed with revisions and additions in 1992. Finally, we wish to acknowledge our spouses, Molly and Paul, who helped in many ways during the compilation of this manual.

SOME ABBREVIATIONS IN TEXT

a.s.l. = above sea level
approx. = approximately
biol. = biology
ca. = about or near
cf. = compared
coll. = collector or collection
descript. = description
dist. = distribution
exp. = experimental
female = ♀
Fig. = figure(s)
flag. = flagellomere
gen. = general
ident. = identification
L. = *Lutzomyia*
lab. = laboratory
Le. = *Leishmania*
male = ♂
misident. = misidentification
mm = millimeter
morphol. = morphology
nat. = natural
neg. = negative
orig. = original
palp. = palpomere
pers. comm. = personal communication
physiol. = physiology
pop. = population
redescript. = redescription
rel. = relative
refs. = references
tax. = taxonomy
unident. = unidentified
unpub. = unpublished

COLLECTION AND PRESERVATION METHODS

COLLECTION TECHNIQUES

Sand flies are collected and preserved by various methods depending on the objectives of a particular study and the degree to which the local fauna is known.

A combination of sampling techniques for adult flies is desirable at poorly studied sites to determine the species spectrum. Some *Lutzomyia* species, such as *L. anthophora*, are abundant and easily captured at their diurnal resting sites but are rarely encountered in light traps or humar bait. The converse behavior is true for other species.

Collecting adults from their daytime microhabitats can be accomplished with or without traps. The simplest way to collect these resting insects is with the aid of a suction tube (Chaniotis 1978) or mechanical aspirator (Trpis 1968). Phlebotomines have a characteristic hopping flight when disturbed and it takes only a brief time to learn to distinguish them from other flying insects that occupy the same shelters. Examples of diurnal resting sites include leaf litter, rock crevices (Fig. 1), caves, animal burrows, nests, dark places in man-made structures, tree trunks and tree hollows (Fig. 2). A flashlight is not only helpful for illuminating dark areas but also may disturb the flies so that they are more easily spotted and captured. Collectors

FIG. 1. Rock crevices and caves near Belo Horizonte, Brazil that serve as resting and breeding sites for several phlebotomine species (Photograph, D.G. Young, 1974).

FIG. 2. Collecting sand flies from a buttressed tree trunk with a suction tube; Trujillo State, Venezuela (Photograph, D.G. Young, 1965)

commonly agitate resting flies by moving a small branch or stick over resting surfaces to achieve the same result.

Certain traps have been devised to sample sand flies in these microhabitats, notably tree trunks (Damasceno trap, Forattini 1973), tree hollows (funnel trap, Comer & Corn 1991) and animal burrows (funnel trap, Chaniotis 1978). Rutledge & Ellenwood (1975a) placed emergence traps on the forest floor in Panama to recover adult sand flies from their breeding sites. Sticky traps made of paper or plastic and covered with oil can also be placed at or near resting sites to sample sand fly populations (W.H.O. 1984, Chaniotis 1978). These have been used more in relatively dry areas than in tropical wet forests because of practical problems resulting from excessive moisture.

Flight traps such as the Malaise trap (Townes 1962) and modifications of it (Fig. 3), also intercept sand flies, but they have not been widely used by sand fly specialists. One such trap, set up in forest near the Rio Urubu, Amazonas, Brazil in March, 1979, captured over 20 *Lutzomyia* spp. (350+ specimens) during one evening (Young & Arias, unpublished data). No obvious attractants were added to this trap.

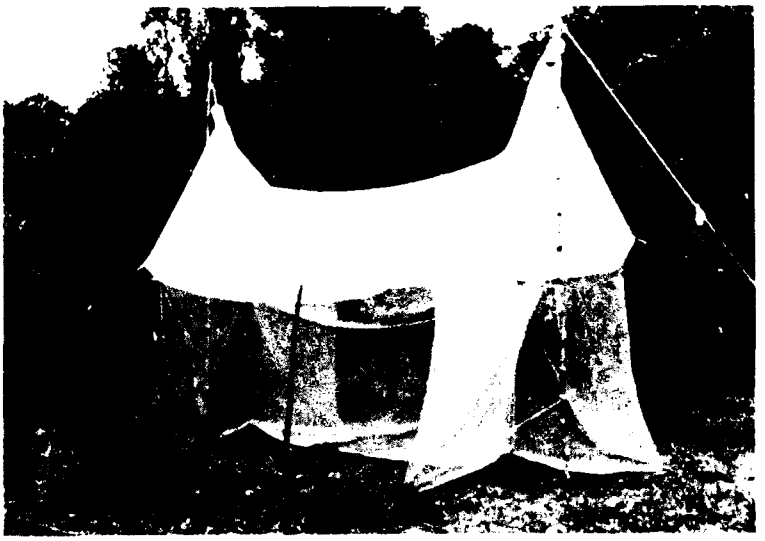

FIG. 3. A flight trap for intercepting sand flies and other insects. Killing jars are visible at the two top ends (Photograph, J.F. Butler).

Traps that rely on attractants, either alone or in combination, include light traps, chemical traps, and animal traps. The lightweight CDC miniature light trap (Sudia & Chamberlain 1962) is widely used to sample *Lutzomyia* populations. Chaniotis

& Anderson (1968) developed a modified version of it and Williams et al. (1981) compared the two in Brazil. The results were inconclusive when only sand fly captures were compared but the CDC model trapped more dipterous specimens than the Chaniotis trap. Heavier light traps, such as the New Jersey mosquito light trap (Mulhern 1942), also attract sand flies and are best suited for permanent installation.

The Shannon trap (Shannon 1939) and modifications of it (Pérez et al. 1988) is a large, rectangular structure made of bed sheeting or other cloth that serves as a nocturnal collecting station, not a trap *per se*. Sand flies are attracted to a light source located inside the structure and to sand fly collectors who stand near, or inside of the "trap", to detect and capture the easily-seen flies that land on the fabric.

Carbon dioxide gas, slowly released from metal tanks or from dry ice, can be emitted in or near these traps to increase their effectiveness. Brenner & Wargo trapped a desert species, *L. xerophila*, in California, USA, in CO_2 traps without obvious additional attractants (Young et al. 1983).

Traps have also been devised to capture sand flies that are attracted to animal bait. The Disney trap (Disney 1966) consists basically of a shallow metal pan into which oil is spread. A small animal is placed in a cage near the center of the pan close to the sticky surface. Sand flies become stuck in the oil before or after reaching the bait animal. Ward (1977b) in Brazil used a funnel-type trap, baited inside with a small mammal, to collect blood-engorged sand flies for laboratory colonization attempts. Larger mammals are also used as bait and the flies can be aspirated on, or near, them or else collected from inner surfaces of stable or drop traps (Roberts 1965, Schmidtmann et al. 1981).

The risk of contracting sand fly-borne or other arthropod-borne diseases during human bait collections can obviously be reduced by wearing protective clothing. Also, there are other ways to determine which species are anthropophilic (e.g. precipitin or DNA tests of blood meals from recently engorged females).

The immature stages of phlebotomines are very difficult to collect in nature owing to their small size, terrestrial habitat, and lack of characteristic movement. Hanson (1961) recovered and reared a number of sand fly larvae in Panama using mainly a sugar-flotation technique that he describes in detail.

PRESERVATION

Flies can be killed by various means such as freezing in dry ice (CO_2), heating in direct sunlight or by exposing them to poisons in killing bottles. Ethyl acetate and chloroform are commonly used killing agents.

Before most sand flies can be identified with certainty, several steps should be taken in their preparation. Field-collected material stored dry between layers of tissue paper in small containers (e.g., pill boxes) is preferable to alcohol-preserved

specimens, the muscles of which harden with age and become difficult or impossible to macerate at a later time (6+ months after preservation).

Dry or frozen specimens, on the other hand, can be macerated and studied at any time using the following procedures.

A. Place dry flies in 2-5% detergent-water solution for one hour or until they become thoroughly wet and soft.

B. Put flies in crucible containing 10-20% NaOH in water.

C. Heat the NaOH solution to the boiling point; remove crucible from heat source and allow to cool at room temperature for 30 minutes to 2 hours.

D. Lift flies with a needle or forceps into a drop of 90-95% liquid phenol on a depression microslide. Lactophenol (1 part phenol: 0.75 parts lactic acid) can be substituted, but these acids, especially phenol, should be handled and used with care as noted on the original containers. It is often helpful, at this time, to roughly sort the specimens by coloration with the aid of a dissecting microscope.

E. Identify the specimens *with the aid of a compound* microscope. Phase contrast microscopy will enhance viewing of nearly all structures, especially the delicate antennal ascoids and spermathecal ducts. A cover glass can be placed over the specimens, if desired.

F. Store identified flies in 70% ethyl alcohol or else mount on microslides (1 fly/slide) using the following method outlined by Young & Perkins (1984). Coloring flies with acid fuschin or other stains may obscure natural coloration and therefore is not necessary.

G. Place one drop of Canada balsam in the depression of another microscope slide. Mix 2-5 drops of phenol with it and put specimen or specimens (up to 12) in the mixture.

H. Allow the phenol to slowly evaporate at room temperature until the balsam-phenol mixture becomes somewhat viscous. The mixture has now infiltrated the body of the sand fly and the spermathecae and other structures should be normal in appearance.

I. Dissect the specimen by removing the head and wings. Lift these parts and the remainder of the specimen with a small needle and position them on a coverslip in small drops of the balsam-phenol mixture in which the fly was dissected. Orient the head so that the cibarium can be viewed as in the illustrations in this paper.

J. Place a small piece of glass, from a previously ground coverslip, in each corner of the coverslip holding the dissected sand fly. Allow to dry until the drops of mixture are completely hard.

K. Invert coverslip over a drop of Canada balsam placed in the middle of a clean microscope slide. Store the slide horizontally until dry.

Specimens on slides can easily be remounted by soaking them in liquid phenol, *not* xylene, for a week or more. We do not use water-soluble mounting media (e.g., Hoyer's or Berlese's media) for preserving sand flies; these are considered temporary mounts even when properly sealed. In contrast, Canada balsam-preserved specimens will probably last for centuries.

BIOLOGY OF *LUTZOMYIA* SAND FLIES

References on the biology of individual sand fly species are given in the species account. This section serves only to provide some general information. Ward (1990) gives an excellent review of this subject.

IMMATURE STAGES

The eggs of 42 New World *Lutzomyia* species have been described (Endris et al. 1987b; Feliciangeli et al. 1993). They are dark, elliptical (Fig. 4) and are presumably laid in small batches in moist habitats such as rock crevices, bases of trees, leaves on the forest floor, animal burrows, and similar microhabitats. Laboratory studies of *L. longipalpis* suggest that an oviposition pheromone is present (El Naiem & Ward 1991) and is probably produced in the female accessory glands (Dougherty et al. 1992). The egg surface has ridges or other protuberances that form patterns typical of the species or species complex (Fig. 4).

The usual number of eggs laid by a female sand fly during a single oviposition cycle ranges from 40 to 70+ depending on species, size, and nature of the previous blood meal, larval diet, and other factors. A few species of *Lutzomyia* are autogenous, i.e., females will oviposit their first batch of eggs without having had a previous blood meal (Johnson 1961; Montoya-Lerma 1992). Subsequent ovipositions, however, are possible only after the female fly has taken a blood meal.

Hatching usually occurs within 10 days after oviposition, but some eggs in a batch may have a prolonged incubation period, hatching 30 or more days after the others, when kept under identical conditions (staggered or delayed egg hatch) (Lawyer & Young 1991). There is also evidence that some species survive adverse conditions (cold weather or dry periods) in the egg stage (Lawyer 1984).

At present, the larvae of about 62 species of *Lutzomyia* and *Brumptomyia* have been described. The larvae (Figs. 4 & 5) are small and caterpillar-like (< 12 mm)

FIG. 4. *Lutzomyia* eggs and newly hatched larva (photograph, E. Rowton). Surface structure of one egg is shown by SEM.

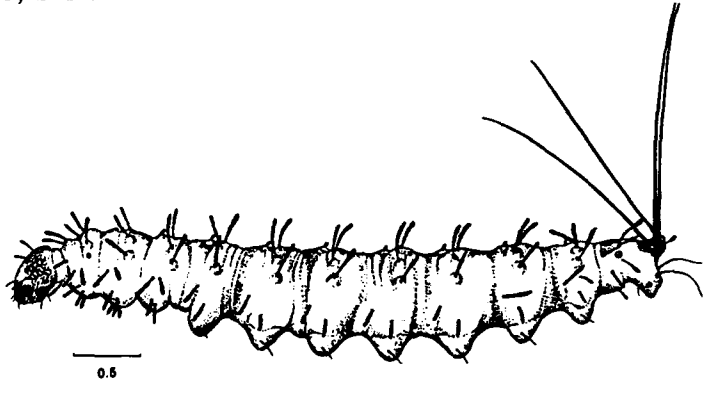

FIG. 5. Fourth instar *Lutzomyia longipalpis* larva, lateral view.

with a well-developed head capsule, many brush-like setae on the body and long caudal setae, the length of which may be related to the habits of the species. Surface feeders generally have longer caudal setae than those that burrow (Hanson 1961). Mature larvae (4th instar) of the *Brumptomyia* spp. have only 2 caudal setae, whereas those of *Lutzomyia* have 4.

Upon hatching, the first instar larvae begin to feed on available dead organic matter, sometimes including the egg shell from which they may ingest oocysts of gregarine parasites (Protozoa). Larvae have been recovered from soil in animal burrows, on dead leaves on the forest floor at the base of large trees, in debris from depressions in trees, and in other moist microhabitats (Hanson 1961, 1968).

Developmental time for sand fly larvae of some species can be as short as 18 days but may be prolonged for months during cold or dry weather conditions.

FIG. 6. Pupa of *Lutzomyia* attached to substrate (photograph, E. Rowton).

Before transforming to a pupa (Fig. 6) the mature larva ceases to feed and seeks a place, usually drier than where it previously lived, to pupate. The pupa is attached to an object such as a dead leaf, stone, or other object. The compressed larval skin can be seen at the posterior end (the end attached to the substrate) of the pupa. The resting stage ordinarily lasts from 7 to 12 days, the males usually emerging before the females. Pupae have been described for 43 New World sand fly species, four of which are in the genus *Brumptomyia* (Leite et al. 1991).

ADULTS (Figs. 7 & 8)

Within 24 hours following emergence, males rotate their external genitalia 180° and become sexually mature. Locating a receptive female may be aided by pheromones and by locating a resting site or vertebrate host where females are present. Males of *L. longipalpis* usually outnumber females on vertebrate hosts and mating may occur when the females are taking a blood meal. Premating courtship behavior, including rapid wing beating of males and other lek-like behavior (Jarvis & Rutledge 1992), has been witnessed when both sexes are close together (within several centimeters). Different pheromones and wing beat patterns have been observed in different populations of this species (Phillips et al. 1986; Ward et al.

1988; Ward & Morton 1991). Mating swarms have not been observed in Phlebotominae.

Spermatozoa are held in the female spermathecae and can be seen with the aid of light microscopy in dissected flies. One mating may not be sufficient to inseminate a female throughout her lifetime.

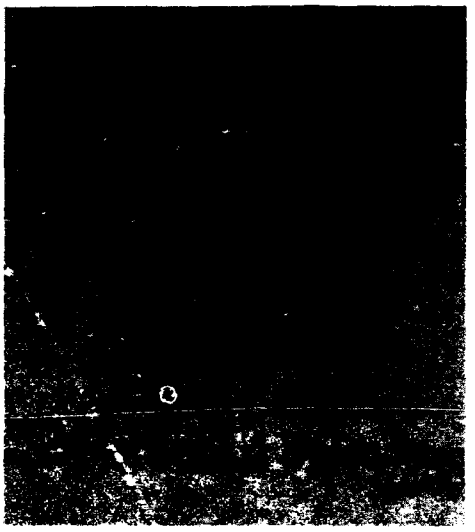

FIG. 7. Adult male *Lutzomyia shannoni* (photograph, R.G. Endris).

FIG. 8. Adult female *Lutzomyia anthophora* showing blood engorged abdomen (photograph, R.G. Endris).

Feeding Habits

Adults of both sexes require carbohydrates (sugars) for energy, the source of which is poorly known for most species. The fact that sand flies ingest sugar was first established by means of the cold anthrone test and chromatography. It has been reported, or suggested, that flies feed on honeydew from aphids or other Homoptera (Wallbanks et al. 1991), nectar from flowers, fruits, and other plant juices. Tesh et al (1992) showed that the aphid alarm pheromone, trans-beta-farnesene, stimulated feeding of males and females of *L. longipalpis* under laboratory conditions. Carbohydrates may also affect the development and infectivity of *Leishmania* in sand flies so it is important to know the origin of these sugars to help understand the dynamics of disease transmission.

Anautogenous females require vertebrate blood for the maturation of their eggs; some species feed once between ovipositions, whereas others (e.g., *L. shannoni*) may take multiple blood meals during a single oviposition cycle.

Members of the subgenus *Coromyia* of *Lutzomyia* feed almost exclusively on bats or rodents; *Brumptomyia* females presumably feed mostly on armadillos; some species feed primarily on reptiles or amphibians whereas others are opportunistic, feeding on a variety of mammals and/or birds depending on their availability. The precipitin test for blood meal identification has proved useful for studying the natural hosts of *Lutzomyia* species in Panama and Brazil (e.g., Tesh et al. 1971a).

Most man-biters feed at dusk and during the evening but *L. wellcomei*, *L. carrerai*, and others will attack in the daytime as well. Windless or nearly windless conditions, along with other optimal conditions, may suddenly induce greater-than-expected numbers of sand flies to seek their hosts. Bloodfeeding females may release aggregation pheromones that attract other females to the host.

The majority of anthropophilic sand flies in the Americas are exophilic, biting persons outside of their houses. *Lutzomyia trapidoi* is one example. Others, including *L. gomezi*, *L. verrucarum*, *L. longipalpis*, and some of the *Lutzomyia* (*Nyssomyia*) spp., readily enter human dwellings where they bite the occupants. Porch or other lights inside houses may also help attract some anthropophilic species to homes. The degree of anthropophily varies not only among species but also among conspecific populations (e.g. *L. shannoni*, if indeed all populations are conspecific).

Flight Range

We know little about the dispersal and flight range of American Phlebotominae. Chaniotis et al. (1974) in Panama marked 20,000 wild-caught flies with fluorescent powders, released them at ground level and in the canopy, then recaptured fewer than 9% of marked individuals as long as 13 days afterwards. Four sand flies flew

200 m from the release point but the majority were recaptured within a radius of 57 m, indicating that these forest-inhabiting species have a limited flight range. There is also vertical movement, perhaps daily, of some *Lutzomyia* species from the forest floor to canopy. Alexander (1987) studied the flight range of phlebotomines in a coffee-growing area of NE Colombia and observed similar horizontal flight patterns.

Resting Sites

The type of resting site used by adult sand flies varies according to availability of microhabitat, season, amount of moisture present and species of sand fly. *Lutzomyia longipalpis*, a species usually occurring in nonforested areas, is often found resting in rock crevices or caves, if they are present (Fig. 1). In localities lacking these shelters, such as in NW Costa Rica, the resting sites of this species have not yet been determined.

The tropical rain forest offers the greatest variety of resting sites and it is there where most sand fly species occur. Resting sites that become excessively wet are abandoned by these insects but may be utilized at other times when conditions become more favorable.

The forest floor itself is the most extensive microhabitat used by many resting sand flies [e.g., *L. flaviscutellata*, *L. olmeca*, and some *Lutzomyia* (*Psychodopygus*) spp.]. These and other species are also found on the undersides of leaves of small shrubs and plants, particularly when the forest floor becomes too wet. *Lutzomyia umbratilis*, *L. ylephiletor*, and *L. shannoni* are associated with tree trunk resting sites; *L. anthophora* and some other *Lutzomyia* (*Dampfomyia*) spp. rest in mammal nests which may also serve as breeding sites. The *Brumptomyia* spp. and those in the *Lutzomyia aragaoi* species group are often found in armadillo burrows; some *Lutzomyia* (*Coromyia*) species are commonly observed in hollow trees or caves that are occupied by bats. Anthropophilic species of *Lutzomyia* that enter homes to feed may rest on the inside walls for a short time, usually leaving within 24 hours after the blood meal.

Seasonal Distribution

The abundance of adult sand flies may or may not vary greatly throughout the year depending on locality. When there are seasonal fluctuations in temperature (temperate zones) or in precipitation (neotropics), seasonal changes in sand fly populations are usually marked. Populations of *L. umbratilis* in French Guiana are highest at the beginning and end of the rainy season (based on man-biting collections). Populations of *L. longipalpis* in Ceará, Brazil, increase during the rainy season (January to May) and reach a peak shortly after the rains stop.

It is not always possible to predict when populations of a particular species will be highest based on results of studies done elsewhere. For example, in one study

in Panama the man-biting activity of *L. panamensis* was greatest during the dry season but dissimilar results were obtained in northern Colombia where biting activity of this species was greatest during the rainy season (Porter & De Foliart 1981).

Parasites

Young & Lewis (1977) and Warburg et al. (1991a) summarized published reports of parasites (excluding mites) that have been observed in phlebotomines. Adult sand flies have been found naturally infected with various protozoans, nematodes, cestodes, fungi, bacteria, and viruses. Mites sometimes attach to the exoskeleton of adult flies (Lewis & Macfarlane 1981). The effects of these organisms on the longevity, reproductive capacity and development of sand flies are mostly unknown. Some preliminary laboratory studies, however, indicate that heavy infections of a tylenchid nematode, found in *L. longipalpis*, can cause sterility in female flies or reduce egg production (Poinar et al. 1993). Protozoa in the genus *Ascogregarina* (Ward, Levine & Craig) have been found in more than 20 *Lutzomyia* spp. (Wu & Tesh 1989). *Ascogregarina chagasi* (Adler & Mayrink) and *A. saraviae* (Ostrovska, Warburg & Montoya-Lerma) are the only two named species in the Americas (Warburg & Ostrovska 1991). The former species significantly reduced longevity of adults of a Brazilian population of *L. longipalpis* in the laboratory (Wu & Tesh 1989).

Mortality rates ranging from 12% to 100% were observed when adult *L. longipalpis* were fed *Bacillus thuringiensis* var. *israelensis* in sucrose solutions (Yuval & Warburg 1989).

MEDICAL IMPORTANCE OF *LUTZOMYIA*

Lutzomyia sand flies are common, nocturnal biting insects at many neotropical localities, from lowland forests in Amazonia to treeless sites in the Andes mountains. Their notoriety obviously reflects their role as disease vectors but sand flies also affect people directly by their biting habits. The female mouthparts produce a sharp, needle-like pain when they puncture the skin. Antigenic salivary components add to this irritation and, in some cases, may initiate an allergic response although this has not been well documented for the New World sand flies.

Residents sometimes lose sleep due to the relentless attacks of these insects. It is also assumed that secondary infections may develop at pruritic bite sites where aggressive scratching abrades the skin.

Transmission of vertebrate pathogens usually occurs during the bloodfeeding of an infectious female sand fly. Posterior transmission (i.e., fecal contamination) of some agents is also possible but little studied. The diseases they cause in humans are discussed below. Other sand fly-borne microorganisms, especially trypanosomatids,

that are associated with vertebrate hosts, other than man, have been observed in dissected flies (Ryan et al. 1987c). These include *Trypanosoma phyllotis*, a parasite of a Peruvian mouse, *Phyllotis* sp. (Herrer 1942); *T. leonidasdeanei*, a bat parasite in Central America (Christensen & Herrer 1975; Williams 1976c); *T. thecadactyli* of neotropical lizards (Christensen & Telford 1972); *T. bufophlebotomi* of toads (U.S.A.); *T. scelopori* and *T. gerrhonoti*, both found in California lizards (see Williams & Coelho 1978). Naiff et al. (1989) isolated *T. freitasi* from the posterior midgut and hindgut of *L. claustrei* in Brazil, indicating that transmission to opossums (*Didelphis*) may occur by skin contamination or by ingestion of infective flies. There is considerable evidence that *Endotrypanum* of sloths is transmitted by sand flies (Shaw 1981, 1992; Rogers et al. 1988).

Experimental transmission studies of sand flies and other Protozoa (*Plasmodium mexicanum* and *Schellackia* spp.) that infect lizards (Fig. 9) indicate that these insects may also be natural vectors (Klein et al. 1987, 1988).

Many of these studies have been made possible by the establishment of vigorous laboratory colonies of sand flies. Killick-Kendrick et al. (1991) give references to practical colonization methods.

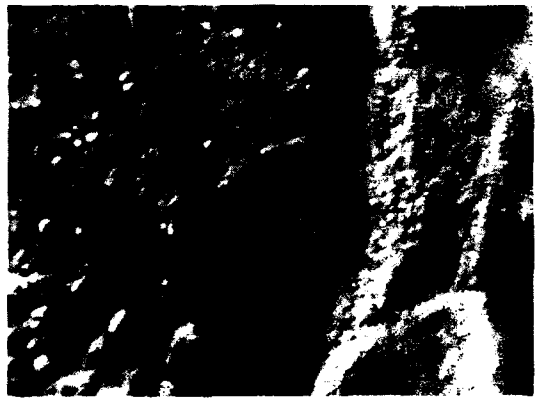

FIG. 9. A spherical *Plasmodium mexicanum* oocyst, 5 days old, attached to the midgut of an experimentally-infected *Lutzomyia vexator* sand fly (Photograph, T.A. Klein).

THE LEISHMANIASES

The etiologic agents of leishmaniasis are *Leishmania* Ross 1903 belonging in the protozoan family Trypanosomatidae. A World Health Organization Expert Committee listed *Leishmania* species that have been isolated from humans in the Americas (W.H.O. 1990). Since then, two additional species, *Le. naiffi* and *Le.*

shawi, have been added to the list (Table 1 and Lainson & Shaw 1992). Other *Leishmania*, such as *Le hertigi*, *Le. deanei*, *Le. enrietti* and *Le. aristidesi*, are known only to infect lower mammals (W.H.O. 1990).

The leishmaniases are the most severe and common of the sand fly-borne diseases. Autochthonous human cases have been reported from most countries in the Americas except for Canada, some island nations in the Carribean, Chile and Uruguay (Grimaldi et al. 1989, 1991; W.H.O. 1990; Corredor et al. 1990; Dedet 1990; Hashigushi et al. 1991).

The clinical symptoms of leishmaniasis in man vary greatly and do not always reflect which *Leishmania* species is causing the infection. Thus, the classification of these parasites is now based on their intrinsic characteristics, rather than on the signs of infection that develop in vertebrate hosts (Grimaldi et al. 1989). Some examples of skin lesions due to two *Leishmania* species are shown in Figs. 10-13.

FIG. 10. Colombian child with a facial lesion caused by *Leishmania braziliensis* (Photograph, D.G. Young).

FIG. 11. Three primary leishmanial lesions due to *Leishmania mexicana* on the lower leg and ankle of a Colombian hunter (Photograph, J. Boshell, 1984).

FIG. 12. Mucocutaneous leishmaniasis due to *Leishmania braziliensis* in Bahia State, Brazil (Photograph, P.D. Marsden & D.G. Young, 1985).

FIG. 13. Diffuse cutaneous leishmaniasis due to *Leishmania mexicana* variant on the lower legs of a patient from the Dominican Republic (Photograph, R.N. Johnson, 1981).

Man is regarded as an accidental host of leishmaniasis in the Americas, not a true reservoir host. This generally applies to domestic animals as well, except for dogs which are proven reservoirs of visceral leishmaniasis caused by *Leishmania chagasi* (= *Le. infantum*?) (Fig. 14) and possibly *Le. braziliensis* (Falqueto et al. 1991). The number of New World mammals that are recognized as reservoirs of *Leishmania* continues to grow as more epidemiological studies are undertaken and as improved methods of parasite identification develop.

FIG. 14. Domestic dog showing clinical signs of infection with *Leishmania chagasi* (= *infantum*?) near Melgar, Cundinamarca Dept., Colombia (Photograph, D.G. Young & A. Morales, 1985).

The list of *Lutzomyia* vectors also continues to grow (Table 1). Determining which species of sand fly is a vector of leishmaniasis in a given area requires careful, often long-term study (Killick-Kendrick 1990). It must be demonstrated that leishmanial parasites from naturally-infected sand flies are indistinguishable from those isolated from humans. The vector species must, of course, be anthropophilic, but it does not necessarily follow that it must be the most common man-biting species in the area. Knowing where and when transmission takes place, correlated with information on the habits, seasonal and geographic distribution of the suspected vector, provides additional evidence for incriminating vector species. Because a particular *Lutzomyia* species is experimentally capable of transmitting leishmanial parasites by bite does not, by itself, conclusively prove that it is a vector in nature. Vectors remain to be discovered in many leishmaniasis foci in the Americas. Specific references on this subject are cited in the present review.

Table 1. *Leishmania* Known to Infect Humans in the Americas

Leishmania sp.	Distribution	Suspected/Proven Vectors	Recent Reference(s)*
Le. (Viannia) braziliensis	widespread, Belize to N. Argentina	many	1,3,4,5,7,9, 11,12
Le. (V.) colombiensis	Colombia, Panama, Venezuela	*L. hartmanni* *L. gomezi* *L. panamensis*	10,17
Le. (V.) guyanensis	Colombia, Ecuador, French Guiana, Brazil	*L. umbratilis* *L. whitmani* *L. anduzei*	1,4,5,7,11
Le. (V.) lainsoni	Brazil	*L. ubiquitalis*	11,15,20
Le. (V.) naiffi	Brazil	*L. paraensis* *L. squamiventris* *L. ayrozai*	8,11,18
Le. (V.) panamensis	Honduras, Costa Rica, Panama, Colombia, Ecuador	*L. trapidoi* *L. ylephiletor* *L. gomezi* *L. panamensis* *L. hartmanni*	1,4,5,7
Le. (V.) peruviana	Peru	*L. peruensis* *L. verrucarum*	1,4,16
Le. (V.) shawi	Brazil	*L. whitmani*	19
Le. (Leishmania) amazonensis	Panama, northern South America	*L. flaviscutellata* *L. reducta* *L. olmeca nociva*	1,2,5,7,11
Le. (L.) garnhami	Venezuela	*L. youngi*	1,4
Le. (L.) chagasi (= *Le. infantum* ?)	widespread, but local, Mexico to N. Argentina	*L. longipalpis* *L. evansi* *L. antunesi*	1,4,6,7,11
Le. (L.) pifanoi	Venezuela	?	1
Le. (L.) mexicana	U.S.A., Central America to western South America; Dominican Republic	*L. anthophora* *L. olmeca olmeca* *L. ylephiletor* *L. christophei* *L. diabolica*	1,4,5,7,11,13
Le. (L.) venezuelensis	Venezuela	*L. olmeca bicolor*	1,4

* The reference numbers in Table 1 refer to the following articles:
1) Grimaldi et al. (1989); 2) Freitas et al. (1989c); 3) LePont et al. (1989c); 4) Killick-Kendrick (1990b); 5) Armijos et al. (1990); 6) Travi et al. (1990); 7) Corredor et al. (1990); 8) Lainson et al. (1990a); 9) Azevedo et al. (1990); 10) Kreutzer et al. (1991); 11) Grimaldi et al. (1991); 12) Rowton et al. (1992); 13) McHugh et al. (1993); 14) Johnson et al. (1992); 15) Silveira et al. (1991); 16) Pérez et al. (1991); 17) Delgado et al. (1993); 18) Naiff et al. (1991); 19) Shaw et al. (1991); 20) Lainson et al. (1992).

Detailed studies with full references on the development of *Leishmania* in their extrinsic hosts, i.e., sand flies, are given by Killick-Kendrick (1990a) and Walters et al. (1987, 1989a,b).

BARTONELLOSIS (CARRIÓN'S DISEASE)

Schultz (1968) and Weinman & Kreier (1977) wrote informative accounts of this disease which remains endemic in the high mountain valleys of Peru (Vargas & Peréz 1985; Gray et al. 1990) and in several areas of Ecuador (Huerta et al. 1978) (Fig. 15). A major epidemic began in southern Colombia in the 1930s but ended abruptly in the mid-1940s and has not reappeared. Reports of autochthonous human cases in other countries by various authors are not confirmed (e.g., in Chile, Bolivia & Guatemala).

Bartonella bacilliformis, the bacterial etiologic agent, is unusual in that is causes two distinct clinical manifestations in man - Oroya fever and Verruga peruana. The former condition is characterized by severe hemolytic anemia, joint pains, pallor, fever and jaundice. Mortality rates range as high as 90%. Fourteen of 16 untreated patients died during a recent epidemic at Shumpillan, Peru (Gray et al. 1990). *Salmonella* infections are serious concomittant complications of Oroya fever.

The other, less life-threatening form of bartonellosis is Verruga peruana, aptly named for the warty appearance of the skin of infected persons (Fig. 16). These lesions usually develop following recovery from Oroya fever and may last up to a year. The number and appearance of the painless nodules vary considerably. Chloramphenicol has been used successfully for treating patients with both forms of the disease.

Initial evidence supporting that Oroya fever and Verruga peruana have a common etiology was gained inadvertently from the tragic experiment of Daniel Carrión, a Peruvian medical student. He decided to study the course of infection of the benign Verruga peruvana by allowing himself to be inoculated with material from an infected patient. At that time (27 Aug. 1885), he did not suspect that Oroya fever and Verruga peruana were caused by the same organism. Three weeks later, however, Carrión developed symptoms of Oroya fever. He died on 5 Oct. 1885, 38 days following inoculation. Daniel Carrión was thus the first to link Oroya fever with Verruga peruvana and his surname has remained a synonym of bartonellosis in tribute to his dedication. Subsequent studies by Strong et al. (1913) and Noguchi & Battistini (1926) removed any doubt that the causative agent of both forms of bartonellosis was identical.

It remains an open question whether bartonellosis is a zoonosis. Hertig (1948b) isolated *Bartonella bacilliformis* from the blood of a wild mouse, *Phyllotis* sp., in Peru but later attempts to find additional infected mice, and to experimentally infect others, failed. No other vertebrate, aside from man, has been found infected with *B. bacilliformis* under natural conditions (Herrer 1953).

FIG. 15. Verrugas Bridge or Puente Carrión - a notorious site spanning the Rió Rimac in Peru (ca. 1850 m. a.s.l.) where many construction workers lost their lives to bartonellosis in the late 1800's (Photograph, E.R. Pérez, 1987).

FIG. 16. Verruga peruana, the benign form of bartonellosis, on the forearms and hands of a Peruvian patient (Photograph, G.B. Fairchild, 1940s).

There is stronger evidence incriminating *Lutzomyia* sand flies as vectors of bartonellosis. Townsend (1913) first reported sand flies in Peru and suggested that these insects were involved with transmission. He noted that the distribution of *L. verrucarum* (as *Phlebotomus verrucarum*) was similar to that of the disease. Additional and stronger evidence was added by Noguchi et al. (1929) and Hertig (1948b) who found *B. bacilliformis* in wild-caught Peruvian sand flies. The organism was also experimentally transmitted to Rhesus monkeys by bites of wild-caught *L. verrucarum* (see Hertig 1942 for excellent account of transmission studies).

But, the development of *B. bacilliformis* has yet to be demonstrated in this sand fly species or in *L. columbiana* which was probably the vector of bartonellosis during the Colombian epidemic from 1936 to 1944. No potential vectors have thus far been identified in Ecuador.

ARBOVIRUSES

Viruses in 3 families and 3 genera are transmitted to man and other vertebrates by sand flies. Symptoms of human illness usually resemble influenza, with fever, retro-orbital pain, myalgia, and malaise. Complete recovery within a week is the norm but encephalitis has been reported in at least 2 patients infected with *Vesiculovirus*.

The genus *Phlebovirus* (family Bunyaviridae) contains the majority of known sand fly-borne viruses. Thirty serotypes have been characterized in the New World (Table 2), 22 of which have been isolated from pools of wild-caught *Lutzomyia* (Tesh 1988; Tesh et al. 1989). Many unnamed isolates from sand flies have been reported but remain incompletely defined due to their inability to produce readable plaques in tissue culture (Tesh et al. 1989). Maintenance of the viruses in nature appears to depend on transovarian transmission (sand fly to sand fly) as well as horizontal transmission (infected vertebrate reservoir to sand fly). Evidence of the former cycle is based on repeated isolations of phleboviruses from wild-caught male sand flies and on experimental studies (see Tesh 1988 for documentation).

Like the phleboviruses, members of the genus *Orbivirus* (Changuinola serogroup, family Reoviridae) form a large assemblage of closely related viruses. They are associated primarily with sand flies and mammals, especially edentates (Travassos da Rosa et al. 1984a). Changuinola virus, the first serotype discovered in this group in 1960 in Panama, was isolated from a febrile patient with flu-like symptoms. No other human illness due to these viruses has been reported. All of the isolations (175+) have been made in Panama, Colombia and Brazil from a wide variety of mammals, sand flies and mosquitoes. The names of these viruses, like the phleboviruses and vesiculoviruses, are usually based on localities from which they were isolated. Examples include Aguacate, Alenquer, Gurupi, Saraca, Jari and Altamira.

Table 2. Phleboviruses (Bunyaviridae: *Phlebovirus*) Isolated from New World Sand Flies *

Serotype	Known Distribution	Sand Fly Host	Evidence of Human Infection
Aguacate	Panama	*Lutzomyia* spp.	
Ambe	Brazil	*Lutzomyia* spp.	
Anhanga	Brazil	*Lutzomyia* spp.	
Arboledas	Colombia	*Lutzomyia* spp.	specific antibodies
Armero	Colombia	*Lutzomyia* spp.	
Buenaventura	Colombia	*Lutzomyia* spp.	
Cacao	Panama	*L. trapidoi*	specific antibodies
Caimito	Panama	*L. ylephiletor*	
Chagres	Panama	*L. trapidoi*	clinical illness
Chilibre	Panama	*Lutzomyia* spp.	
Durania	Colombia	*Lutzomyia* spp.	
Frijoles	Panama	*Lutzomyia* spp.	
Icoaraci	Brazil	*L. flaviscutellata*	
Ixcanal	Guatemala	*Lutzomyia* spp.	
Joa	Brazil	*Lutzomyia* spp.	
Mariquita	Colombia	*Lutzomyia* spp.	
Munguba	Brazil	*L. umbratilis*	
Nique	Panama	*L. panamensis*	
Oriximina	Brazil	*Lutzomyia* spp.	
Pacui	Brazil, Trinidad, French Guiana	*L. flaviscutellata*	
Punta Toro	Panama	*L. trapidoi* *L. ylephiletor*	clinical illness
Turana	Brazil	*Lutzomyia* spp.	

* Information in this table was taken from, or cited by, Aitken et al. (1975), Travassos et al. (1983), Tesh et al. (1986, 1989) and Tesh (1988). Other New World phleboviruses that have been isolated from mammals, but not sand flies, include Alenquer (human), Belterra (rodents), Bujaru (rodents), Candiru (human), Itaituba (marsupial) and Urucuri (rodents). These agents are known only from Brazil. Itaporanga (rodents & marsupials) has also been recovered in Brazil as well as Trinidad and French Guiana. Rio Grande Virus (rodents) was isolated in southern Texas, USA, close to the Mexican border (Calisher et al. 1977) and undoubtedly occurs in that country as well.

Transmission cycles are incompletely known although it is likely that vertebrates, rather than the insects themselves, serve as true reservoirs of the viruses. Long-lasting (3+ months) infections in the erythrocytes of sloths, for example, suggest that sand flies can become infected after bloodfeeding on these common tropical edentates.

The vesicular stomatitis viruses (genus *Vesiculovirus*, family Rhabdoviridae) comprise the third group of viruses associated with sand flies and vertebrates. Five of the nine New World serotypes in this genus have been isolated from sand flies and have been transovarially transmitted by these insects under controlled conditions (Table 3). The poorly known Inhangapi virus, isolated from *L. flaviscutellata* near Belém, Pará, Brazil (Aitken et al. 1975), belongs in the same family but remains unclassified at the genus level. Comer & Tesh (1991) recently reviewed the vectors of vesiculoviruses.

Table 3. Vesiculoviruses (VSV) Isolated from Wild-Caught *Lutzomyia* Sand Flies

Serotype (VSV)	Distribution	Evidence of Human Infection	Reference
Alagoas	Brazil, Colombia	yes, high antibody rates	Tesh et al. 1987
Carajas	Brazil (Pará)	no antibodies found in 30 persons tested	Travassos da Rosa et al. 1984b
Marabá	Brazil (Pará)	one person out of 114 in sample had antibodies	Travassos da Rosa et al. 1984b
Indiana	widespread in nearctic & neotropical localities	yes, clinical disease, mild to severe	Shelokov & Peralta 1967 Tesh & Johnson 1975 Tesh 1984 Shope & Tesh 1987 Quiroz et al. 1988
New Jersey	widespread in nearctic & neotropical localities	yes, clinical disease, mild	Tesh & Johnson 1975 Shope & Tesh 1987 Comer et al. 1990

The vesiculoviruses that are the most widely distributed and the best studied, are the VSV-New Jersey and VSV-Indiana serotypes. Accidental infections in humans usually cause self-limited, flu-like illness of 3 to 6 days duration but encephalitis due to a natural infection of VSV-Indiana was recently reported in a Panamanian child (Quiroz et al. 1988). Serological surveys in Central and northern South America indicate that a high percentage of people living in endemic areas have been previously infected with these 2 viruses and VSV-Alagoas, known only from Colombia and Brazil (Tesh et al. 1987).

These 3 serotypes and VSV-Cocal, which, unlike them, has not been recovered in sand flies, also cause vesicular disease in cattle, horses and pigs. The signs and symptoms of these diseases resemble those of foot-and-mouth disease but vesicles are not always observed in VSV-infected animals (Corn et al. 1990). Epizootics among these animals are well documented (see Tesh et al. 1987, for references) but the determination of the *Vesiculovirus* causing the outbreaks, often attributable to VSV-Indiana in South America, may be erroneous owing to the close antigenic similarity among VSV-Indiana, Alagoas, Cocal and Marabá serotypes (Tesh et al. 1987).

The latter *Vesiculovirus*, Marabá, was isolated from a pool of 70 *Lutzomyia* females collected at Serra Norte, Pará State, Brazil. This virus and VSV-Carajas, which was isolated from the same locality but which was recovered from male sand flies as well as females, were transmitted transovarially by *L. longipalpis* after intrathoracic inoculation (Travassos da Rosa et al. 1984b). Transmission rates were low (<7.0%), indicating perhaps, that *L. longipalpis*, which does not coexist with these viruses at Serra Norte, is an unnatural host.

The natural maintenance cycles of the vesiculoviruses like the phleboviruses, seem to depend on transovarial and horizontal transmission but these cycles are not fully understood (Tesh 1984). High neutralizing antibody rates to certain vesiculoviruses in indigeneous tropical mammals, especially arboreal species such as monkeys (*Ateles*), porcupines (*Coendou*) and *Didelphis* opossums, have been recorded (Srihongse 1969; Tesh et al. 1987).

Natural infections of VSV-New Jersey were found in male and female *L. shannoni* at one endemic site on Ossabaw Island, Georgia, USA (Corn et al. 1990; Comer et al. 1991; Comer et al. 1992). Laboratory-reared *L. shannoni* from the same locality were infected by the oral and intrathoracic routes with this virus and female flies later transmitted it by bite to susceptible rodents (Comer et al. 1990). Natural VSV-New Jersey infections have been discovered in other insects during epizootics (Francy et al. 1988) but only sand flies have thus far been incriminated as vectors in enzootic foci (Comer et al. 1990). In Panama, VSV-Indiana was isolated from *L. trapidoi* and mixed pools of *Lutzomyia* spp. (Tesh et al. 1974). Isolations of VSV-Alagaos, Marabá and Carajas were also made from mixed pools of wild-caught sand flies in Colombia and Brazil (Travassos da Rosa 1984b; Tesh et al. 1987).

TAXONOMIC CHARACTERS

Structural terminology generally corresponds to that explained and illustrated for nematocerous Diptera by McAlpine (1981). Exceptions are the terms, coxite and style of the male terminalia, instead of gonocoxite and gonostylus, respectively. Also, we shorten the cumbersome words, "ejaculatory apodeme, sperm pump and aedeagal filaments" to "genital pump and filaments." These and other structures commonly used in sand fly systematics are shown in Figs. 17 & 18 and are briefly discussed below. Additional information on anatomy is given by Fairchild & Hertig (1947a), Kirk and Lewis (1951), Davis (1967), Abonnenc (1972), Lewis (1973, 1975a, 1982, Forattini (1973) and Young (1979).

HEAD (Figs. 17 & 18)

The shape of head is suboval when viewed anterior but varies somewhat according to species. Head height is measured from the occiput to the front edge of the clypeus. Maximum width is the greatest distance between the outer margins of the compound eyes.

The prominent eyes are bare and consist of numerous ommatidial or corneal facets. The shortest distance between the eyes is determined by direct measurement or by the number of facet diameters equalling that distance.

The paired, hairy antennae are composed of a basal *scape*, *pedicel* and 14 subcylindrical *flagellomeres* (= antennal segments). The longest flagellomere is always the first (flag. I). It and others bear sensory structures, the most taxonomically important of which are the slender *ascoids*. These are thin-walled, apically pointed structures that vary in length and number according to species. Ascoids may be simple (without distinct proximal spurs) or they may have proximal spurs of variable length. Other sensory structures of the antennae, such as papillae (Theodor 1965), are present but their importance in classification has not been fully determined.

The paired palpi consist of 5 *palpomeres*. The first (palp. 1) is always the shortest and is partially fused with palp. 2. *Palpal sensilla* (= Newstead's scales or clavate sensilla) are present on one or more of the palpomeres. The lengths of the palpomeres are sometimes expressed by a formula indicating their relative lengths. For example, 1-2-4-3-5 reflects the fact that palp. 2 is longer than palp. 1, palp. 4 is longer than palp. 2, etc. The length of palpomere 5 differs according to species group or subgenus.

The appendages arising from the apex of the clypeus, and pointing downwards, collectively form the *proboscis*. In the female, there are paired, toothed *mandibles*, paired maxillae and a hypopharynx, all of which lie between a ventral *labium* (which is apically bilobed & setose) and a dorsal *labrum* that bears 4-8 sensilla at its tip. The length of the labrum from the ventral edge of the clypeus to its tip is often compared

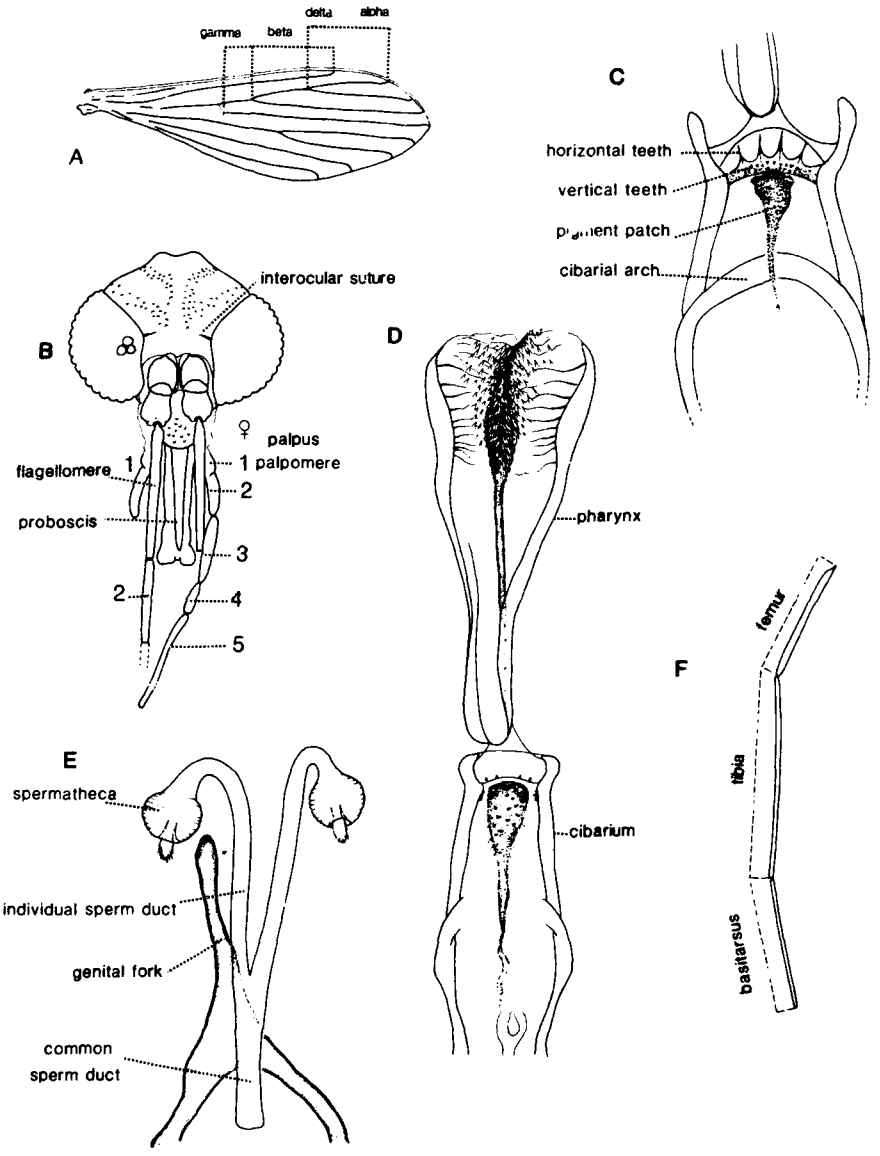

FIG. 17. ***Lutzomyia*** **spp. Structural terminology. A. Wing; B. Head; C. Female cibarium; D. Female cibarium & pharynx; E. Spermathecae; F. Hindleg, in part.**

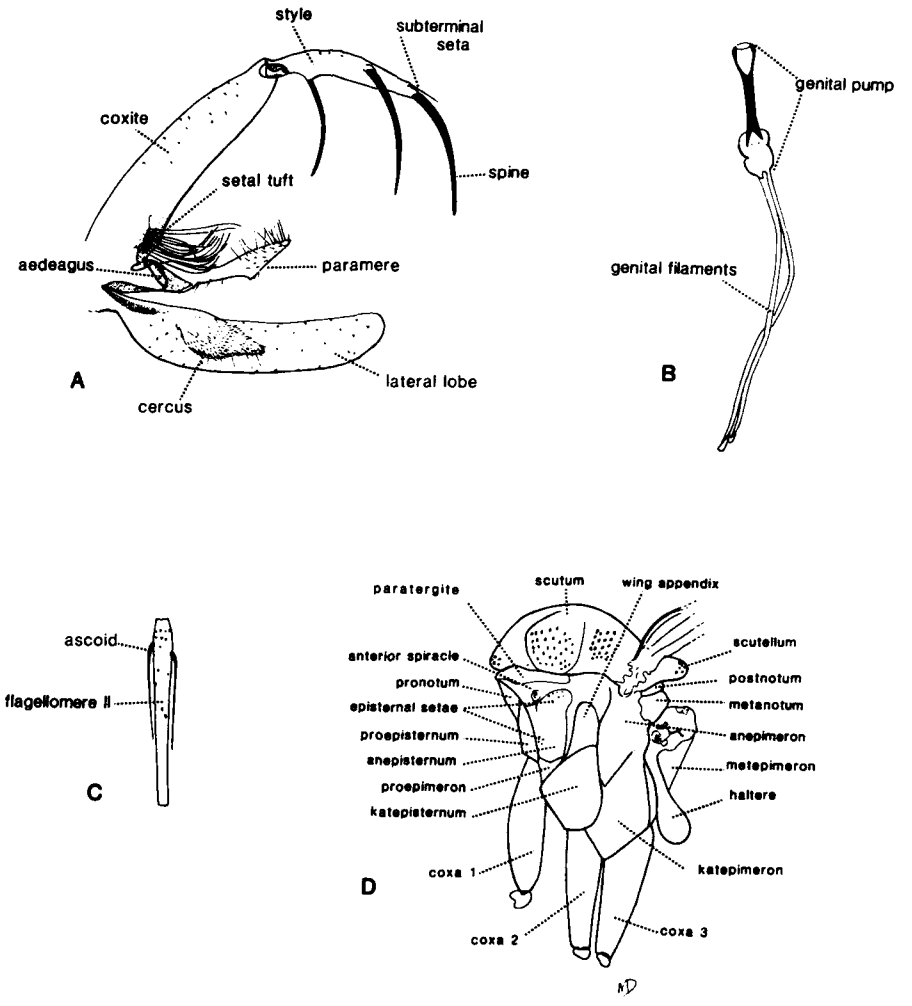

FIG. 18. ***Lutzomyia*** **spp. Structural terminology. A. Male terminalia, later view; B. Genital pump & filaments; C. Flagellomere II showing paired ascoids; D. Thorax.**

to the length of flagellomere I or head height. Lewis (1975a) and Jobling (1976) studied the mouthparts in relation to their function. The mouthparts of male sand flies lack mandibles; other structures are reduced in size.

The cibarium is an internal structure of the head that lies between the pharynx and the mouthparts. The posterior part of the cibarium, especially that of the female, may have 2 or more horizontal teeth (= hind teeth) and vertical teeth (= fore teeth). The only *Lutzomyia* female that lacks such teeth is *L. oligodonta* from Peru. Lateral teeth, i.e., those on either side of the horizontal teeth, are present in some *Lutzomyia* spp. The *pigment patch* represents the site of attachment of the posterior clypeus muscles on the dorsal wall of the cibarium. This patch area varies in size, shape and degree of infuscation according to species. The *cibarial* or *chitinous arch* crosses the ventral wall of the cibarium completely in some species or, in others, may be conspicuous only at the sides of the cibarium (incomplete cibarial arch).

The pharynx consists of 3 plates that widen from the junction of cibarium to the posterior end. It is likely that the hind part contains spines in most *Lutzomyia* females but with light microscopy they are too small to be observed. Some females, however, have a well developed pharyngeal armature.

THORAX (Figs. 17 & 18)

The location and intensity of pigmentation of the thorax serve as useful characteristics for distinguishing some *Lutzomyia* species. The thorax is divided into 3 segments -- the prothorax, the enlarged mesothorax that bears the wings, and the metathorax. Each of these segments is associated with a pair of legs. Episternal and other setae are present on the *Lutzomyia* species, but their number and size have relatively low weight in classification at the species level.

Wing length, measured from the basal costal node to pointed apex, reflects the size of the sand fly and varies between 1 to 3 or more millimeters, depending on species. Certain other measurements of the wing veins are denoted by the following terms. *Alpha* (α) is the length of R_2 from its junction with R_3 to the costa. *Beta* (β) represents the length of R from junction of R_2 & R_3 to junction with R_4. *Delta* (δ) is that part of R_1 that extends beyond junction of R_2 & R_3. *Gamma* (γ) is the length of R from origin of R_5 to origin of R_{2+3} & R_4. The width of the wing in relation to its length varies by species and is measured at its widest part.

Distinctive spines occur on the hind femora of the *Lutzomyia* (*Pintomyia*) species and the relative lengths of the segments are sometimes useful as diagnostic features for other species. The leg segments are shown and labelled on Fig. 17.

ABDOMEN (Figs. 17 & 18)

Coloration of the abdomen varies according to species and the setal pattern of the tergites has been used to group some taxa (Lewis 1975b).

The *male terminalia* or *genitalia* are described in lateral view following rotation of newly emerged males. The paired *coxites* and *styles* are dorsal appendages. The coxite is usually larger than the distal style and may bear persistent (= nondeciduous) setae on its inner surface. The shape and size of these setae differ greatly depending on species. Each style has one or more large spines, their number and arrangement being important in identification. The presence or absence of a small *subterminal seta* is generally regarded as a group character but there are exceptions. The paired *parameres* lie between the coxites and the lateral lobes and may be simple or divided (bifurcate or trifurcate). The setation of the parameres is important as a species-level character. The subtriangular or suboval *aedeagi* (sing. *aedeagus*) are conspicuous, often well sclerotized, structures pointing posteriorly or downwards to the lateral lobes. They are fused together at their bases and may have dorsal projections or modified apices. The two *genital* filaments extend through the aedeagi during mating and sometimes at other times depending on the individual. The filaments join an internal pump within the abdomen and their length, in relation to the pump, is frequently used to separate species. In addition, the tips of the filaments of different species vary in shape. The nonsegmented, paired *lateral lobes* bear distal persistent setae in a few taxa or they may be greatly inflated in some others. The setose *cerci* join the lateral lobes at or near their bases but do not vary greatly among most species.

Externally, the paired and setose cerci are the most conspicuous structures at the end of the abdomen. Their size and shape are generally similar in most species but the cerci of the *Lutzomyia* (*Trichopygomyia*) spp. are characteristically short and broad.

Internally, there is a well-sclerotized *genital fork* (= furca) that is shaped like an inverted "Y." Either a *common* spermathecal duct or the *individual sperm ducts* (if the common duct is absent) originate between the lower arms of the *genital fork*. The actual and relative lengths of these ducts are important taxonomic features. The paired *spermathecae* join the individual ducts (or common duct in some species) as illustrated for most of the females shown in this review. The size and shape of the spermathecae show much variation and are salient characters at the species and subgeneric levels.

CLASSIFICATION OF SAND FLIES

The family Psychodidae of Diptera is divided into four or more subfamilies according to author (see Lewis et al. 1977). The two subfamilies in the New World containing hematophagous females are Sycoracinae and Phlebotominae, the latter

group distinguished from the former, and other subfamilies, by the following combination of adult character states (Fig. 17).

-- Radius of wing with 5 branches
-- Mouthparts relatively long, adapted for bloodsucking
-- Maxillary palpus of 5 palpomeres
-- Paired spermathecae

After Lewis et al. (1977) reviewed and discussed the various classification schemes that have been proposed for Phlebotominae, several other proposals have been published, notably those of Martins et al. (1978) for the American fauna and Artemiev (1991) and Williams (1993) for the subfamily in general. Ready et al. (1980, 1981) and Ashford (1991), among others, deal with limited aspects of this subject. The present classifications are based on adult characters because our knowledge of the immature states is limited.

We adopt the classification of Lewis et al. (1977), with some minor changes, for reasons given in that paper. Thus, we recognize three New World genera (*Lutzomyia*, *Brumptomyia* França & Parrot and *Warileya* Hertig) and three Old World genera (*Phlebotomus* Rondani & Berté, *Sergentomyia* França & Parrot, and *Chinius* Leng). The latter genus was created recently to accommodate an unusual sand fly from China (*Leng* 1987).

Differences of opinion vary greatly among sand fly specialists regarding the classification of these insects, especially the ranking of genera and subgenera. On one hand, Ashford (1991) stated that *Phlebotomus*, *Sergentomyia* and *Lutzomyia* "must strictly be regarded as invalid" on the basis that no morphological character has been discovered that will separate them consistently, and that geographical distribution can not be used to define genera. At the other extreme, Artemiev (1991) proposes to raise many supraspecific groups to generic and subgeneric rank, resulting in 24 phlebotomine genera and numerous subgenera. His justification for this increase is to show "regular features of each taxonomic group", but, in our view, the subgenus grouping achieves the same purpose; there is less risk of creating monotypic genera and the information content, concomittant with less memory burden, remains the same.

More specifically, Artemiev (1991) does not define, or key any of his new taxa. According to the International Code of Zoological Nomenclature published in 1985, "to be available every new scientific name ... must be accompanied by a description or definition that states in words characters that are purported to differentiate the taxon ..." [Article 13a(i)]. Only type species are designated and we are therefore unable to understand his rationale for creating some new taxa [e.g., the genus *Isolutzomyia* Artemiev 1991 with *Isolutzomyia cirrita* (Young & Porter) as the type species]. *Xiphomyia* Artemiev 1991 [type species: *L. aclydifera* (Fairchild & Hertig) is a junior homonym of *Xiphomyia* Alexander 1916 (type species: *Xiphomyia gladiatrix* Alexander, a muscoid fly]. *Shannonomyia* Dyar (1929) is also

preoccupied, as was noted by Pratt (1947) who proposed a replacement name, *Shannonomyina*, with the same type species, *Phlebotomus panamensis* Shannon.

Finally, we restate that the evolutionary history of Phlebotominae remains incomplete and that the Linnean hierarchical system is ill-designed to express views on evolutionary or other relationships (Lewis et al. 1977). Information on rates of evolution and phylogeny are expressed far better by phylogenetic diagrams (Hull 1964), associated with supporting evidence, or inferences, detailed in the text. The Linnean system was not designed to reflect theories of phylogeny and its stability is the basis of its usefulness. Both Ashford (1991) and Artemiev (1991) appear to believe that the main purpose of nomenclature is to indicate phylogenetic relationships, rather than serve as a system of names, and provisions for their formation and usage. In rebuttal to their criticisms of Lewis et al. (1977), we point out that their publications, recommending diametrically opposed results from the same theoretical phylogentic base, is a shining example of the instability resulting for the reasons given in the beginning pages of Lewis et al. (1977).

AMERICAN PHLEBOTOMINAE

The genus *Brumptomyia* includes 22 species that are distributed from southern Mexico to northern Argentina (Martins et al. 1978). Adults are commonly found in armadillo burrows, sometimes on tree trunks or in light and flight traps. None of the species has been reported biting man. Identification of species is based almost entirely on male structures (see Fraiha et al. 1970a for key to species and refs.).

The smaller genus *Warileya* is represented by 6 species known from Costa Rica (Murillo & Zeledón 1985), Panama (Fairchild & Hertig 1951b), Colombia (Young 1979), French Guiana (Le Pont & Desjeux 1984a), Bolivia (Velasco & Trapido 1974), Ecuador (Alexander et al. 1992a), and Peru (Hertig 1948a; Vargas & Pérez 1985). Females of *W. phlebotomanica* Hertig and *W. rotundipennis* Fairchild & Hertig are anthropophilic and it is likely that some others share the same habit. None of the *Warileya* species has been implicated in disease transmission but little is known about their relationships with human pathogens. *Warileya hertigia* (Fairchild) was originally described in the genus *Hertigia* Fairchild (Lewis et al. 1977). *Warileya* is still regarded as a monotypic genus by Artemiev (1991).

The genus *Lutzomyia* contains the majority of American Phlebotominae with nearly 400 species and subspecies reviewed in the present paper and separated from the *Warileya* and *Brumptomyia* species by the following key to the adults.

Key to the Genera of New World Phlebotominae

1. Wing broad, rounded at tip; $R_2 + R_3 + R_4$ forks before, above or but slightly beyond r-m crossvein. Male terminalia with style longer than coxite. Thorax without episternal setae . . . . . *Warileya* (Fig. 19)

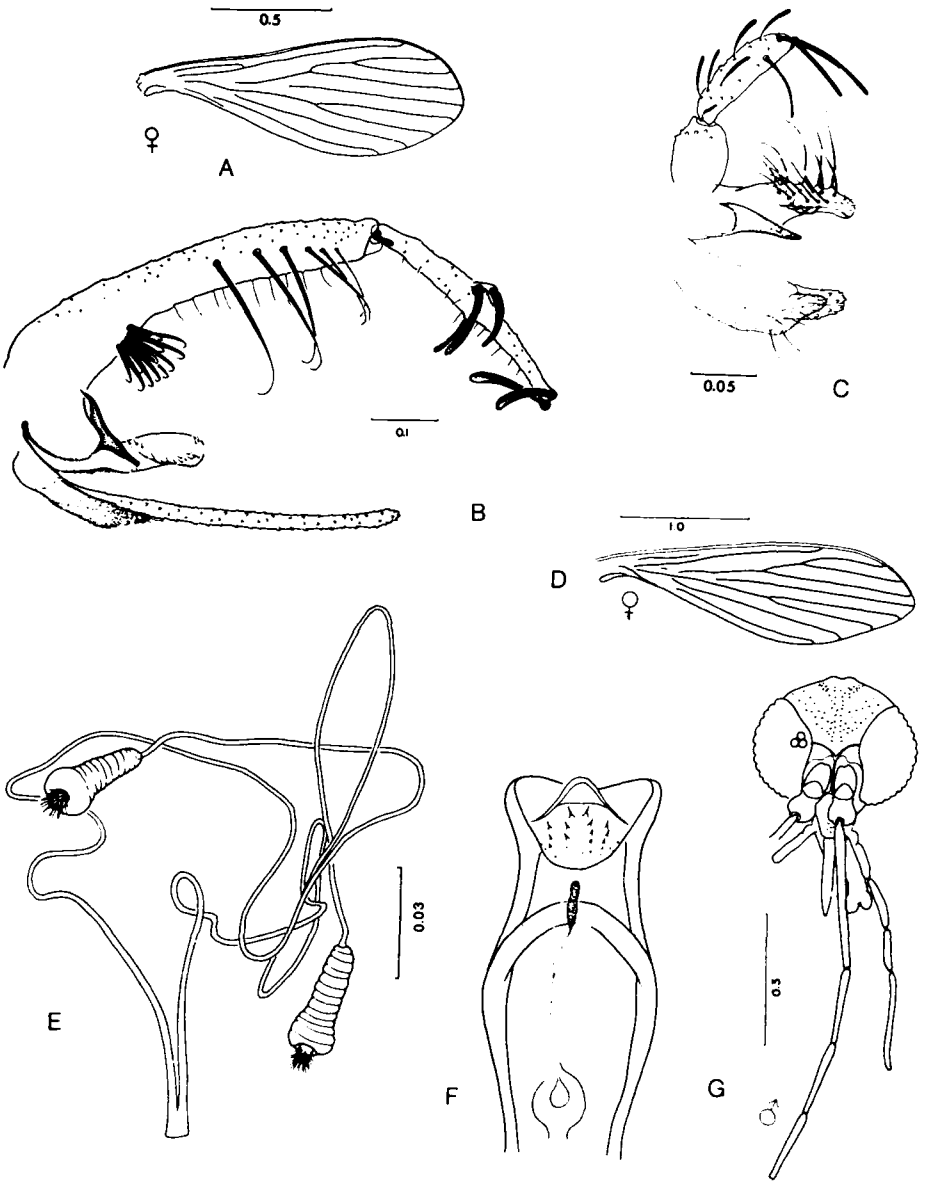

FIG. 19. ***Warileya*** sp. A. Female wing; C. Male terminalia. ***Brumptomyia*** sp. B. Male terminalia; D. Female wing; E. Spermathecae; F. Female cibarium; G. Male head.

Wing relatively narrow, pointed at tip; $R_2 + R_3 + R_4$ forks well beyond r-m crossvein. Male terminalia with style usually shorter than coxite. Thorax with episternal setae 2

2. Male terminalia with style bearing 5 spines, 2 of which are borne on a common tubercle (usually proximal pair). Coxite with 1 or more long distal setae in addition to persistent setae at base or middle. Female cibarium with 4 longitudinal rows of horizontal teeth. Head with complete interocular suture . . . . . *Brumptomyia* (Fig. 19)

Male terminalia with style bearing 1-8 spines; if 2 spines are borne on a common tubercle of those species having 5 spines, then there are no distal setae on the coxite. Female cibarium with 1 transverse row of horizontal teeth or lacking them altogether (only *L. oligodonta*). Head with interocular suture usually incomplete . . . . . *Lutzomyia* (Figs. 17 & 18)

Creating an unambiguous key to the subgenera and species groups of *Lutzomyia* is beset with problems. Subgeneric characteristics may be obvious in one sex, but not the other, so that in many cases both sexes must be on hand before the specimens can be assigned to a particular group. For example, some males in the *verrucarum*, *migonei* and other groups that are keyed to couplet 25 are inseparable from one another at this level. Accordingly, it may be necessary to use two or more appropriate species keys to identify a particular specimen. Relative terms such as short, long, etc. can be understood by comparing figures of the structures under consideration.

Key to the Subgenera, Species Groups and Ungrouped Species of *Lutzomyia*

1. Hindfemur with row of short spines . . . . Subgenus *Pintomyia* (p. 269)
Hindfemur without spines 2

2(1). Palpomere 5 shorter than 1/2 length of palp. 3. Spermathecae imbricated. Coxite without persistent setae . . . . . Subgenus *Psychodopygus* (p. 559)
Palpomere 5 longer than 1/2 length of palp. 3. Spermathecae otherwise. Coxite with or without persistent setae 3

3(2). Male 4
Female 37

4(3). Lateral lobe markedly inflated . . . . . Subgenus *Coromyia* (p. 227)
Species Group *Delpozoi*, in part (p. 242)
Lateral lobe not inflated 5

5(4). Lateral lobe with 2 or more dorsal spatulate setae at or near apex . . . . . Subgenus *Evandromyia*, in part (p. 303)
Lateral lobe without such spatulate setae 6

6(5). Coxite with distal row or group of 3-8 long setae 7
Coxite without distal row or group of long setae but a group of 10+ short setae sometimes present 9

7(6). Style with subterminal seta. Palpomere 5 longer than combined length of palps. 2 + 3 . . . . . Species Group *Baityi* (p. 296)
Style without subterminal seta. Palpomere 5 shorter than combined length of palps. 2 + 3 8

8(7). Antennal ascoids bifurcate, i.e., each with long proximal spur . . . . . Species Group *Dreisbachi* (p. 411)
Antennal ascoids simple or nearly so . . . . . Subgenus *Trichophoromyia*, in part (p. 496)

9(6). Genital filament tips extremely inflated, maximum width of each greater than width of genital pump . . . . . *Lutzomyia caminoi*, ungrouped (p. 769)
Genital filament tips simple or inflated but never as wide as above . 10

10(9). Style simple, with 2-3 large spines 11
Style simple or forked, with 4-8 large spines 15

11(10). Coxite with basal group of persistent setae 12
Coxite without basal group of persistent setae 13

12(11). Coxite tuft of modified setae, in part. Style with small median and subterminal seta in addition to 3 strong spines . . . . . Subgenus *Pressatia* (p. 283)
Coxite tuft of simple setae. Style without small median seta; subterminal seta and 3 strong spines present . . . . . Species Group *Verrucarum*, in part (p. 171)

13(11). Paramere trifurcate . . . . . *L. boliviana*, ungrouped (p. 768)
Paramere simple or with dorsal arm 14

14(13). Paramere with dorsal arm . . . . Subgenus *Dampfomyia*, in part (p. 249) Species Group *Oswaldoi* (p. 675) & *L. samueli*, ungrouped (p. 767)
Paramere without dorsal arm . . . . . Species Group *Pilosa* (p. 669)

15(10). Style with 4 spines 16
Style with 5-8 spines 30

16(15). Style forked, without subterminal seta 17
Style usually unforked, but if appearing forked, subterminal seta present 18

17(16). Coxite with 1 or more persistent setae at inner base. Paramere without modified dorsal setae. Palpomere 5 longer than 1.5X length of palp. 3 . . . . . Species Group *Rupicola* (p. 335)
Coxite without persistent setae at base. Paramere with 2-4 modified dorsal setae. Palpomere 5 shorter than 1.5X length of palp. 3 . . . . . Subgenus *Viannamyia* (p. 325)

18(16). Coxite with ventral row of numerous long setae, no basal tuft. Paramere bifurcate, trifurcate or with dorsal arm . . . . . Subgenus *Trichopygomyia* (p. 418)
Coxite without ventral row of long setae in those males also lacking a basal tuft. Paramere divided or not, with or without dorsal arm 19

19(18). Paramere trifurcate. Aedeagus with short or long lateral extensions . . . . . Subgenus *Evandromyia*, in part (p. 303)
Paramere simple or bifurcate. Aedeagus without lateral extensions 20

20(19). Antennal ascoids with conspicuous proximal spurs 21
Antennal ascoids without proximal spurs 22

21(20). Paramere with dorsal basal hump . . . . Species Group *Aragaoi* (p. 375)
Paramere without dorsal basal hump . . . . . Subgenus *Psathyromyia* (p. 339)
Species Group *Lanei* (p. 404)
L. ignacioi, ungrouped (p. 765)

22(20). Coxite with 1 or more persistent setae at inner base or middle of structure 23
Coxite without p rsistent setae 25

23(22). Flagellomere I very long, at least 2X length of labrum . . . . . Subgenus *Sciopemyia*, in part (p. 107)
L. acanthopharynx, ungrouped (p. 767)
Flagellomere I shorter than 2X length of labrum 24

24(23). Paramere with 1-3 isolated setae on dorsal margin near middle of structure . . . . . Subgenus *Lutzomyia*, in part (p. 45)
Species Group *Migonei*, in part (p. 122)
Species Group *Verrucarum*, in part (p. 171)
Species Group *Delpozoi*, in part (p. 242)

Paramere without such isolated seta or setae . . . . . Species Group *Migonei*, in part (p. 122)
Species Group *Verrucarum*, in part (p. 171)
Species Group *Saulensis* (p. 263)
Species Group *Delpozoi*, in part (p. 242)

25(22). Style with isolated proximal spine . . . . . Subgenus *Trichophoromyia*, in part (p. 496)
Subgenus *Nyssomyia*, in part (p. 445)
Subgenus *Micropygomyia*, in part (p. 633)
L. rangeliana, ungrouped (p. 765)
L. species of Anchicaya, ungrouped (p. 767)
Style with paired or nearly paired proximal spines 26

26(25). Coxite with basal or median group of setae implanted on raspberry-shaped tubercle . . . . . Subgenus *Lutzomyia*, in part (p. 45)
Coxite with persistent setae implanted otherwise 27

27(26). Style with subterminal seta . . . . . Species Group *Verrucarum* (*L. nevesi*) (p. 188)
Style without subterminal seta 28

28(27). Flagellomere I longer than 2X length of labrum . . . . . Subgenus *Sciopemyia*, in part (p. 107)
Flagellomere I shorter than 2X length of labrum 29

29(28). Palpomere 5 longer than combined length of palps. 3 + 4 . . . . . Subgenus *Micropygomyia*, in part (p. 633)
Palpomere 5 shorter than combined length of palps. 3 + 4 . . . . . Subgenus *Nyssomyia*, in part (p. 445)
L. brisolai, ungrouped (p. 766)
L. monticola, ungrouped (p. 763)
L. misionensis, ungrouped (p. 764)

30(15). Paramere divided or with dorsal arm 31
Paramere simple, without dorsal arm 32

31(30). Style with subterminal seta. Paramere width greater than that of coxite; dorsal arm with apically recurved setae . . . . . Subgenus *Dampfomyia* (*L. insolita*) (p. 252)
Style without subterminal setae. Paramere otherwise . . . . . Species Group *Oswaldoi*, in part (p. 675)

32(30). Style with subterminal seta 33
Style without subterminal seta 35

33(32). Coxite with basal or median tuft of setae 34
Coxite without persistent setae . . . . . *L. pia*, ungrouped (p. 764)

34(33). Paramere somewhat clubbed. Coxite tuft of foliaceous setae . . . . . Species Group *Migonei* (*L. bahiensis*) (p. 131)
Subgenus *Helcocyrtomyia* (*L. reclusa*) (p. 719)
Paramere not clubbed. Coxite tuft of simple setae . . . . . *L. torrealbai*, ungrouped (p. 766)

35(32). Style with median spines inserted on a common process . . . . . *L. oligodonta*, ungrouped (p. 768)
Style with no 2 spines on a common process 36

36(35). Paramere with 2-6 hooked or otherwise modified setae on dorsal margin . . . . . Subgenus *Lutzomyia*, in part (p. 45)
Paramere with simple setae . . . . . Species Group *Oswaldoi*, in part (p. 675)
Subgenus *Helcocyrtomyia*, in part (p. 714)
Subgenus *Micropygomyia*, in part (p. 633)

37(3). Spermathecae associated with paired sclerotized structures as shown in Figs. 133 and 135 . . . . . Subgenus *Viannamyia* (p. 325)
Spermathecae without such structures 38

38(37). Spermathecae with bubble-like evaginations . . . . . Subgenus *Dampfomyia* (p. 249)
Species Group *Saulensis* (p. 263)
Species Group *Verrucarum*, in part (p. 171)
Spermathecae without bubble-like evaginations 39

39(38). Antennal ascoids with distinct proximal spurs 40
Antennal ascoids simple or with barely discernible short proximal spurs 41

40(39). Cibarium with 4 horizontal teeth . . . . . Subgenus *Psathyromyia*, in part (p. 339)
Species Group *Lanei* (p. 404)
Species Group *Aragaoi*, in part (p. 375)
L. ignacioi, ungrouped (p. 765)

Cibarium with 6 or more horizontal teeth . . . . . Subgenus *Psathyromyia*, in part (p. 339)
Species Group *Aragaoi*, in part (p. 375)
Species Group *Dreisbachi* (p. 411)
L. ponsi, ungrouped (p. 766)

41(39). Pharynx with numerous, distinct posterior spines 42
Pharynx without posterior spines 43

42(41). Cibarium with 6 or more horizontal teeth . . . . . Subgenus *Micropygomyia*, in part (p. 633)
Cibarium with 4 horizontal teeth . . . . . Subgenus *Micropygomyia*, in part (p. 633)
Species Group *Oswaldoi*, in part (p. 675)
L. acanthopharynx, ungrouped (p. 767)

43(41). Cibarium with 0-2 horizontal teeth 44
Cibarium with 4 or more horizontal teeth 46

44(43). Cibarium without horizontal teeth. Individual sperm ducts very long, ca. 8X length of spermatheca . . . . *L. oligodonta*, ungrouped (p. 768)
Cibarium with 2 horizontal teeth. Individual sperm ducts much shorter than 8X length of spermatheca 45

45(44). Cibarium with subtriangular, pointed horizontal teeth. Spermatheca with distinct annulations, its length greater than that of individual sperm duct . . . . . Species Group *Migonei* (p. 122)
Subgenus *Lutzomyia*, in part (p. 45)
Cibarium with blade-like horizontal teeth. Spermatheca sac-like and striated, without distinct annulations, its length much shorter than that of individual sperm duct . . . . . Species Group *Delpozoi* (p. 242)

46(43). Individual sperm ducts heavily sclerotized as shown in Fig. 120 . . . . . Subgenus *Pressatia* (p. 283)
Individual sperm ducts not heavily sclerotized 47

47(46). Cibarium with 4 horizontal teeth 48
Cibarium with 6 or more horizontal teeth 62

48(47). Spermathecae with large bladder-like expansion . . . . . Subgenus *Coromyia*, in part (p. 227)
Spermathecae otherwise, without bladder-like expansion 49

49(48). Spermathecae sac-like and enormous, without terminal knob . . . . . *L. bursiformis*, ungrouped (p. 764)

Spermathecae otherwise, terminal knob usually present (exception: *L. firmatoi*) 50

50(49). Cibarium with comb-like row of horizontal teeth . . . . . Species Group *Pilosa* (p. 669)
Cibarium with horizontal teeth otherwise 51

51(50). Individual sperm ducts greatly inflated . . . . . Species Group *Migonei* (p. 122)
Individual sperm ducts not inflated as above 52

52(51). Cibarium with wide gap between middle pair of horizontal teeth . . 53
Cibarium with horizontal teeth more or less evenly spaced 54

53(52). Palpomere 5 subequal to, or shorter than, palps. 3 + 4. Spermathecae slender, subequal in width and annulated throughout . . . . . Subgenus *Sciopemyia* (p. 107)
Spermathecae smooth-walled or annulated, but if annulated then terminal annulation much larger than others . . . . . Species Group *Oswaldoi*, in part (p. 675)

54(52). Spermatheca with basal annulation nearly twice as wide as terminal annulation, each connected by slender stalk . . . . . *L. boliviana*, ungrouped (p. 768)
Spermathecae otherwise 55

55(54). Spermathecae smooth-walled or else with only incipient, incomplete striations only at base 56
Spermathecae with distinct, complete annulations or striations, in whole or part 58

56(55). Spermathecae curved apically like an inverted "j"; individual sperm duct with median or distal transverse constriction . . . . . Subgenus *Evandromyia*, in part (p. 303)
Spermathecae and individual ducts otherwise 57

57(56). Common sperm duct longer than individual ducts . . . . . Species Group *Rupicola* (p. 335)
Species Group *Migonei*, in part (p. 122)
Common sperm duct subequal to, or shorter than individual duct . . . . . Species Group *Baityi* (p. 296)
Subgenus *Helcocyrtomyia*, in part (p. 714)
Species Group *Migonei*, in part (p. 122)

58(55). Palpomere 5 subequal to, or shorter than, combined length of palps. 3 + 4 59
Palpomere 5 longer than palps. 3 + 4 60

59(58). Spermathecae as shown in Fig. 321; common sperm duct clearly much longer than individual duct . . . . . *L. pia*, ungrouped (p. 764)
Spermathecae otherwise; common sperm duct shorter than individual duct . . . . . Subgenus *Helcocyrtomyia*, in part (p. 714)
L. brisolai, ungrouped (p. 766)

60(58). Spermathecae sac-like, striated 61
Spermathecae otherwise . . . . . Subgenus *Helcocyrtomyia*, in part (p. 714)
Subgenus *Lutzomyia*, in part (p. 45)
Subgenus *Micropygomyia*, in part (p. 633)
Species Group *Oswaldoi*, in part (p. 675)

61(60). Individual sperm ducts clearly shorter than common duct . . . . . Subgenus *Evandromyia*, in part (p. 303)
Subgenus *Coromyia*, in part (p. 227)
Species Group *Verrucarum*, in part (p. 171)
Species Group *Migonei* (*L. gruta*) (p. 128)
L. rangeliana, ungrouped (p. 765)
Individual sperm ducts subequal to, or longer than, common duct . . . . . Species Group *Verrucarum*, in part (p. 171)
Subgenus *Trichopygomyia* (p. 418)
Subgenus *Coromyia*, in part (p. 227)
L. monticola, ungrouped (p. 763)
L. misionensis, ungrouped (p. 764)

62(47). Cibarium with comb-like row of horizontal teeth . . . . . Subgenus *Micropygomyia*, in part (p. 633)
Cibarium with horizontal teeth otherwise 63

63(62). Palpomere 5 shorter than combined length of palps. 3 + 4 64
Palpomere 5 longer than combined length of palps. 3 + 4 65

64(63). Antennal ascoids with barely discernible posterior spurs. Cerci characteristically short and broad . . . . . Subgenus *Trichophoromyia* (p. 496)
Antennal ascoids simple. Cerci otherwise . . . . . Subgenus *Nyssomyia* (p. 445)

65(63). Spermathecae sac-like, about as wide as long . . . . . *Lutzomyia caminoi*, ungrouped (p. 769)

Spermathecae otherwise, longer than wide . . . . . Subgenus *Lutzomyia*, in part (p. 45)

SYSTEMATIC ACCOUNT OF GENUS *LUTZOMYIA*

SUBGENUS *LUTZOMYIA* FRANÇA

Phlebotomus, subgenus *Lutzomyia* França 1924: 10 (type species: *Phlebotomus longipalpis* Lutz & Neiva by orig. designation).

Flebotomus, subgenus *Castromyia* Mangabeira 1942a: 185 (type species: *Phlebotomus castroi* Barretto & Coutinho 1941d: 180, in part). Theodor 1965: 191 (in part).

Lutzomyia, subgenus *Lutzomyia*: Barretto 1962: 92. Theodor 1965: 181 (in part). Forattini 1971a:99; 1973: 212 (in part). Lewis et al. 1977: 325. Martins et al. 1978: 18 (in part). Artemiev 1991: 73 (in part).

Lutzomyia species group *cruciata* Theodor 1965: 181. Martins et al. 1978: 120.

Lutzomyia species group *amarali* Martins et al. 1978: 148.

Lutzomyia species group *gasparviannai* Lewis et al. 1977: 325. Martins et al. 1978: 159.

Lutzomyia, subgenus *Aguayoi* Vargas 1978: 89 (in part, type species: *Lutzomyia dispar* Martins & Silva by orig. designation).

Lutzomyia, subgenus *Helcocyrtomyia* (in part): Artemiev 1991: 73 (*cruciata* group spp.).

Micropygomyia, subgenus *Sciopemyia* (in part): Artemiev 1991: 73 (*gasparviannai* group spp.).

Identification. Coloration variable, pale to dark. Antennal ascoids simple or with barely discernible proximal spurs. Palpomere 5 usually longer than palp. 3. ♀ cibarium with 2-12 horizontal teeth & variable number of vertical teeth; arch complete or nearly complete; pigment patch conspicuous. ♀ pharynx unarmed. Spermathecae annulated in part or whole, ducts variable in length. ♂ *genitalia*. Coxite with simple or modified persistent setae at base. Style with 4-5 spines; subterminal setae present or absent. Paramere with or without isolated seta or setae at median dorsal margin.

The subgenus name, *Aguayoi* Vargas 1978, is incorrectly formed, in the genitive case, and is therefore invalid according to Article 11F of the International Rules of Zoological Nomenclature.

Several groups of species related to *L. cruciata*, *L. gasparviannai* and *L. castroi* are included in this subgenus because of female character states and similarities among the males. The presence of one or 2 isolated setae on each paramere of *L. falcata* n.sp. indicates, among other character states, its close affinity to allies of *L. longipalpis*. In other aspects, *L. falcata* closely resembles *L. cruciata* and its relatives, species which are often placed in their own species groups by other authors [e.g. *cruciata* group of Theodor (1965)].

We have doubts, however, about placing *L. castroi* and *L. caligata* in the subgenus *Lutzomyia* but will retain them here for the present.

Medical Importance. Considerable; many species are anthropophilic and some are proven and suspected vectors of *Leishmania*.

Key to the Males of the Subgenus *Lutzomyia*

1. Style with 5 spines 2
   Style with 4 spines 6

2. Coxite with 1-2 highly modified setae, with apices greatly expanded. . . . 3
   Coxite without such setae 4

3. Paramere undivided, with dorsal group of 5 to 6 large apically curved setae. Coxite with blunt spine on a tubercle at inner base, 3 long straight setae & 1 modified seta inserted on another tubercle . . . *L. battistinii* (Fig. 20)
   Paramere divided into 3 lobes; proximal lobe with 2 apically curved setae. Coxite base with 2 modified setae borne on a tubercle & a long pointed setae isolated above modified setae . . . . . *L. forattinii* (Fig. 21)

4. Coxite base with 4 to 6 setae implanted on prominent common tubercle. Paramere as shown . . . . . *L. bicornuta* (Fig. 22)
   Coxite base with 4 setae inserted individually on small tubercles. Paramere otherwise 5

5. Paramere deeply indented apically, shaped like a bottle opener. Coxite base with all setae similar in size & shape . . . . . *L. cavernicola* (Fig. 23)
   Paramere otherwise, not indented. Coxite base with 3 foliaceous and 1 simple setae . . . . . *L. renei* (Fig. 24)

6. Coxite base with 2 broad, fan-shaped setae 7
   Coxite base with 4 or more, relatively slender setae 8

7. Paramere with dorsal process bearing 2 slender recurved setae. Coxite with median group of long, numerous setae . . . . . *L. bifoliata* (Fig. 25)
   Paramere with dorsal process bearing 2 fan-shaped setae. Coxite lacking a median group of setae . . . . . *L. lichyi* (Fig. 26)

8. Paramere with 2-3 distinct isolated setae on dorsum, near base or middle of structure 9
   Paramere with 0 to 1 such setae 17

9. Paramere with 3 strong, curved setae borne on a slender tubercle. . . . . *L. dispar* (Fig. 27)

Paramere with 2 straight or curved isolated setae borne on a tubercle or not 10

10. Paramere with 2 straight isolated dorsal setae. Style lacking subterminal seta; terminal spines inserted at nearly same level . . . . . *L. ischnacantha* (Fig. 28A)
Paramere with 2 curved or hooked dorsal setae. Style with small subterminal seta; terminal spines more widely separated 11

11. Coxite with 6 persistent setae at inner base. Pleura strongly pigmented . . . . . *L. amarali* (Fig. 28J)
Coxite with 4 persistent setae at inner base. Pleura pale or strongly pigmented 12

12. Coxite with foliaceous setae at inner base 13
Coxite with simple setae at inner base 14

13. Paramere with dorsal curved setae nearly reaching end of paramere. . . . . *L. cruzi* (Fig. 29A)
Paramere with dorsal curved setae much shorter, reaching only to middle third of paramere . . . . . *L. souzalopesi* (Fig. 29L)

14. Paramere with dorsal curved setae inserted directly on paramere, i.e., not on a well developed tubercle . . . . . *L. longipalpis* (Fig. 30)
Paramere with dorsal curved setae inserted on a well developed tubercle or lobe 15

15. Style with isolated proximal spine. Paramere as shown. Labrum and flagellomere I subequal in length . . . . . *L. gaminarai* (Fig. 31)
Style with paired, or nearly paired, proximal spines. Paramere otherwise. Labrum much shorter than flagellomere I 16

16. Paramere broader & with 25+ lateral setae on each side . . . . . *L. ischyracantha* (Fig. 32L)
Paramere more slender & with fewer than 20 lateral setae on each side . . . . . *L. alencari* (Fig. 32B)

17. Paramere with 1 isolated seta on dorsal margin, near middle of structure 18
Paramere without such a seta 20

18. Style with 4 spines & no subterminal seta. Coxite tuft of 12+ persistent setae borne on a raspberry-like tubercle. Paramere with curved isolated seta on dorsum . . . . . *L. falcata* (Fig. 37)

Style with 4 spines & small subterminal seta. Coxite tuft of 8 or fewer setae not implanted in a raspberry-like tubercle. Paramere with straight isolated seta on dorsum 19

19. Paramere with distal 1/2 markedly darker (pigmented) than basal half & covered with scattered setae. Coxite base with 6 setae, some longer than width of coxite . . . . . *L. caligata* (Fig. 33A)
Paramere without heavily pigmented distal portion; setae, except isolated seta, restricted to distal 1/3 of structure. Coxite base with more slender setae, none longer than width of coxite . . . . . *L. castroi* (Fig. 33D)

20. Coxite base with a relatively large, elongated tubercle bearing 1 or more foliaceous setae 21
Coxite base with a raspberry-like, slightly raised circular tubercle bearing only simple setae 26

21. Genital filaments shorter than 1.7X pump length, tips with small tooth-like serrations. Pleuron pale 22
Genital filaments longer than 1.7X pump length, tips simple without tooth-like serrations. Pleuron, in part or whole, moderately to strongly pigmented 23

22. Genital filaments distinctly inflated at tips, heavily sclerotized, relatively wide & about 1.3X length of pump . . . . . *L. cipoensis* (Fig. 34)
Genital filaments barely enlarged at tips, lightly sclerotized, more slender & 1.6X length of pump . . . . . *L. gasparviannai* (Fig. 35)

23. Coxite tubercle bearing 15 or more setae . . . . . *L. flabellata* (Fig. 36)
Coxite tubercle bearing 6-9 setae 24

24. Style with proximal spines inserted at different levels . . . . . *L. spathotrichia* (Fig. 38)
Style with proximal spines inserted at same level 25

25. Coxite tuft of foliaceous & simple setae. Paramere as shown . . . . . *L. carvalhoi* (Fig. 39)
Coxite tuft of foliaceous setae only. Paramere otherwise . . . . . *L. araracuarensis* (Fig. 40)

26. Pleuron completely pale 27
Pleuron with at least well pigmented pronotum 29

27. Scutum lightly pigmented at sides only. Head completely pale . . . . . *L. evangelistai* (Fig. 41)

Scutum entirely well pigmented. Head with at least a median longitudinal strip of pigmentation 28

28. Paramere slightly upturned. Coxite tuft of 40 or more setae borne on a larger tubercle . . . . . *L. sherlocki* (Fig. 42)
Paramere not upturned. Coxite tuft of 20 or fewer setae . . . . . *L. gomezi* (Fig. 43)

29. Scutum, pronotum & paratergite well pigmented, remainder of pleuron pale . . . . . *L. cruciata* (Fig. 44)
Scutum, pronotum, paratergite & anepisternum, at least, well pigmented 30

30. Paramere upturned, with short dorsal & lateral setae all restricted to distal third of structure . . . . . *L. marinkellei* (Fig. 45)
Paramere not upturned, with longer dorsal & lateral setae inserted on distal half or more of structure . . . . . *L. diabolica* (Fig. 46)

Key to the Females of the Subgenus *Lutzomyia**

1. Cibarium with 3-4 longitudinal rows of horizontal teeth. Spermathecae as shown. Pleura heavily pigmented, as dark as scutum . . . . . *L. amarali* (Fig. 28H&L)
Cibarium with 1 transverse row of 2-10+ horizontal teeth. Spermathecae otherwise. Pleura pale or heavily pigmented 2

2. Spermathecae longer than individual sperm ducts 3
Spermathecae much shorter than individual sperm ducts 4

3. Cibarium with 2 large horizontal teeth. Spermatheca with ca. 8 annulations . . . . . *L. gasparviannai* (Fig. 35)
Cibarium with 4 horizontal teeth. Spermatheca with 12-13 annulations . . . . . *L. cipoensis* (Fig. 34)

4. Cibarium with 6 or more horizontal teeth 5
Cibarium with 4 horizontal teeth 8

5. Cibarium with 6 horizontal teeth 6
Cibarium with 8-12 horizontal teeth 7

*The females of *L. flabellata*, *L. castroi*, *L. araracuarensis* and *L. caligata* are undescribed. The original description of the female of *L. gaminarai* is inadequate for recognition.

6. Labrum longer than flagellomere I. Spermatheca with hemispherical terminal annulation much larger than preceding annuli; individual sperm ducts about 4X length of spermathecae . . . . . *L. diabolica** (Fig. 46)
   Labrum subequal to, or shorter than, flagellomere I. Spermathecae with terminal annulation about same width as others; individual sperm ducts greater than 8X length of spermathecae . . . . . *L. alencari* (Fig. 32F)

7. Flagellomere I longer than labrum. Spermathecae about 4X as long as wide, with 12-13 complete annulations . . . . . *L. souzalopezi* (Fig. 29N)
   Flagellomere I subequal to, or shorter than, labrum. Spermathecae shorter, its length less than 4X its width & with fewer annulations . . . . . *L. longipalpis* (Fig. 30)
   L. cruzi (Fig. 29E)
   L. ischyracantha (Fig. 32K)

8. Spermathecae with subspherical terminal annulation much larger than any of the preceding annuli 9
   Spermathecae with terminal annulation subequal in size to the 4 preceding annuli, at least . . . . . *L. battistinii* (Fig. 20)
   L. forattinii (Fig. 21)
   L. renei (Fig. 24)

9. Antennae with terminal flagellomere (XIV) clearly longer than preceding flagellomere (XIII) . . . . . *L. lichyi* (Fig. 26)
   Antennae with terminal flagellomere (XIV) shorter than, or subequal to, preceding flagellomere (XIII) 10

10. Scutum pale . . . . . *L. bicornuta* (Fig. 22)
    L. cavernicola (Fig. 23)
    L. ischnacantha (Fig. 28)
    Scutum pigmented, in part or whole . . . . . 11†

11. Pleuron completely pale 12
    Pleuron with well pigmented pronotum, at least 14

12. Head completely pale. Scutum lightly pigmented at sides only. Labrum <0.24 mm long . . . . . *L. evangelistai* (Fig. 41)

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*This species is keyed twice; some females have only 4 horizontal teeth in their cibaria.

†We have not examined the female of *L. dispar*. Williams & Carvalho (1979) did not mention its coloration, but the spermathecae resemble those of *L. lichyi*. It is not keyed in this review.

Head pigmented in part or whole. Scutum entirely well pigmented. Labrum >0.25 mm long 13

13. Individual sperm ducts relatively thin as shown . . . . . *L. gomezi* (Fig. 43)
Individual sperm ducts clearly wider . . . . . *L. sherlocki* (Fig. 42)

14. Scutum, pronotum & paratergite well pigmented, remainder of pleuron pale . . . . . *L. cruciata* (Fig. 44)
Scutum, pronotum, paratergite, anepisterum, at least, well pigmented . . 15

15. Labrum longer than flagellomere I . . . . . *L. diabolica* (Fig. 46)
Labrum subequal to, or shorter than, flagellomere I 16

16. Labrum longer than 0.35 mm . . . . . *L. bifoliata* (Fig. 25)
Labrum shorter than 0.30 mm . . . . . *L. carvalhoi* (Fig. 39)
L. falcata (Fig. 37)
L. marinkellei (Fig. 45)
L. spathotrichia (Fig. 38)

Lutzomyia (*Lutzomyia*) *battistinii* (Hertig)
Fig. 20

Phlebotomus battistinii Hertig 1943: 247 (♂, ♀, Andahuaylas, Apurimac, Peru). Blancas & Herrer 1959-1960: 61 (cf. to *bicornutus*).
Lutzomyia battistinii: Theodor 1965: 181 (listed). Forattini 1973: 248 (♂ fig., tax.). Martins et al. 1978: 24 (dist., refs.). Llanos 1983: 183 (listed, Peru). Galati et al. 1985: 266 (♂ keyed).

Distribution (Map 1). PERU (Hertig 1943; Llanos 1983).

Remarks. The spermathecae of *L. battistinii* have not been figured previously. They are slender, annulated, without an enlarged terminal annulation, and resemble those of *L. renei*. The sperm ducts were not visible in the females examined.

Llanos (1983) reported this species from Junin Department, Peru, but did not give a specific locality. Specimens mentioned by Hertig (1943) were found at elevations ranging from 2,000 to 2,400 m above sea level.

Lutzomyia battistinii and the following 4 species are usually grouped together because the males have 5 large spines on their styles [e.g., series *renei* of Theodor (1965) or species group *cavernicola* of Barretto (1962)].

Lutzomyia* (*Lutzomyia*) *forattinii Galati, Rego, Nunes & Teruya
Fig. 21

Lutzomyia forattinii Galati, Rego, Nunes & Teruya 1985: 261 (♂, ♀, Corumbá, Mato Grosso do Sul, Brazil).

Distribution (Map 2). BRAZIL (type locality).

Lutzomyia* (*Lutzomyia*) *bicornuta (Blancas & Herrer)
Fig. 22

Phlebotomus bicornutus Blancas & Herrer 1959-1960: 58 (♂, ♀, near Anco, Rio Mantaro, Huancavelica, Peru).

Lutzomyia bicornuta: Theodor 1965: 181 (listed). Forattini 1973: 248 (♂, ♀ figs., tax.). Martins et al. 1978: 24. Llanos 1983: 183 (listed). Galati et al. 1985: 266 (♂ keyed).

Distribution (Map 3). PERU (type locality).

Remarks. One of us (D.Y.) examined the holotype and allotype of *L. bicornuta* at the National Institute of Health, Lima, in 1988. They agree well with the original description and figures. One spermatheca of the allotype was sketched & is shown here in Fig. 22.

Lutzomyia* (*Lutzomyia*) *cavernicola (Costa Lima)
Fig. 23

Phlebotomus cavernicola Costa Lima 1932: 49 (♀, Gruta Maquiné, Minas Gerais, Brazil).

Lutzomyia cavernicola: Martins et al. 1961a: 226 (♂ descript., ♀ redescript.). Barretto 1962: 92 (listed). Theodor 1965: 181 (listed). Forattini 1973: 251 (♂, ♀ figs., tax.). Martins et al. 1978: 24 (♂, ♀ figs., dist.). Galati et al. 1985: 266 (♂ keyed).

Distribution (Map 4). BRAZIL (Martins et al. 1978).

Remarks. Léger et al. (1977) reported *L. cavernicola* from French Guiana (? ♀), but its presence there is very unlikely and this record is probably a misidentification of another species in the subgenus *Lutzomyia*.

Lutzomyia* (*Lutzomyia*) *renei (Martins, Falcão & Silva)
Fig. 24

Phlebotomus renei Martins, Falcão & Silva 1957: 322 (♂, Gruta da Lapinha, Lagoa Santa, Minas Gerais, Brazil). Sherlock 1957b: 548 (♀, immatures).

Lutzomyia renei: Barretto 1962: 92 (listed). Theodor 1965: 181 (listed). Coelho et al. 1967a-d (exp. infections with *Leishmania*). Forattini 1973: 226 (♂, ♀ figs., tax.). Martins et al. 1978: 25 (dist.). Galati et al. 1985: 266 (♂ keyed). Killick-Kendrick 1986: 135 (listed). Gontijo et al. 1987: 445 (exp. *Leishmania* infection in ♂ *renei*).

Distribution (Map 5). BRAZIL (Martins et al. 1978).

Remarks. *Lutzomyia renei* has been used as an experimental vector of *Leishmania mexicana* (as *Le. braziliensis*) by Coelho and Falcão (1962) who later (Coelho et al. 1967a-d) conducted experimental infection studies using another *Leishmania*, possibly *Le. braziliensis* (see Killick-Kendrick 1986). There is no evidence at present that *L. renei* is a natural vector of *Leishmania*.

Lutzomyia (*Lutzomyia*) *bifoliata* Osorno-Mesa, Morales, Osorno & Hoyos
Fig. 25

Lutzomyia bifoliata Osorno-Mesa, Morales, Osorno & Hoyos 1970: 8 (♂, El Terminal, Puerto Boyacá, Boyacá, Colombia). Forattini 1973: 248 (♂ fig.). Martins et al. 1978: 21 (dist.). Young 1979: 52 (♂, ♀, refs.). Morales et al. 1981: 201 (Mariquita, Tolima, Colombia). Porter & de Foliart 1981: 144 (biting habits). Le Pont & Desjeux 1983: 51 (cf. to *eliensis*).

Distribution (Map 1). COLOMBIA (Young 1979; Morales et al. 1981).

Remarks. The females of *L. bifoliata* and *L. lichyi* are anthropophilic; both occur together at Mariquita, Tolima Dept., Colombia, and are separated by the relative lengths of the terminal 2 flagellomeres, i.e., the ultimate flagellomere of *L. lichyi* is longer than the preceding flagellomere, unlike that of *L. bifoliata*.

Lutzomyia (*Lutzomyia*) *lichyi* (Floch & Abonnenc)
Fig. 26

Phlebotomus lichyi Floch & Abonnenc 1950a: 1 (♀, Rio Borburata, Carabobo, Venezuela).

Phlebotomus vexillarius Fairchild & Hertig 1952: 514 (♂, ♀, Panama). Floch & Kramer 1965: 1 (as synonym of *lichyi*). Scorza et al. 1968b: 28 (bionomics).

Phlebotomus foliatus Mirsa & Ortiz 1952: 249 (♂, Venezuela). Fairchild & Hertig 1958b: 205 (as synonym of *vexillarius*).

Lutzomyia vexillaria: Martins et al. 1963: 335 (♂, ♀, Brazil).

Lutzomyia lichyi: Barretto 1962: 98 (listed). Forattini 1973: 259 (♂, ♀ figs.). Martins et al. 1976a: 488 (♂, Peru). Mogollon et al. 1977: 209 (Venezuela). Martins et al. 1978: 22 (dist., refs.). Ramirez Pérez et al. 1978: 49 (♂, ♀ figs., Aragua, Venezuela). Williams & Carvalho 1979: 329 (cf. to *dispar*). Young 1979: 54 (♂, ♀ figs., full refs.). Feliciangeli 1980: 246 (figs., keyed).

Léger et al. 1980: 117 (French Guiana). Ramirez Pérez et al. 1982a: 14 (figs., Sucre, Venezuela); 1982b: 58 (figs., Tachira, Venezuela). Le Pont & Desjeux 1983: 51 (cf. to *eliensis*). Bonfante-Garrido 1984: 850 (Venezuela). Murillo & Zeledón 1985: 36 (♂, ♀ figs., Costa Rica). Young et al. 1987: 588 (neg. for flagellates, Colombia). Lebbe et al. 1987: 28 (computer aided ident.). Añez et al. 1988: 457 (Mérida, Venezuela). Cazorla et al. 1988b: 91 (anomalies. Feliciangeli 1988: 103 (dist., Venezuela). Bonfante-Garrido et al. 1991: 99 (Venezuela). Warburg et al. 1991b: 9 (biol., Colombia). Alexander et al. 1992c: 124 (Ecuador). Montoya-Lerma 1992: 698 (autogeny). Feliciangeli et al. 1993: 652 (egg morphol.).

Distribution (Map 6). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales et al. 1981; Young et al. 1987); ECUADOR (Alexander 1992c); VENEZUELA (Feliciangeli 1988); TRINIDAD (Young 1979); BRAZIL (Martins et al. 1963a); PERU (Martins et al. 1976a).

Remarks. The record of *L. lichyi* in Mato Grosso, Brazil (Lainson et al. 1976a) was based on a single female provisionally identified as this species by D. Young. The specimen, however, is conspecific with *L. sherlocki*.

Hanson (1968) described the fourth instar larva and pupa of *L. lichyi* (as *vexillarius*) from specimens reared in Panama. He noted that the larvae of this species and *L. gomezi* share certain characters not found in any other known species.

Lutzomyia lichyi females are autogenous in western Colombia (Montoya-Lerma 1992). They are also anthropophilic.

Lutzomyia* (*Lutzomyia*) *dispar Martins & Silva
Fig. 27

Lutzomyia dispar Martins & Silva 1963: 243 (♂, Aquidauana, Mato Grosso, Brazil). Forattini 1973: 254 (♂ fig.). Martins et al. 1978: 21 (dist.). Williams & Carvalho 1979: 325 (♀ descript., ♂ redescript., dist.).

Distribution (Map 7). BRAZIL (Martins et al. 1978).

Remarks. Williams & Carvalho (1979) reported females of *L. dispar* attacking man during the daytime at Camapua, Mato Grosso, Brazil. Males from there have shorter structures of the terminalia than those of the holotype, but Williams & Carvalho regarded them as conspecific.

Lutzomyia (Lutzomyia) ischnacantha Martins, Souza & Falcão
Fig. 28 A-G

Lutzomyia ischnacantha Martins, Souza & Falcão 1962e: 39 (♂, Lapão, Minas Gerais, Brazil). Theodor 1965: 181 (listed). Forattini 1973: 257 (♂ fig.), Martins et al. 1975c: 298 (♀ descript.); 1978: 21 (dist.). Williams & Carvalho 1979: 329 (cf. to *dispar*).

Distribution (Map 3). BRAZIL (Martins et al. 1978).

Remarks. Apart from being found in limestone caves, there is no published information on the habits of this species.

Lutzomyia (Lutzomyia) amarali (Barretto & Coutinho)
Fig. 28 H-M

Phlebotomus amarali Barretto & Coutinho 1940: 134 (♀, São Paulo, São Paulo, Brazil). Floch & Abonnenc 1952: 47 (♀ keyed, figs.).
Flebotomus amarali: Barretto 1947a: 184 (refs.).
Lutzomyia amarali: Theodor 1965: 196 (listed). Martins et al. 1978: 150 (refs., dist.). Mayrink et al. 1979: 131 (Caratinga, Brazil, infected with gregarines). Aguiar et al. 1985c: 467 (coll. data, Brazil).
Lutzomyia diacantha: Martins & Silva 1965: 273 (♂, Bonito, Minas Gerais, Brazil). Forattini 1973: 254 (♂ fig.). Martins et al. 1978: 150 (as synonym of *amarali*, dist.).
Brumptomyia amarali: Forattini 1971a: 98 (listed); 1973: 523 (♀ figs.).

Distribution (Map 3). BRAZIL (Martins et al. 1978).

Remarks. The unusual arrangement of the cibarial teeth and the shape of the spermathecae of *L. amarali* resemble those of the *Brumptomyia* females but the interocular suture is incomplete in both sexes and the *L. amarali* male differs greatly from those in the genus *Brumptomyia*.

Lutzomyia (Lutzomyia) cruzi (Mangabeira)
Fig. 29 A-J

Flebotomus cruzi Mangabeira 1938: 351 (♂, Camapuan, Mato Grosso do Sul, Brazil) Barretto 1947a: 195 (refs.).
Lutzomyia cruzi: Barretto 1962: 92 (listed). Forattini 1973: 252 (♂ fig., tax.). Martins et al. 1978: 21 (dist.); 1984: 439 (♂ redescript., ♀ descript.). Galati et al. 1985: 261 (Mato Grosso do Sul, Brazil).

Distribution (Map 8). BRAZIL (Martins et al. 1978; 1984; Galati et al. 1985).

Remarks. The females of *L. cruzi* and *L. longipalpis* are structurally indistinguishable (Martins et al. 1984), but little is known about the habits of the former species. The male of *L. cruzi* has 4 foliaceous setae at the inner base of the coxite, not 6 as Mangabeira (1938) described.

Lutzomyia (Lutzomyia) souzalopesi Martins, Silva & Falcão
Fig. 29 K-O

Lutzomyia souzalopesi Martins, Silva & Falcão 1970c: 559 (♂, ♀, Aracruz, Espirito Santo, Brazil). Forattini 1973: 270 (♂, ♀ figs.). Martins et al. 1978: 24.

Distribution (Map 1). BRAZIL (type locality).

Remarks. This species, known only from the type series, was collected from tree trunks at Aracruz, Brazil.

Lutzomyia (Lutzomyia) longipalpis (Lutz & Neiva)
Fig. 30

Phlebotomus longipalpis Lutz & Neiva 1912: 89 (♂, ♀, Brazil, locality indeterminate). Guitton & Sherlock 1969: 383 (immature stages).
Phlebotomus otamae Nuñez-Tovar 1924: 44 (♂, Isla de Otama, Carabobo, Venezuela).
Phlebotomus almazani Galliard 1934b: 193 (♀, Chichen Itza, Yucatan, Mexico).
Flebotomus longipalpis: Barretto 1947a: 208 (full refs.).
Lutzomyia longipalpis: Theodor 1965: 181 (♂, ♀ figs.). Forattini 1973: 213 (♂, ♀, immatures, figs., gen. review). Ward & Ready 1975: 128 (egg descript.). Lainson et al. 1977: 628 (exp. vector, *Leishmania chagasi*). Mogollon et al. 1977: 209 (Venezuela record). Lainson et al. 1978: 309 (exp. host, *Leishmania*). Ready 1978: 545 (lab. feeding habits). Ramirez Pérez et al. 1978: 49 (figs., Venezuela). Martins et al. 1978: 22 (♂, ♀ figs., dist., refs.). Young 1979: 56 (figs., refs.). Ready 1979: 413 (physiol., egg production). Shaw 1981: 232 (exp. host, *Endotrypanum*). Killick-Kendrick & Molyneux 1981: 152 (mouthpart sensilla). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Araujo & Sherlock 1981: 81 (Ilha Grande, Brazil). Rudin & Hecker 1982: 751 (functional gut morphol.). Buescher et al. 1982: 176 (repellent testing). Ramirez Pérez et al. 1982a: 14 (figs., Venezuela). Modi & Tesh 1983: 568 (lab rearing). Lainson et al. 1983: 323 (Marajó Island, Brazil). Pratt et al. 1983: 1268 (detection of *Leishmania amazonensis* by monoclonal antibodies). Tesh & Modi 1983: 199 (*in vitro* cell line developed). Bonfante-Garrido 1983: 740 (exp. host, *Leishmania venezuelensis*). Desjeux et al. 1983: 851 (Bolivia). Ward et al. 1983: 269 (crossbreeding, variants of *longipalpis*). Le Pont & Desjeux 1984b: 277 (Bolivia). Magnarelli et al. 1984: 681 (age grading). Ryan et al. 1984: 547 (nat. *Leishmania* infection, Pará, Brazil). Ryan & Brazil 1984: 383 (nat. *Leishmania* infection, Maranhão, Brazil). Travassos et al. 1984b:

1000 (exp. *Vesiculovirus* infections). Tesh & Modi 1984: 1007 (exp. *Phlebotomus* infections). Buescher et al. 1984: 76 (multiple feeding, *Phlebovirus* lab. ♀♀). Hoch et al. 1984: 295 (exp. host of Rift Valley Fever virus). Lane & Ward 1984: 245 (tergal spots). Feliciangeli et al. 1984a: 360 (Venezuela). Lane et al. 1985: 225 (tergal spots as possible pheromone release sites). Rangel et al. 1985a: 371 (exp. infections, *Leishmania amazonensis*). Navin et al. 1985: 1074 (Honduras). Murillo & Zeledón 1985: 36 (♂, ♀ figs., Costa Rica). Ward et al. 1985: 145 (dist. of 1 & 2 tergal spot forms). Sacks & Perkins 1985: 456 (exp. host of *Leishmania*). Killick-Kendrick 1985: 751 (exp. & nat. vector, *Leishmania*). Añez et al. 1985: 113 (exp. host, *Leishmania*). Lainson et al. 1985: 223 (nat. *Leishmania chagasi* infections, Brazil). Le Pont & Desjeux 1985: 227 (nat. *Leishmania chagasi* infections, Bolivia). Cuba Cuba et al. 1985: 503 (exp. host, *Leishmania*). Gonçalves et al. 1985: 337 (exp. vector, *Leishmania*). Ward et al. 1986: 69 (genetics). Phillips et al. 1986: 271 (compounds in tergal spots). Ribeiro et al. 1986: 683 (capillary feeding). Bonnefoy et al. 1986: 213 (isozyme study). Killick-Kendrick 1986: 135 (listed). Braga et al. 1986: 143 (nat. *Leishmania chagasi* infections, Brazil). Deane et al. 1986: 133 (exp. *Leishmania* infections). Jefferies 1987: 444 (mouthpart sensilla). Kreutzer et al. 1987: 610 (brain cell karyotypes). Morales et al. 1987: 93 (Colombia). Young et al. 1987: 588 (Norte de Santander, Colombia). Young & Lawyer 1987: 49 (2 tergal spot ♀♀, Paraguay). Rangel et al. 1987: 385 (biol.). Lainson et al. 1987: 421 (exp. data, transmission of *Leishmania chagasi*). Wermelinger et al. 1987: 441 (lab rearing). Feliciangeli 1988: 103 (dist., Venezuela). Ward et al. 1988: 257 (tax., dist., biol.). Coleman & Edman 1988: 229 (feeding behavior). Yuval & Warburg 1989: 195 (exp. infections, *Bacillus thuringiensis* var. *israelensis*). Morton & Ward 1989: 219 (pheromone study). Ribeiro et al. 1989: 212 (novel peptide identified from salivary glands). Walters et al. 1989b: 295 (exp. infections, *Leishmania chagasi*). Wu & Tesh 1989: 237 (exp. infections with gregarines). Le Pont et al. 1989b: 423 (2 tergal spot form in Bolivia); 1989d: 223 (insecticidal control, Bolivia). Lainson et al. 1990b: 135 (dist., role as vector of *Leishmania chagasi*). Munns et al. 1990: 462 (DNA probes to distinguish populations). Leite et al. 1991: 477 (pupal descript.). Santos et al. 1991a: 169; 1991b: 177 (lab. data, sex ratio changes, behavior). Queiroz et al. 1991: 159 (coll. data, Ceará, Brazil). El Naiem et al. 1991: 217 (oviposition studies). Dougherty & Ward 1991: 185 (reducing numbers of gregarines in lab. colonies). Hamilton & Ward 1991: 283 (analysis of tergal gland extract). Warburg 1991: 189 (nat. fungal infection). Ward & Morton 1991: 527 (pheromones, mating behavior). El Naiem & Ward 1991: 87 (oviposition pheromone study). Warburg & Ostrovska 1991: 91 (host-parasite study, *Ascogregarina*). Booth et al. 1991: 105 (genetics, retrotransposons). El Naiem & Ward 1992: 5 (oviposition attractants). Tesh et al. 1992: 226 (feeding stimulant identified). Jarvis & Rutledge 1992: 171 (mating behavior). Dougherty et al. 1992: 1165 (accessory glands as sites for oviposition

pheromone). Poinar et al. 1993: 11 (nematode parasite). Morrison et al. 1993: 68 (host preferences, Colombia).

Distribution (Map 9). MEXICO to ARGENTINA (Martins et al. 1978) with following additions: HONDURAS (Navin et al. 1985); NICARAGUA (Le Pont et al. 1987); COSTA RICA (Murillo & Zeledón 1985); PANAMA (1 ♂, 7 ♀♀, Toboga Island, light traps, 1953-1954, F. Blanton); COLOMBIA (Young et al. 1987; Morales et al. 1987); VENEZUELA (Feliciangeli 1988); BOLIVIA (Le Pont et al. 1989d); PARAGUAY (Young & Lawyer 1987); BRAZIL (Ward et al. 1983).

Remarks. *Lutzomyia longipalpis* is undoubtedly the best studied sand fly in the Americas as indicated by the number of references cited here. It is the principal vector of visceral leishmaniasis due to *Leishmania chagasi*; it is geographically widespread, and locally abundant, especially at farms where domestic animals are kept. There are many laboratory colonies which have provided material for studies on taxonomy, physiology, biology, behavior and host/parasite relationships of *L. longipalpis*.

At the time of the original description, Lutz & Neiva (1912) studied several females from São Paulo State, Brazil and a single male from Benjamin Constant, Minas Gerais, Brazil. No holotype was designated, nor, as far as we know, was a lectotype specimen selected from the original series, supposedly housed in the collection at the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil. These specimens may now be lost.

There is mounting evidence that this species represents a species complex of 2 or more taxa (Ward et al. 1988). This hypothesis is based on morphological differences (♂♂ with pale spots on tergites 3 & 4 versus those with pale spot only on tergum 4); crossbreeding experiments (Ward et al. 1983); wing beat patterns and pheromones (Ward & Morton 1991 for references).

Lutzomyia* (*Lutzomyia*) *gaminarai (Cordero, Vogelsang & Cossio)
Fig. 31

Phlebotomus gaminarai Cordero, Vogelsang & Cossio 1928: 649 (♂, ♀, Salto & Tacuarembó, Uruguay, type locality indeterminate).
Flebotomus gaminarai: Barretto 1947a: 201 (refs.).
Lutzomyia gaminarai: Martins et al. 1961c: 312 (♂ redescript.). Forattini 1973: 255 (♂ fig.). Martins et al. 1978: 21 (dist.).

Distribution (Map 6). BRAZIL; URUGUAY (Martins et al. 1978).

Remarks. We have not seen the original description of *L. gaminarai* but Martins et al. (1961c) carefully redescribed the male. The female according to Forattini (1973) is unrecognizable based on the original description.

Lutzomyia* (*Lutzomyia*) *ischyracantha Martins, Falcão & Silva
Fig. 32 H-M

Lutzomyia ischyracantha Martins, Falcão & Silva 1962b: 227 (♂, ♀, Rio Manso, Minas Gerais, Brazil). Forattini 1973: 259 (♂, ♀ figs.). Martins et al. 1978: 21 (dist.). Mayrink et al. 1979: 130 (Minas Gerais, Brazil, biting man in day).

Distribution (Map 6). BRAZIL (Martins et al. 1978).

Lutzomyia* (*Lutzomyia*) *alencari Martins, Souza & Falcão
Fig. 32 A-G

Lutzomyia alencari Martins, Souza & Falcão 1962e: 42 (♂, Jequitinhonha, Minas Gerais, Brazil). Theodor 1965: 181 (listed). Forattini 1973: 247 (♂ fig.). Martins et al. 1978: 21 (dist.); 1982: 421 (♀ descript.).

Distribution (Map 7). BRAZIL (Martins et al. 1978).

Remarks. The male of *L. alencari* has a pale tergal spot on each side of abdominal tergite 4, indicating among other character states, its close resemblance to *L. longipalpis*.

Lutzomyia* (*Lutzomyia*) *caligata Martins, Falcão & Silva
Fig. 33 A-C

Lutzomyia caligata Martins, Falcão & Silva 1965: 7 (♂, Nucleo Agrícola Iata, Rôndonia, Brazil). Forattini 1973: 349 (♂ fig). Martins et al. 1978: 150 (listed). Biancardi et al. 1982: 168 (listed).

Distribution (Map 2). BRAZIL (type locality).

Remarks. We have not examined specimens of this little-known species that was described from a single male. Its placement in the subgenus *Lutzomyia* is provisional.

Lutzomyia* (*Lutzomyia*) *castroi (Barretto & Coutinho)
Fig. 33 D-I

Phlebotomus castroi Barretto & Coutinho 1941c: 180 (♂, Itaporanga, São Paulo, Brazil).

Flebotomus castroi: Mangabeira 1942a: 185 (as type species of *Phlebotomus* subgenus *Castromyia*). Barretto 1947a: 192 (refs.).
Lutzomyia castroi: Barretto 1962: 92 (mention). Theodor 1965: 191 (listed). Martins & Silva 1968: 3. Forattini 1973: 351 (♂ fig.). Martins et al. 1978: 151 (listed).

Distribution (Map 2). BRAZIL (type locality).

Remarks. The male of *L. castroi* closely resembles that of *L. caligata* and, like it, is known only from the type locality. Also, its placement in this subgenus is not definite.

Lutzomyia* (*Lutzomyia*) *cipoensis Martins, Falcão & Silva
Fig. 34

Lutzomyia cipoensis Martins, Falcão & Silva 1964a: 312 (♂, Serra do Cipó, Minas Gerais, Brazil). Forattini 1973: 252 (♂ fig., as possible variant of *gasparviannai*). Martins et al. 1975c: 297 (♀ descript.); 1978: 160.

Distribution (Map 10). BRAZIL (type locality).

Lutzomyia* (*Lutzomyia*) *gasparviannai Martins, Godoy & Silva
Fig. 35

Lutzomyia gasparviannai Martins, Godoy & Silva 1962d: 86 (♂, ♀, Tinguá, Rio de Janeiro, Brazil). Forattini 1973: 255 (♂, ♀ figs., tax.). Martins et al. 1978: 160 (dist., ♂, ♀ figs.). Mayrink et al. 1979: 131 (attracted to man & rodents, Minas Gerais, Brazil). Falqueto et al. 1985: 497 (in Disney traps, Espirito Santo, Brazil).

Distribution (Map 11). BRAZIL (Martins et al. 1978; Falqueto et al. 1985).

Remarks. The presence of 2 large horizontal teeth in the female cibarium of *L. gasparviannai* is distinctive and readily serves to separate it from the female of *L. cipoensis*, a close ally.

Falqueto et al. (1985) suggest that this species is a probable vector of *Leishmania* in Espirito Santo State, Brazil).

Lutzomyia* (*Lutzomyia*) *flabellata Martins & Silva
Fig. 36

Lutzomyia flabellata Martins & Silva 1964: 133 (♂, Rio Branco, Acre, Brazil). Forattini 1973: 352 (♂ fig.). Martins et al. 1978: 160 (listed). Biancardi et al. 1982: 171 (Rondônia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil).

Distribution (Map 10). BRAZIL (Martins et al. 1978; Biancardi et al. 1982). 3 ♂♂, Aripuana, Mato Grosso, J. Arias, no other data.

Remarks. The pleuron of *L. flabellata* is very dark, like that of *L. marinkellei*, *L. araracuarensis* and several other species closely related to *L. cruciata*. The female remains undescribed.

Lutzomyia (*Lutzomyia*) *falcata* Young, Morales & Ferro, n.sp.
Fig. 37

Holotype ♂ (measurements in mm). Wing length 1.5, width 0.47. coloration dark throughout. Head height from vertex to tip of clypeus 0.36, width 0.34. Eyes separated by 0.10 or by distance equal to 5.1 facet diameters. Flagellomere I 0.28 long; II+III=0.26; ascoids simple, those on I reaching only to middle of flagellomere, visible on flagellomeres I-XI. Labrum 0.20 long. Length of palpomeres: 1, 0.04; 2, 0.11; 3, 0.14; 4, 0.11; 5, 0.35; palpal sensilla at end of palp. 2 & along inner side of palp. 3. Cibarium with remnants of teeth; pigment patch slender & triangular; arch complete. Pharynx 0.16 long, unarmed. Pleura with 17-18 upper & 3 lower episternal setae. Length of wing vein sections: α, 0.36; ß, 0.25; δ, 0.04; γ, 0.25. Length of femora, tibiae & basitarsi: foreleg, 0.67, 0.67, 0.39; midleg, 0.68, 0.84, 0.44; hindleg, 0.71, 1.02, 0.51. *Genitalia*. Style 0.15 long, with paired median spines, 1 isolated spine & 1 terminal spine; no subterminal seta. Coxite 0.25 long, with basal tuft of ca. 20 slender setae inserted on a raspberry-like tubercle. Paramere simple with most dorsal setae at distal third; 1 conspicuous dorsal seta, recurved apically, inserted near middle of paramere. Aedeagus 0.11 long, well pigmented, shaped as shown. Genital pump 0.14 long, each filament 0.45 long or 3.2X length of pump; filament tips simple. Lateral lobe 0.23 long, its tip slightly beyond end of paramere.

Allotype ♀. Wing length 1.74; width 0.59. Coloration very dark as in ♂. Head height 0.40, width 0.44 (head unduly compressed due to slide mount). Eyes separated by 0.11 or by distance equal or 5.9 facet diameters. Flagellomere I 0.26 long; II+III=0.22; ascoids simple, reaching to distal fifth of flagellomere II; on all flagellomeres except XIV. Labrum 0.24 long. Length of palpomeres: 1, 0.038; 2, 0.122; 3, 0.15; 4, 0.126, 5, 0.36, palpal sensilla not visible. Cibarium with 4 sharp, equidistant horizontal teeth; 2 irregular rows of about 20 small vertical teeth; subtriangular, slender pigment patch present; arch complete. Pharynx 0.17 long, with posterior ridges. Pleura with 9-10 upper & 4-5 lower episternal setae. Length of wing vein sections: α, 0.45; ß, 0.23; δ, 0.15; γ, 0.24. Length of femorae, tibiae & basitarsi: foreleg, 0.71, 0.67 (missing); midleg missing; hindleg, 0.75, 1.02, 0.51. Spermathecae as shown, annulated with smooth-walled ducts, individual ducts at least 10X longer than short common duct.

Type Material (Map 1). *Holotype* ♂. **Colombia**, Amazonas, 8 km N of Leticia, tree trunk 8 Sept. 1986, A. Morales. *Allotype* ♀. **Brazil**, Amazonas, 14 km E of Manaus, (reared), 27 July 1977, J. Arias. *Paratypes*. 2 ♂♂, same data as holotype but 9 Sept. 1986 & July 1988. 3 ♂♂, 3 ♀♀, same data as allotype. 6 ♂♂, Brazil, Amazonas, 26 to 269 km E of Manaus, light traps, July-Nov., 1976-1977, J. Arias. 5 ♂♂, Brazil, Mato Grosso, Humboldt Reserve near Rio Aripuanã, light traps, 3 Oct. 1975, R. Freitas & J. Vidal. 1 ♂, **Ecuador**, Napo, Limoncocha, light trap, 22 May 1976, D.G. Young & T.E. Rogers.

Remarks. *Lutzomyia falcata* is the only member of the *cruciata* group that has one isolated seta on the dorso-median margin of each paramere. Three males collected along highway 010, East of Manaus at Km 26, 142 and 269 are the only ones in the type series with paired setae on the parameres. A Colombian male was selected as the holotype because of its excellent preservation and presentation in Canada balsam on a microslide. The paratypes of *L. falcata* from Brazil will require remounting within a decade.

The female of this species has a very dark pleuron similar to that of the conspecific male, *L. marinkellei*, *L. spathotrichia*, *L. araracuarensis* and *L. flabellata*. All of these species are sympatric with *L. falcata* in parts of their geographic ranges but we are not able to separate the females without associated males. The female paratypes, including the allotype, and some male paratypes were reared from a single female at INPA, Manaus, Brazil so there is no doubt about the correct association of the sexes. The specific name refers to the sickle shaped dorsal setae of the parameres.

The holotype will be deposited in the collection at the National Institute of Health, Bogota, Colombia. Paratypes will be distributed to Brazilian collections (INPA, Manaus & Centro de Pesquisas René, Rachou, Belo Horizonte). Other paratypes will be retained in the sand fly collection at the Florida State Collection of Arthropods, Gainesville, Florida, USA.

Lutzomyia (*Lutzomyia*) *spathotrichia* Martins, Falcão & Silva
Fig. 38

Lutzomyia spathotrichia Martins, Falcão & Silva 1963: 340 (♂, Pissarreira, Roraima, Brazil). Forattini 1973: 355 (♂ fig.). Martins et al. 1978: 160 (dist.). Ryan 1986: 50 (♂ fig., ♀ descript., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident., as senior synonym of *L. eliensis*). Alexander et al. 1992c: 124 (Ecuador record).

Lutzomyia eliensis Le Pont & Desjeux 1983: 48 (♂, ♀, St. Elie, French Guiana). Geoffroy et al. 1986: 486 (French Guiana).

Distribution (Map 2). FRENCH GUIANA (Le Pont & Desjeux 1983); BRAZIL (Martins et al. 1978; Ryan 1986) ECUADOR (Alexander et al. 1992c).

Remarks. From the description of *L. eliensis* Le Pont & Desjeux (1983), there is little doubt about its conspecificity with *L. spathotrichia*. The female illustrated here was captured on human bait in the forest canopy, Rio Jari, Pará, Brazil, by P.D. Ready.

Lutzomyia* (*Lutzomyia*) *carvalhoi (Damasceno, Causey & Arouck)
Fig. 39

Flebotomus carvalhoi Damasceno, Causey & Arouck 1945: 8 (♂, Tocunduba, Belém, Pará, Brazil).
Phlebotomus carvalhoi: Fauran 1960: 7 (♂ figs., French Guiana).
Lutzomyia carvalhoi: Theodor 1965: 182. Forattini 1973: 349 (♂ fig., tax.). Legér et al. 1977: 219 (French Guiana). Martins et al. 1978: 159 (dist.). Ryan 1986: 44 (♂ fig., ♀ descript., Pará, Brazil). Ryan et al. 1987a: 356 (nat. flagellate infection; Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 10). FRENCH GUIANA (Fauran 1960); BRAZIL (Martins et al. 1978; Ryan 1986).

Remarks. Ryan (1986) observed that the *L. carvalhoi* female lacks a common sperm duct unlike that of *L. spathotrichia* in which there is a short duct. Also, the spermathecal annulations are distinct in the former species but indistinct or incomplete in *L. spathotrichia*.

Lutzomyia* (*Lutzomyia*) *araracuarensis Morales & Minter
Fig. 40

Lutzomyia araracuarensis Morales & Minter 1981: 98 (♂, Araracuara, Caqueta, Colombia).

Distribution (Map 11). COLOMBIA (Morales & Minter 1981; ♂♂, Leticia, Amazonas, 1986-1987, A. Morales, C. Ferro, D.G. Young).

Remarks. The female of this species is unknown but probably resembles *L. spathotrichia* in color and structure.

Lutzomyia* (*Lutzomyia*) *evangelistai Martins & Fraiha
Fig. 41

Lutzomyia evangelistai Martins & Fraiha 1971: 361 (♂, ♀, Belém, Pará, Brazil). Llanos et al. 1975a: 659 (♀, cf. to *sherlocki*); 1976: 480 (Peru). Lainson et al. 1976a: 57. Martins et al. 1978: 122 (dist.). Fraiha et al. 1980a: 21 (Iquitos,

Peru). Llanos 1983: 183 (listed). Biancardi et al. 1982: 168 (Rondônia, Brazil). Le Pont & Desjeux 1983: 51 (cf. to *eliensis*). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 46 (♂, ♀ figs.). Young & Morales 1987: 662 (Amazonas, Colombia).

Distribution (Map 5). BRAZIL (Martins & Fraiha 1971; Biancardi et al. 1982); COLOMBIA (Young & Morales 1987); PERU (Llanos et al. 1976; Fraiha et al. 1980a); BOLIVIA (♀, Rio Yapancani, Santa Cruz, 1983, light trap, H. Bermudez & D.G. Young).

Remarks. Except for a lateral band of faint pigmentation on each side of the scutum, this species is conspicuously pale. The record from Bolivia, where *L. evangelistai* has not been previously collected, suggests that this is a widespread species.

Lutzomyia (*Lutzomyia*) *sherlocki* Martins, Silva & Falcão
Fig. 42

Lutzomyia sherlocki Martins, Silva & Falcão 1971: 415 (♂, Vila Bela, Mato Grosso, Brazil). Llanos et al. 1975a: 657 (♀ descript., Peru); 1975b: 671 (Peru). Martins et al. 1978: 124 (dist.). Biancardi et al. 1982: 170 (Rondônia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil). Le Pont & Desjeux 1983: 51 (cf. to *eliensis*).

Lutzomyia lichyi (not *lichyi* Floch & Abonnenc): Lainson et al. 1976a: 57 (Mato Grosso, Brazil).

Lutzomyia gomezi (not *gomezi* Nitz. in part). Young 1979: 59 (♀, not ♂, Leticia, Colombia). Young & Rogers 1984: 599 (listed, Napo, Ecuador).

Distribution (Map 4). COLOMBIA (Young 1979: ♀♀, Leticia, Amazonas, 1986-1987, A. Morales, C. Ferro & D.G. Young); ECUADOR (♀♀, Limoncocha, Napo, May 1976, light trap, D.G. Young & T. Rogers); PERU (Llanos 1975a,b; Pérez et al. 1991); BRAZIL (Lainson et al. 1976b; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982); BOLIVIA (1 ♂, Rio Yapacani, Santa Cruz, May 1983, light trap, H. Bermudez & D.G. Young).

Remarks. Martins et al. (1971) distinguish the males of *L. sherlocki* from *L. gomezi* by the greater number of setae at the coxite base (40 for *sherlocki* vs. 14-19 for *gomezi*). The female of *L. sherlocki* has larger spermathecae than those of *L. gomezi* according to Llanos et al. (1975a).

The individual sperm ducts of *L. sherlocki* are also wider than those of *L. gomezi*, but the female of the latter species has a longer labrum ranging from 0.31 to 0.36 mm (n = 35 from Trinidad, Venezuela, Colombia, Ecuador, Panama, Costa Rica, and Nicaragua). All females examined from the Amazon basin of Brazil (n = 20), Ecuador (n = 2) and Leticia, Colombia (n = 6) have

shorter labra, ranging from 0.24 to 0.29 mm in length. These females also have wide individual sperm ducts, as figured by Ryan (1986).

Our sample is not sufficient to draw conclusions regarding the status of *L. sherlocki* as a valid species, distinct from *L. gomezi*. The males of *L. gomezi* and *L. sherlocki* are very similar in structure but that of *L. sherlocki* has more setae on the paramere which, in addition, is more upturned & tapered towards its apex. The number of setae of the coxite tuft is difficult to count, but we have examined several males from Tucurui, Pará, Brazil, that have 25-35 such setae.

Additional studies are needed to determine whether these differences reflect clinal variation and to obtain a better picture of the geographic ranges of these taxa.

Lutzomyia (*Lutzomyia*) *gomezi* (Nitzulescu)
Fig. 43

Phlebotomus gomezi Nitzulescu 1931: 247 (♀, San Cristobal, Tachira, Venezuela). Fairchild & Hertig 1948a: 252 (tax.); 1953b: 382 (♂ ♀ figs., refs., dist.). Hanson 1968: 60 (larva, pupa).

Phlebotomus suis Rozeboom 1940: 8 (♂, ♀, Panama). Fairchild & Hertig 1948a: 252 (as junior synonym of *gomezi*).

Phlebotomus japignyi Floch & Abonnenc 1944c: 2 (♂, ♀, French Guiana). Fairchild & Hertig 1948a: 252 (as junior synonym of *gomezi*).

Lutzomyia gomezi: Martins et al. 1962d: 90 (cf. to *gasparvianna*). Forattini 1973: 240 (figs., tax., gen. review). Intermill & Muller 1976: 543 (Honduras). Zimmerman et al. 1977: 575 (egg). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 122 (♂, ♀ figs., refs., dist.). Ramirez Pérez et al. 1978: 65 (figs., Aragua, Venezuela). Young 1979: 56 (figs., refs.). Christensen & Herrer 1980a: 188 (exp. infections with *Leishmania aristidesi*); 1980b: 523 (feeding habits). Feliciangeli 1980: 246 (keyed, figs.). Fraiha et al. 1980a: 21 (Peru). Léger et al. 1980: 116 (French Guiana). Porter & De Foliart 1981: 144 (ecology, biting activity, Colombia). Morales & Minter 1981: 96 (Caqueta, Colombia). Morales et al. 1981: 198 (Tolima, Colombia). Ramirez Pérez et al. 1981: 114 (pop. dynamics, age grading); 1982a: 14 (Sucre, Venezuela); 1982b: 58 (figs., Tachira, Venezuela). Biancardi et al. 1982: 168 (Rôndonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Le Pont & Desjeux 1983: 51 (cf. to *eliensis*). Bonfante-Garrido 1983: 740; 1984: 850 (Venezuela). Hashiguchi et al. 1985b: 442 (Ecuador). Murillo & Zeledón 1985: 34 (♂, ♀ figs., Costa Rica). Ready et al. 1986: 36 (Pará, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan 1986: 47 (figs., Pará, Brazil). Morales et al. 1987: 93 (Colombia record). Young et al. 1987: 588 (nat. promastigote infection, Colombia). Alexander 1987: 554 (dispersal). Feliciangeli 1987a-d (ecology, Carabobo, Venezuela). Cazorla et al. 1988b: 91 (structural anomalies).

Feliciangeli et al. 1988b: 393 (dissection results, neg. for flagellates, Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Kreutzer et al. 1988: 453 (karyotyping). Walters et al. 1989a: 19 (lab. study, development of *Leishmania panamensis* in *gomezi*). Bonfante-Garrido et al. 1991: 99 (Venezuela). Eshita et al. 1992: 22 (Ecuador). Alexander et al. 1992a: 35 (Ecuador); 1992c: 124.

Distribution (Map 3). HONDURAS (Intermill & Muller 1976); EL SALVADOR; NICARAGUA (Martins et al 1978); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979, in part; Morales & Minter 1981; Morales et al. 1981; Young et al. 1987); ECUADOR (Young & Rogers 1984, in part; Hashiguchi et al. 1985a; Alexander et al. 1992a,c); PERU (Martins et al. 1978; Fraiha et al. 1980a; Llanos 1983; Pérez et al. 1991); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1978; 1982a,1982b; Bonfante-Garrido 1983; Feliciangeli 1987a; 1988); TRINIDAD (Martins et al. 1978); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); BRAZIL (Martins et al. 1978, ? in part).

Remarks. As discussed under *L. sherlocki*, we suspect that some published records of *L. gomezi* in the Amazon basin of Brazil and southwards may represent *L. sherlocki* or, less likely, atypical forms of *L. gomezi* (♀♀ with wide sperm ducts).

Females from Trinidad, western Ecuador, western and northern Colombia, and Central America are structurally similar to those figured by Fairchild & Hertig (1953b) and also to specimens captured within 150 km of the type locality in Venezuela (D.G. Young, unpub. data). We have not seen females from French Guiana but, based on the description and illustrations of Floch & Abonnenc (1944c, 1952, as *japignyi*), their material can be assigned to *L. gomezi* (♀♀ with thin sperm ducts). Females from Pará State, Brazil, that we examined (Belém, $n = 10$; Maraba, $n = 2$) correspond to the wide duct form which, we suspect, is conspecific with *L. sherlocki*.

The habits of *L. gomezi* have been studied by several investigators, including Porter & De Foliart (1981) in Colombia. They noted that man-biting activity was greatest near forest clearings at stations in the forest canopy. Most females, in or near such clearings, bit the collectors from 1,800 to 2,000 hrs. No such pattern was observed at a deep forest site.

Lutzomyia gomezi feeds on a variety of mammals and is a suspected vector of *Leishmania panamensis* in Panama (see Christensen et al. 1983 for refs. & additional information).

Lutzomyia (*Lutzomyia*) *cruciata* (Coquillett)
Fig. 44

Flebotomus cruciatus Coquillett 1907: 102 (♀, Trece Aguas, Alta Vera Paz, Guatemala). Barretto 1947a: 194 (full refs.).

Phlebotomus cruciatus: Fairchild & Hertig 1948a: 247 (♀, tax., refs.); 1953b: 377 (figs., tax.).

Lutzomyia cruciata: Theodor 1965: 182 (figs., listed). Martins et al. 1978: 121 (in part, dist.). Lewis & Macfarlane 1981: 179 (mite parasite, Belize). Zeledón et al. 1982: 276 (Honduras). Zeledón & Murillo 1983: 280 (Nicaragua). Le Pont & Desjeux 1983: 51(cf. to *eliensis*). Young & Perkins 1984: 269 (figs., refs., tax.). Murillo & Zeledón 1985: 31 (figs., Costa Rica). Porter et al. 1987: 929 (age grading, Guatemala). Endris et al. 1987b: 413 (egg). Rowton et al. 1991: 501 (man biting, Guatemala).

Distribution (Map 7). U.S.A. (Young & Perkins 1984); MEXICO (Martins et al. 1978, in part; Young & Perkins 1984); BELIZE (Martins et al. 1978); GUATEMALA (type locality; Young & Perkins 1984; Porter et al. 1987; Rowton et al. 1991); HONDURAS; EL SALVADOR; NICARAGUA; PANAMA (Martins et al. 1978; Young & Perkins 1984); COSTA RICA (Murillo & Zeledón 1985).

Remarks. *Lutzomyia cruciata* can be distinguished readily from *L. gomezi* in Central America by coloration. The pronotum and paratergite of *L. cruciata* are heavily pigmented, whereas they are pale in the latter species.

There is increasing evidence indicating that a high proportion of *L. cruciata* females are autogenous (Young & Perkins 1984, Porter et al. 1987). Females will attack man, however, and experimental transmission of *Leishmania mexicana* has been demonstrated in Belize (see Williams 1970b). Rowton et al. (1991). dissected and examined 2,450 females taken on human bait in Guatemala. Five were infected with flagellates but these could not be established in culture.

Lutzomyia (*Lutzomyia*) *marinkellei* Young
Fig. 45

Lutzomyia marinkellei Young 1979: 59 (♂, ♀, Trés Esquinas, Caqueta, Colombia). Morales & Minter 1981: 96 (Caqueta, Colombia). Biancardi et al. 1982: 170 (Rôndonia, Brazil). Le Pont & Desjeux 1983: 51 (cf. to *eliensis*).

Distribution (Map 7). COLOMBIA (Young 1979; Morales & Minter 1981; 4 ♂♂, Leticia, Amazonas, 1986, A. Morales); BRAZIL (Young 1979; Biancardi et al. 1982).

Lutzomyia (Lutzomyia) diabolica (Hall)
Fig. 46

Phlebotomus diabolicus Hall 1936: 28 (♂, ♀, Uvalde, Texas, U.S.A.). Fairchild & Hertig 1948a: 247 (cf. to *gomezi & cruciata*); 1953b: 375 (figs., tax.).
Lutzomyia diabolica: Theodor 1965: 182 (listed). Young & Perkins 1984: 270 (figs., refs., dist.). Lawyer 1984: 1 (biology, disease relationships). Gustafson et al. 1985: 58 (mention). Lawyer & Young 1987: 458 (exp. vector of *Leishmania mexicana*). Lawyer et al. 1987: 347 (exp. host of *Leishmania mexicana*). Endris et al. 1987b: 413 (egg structure). McHugh 1991: 192 (U.S.A., coll. data). Lawyer & Young 1991: 353 (diapause data).
Lutzomyia cruciata diabolica: Lewis 1975a: 509 (mouthpart morphol.).

Distribution (Map 8). U.S.A.: MEXICO (Young & Perkins 1984; McHugh 1991).

Remarks. *Lutzomyia diabolica* is a suspected, but unproven, vector of *Leishmania mexicana* in southern Texas and northern Mexico and has been experimentally infected with *Leishmania infantum* (see Young & Lawyer 1987). Information and references pertaining to the biology and *Leishmania* relationships of this anthropophilic species are provided by Lawyer (1984), Lawyer & Young (1987), and Lawyer et al. (1987). Earlier records of *L. cruciata* in Texas, U.S.A., refer instead to *L. diabolica* (Young & Perkins 1984).

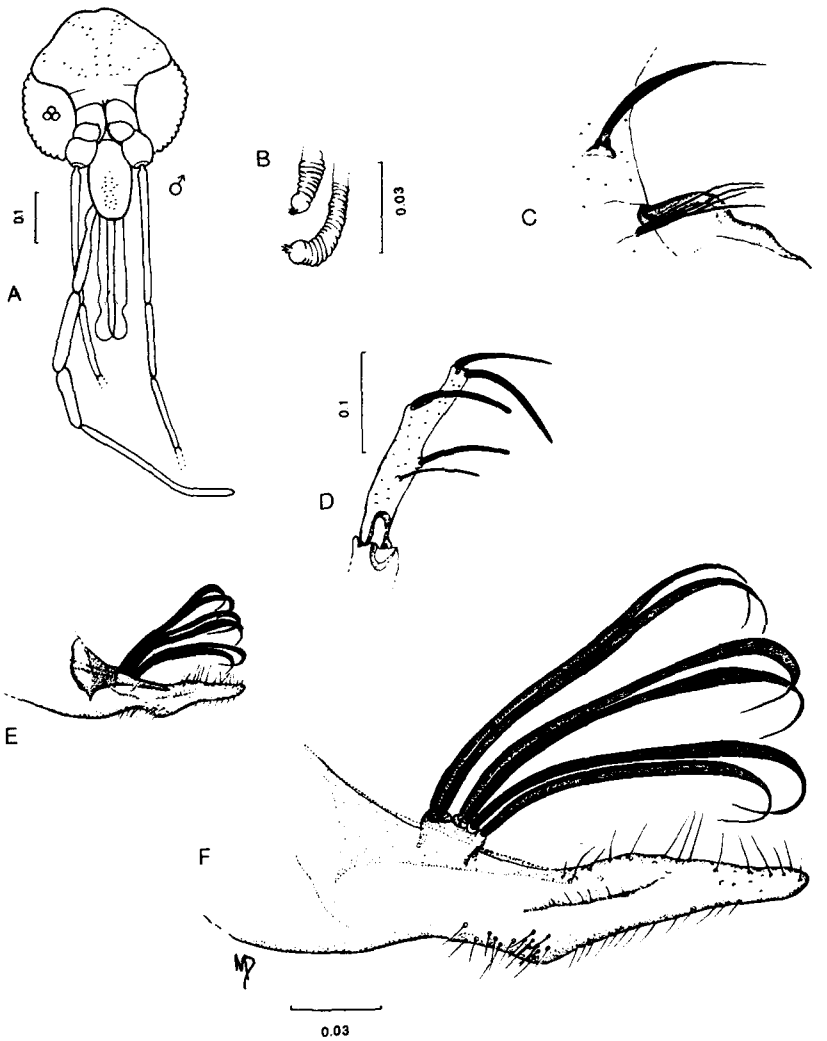


FIG. 20. ***Lutzomyia battistinii***. A. Male head; B. Spermathecae; C. Persistent setae at coxite base; D. Style; E. Paramere; F. Paramere.

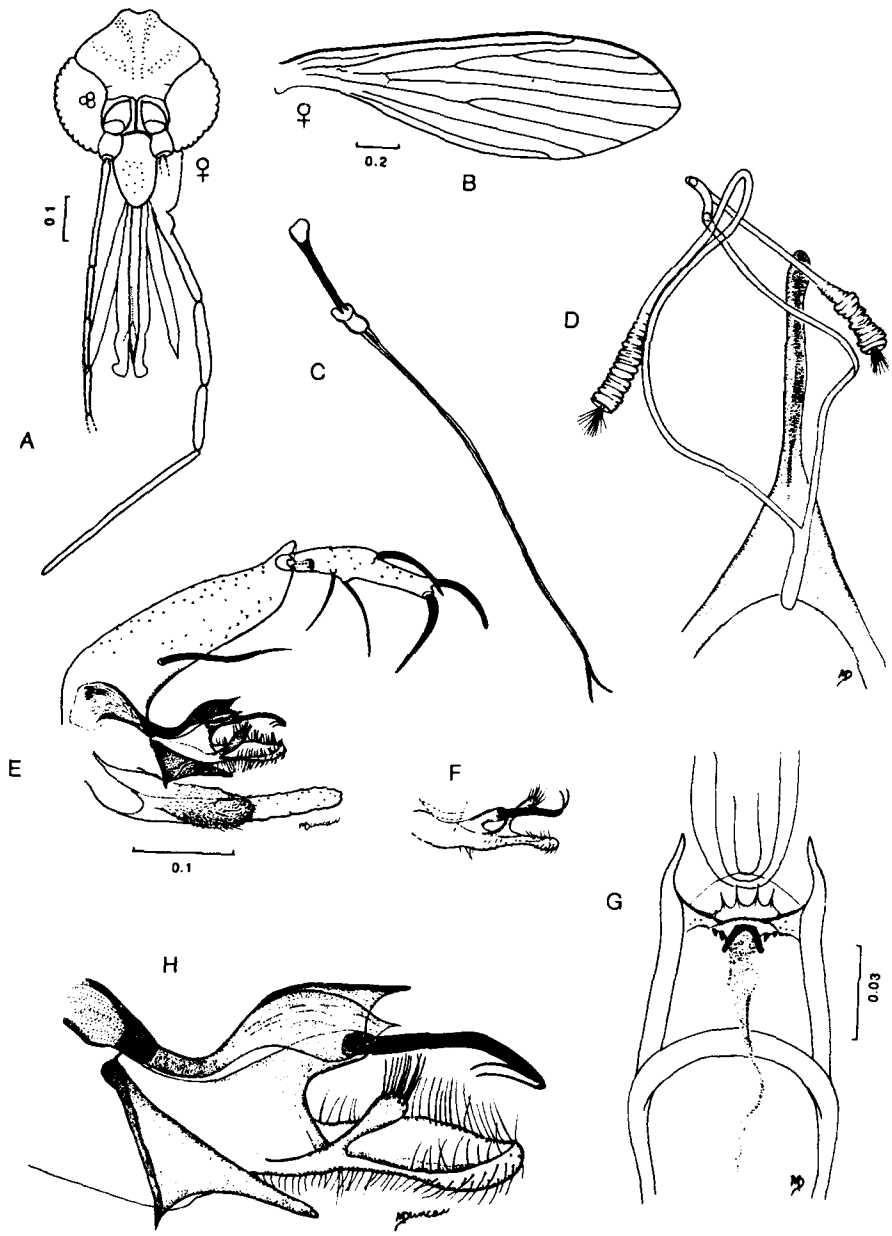


FIG. 21. ***Lutzomyia forattinii.*** A. Female head; B. Female wing; C. Genital pump & filaments; D. Spermathecae; E. Male terminalia; F. Paramere; G. Female cibarium; H. Paramere.

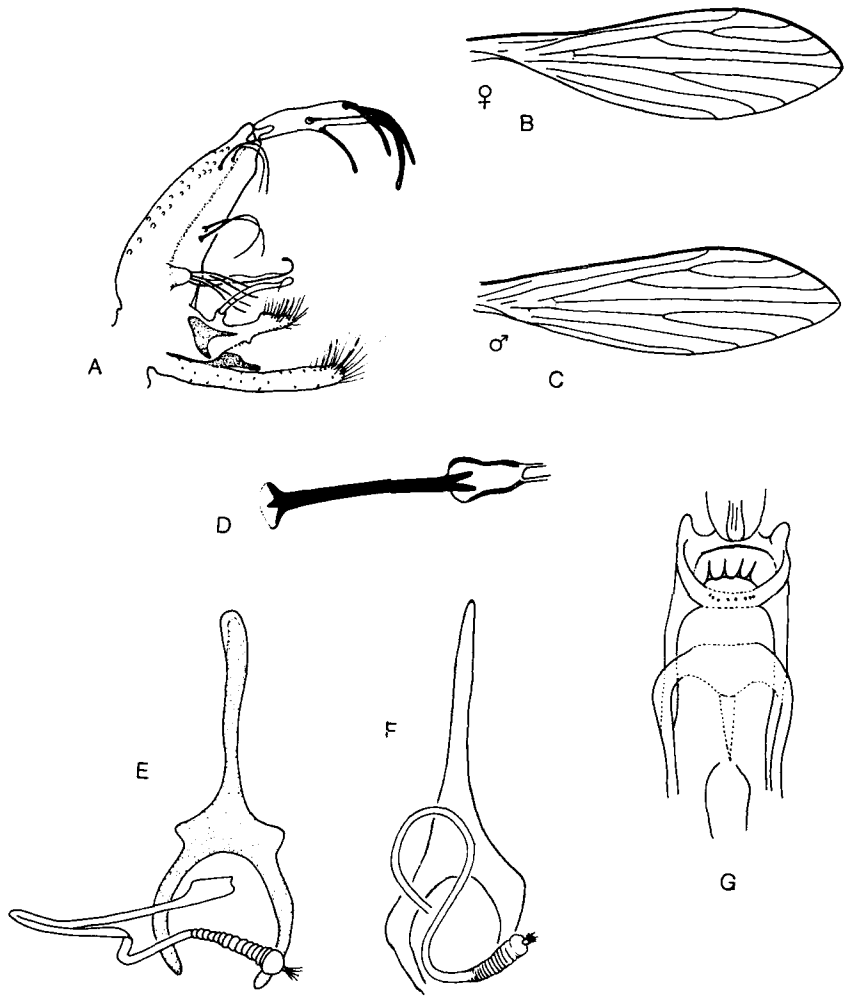


FIG. 22. ***Lutzomyia bicornuta***. A. Male terminalia; B. Female wing; C. Male wing; D. Genital pump; E. Spermathecae; F. Spermathecae; (sketched from allotype); G. Female cibarium (all figs. except F from Blancas & Herrer 1959-1960).

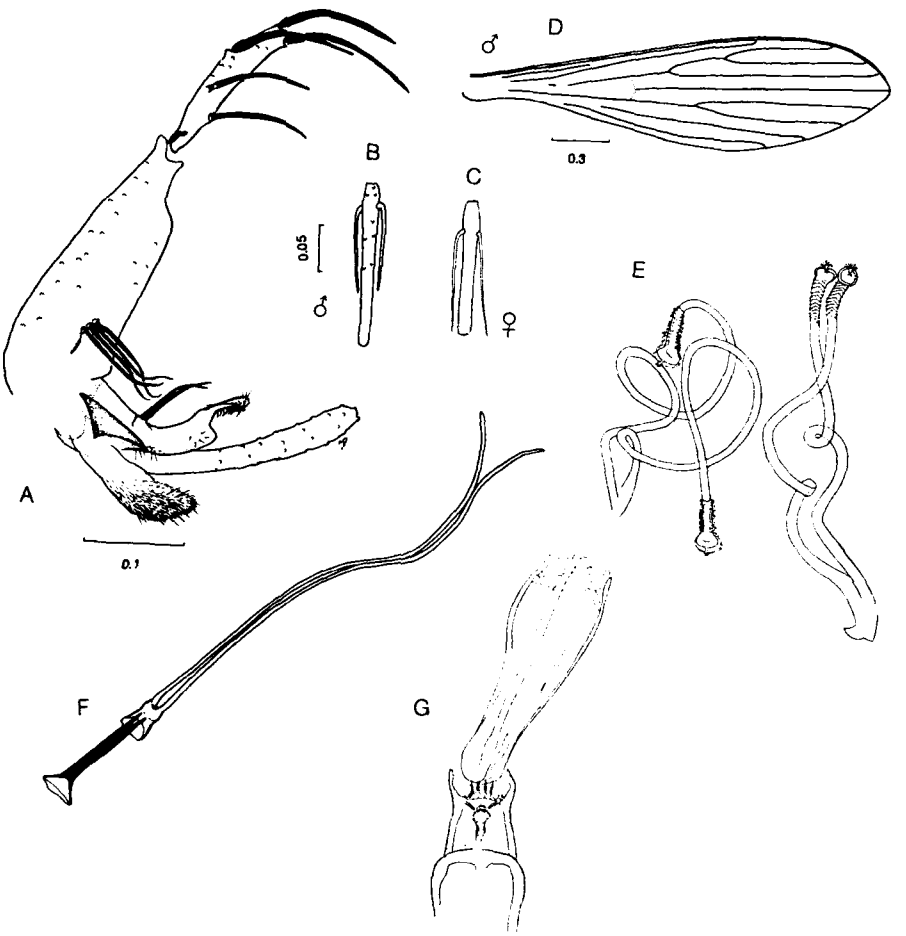


FIG. 23. ***Lutzomyia cavernicola***. A. Male terminalia; B. Male flagellomere II; C. Female flagellomere II; D. Male wing; E. Spermathecae; F. Genital pump & filaments; G. Female cibarium & pharynx (figs. C, E, & G from Martins et al. 1961a).

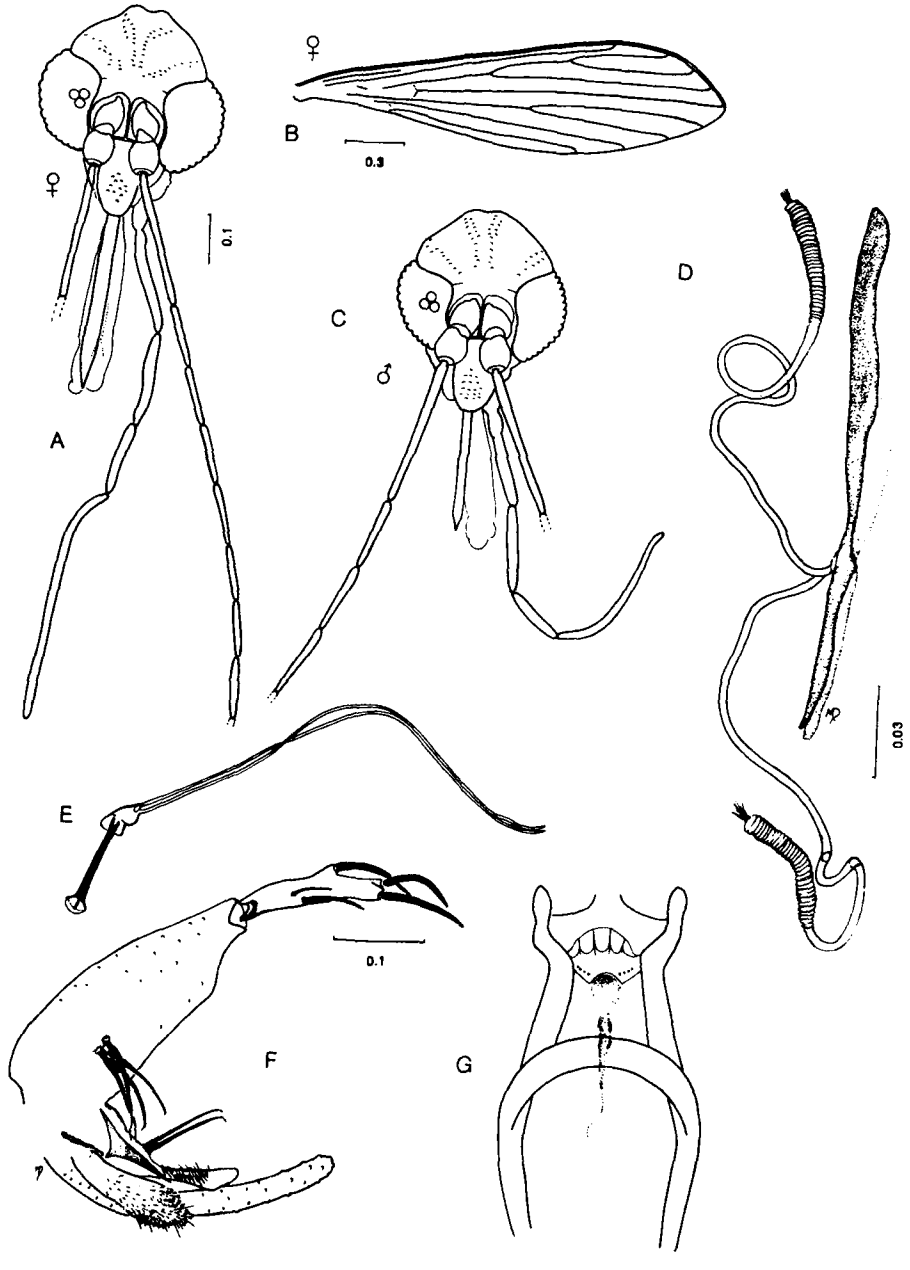


FIG. 24. ***Lutzomyia renei***. A. Female head; B. Female wing; C. Male head; D. Spermathecae; E. Genital pump & filaments; F. Male terminalia; G. Female cibarium.

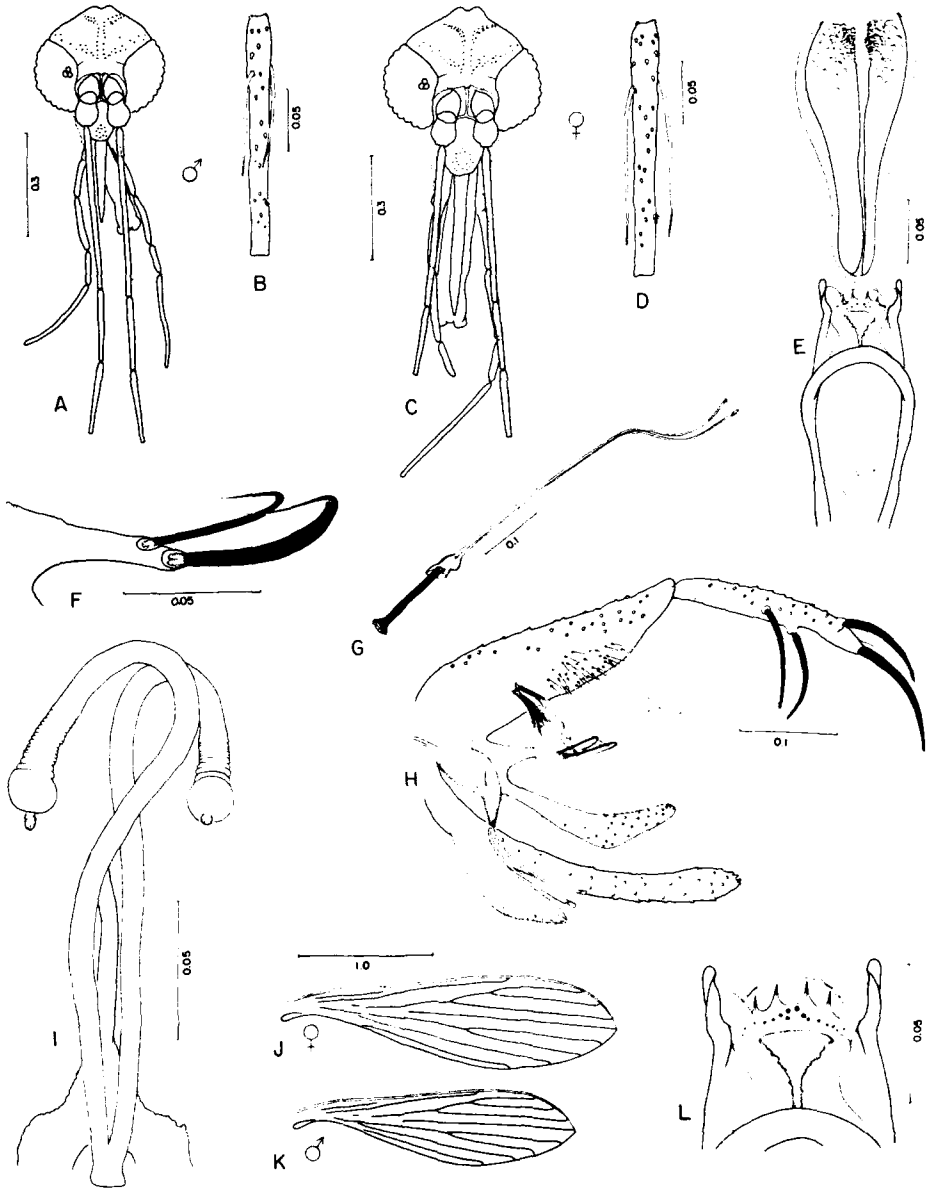


FIG. 25. ***Lutzomyia bifoliata***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Dorsal arm of paramere; G. Genital pump & filaments; H. Male terminalia; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

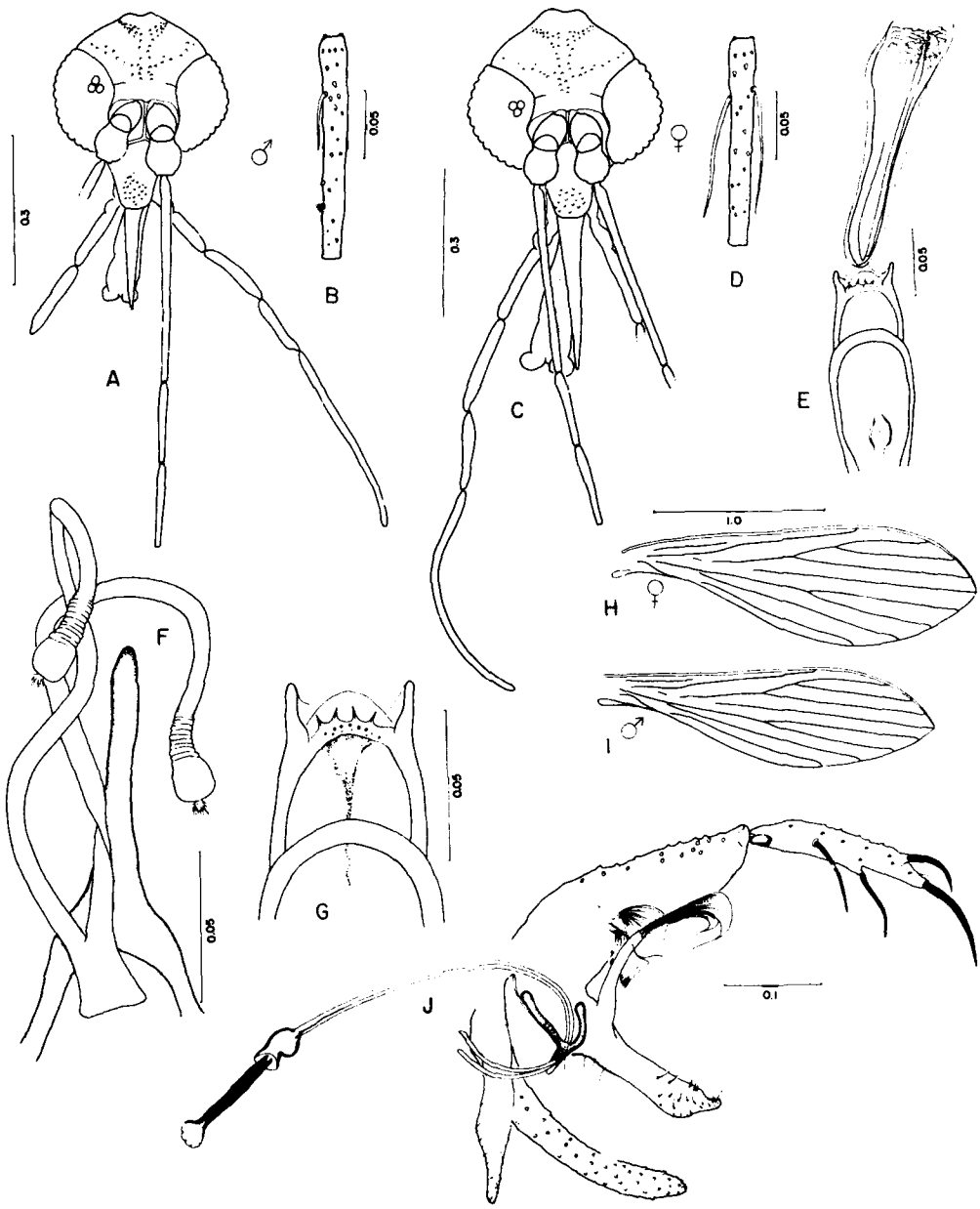


FIG. 26. ***Lutzomyia lichyi***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere; E. Female cibarium & pharynx; F. Spermathecae; G. Female cibarium; H. Female wing; I. Male wing; J. Male terminalia (from Young 1979).

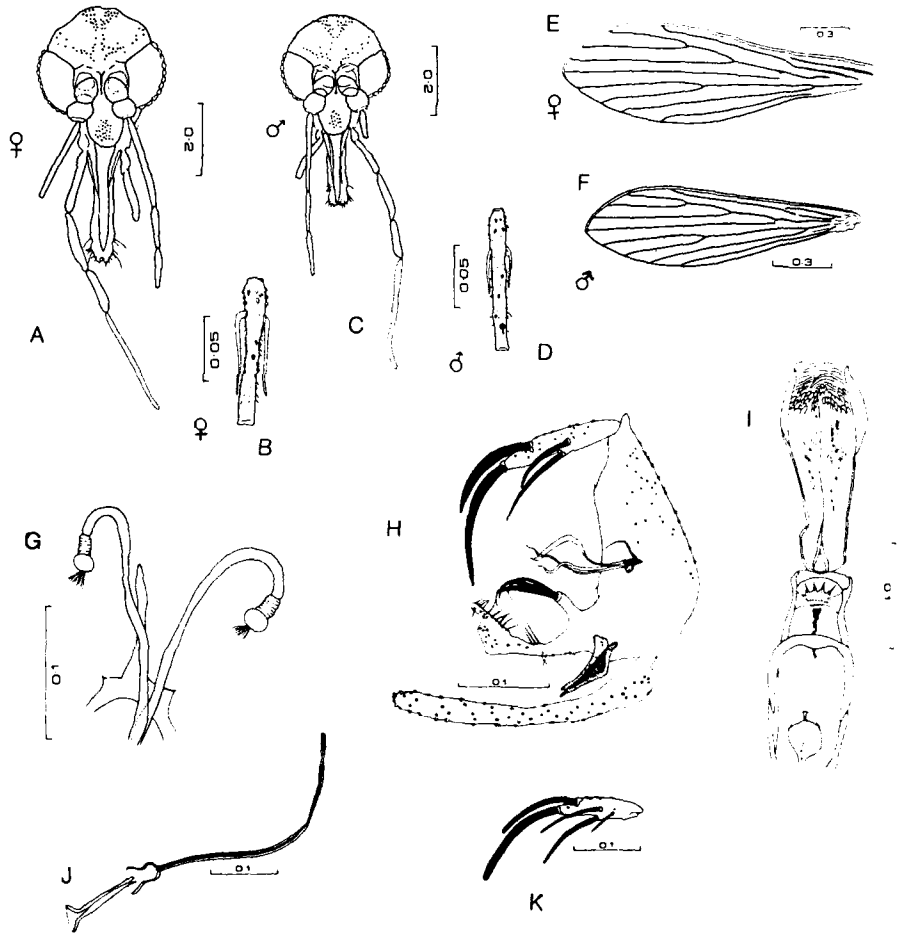


FIG. 27. ***Lutzomyia dispar.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Spermathecae; H. Male terminalia; I. Female cibarium & pharynx; J. Genital pump & filaments; K. Style with extra spine, abnormal (from Williams & Carvalho 1979).

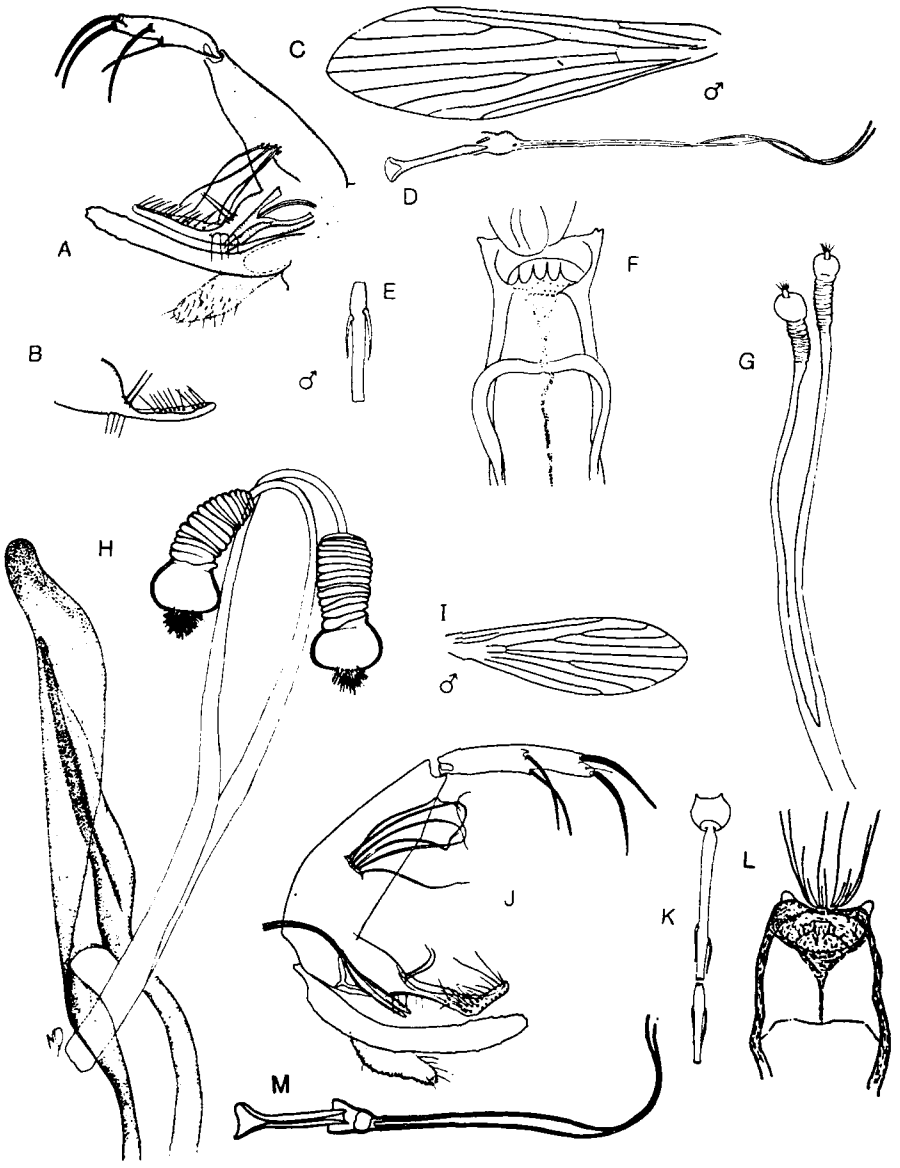


FIG. 28. ***Lutzomyia ischnacantha***. A. Male terminalia; B. Paramere; C. Male wing; D. Genital pump & filaments; E. Male flagellomere II; F. Female cibarium; G. Spermathecae (figs. A-E from Martins et al. 1962e; Figs. F-G from Martins et al 1975c). ***Lutzomyia amarali***. H. Spermathecae; I. Male wing; J. Male terminalia; K. Male flagellomeres I & II; L. Female cibarium; M. Genital pump & filaments (Figs. I & L from Barretto & Coutinho 1940; Figs. J, K & M from Martins & Silva 1965).

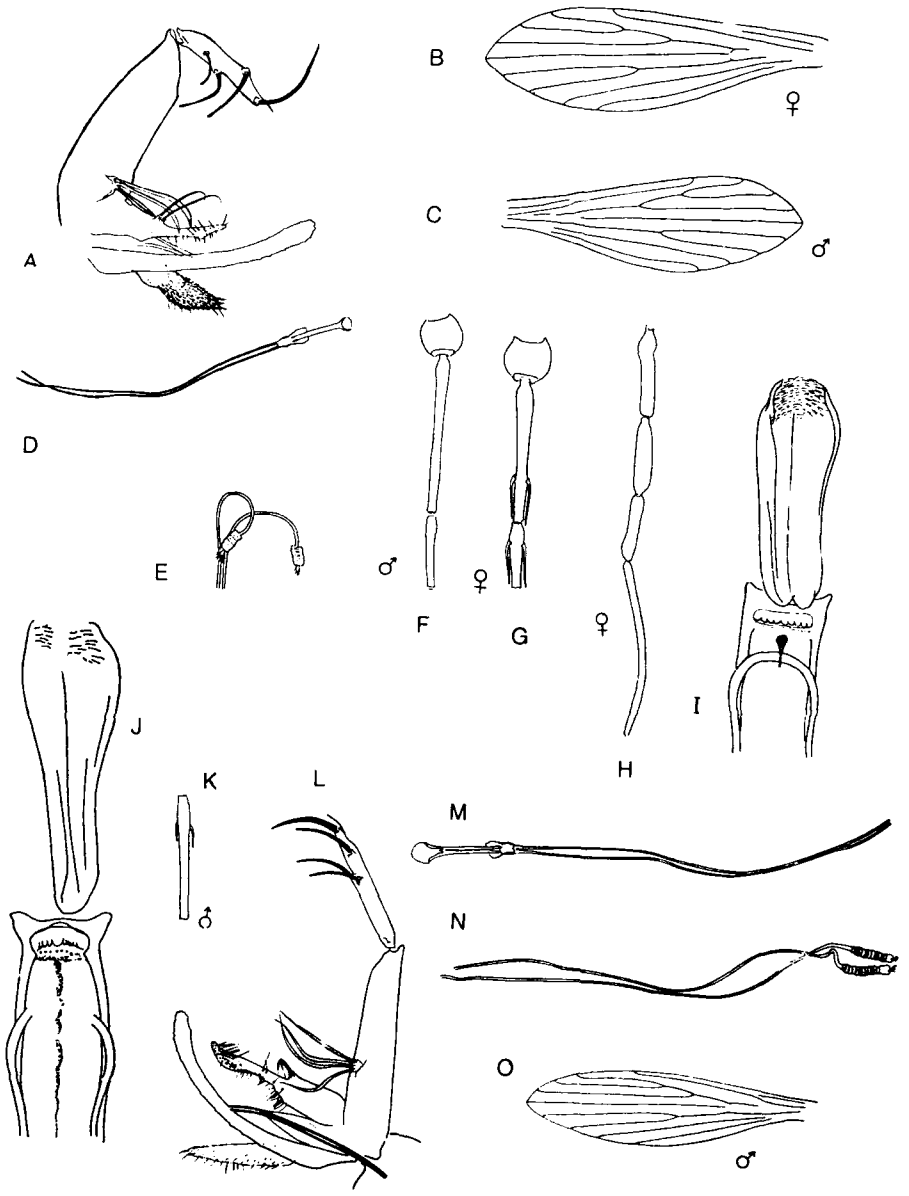


FIG. 29. ***Lutzomyia cruzi***. A. Male terminalia; B. Female wing; C. Male wing; D. Genital pump & filaments; E. Spermathecae; F. Male flagellomeres & pedicel; G. Female flagellomeres & pedicel, showing ascoids; H. Female palpus; I. Female cibarium & pharynx (from Martins et al. 1984); J. Female cibarium & pharynx. ***Lutzomyia souzalopesi***. K. Male flagellomere; L. Male terminalia; M. Genital pump & filaments; N. Spermathecae; O. Male wing (from Martins et al. 1970c).

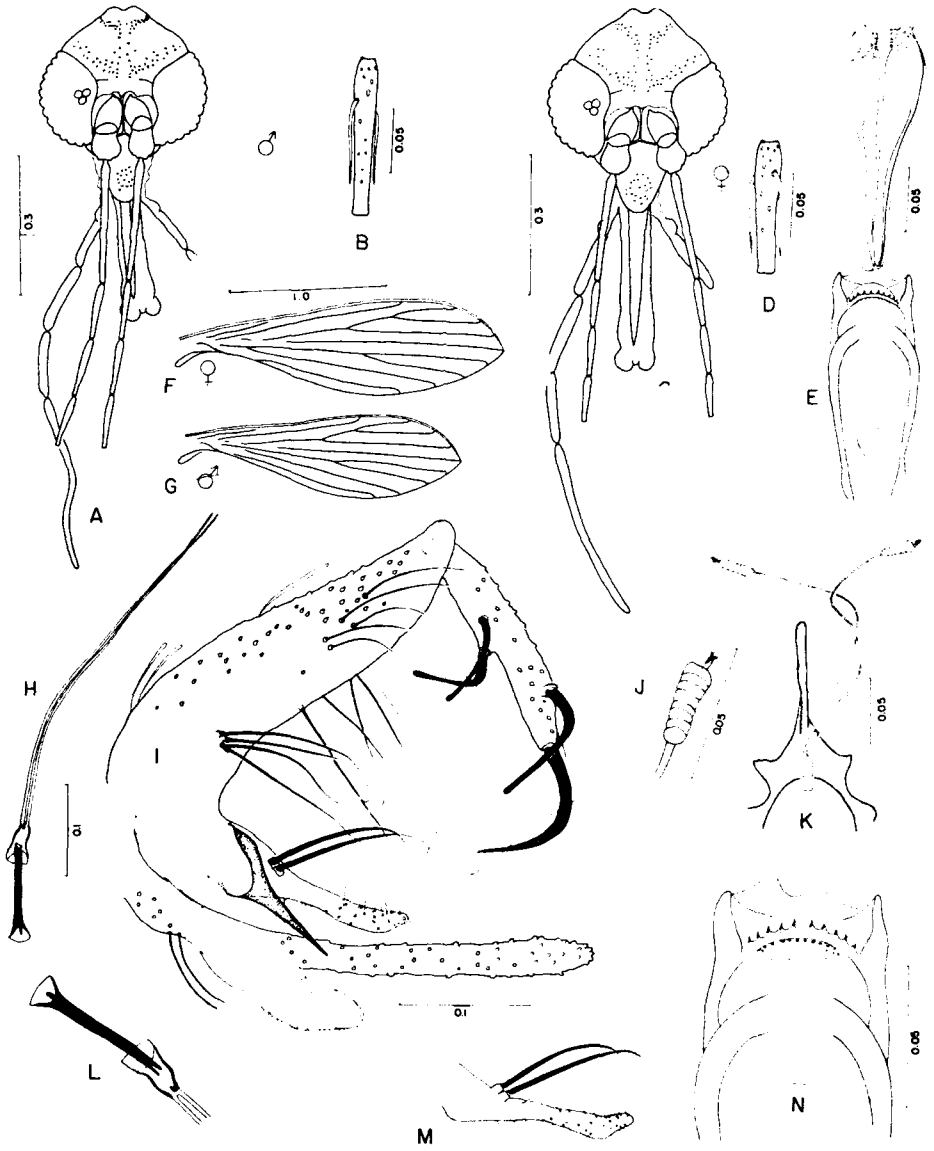


FIG. 30. ***Lutzomyia longipalpis.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Female wing; G. Male wing; H. Genital pump & pharynx; I. Male terminalia; J. Body of spermathecae; K. Spermathecae; L. Genital pump; M. Paramere of male from Huila Dept., Colombia; N. Female cibarium. (figs. from Young 1979).

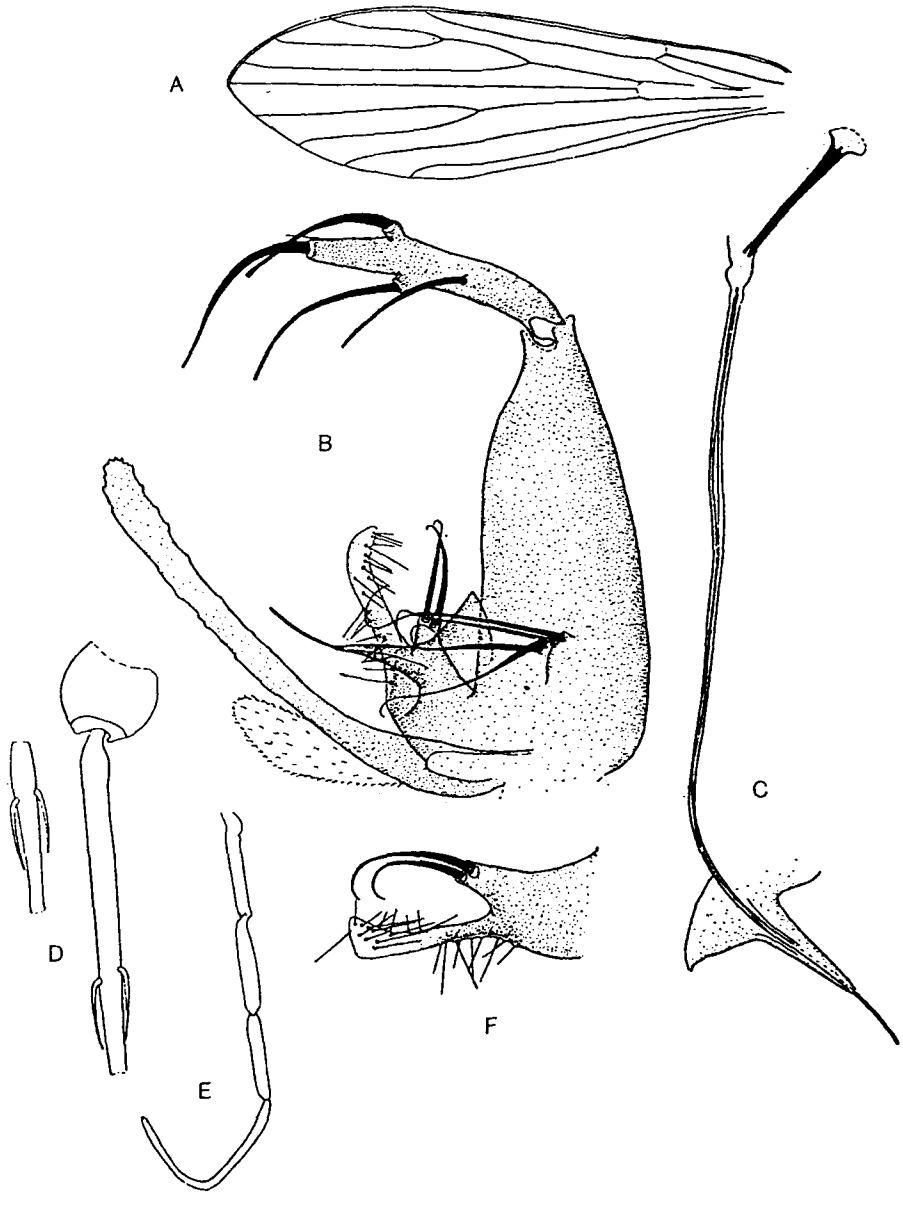


FIG. 31. ***Lutzomyia gaminarai.*** A. Male wing; B. Male terminalia; C. Genital pump & filaments; D. Pedicel & flagellomeres I & II; E. Male palpus; F. Paramere (from Martins et al. 1961c).

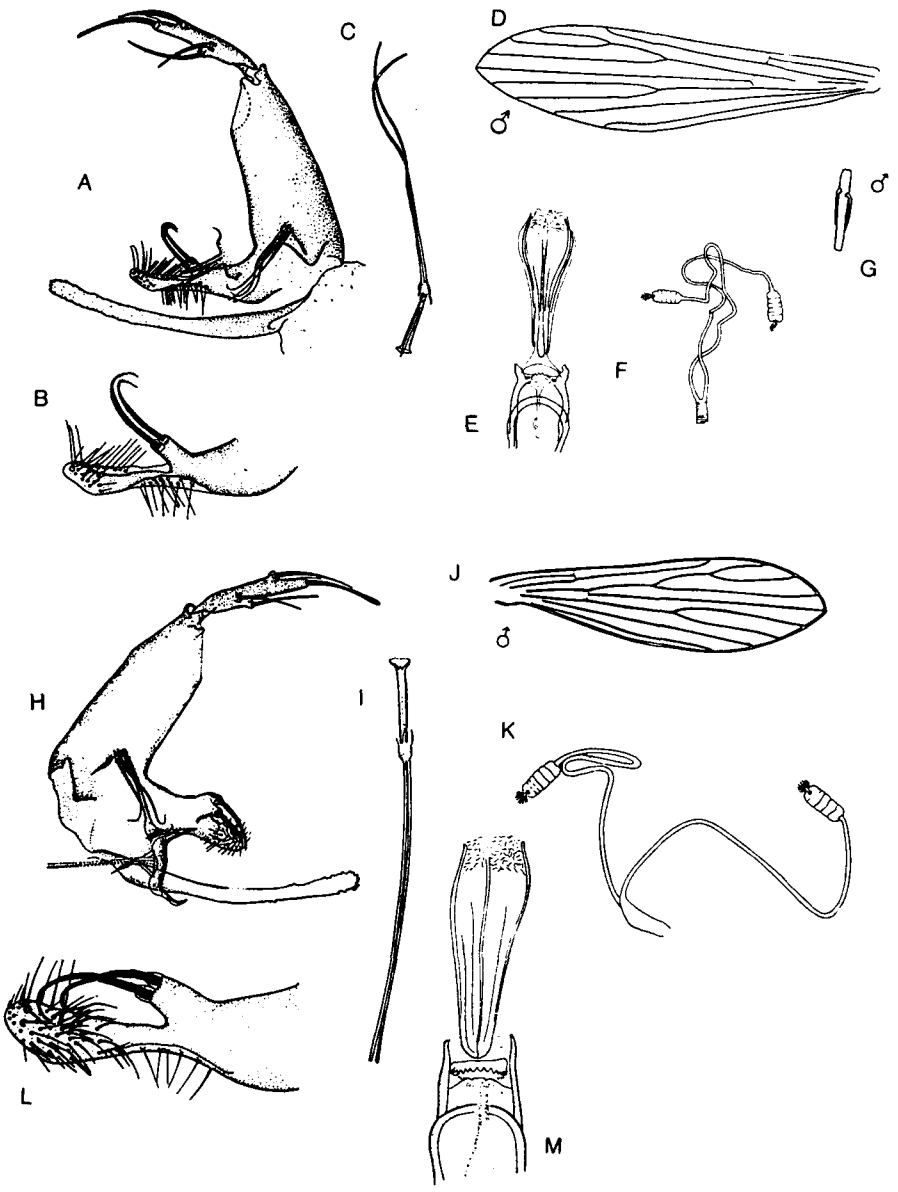


FIG. 32. ***Lutzomyia alencari***. A. Male terminalia; B. Paramere; C. Genital pump & filaments; D. Male wing; E. Female cibarium & pharynx; F. Spermathecae; G. Male flagellomere II. (Martins et al. 1982).
Lutzomyia ischyracantha. H. Male terminalia; I. Genital pump & filaments; J. Male wing; K. Spermathecae; L. Paramere; M. Female cibarium & pharynx (figs. from Martins et al. 1962b).

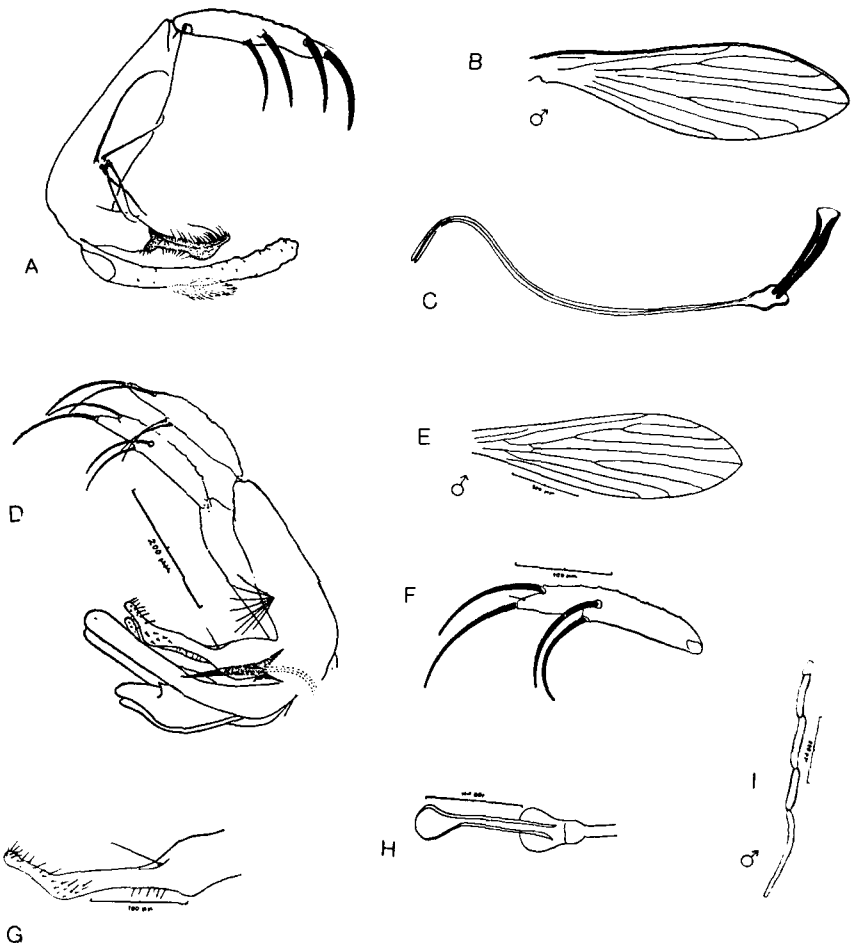


FIG. 33. ***Lutzomyia caligata***. A. Male terminalia; B. Male wing; C. Genital pump & filaments (from Martins et al. 1965).
Lutzomyia castroi. D. Male terminalia; E. Male wing; F. Style; G. Paramere; H. Genital pump; I. Male palpus (figs. from Barretto & Coutinho 1941c).

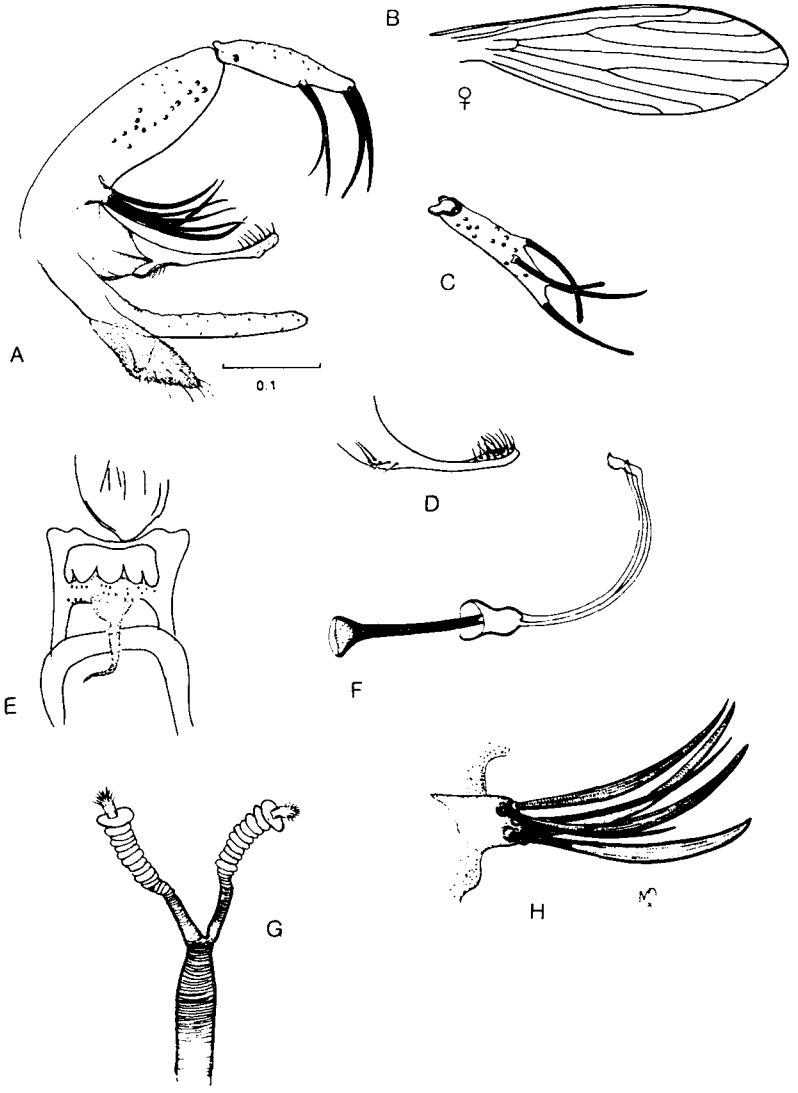


FIG. 34. ***Lutzomyia cipoensis***. A. Male terminalia; B. Female wing; C. Style; D. Paramere; E. Female cibarium; F. Genital pump & filaments; G. Spermathecae; H. Coxite tuft (female figs. from Martins et al. 1975c).

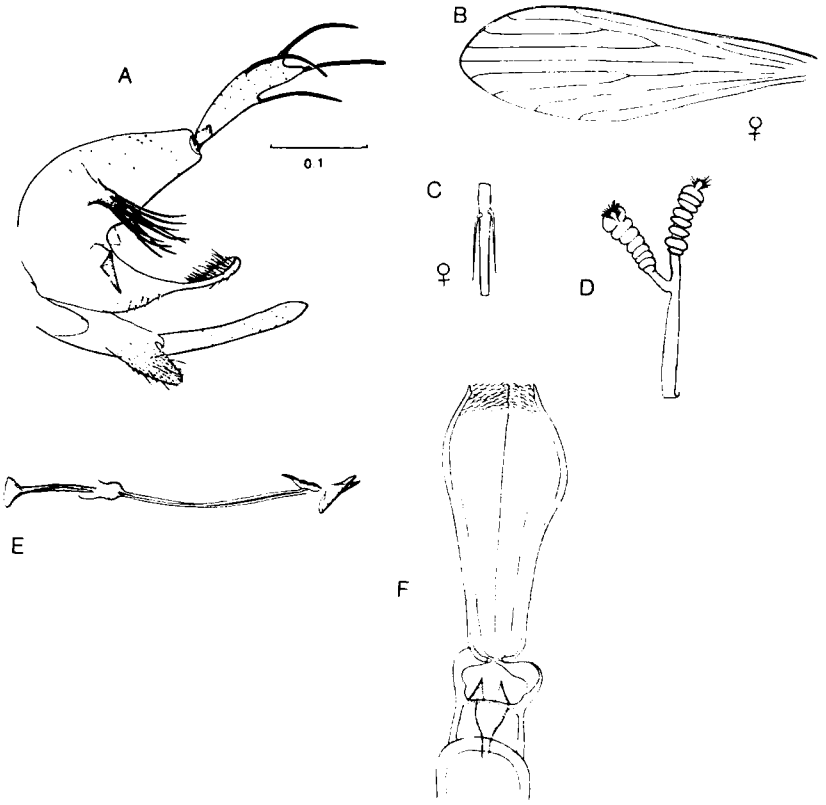


FIG. 35. ***Lutzomyia gasparviannai***. A. Male terminalia; B. Female wing; C. Female flagellomere II; D. Spermathecae; E. Genital pump & filaments; F. Female cibarium & pharynx (from Martins et al. 1962a).

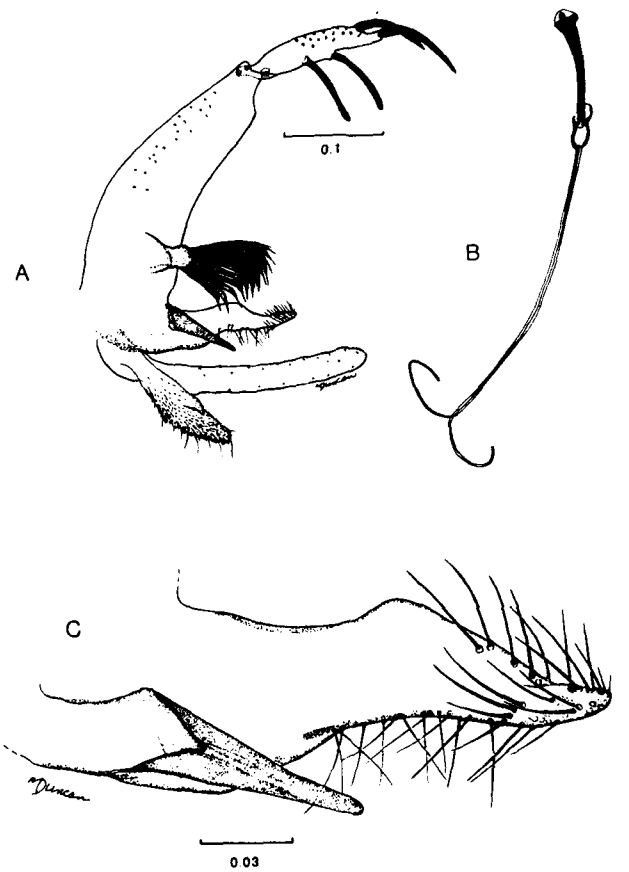


FIG. 36. ***Lutzomyia flabellata.*** A. Male terminalia; B. Genital pump & filaments; C. Paramere.

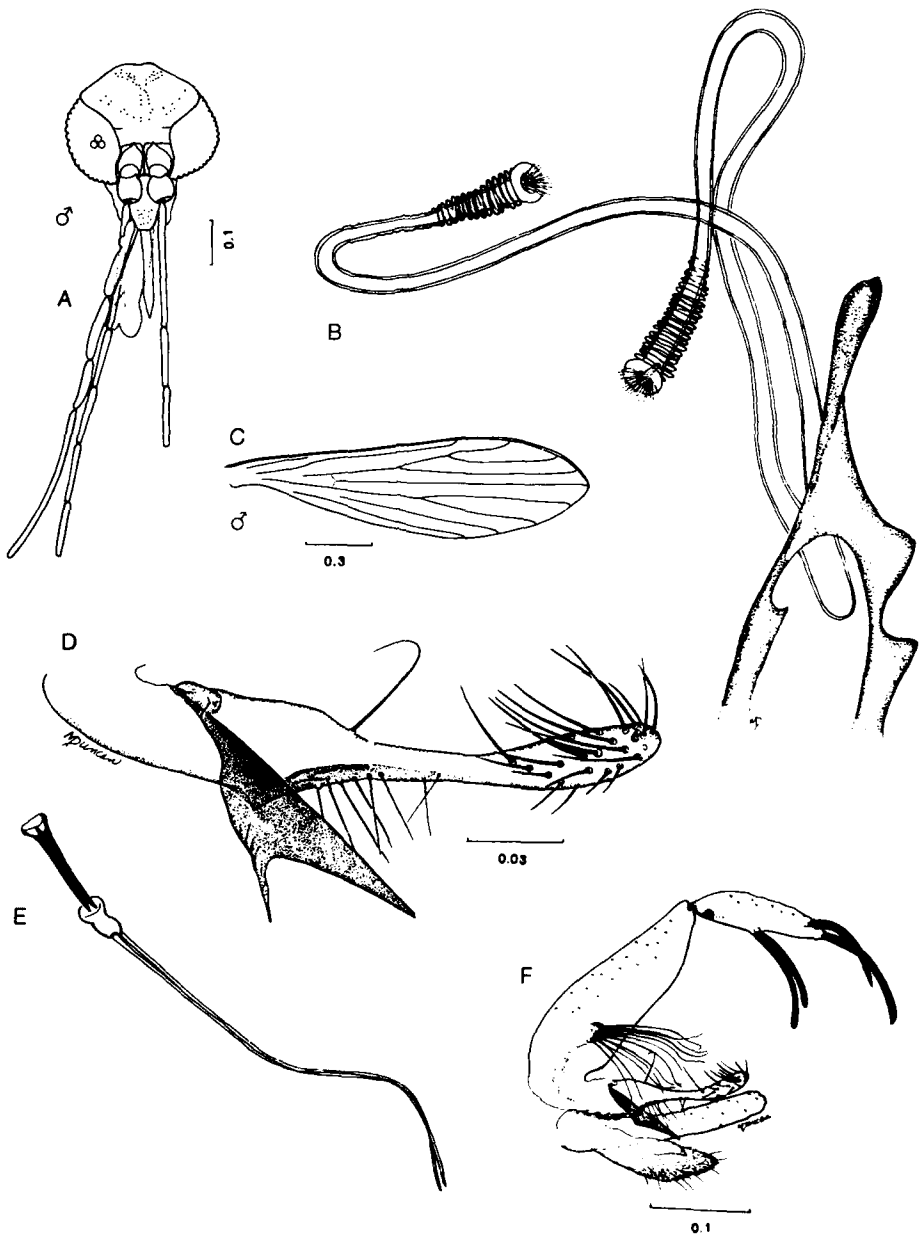


FIG. 37. ***Lutzomyia falcata.*** A. Male head; B. Spermathecae; C. Male wing; D. Paramere; E. Genital pump & filaments; F. Male terminalia.

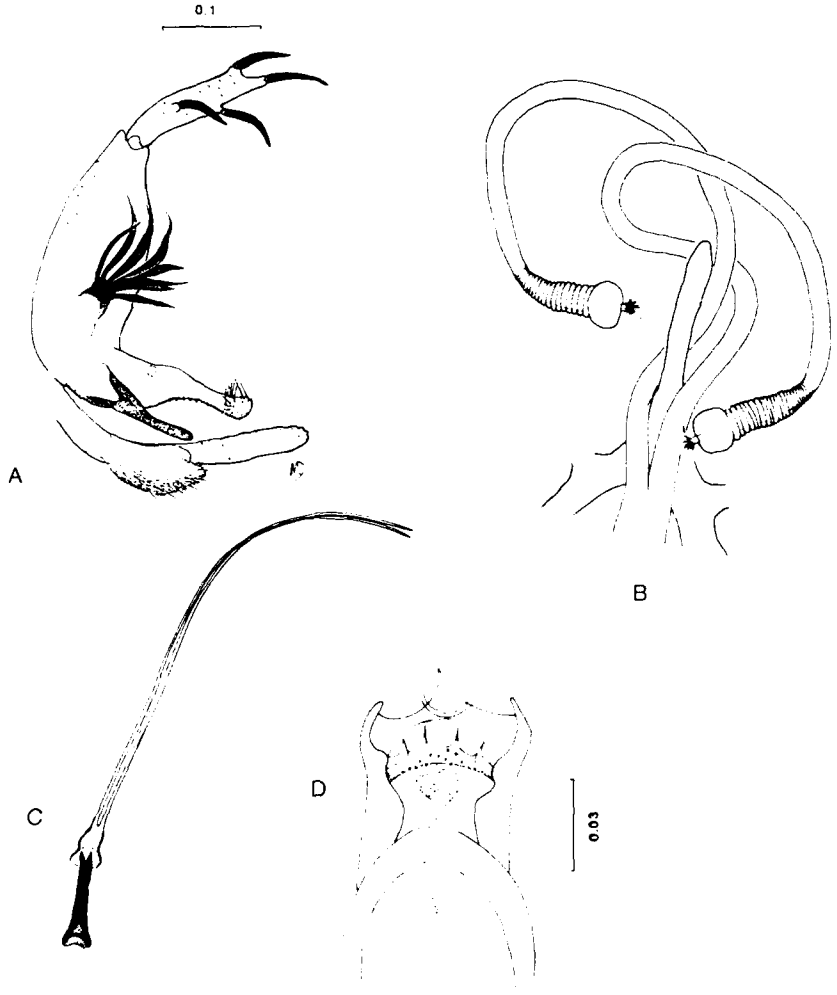


FIG. 38. ***Lutzomyia spathotrichia.*** A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Female cibarium.

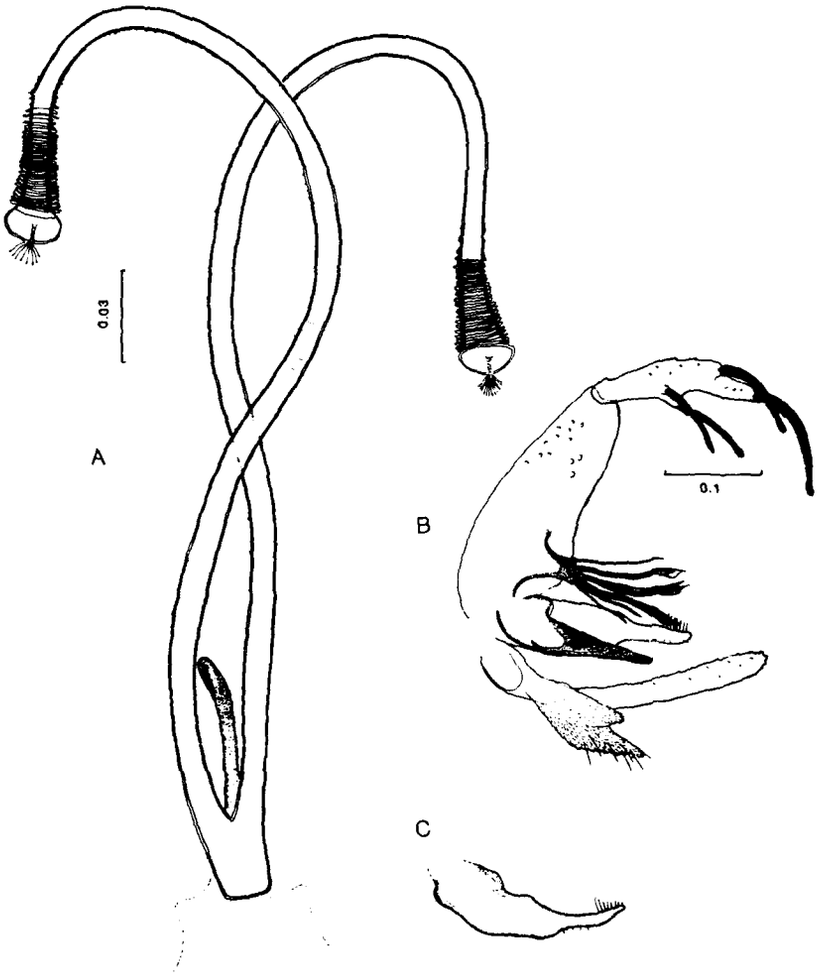


FIG. 39. ***Lutzomyia carvalhoi.*** A. Spermathecae; B. Male terminalia; C. Paramere.

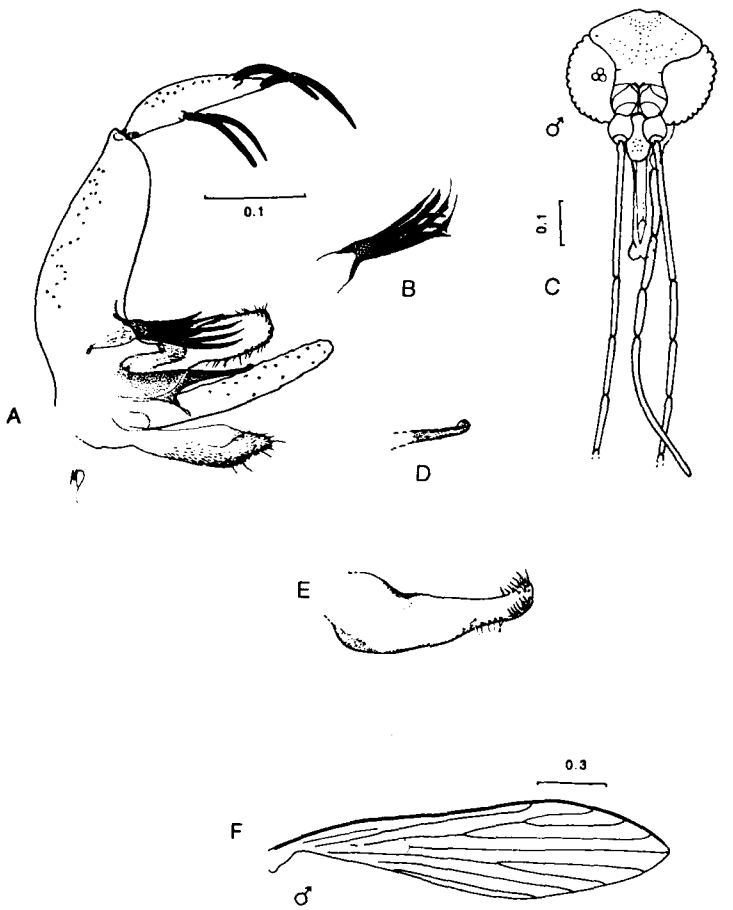


FIG. 40. ***Lutzomyia araracuarensis***. A. Male terminalia; B. Coxite tuft; C. Male head; D. Aedeagus tip; E. Paramere, different view; F. Male wing.

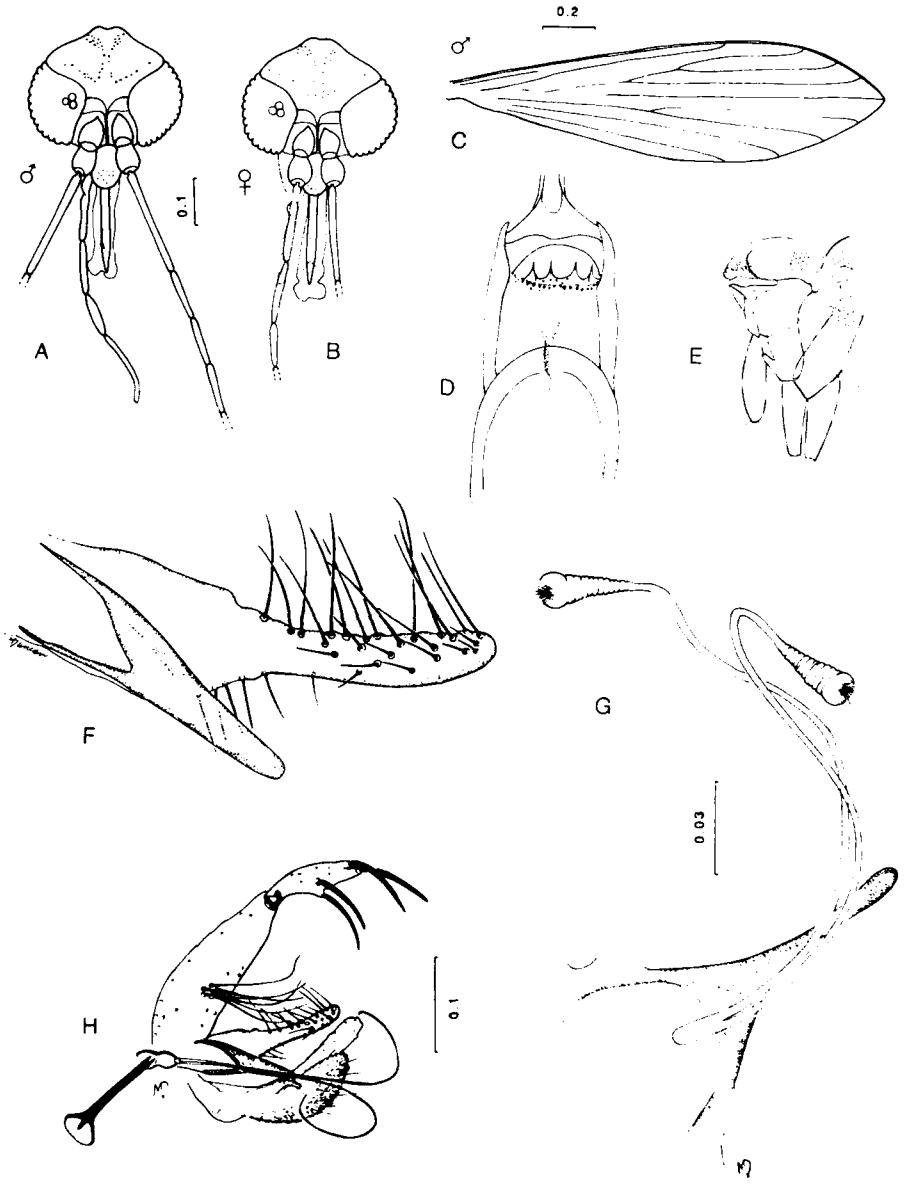


FIG. 41. ***Lutzomyia evangelistai.*** A. Male head; B. Female head; C. Male wing; D. Female cibarium; E. Thorax; F. Paramere; G. Spermathecae; H. Male terminalia.

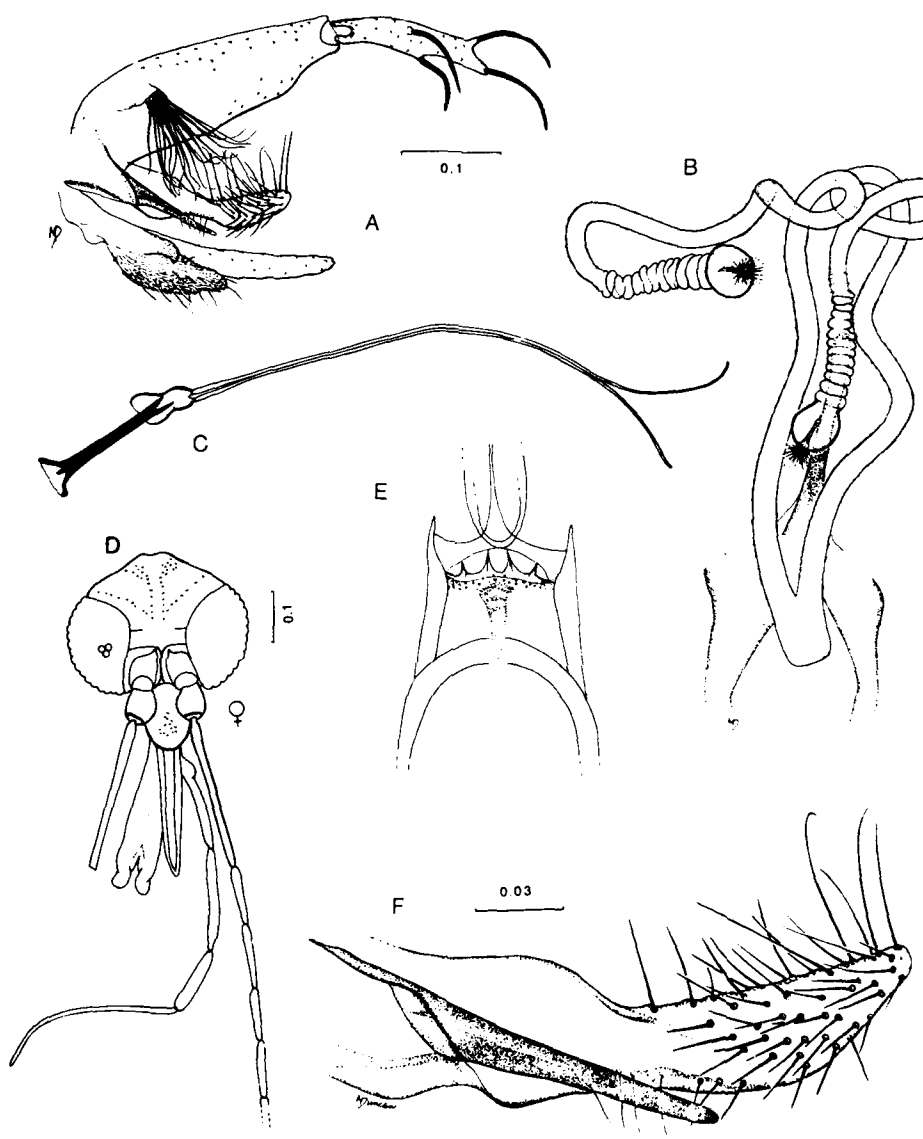


FIG. 42. ***Lutzomyia sherlocki.*** A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Female head; E. Female cibarium; F. Paramere & aedeagus.

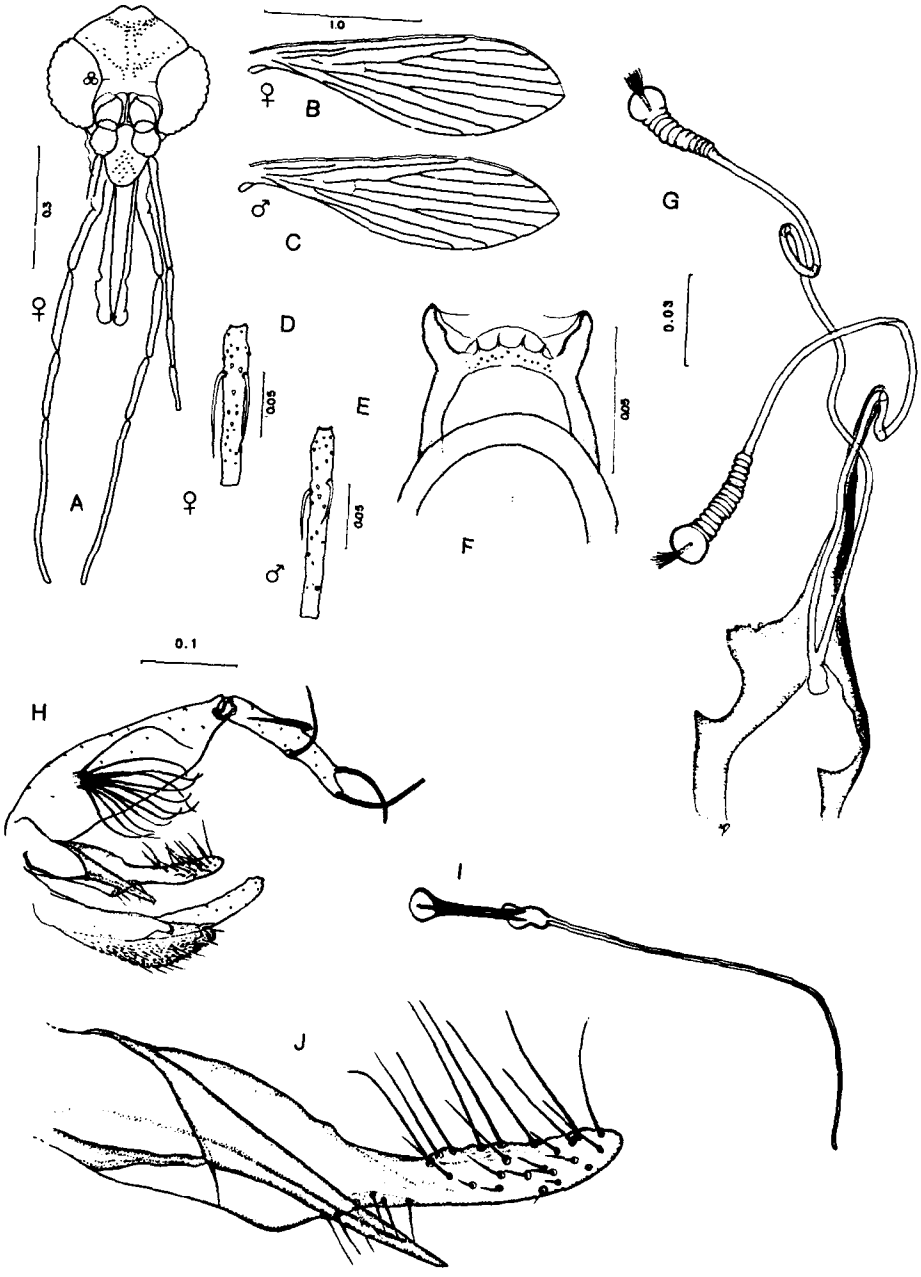


FIG. 43. ***Lutzomyia gomezi***. A. Female head; B. Female wing; C. Male wing; D. Female flagellomere II; E. Male flagellomere II; F. Female cibarium; G. Spermathecae; H. Male terminalia; I. Genital pump & filaments; J. Paramere (figs. A-F from Young 1979).

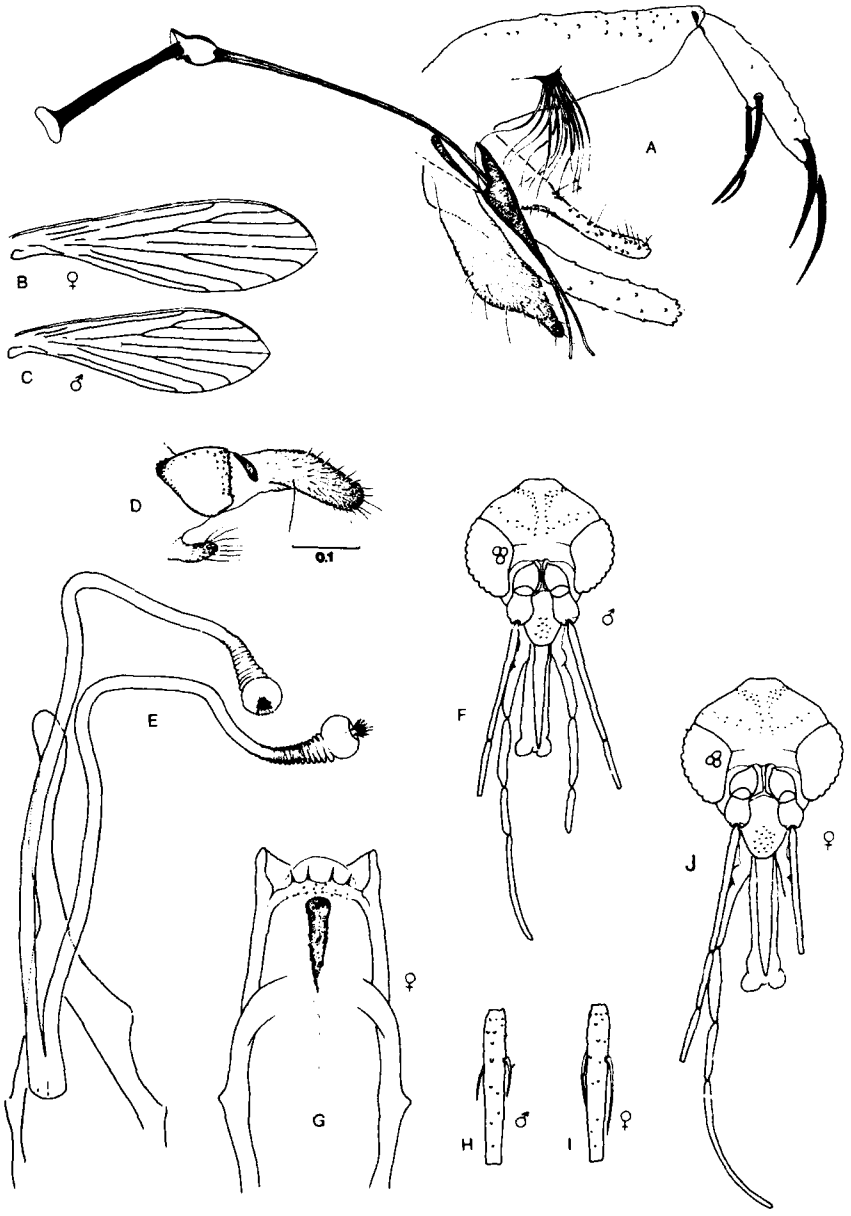


FIG. 44. ***Lutzomyia cruciata***. A. Male terminalia; B. Female wing; C. Male wing; D. End of female abdomen; E. Spermathecae; F. Male head; G. Female cibarium; H. Male flagellomere II; I. Female flagellomere II; J. Female head (from Young & Perkins 1984).

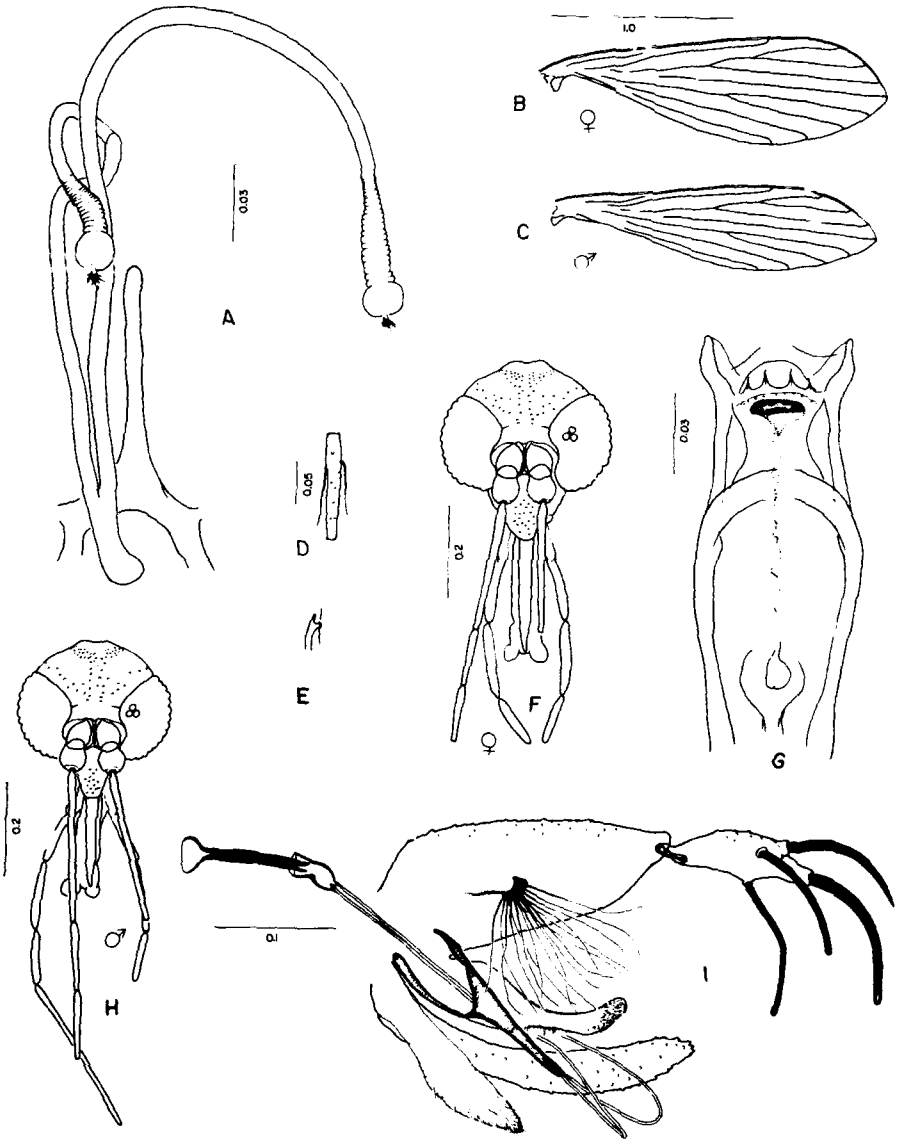


FIG. 45. ***Lutzomyia marinkellei.*** A. Spermathecae; B. Female wing; C. Male wing; D. Female flagellomere II; E. Base of ascoid; F. Female head; G. Female cibarium; H. Male head; I. Male terminalia. (from Young 1979).

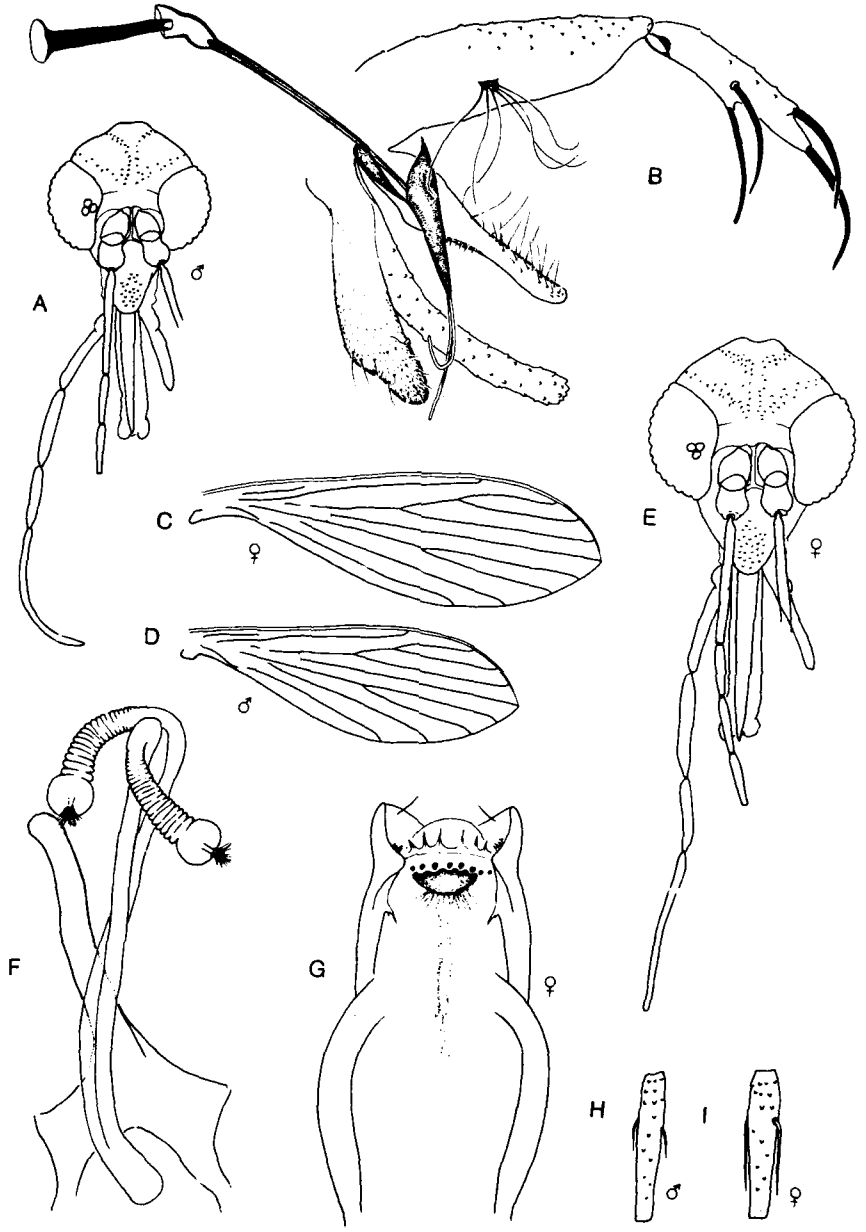
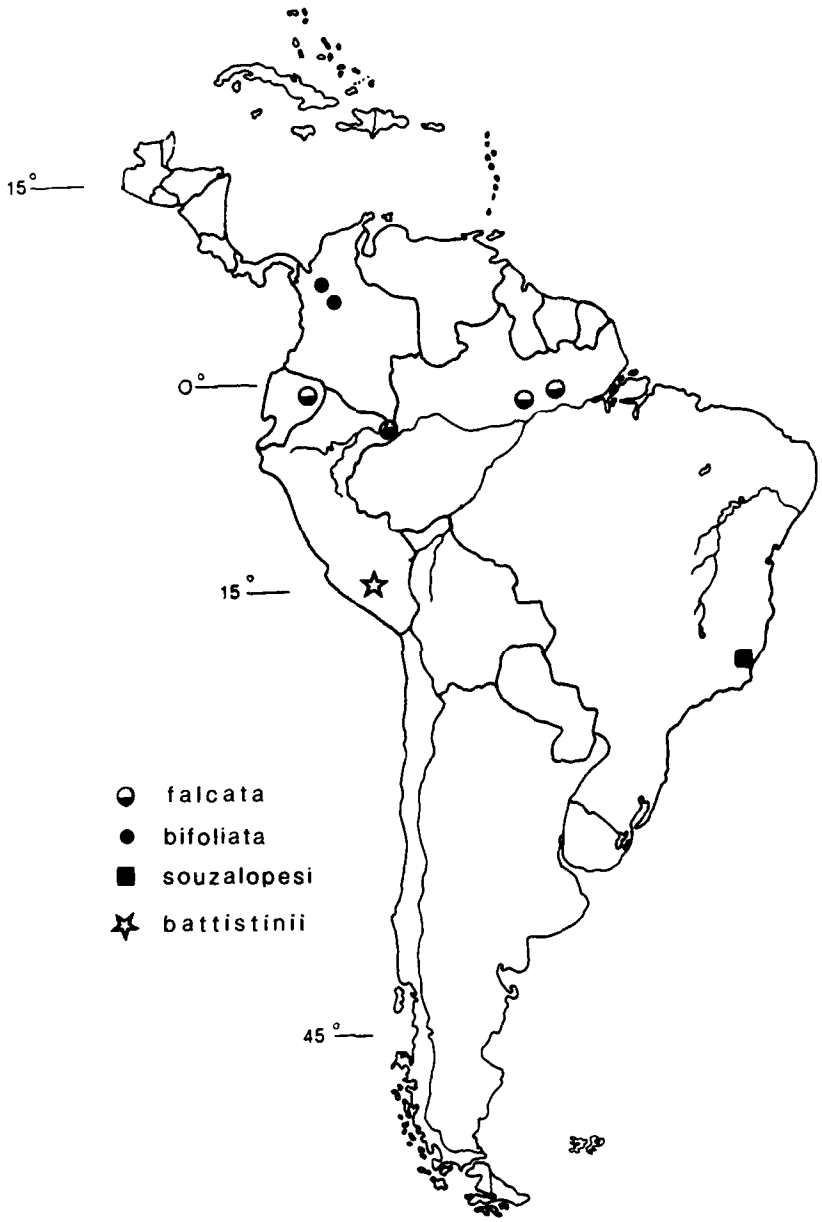
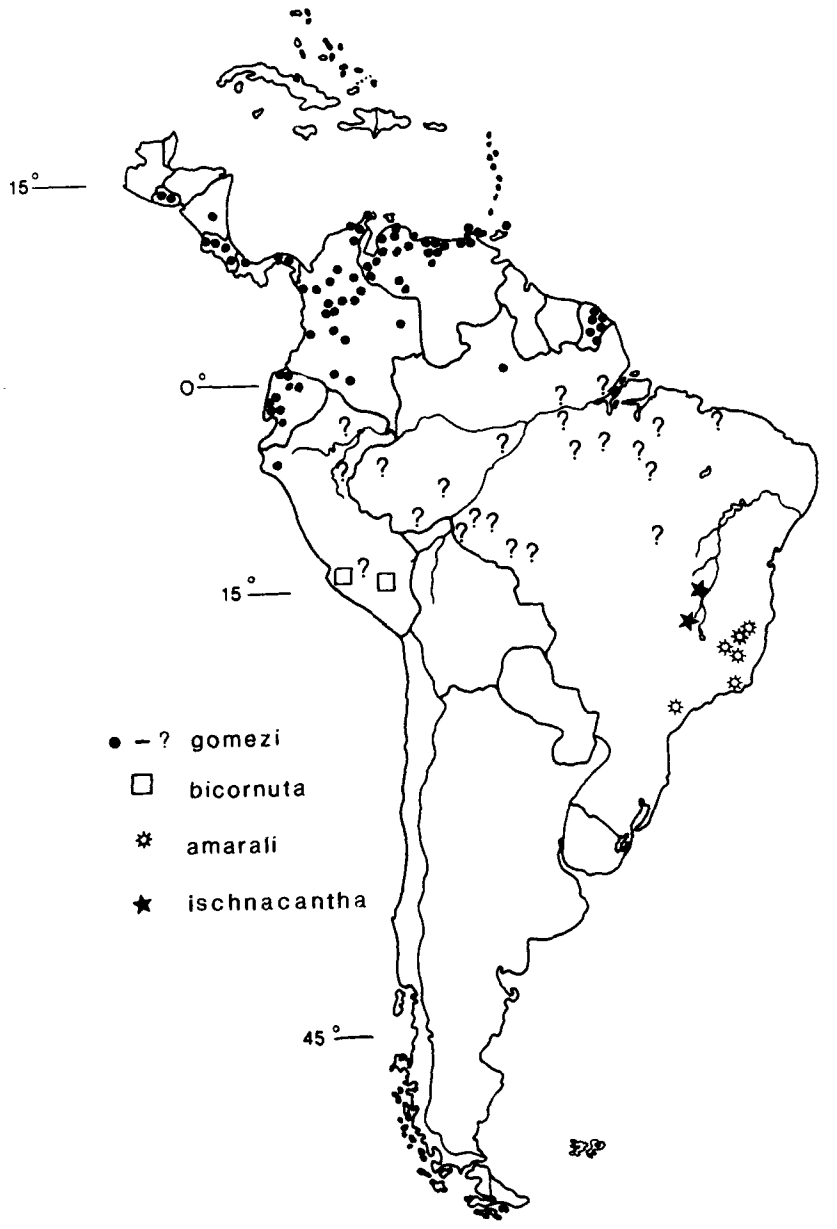


FIG. 46. ***Lutzomyia diabolica***. A. Male head; B. Male terminalia; C. Female wing; D. Male wing; E. Female head; F. Spermathecae; G. Female cibarium; H. Male flagellomere II; I. Female flagellomere II (from Young & Perkins 1984).

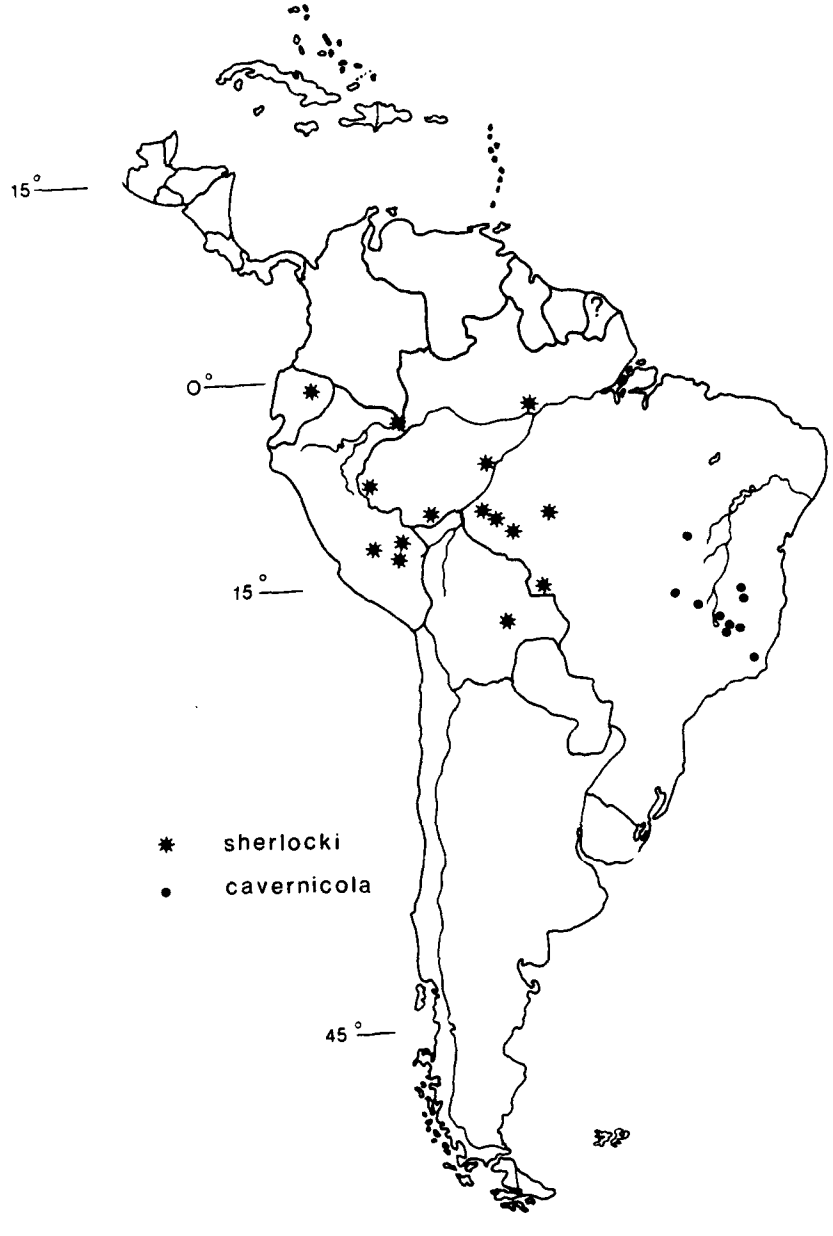


Map 1

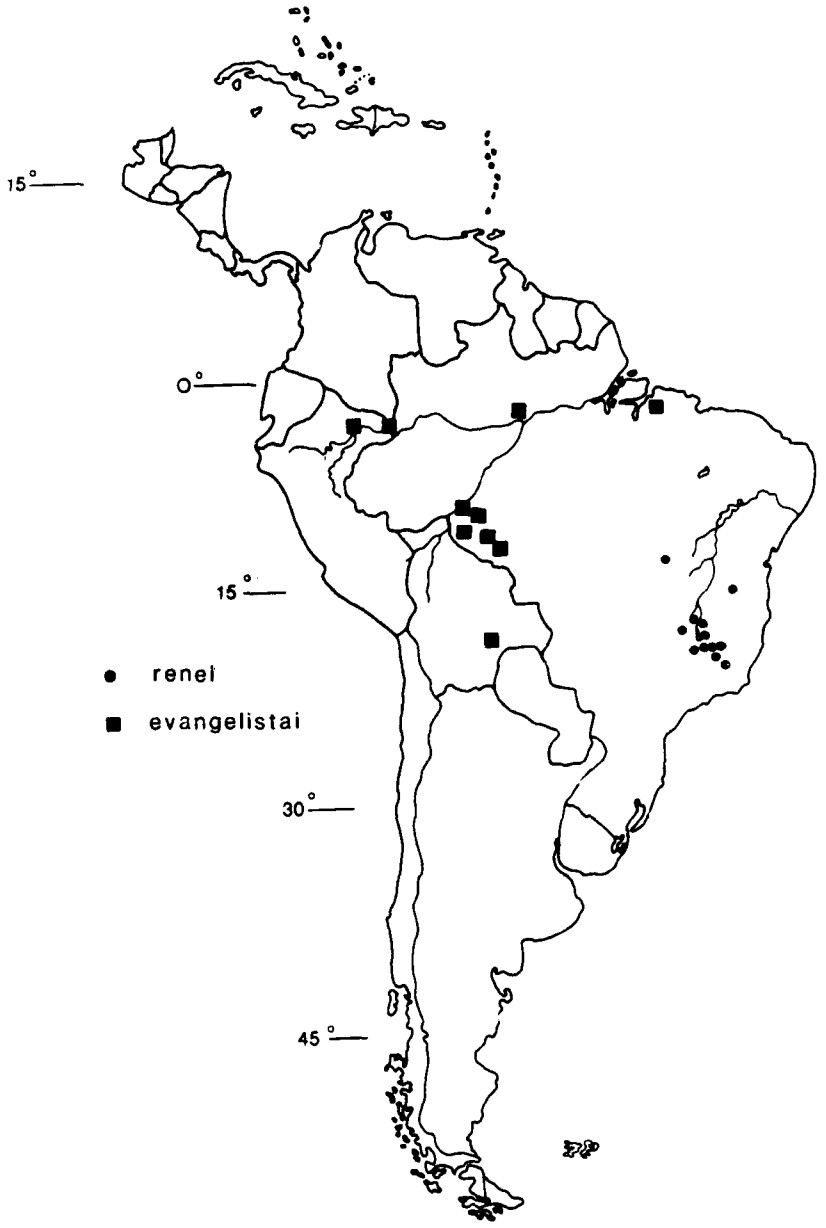
Map 2



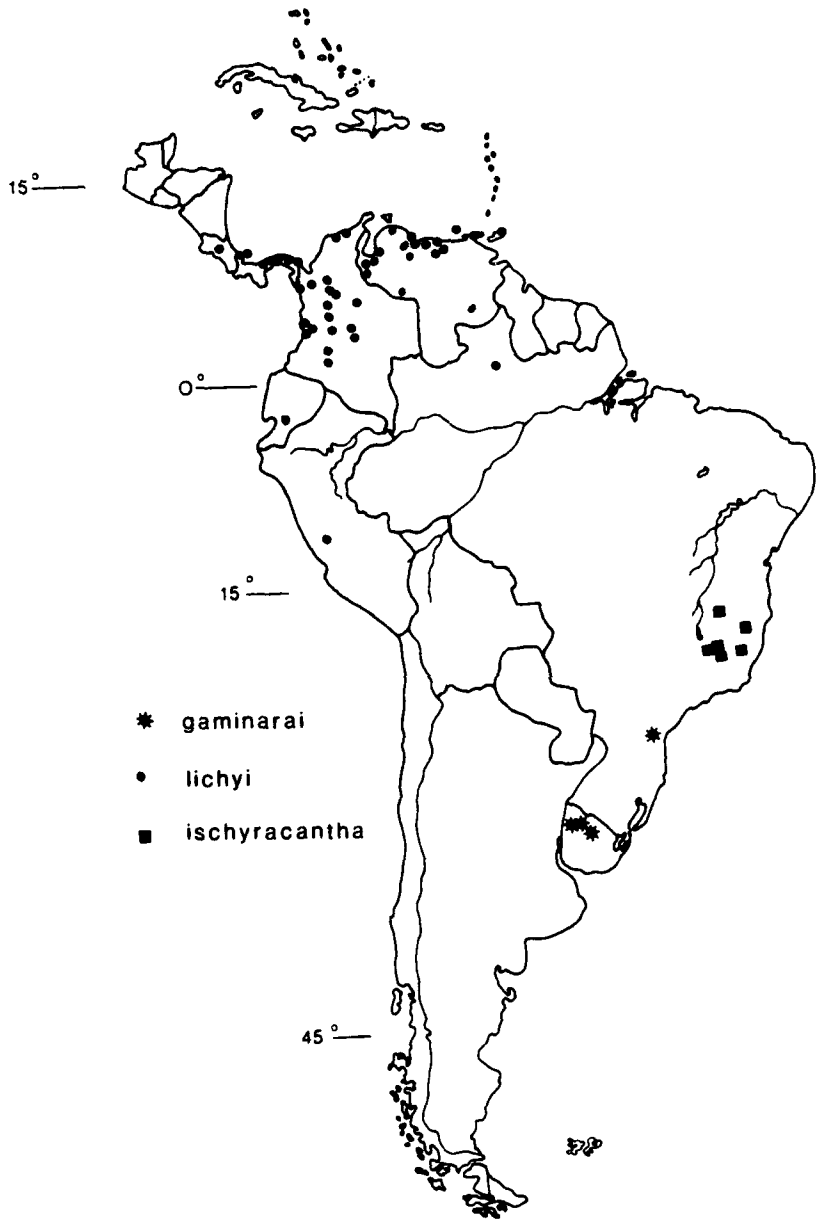
Map 3



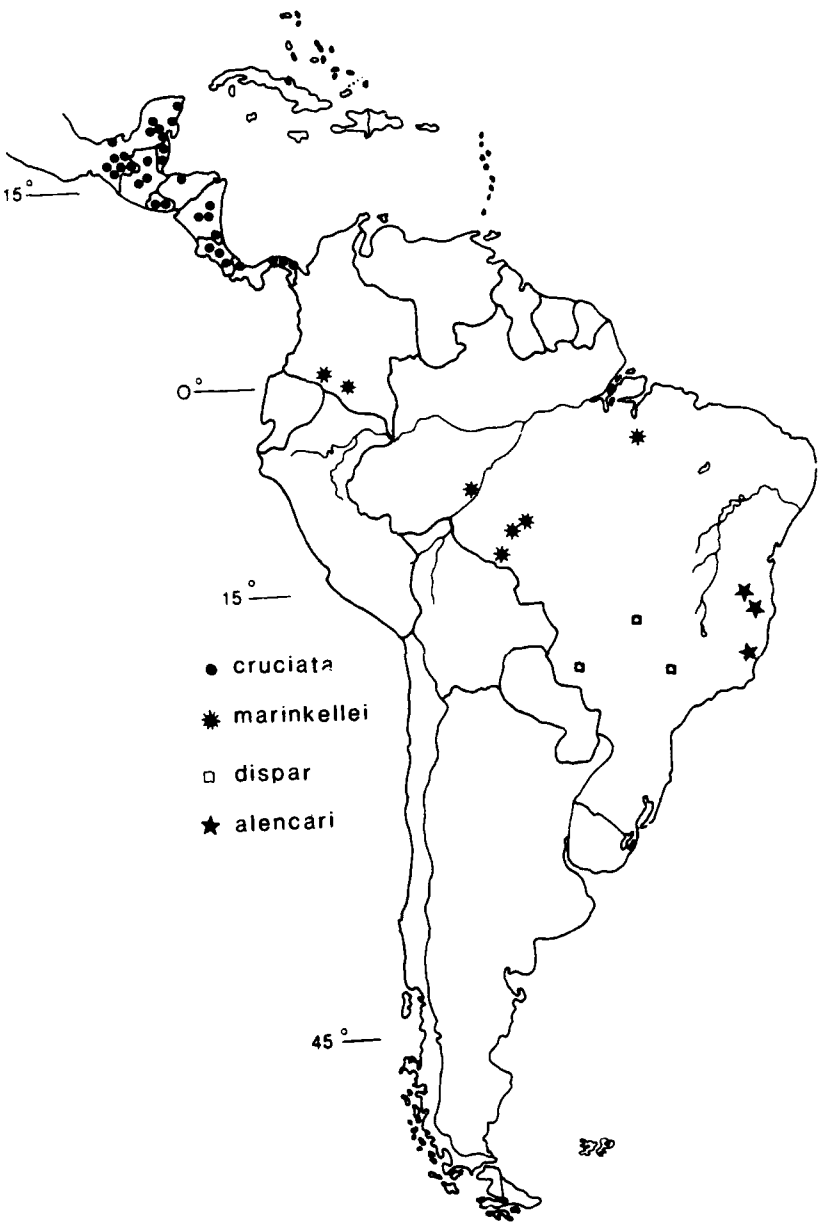
Map 4



Map 5

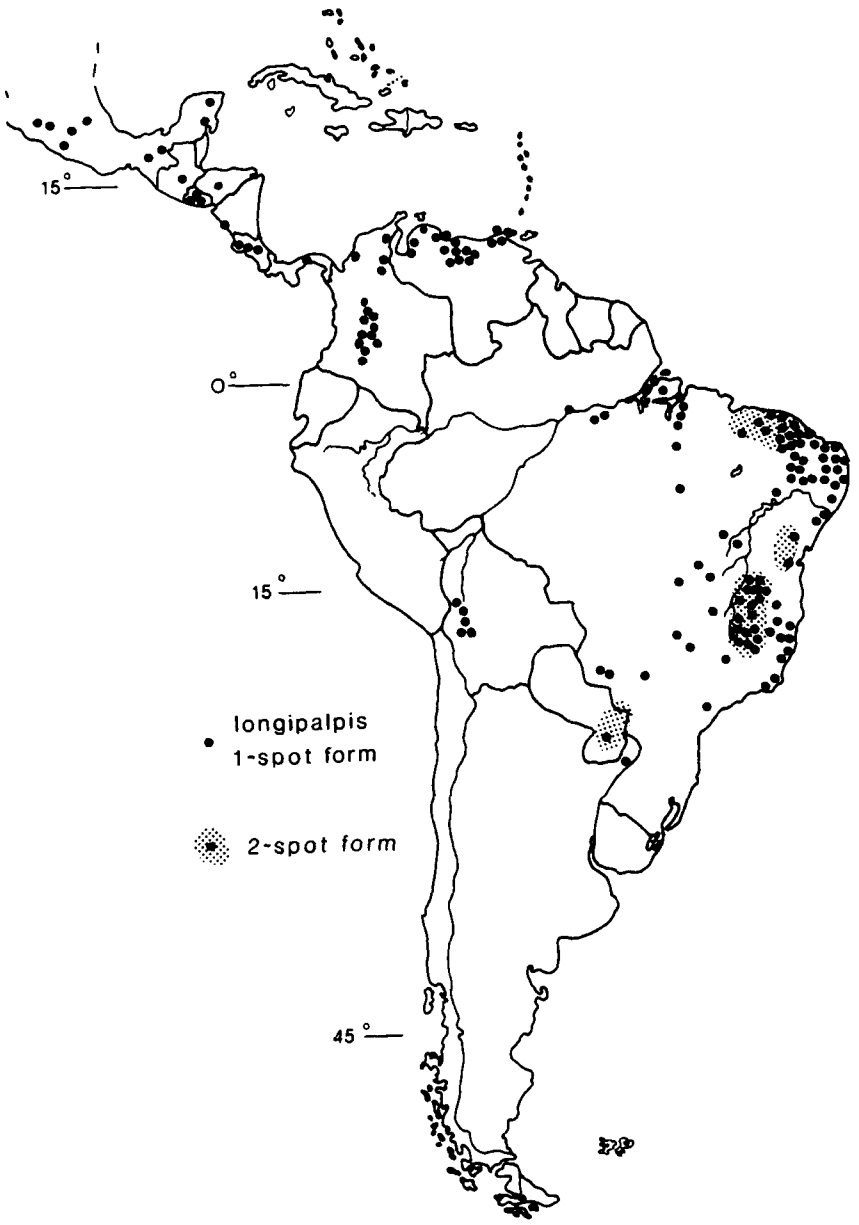


Map 6

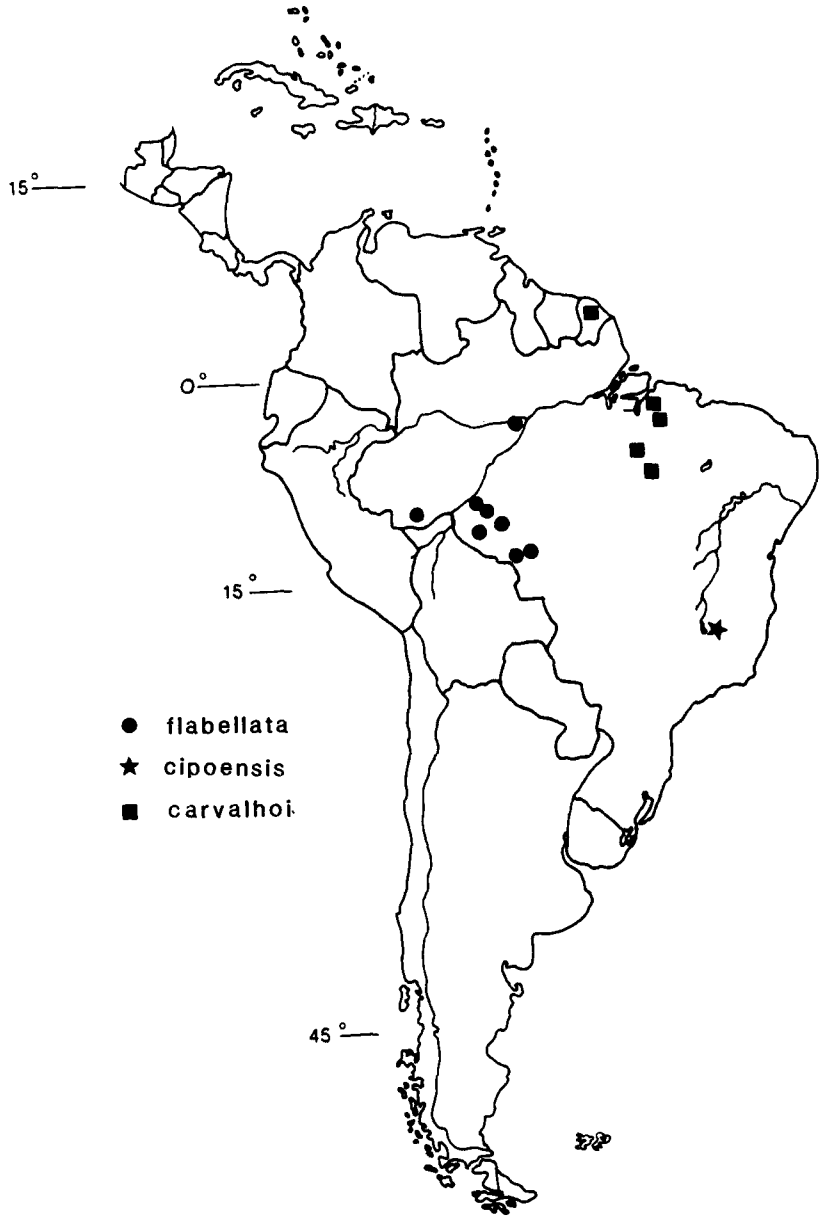


Map 7

Map 8



Map 9



Map 10

Map 11

SUBGENUS *SCIOPEMYIA* BARRETTO

Lutzomyia, subgenus *Sciopemyia* Barretto 1962: 96 (type species: *Phlebotomus nordestinus* Mang. by orig. designation).
Lutzomyia species group *microps* Young & Arias 1984: 425.
Micropygomyia, subgenus *Sciopemyia*: Artemiev 1991: 74.

Identification. Coloration pale to light brown. Antennal flagellomeres relatively long with simple ascoids. Palpomere 5 shorter than or subequal to palps. 3 + 4. ♀ cibarium with 4 horizontal teeth with inner pair separated by a relatively wide gap; vertical teeth nonexistent or few; arch conspicuous only at sides; pigment patch inconspicuous. Pharynx unarmed. Spermathecae tubular with complete or incomplete annuli; common duct much shorter than individual ducts. ♂ *genitalia.* Coxite with or without persistent setae. Style with 4 spines & no subterminal seta. Paramere simple or with short dorsal protuberance or modified setae.

Barretto's original definition and species composition of this subgenus (1962) differ greatly from our present treatment. *Lutzomyia sordellii* (= *P. nordestinus*), the type species of *Sciopemyia*, is the only species retained by us in this group. Its inclusion seems justified on the basis of several character states of both sexes. Forattini (1973) places some of these species in *Lutzomyia*, others in the genus *Psychodopygus*. Artemiev (1991) includes *L. pilosa* and its allies, *L. delpozoi* and 2 closely related species, and *L. gasparviannai* and its relatives in this group but does not explain his reasons for doing so.

Medical Importance. Unknown; *L. fluviatilis* and *L. microps* have been collected infrequently on human bait.

Key to the Males of the Subgenus *Sciopemyia**

1. Coxite with 2 or more persistent setae inserted on inner surface 2
   Coxite without persistent setae . . . . . *L. sordellii* (Fig. 47)
   L. vattierae

2. Coxite with 6 or more persistent setae at inner base 3
   Coxite with 2-5 persistent setae at inner base . . . . . *L. fluviatilis* (Fig. 48)

3. Genital filaments at least 6X length of genital pump 4
   Genital filaments 5X length of genital pump or shorter 6

*Adapted from Young & Arias (1984). See Le Pont & Desjeux (1992b) for information on distinguishing the female of *L. sordellii* (as *nordestina*) from that of *L. vattierae*.

4. Paramere with either a dorsal setiferous projection or relatively thick curved setae near middle of structure 5
   Paramere simple, without a dorsal projection or modified setae . . . . . *L. preclara* (Fig. 49)

5. Coxite with 6-8 long persistent setae. Paramere with short dorsal projection bearing apical setae . . . . . *L. pennyi* (Fig. 50)
   Coxite with group of 12-14 shorter setae. Paramere without dorsal projection but with 3-4 curved setae near middle of structure . . . . . *L. nematoducta* (Fig. 51)

6. Paramere relatively broad, its shape as figured . . *L. servulolimai* (Fig. 52A)
   Paramere more slender with different shape . . . . . *L. microps* (Fig. 52C)

Key to the Females of the Subgenus *Sciopemyia**

1. Individual sperm ducts subequal in width throughout 2
   Individual sperm ducts tapered, i.e., much wider near junction of common duct than near junction of spermathecae . . . . . *L. nematoducta* (Fig. 51)

2. Spermathecae & individual sperm ducts subequal in width . . . . . *L. microps* (Fig. 52F)
   L. fluviatilis (Fig. 48)
   Spermathecae clearly wider than individual ducts 3

3. Individual sperm ducts thin; shorter than 4.5X length of spermathecae . . . . . *L. preclara* (Fig. 49)
   Individual sperm ducts wider; longer than 4.5X length of spermathecae . . . . . *L. sordellii* (Fig. 47)

Lutzomyia* (*Sciopemyia*) *sordellii (Shannon & Del Ponte)
Fig. 47

Phlebotomus sordellii Shannon & Del Ponte 1927: 730 (♂, Resistencia, Chaco, Argentina).

Flebotomus nordestinus Mangabeira 1942f: 327 (♂, Nova Olinda, Ceará, Brazil). Young & Morales 1987: 662 (as synonym of *sordellii*).

Phlebotomus longicornutus Floch & Abonnenc 1943a: 6 (♂, ♀, Montabo, Cayenne, French Guiana). Barretto 1946b: 534 (as synonym of *nordestina*). Forattini 1960a: 478 (Amapá, Brazil).

Lutzomyia nordestina: Barretto 1962: 96 (listed). Llanos 1973: 32 (figs., Peru). Martins et al. 1978: 165 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Young 1979: 233 (figs., refs., dist.). Fraiha et al. 1980a: 21 (Peru).

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*The females of *L. servulolimai* and *L. pennyi* are unknown.

Morales & Minter 1981: 97 (Colombia). Biancardi et al. 1982; 168 (Rôndonia, Brazil). Arias & Freitas 1982: 404 (Acre, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 125 (figs., Costa Rica). Young et al. 1985: 145 (Peru). Arias et al. 1985: 110 (neg. for flagellates, Brazil). Ryan 1986: 120 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (nat. trypanosome infections, Pará, Brazil). Feliciangeli 1988: 110 (Venezuela). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Le Pont & Desjeux 1992: 266 (cf. to *vattierae*).

Lutzomyia sordellii: Theodor 1965: 187 (listed). Young & Morales 1987: 662 (figs. of lectotype). Alexander et al. 1992c: 125 (Ecuador records).

Psychodopygus nordestinus: Forattini 1973: 475 (♂, ♀ figs., tax.).

Distribution (Map 12). COSTA RICA (Murillo & Zeledón 1985). PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales & Minter 1981); ECUADOR (Martins et al. 1978; Young 1979; Alexander et al. 1992c); FRENCH GUIANA (Martins et al. 1978); VENEZUELA (Feliciangeli et al. 1988a); TRINIDAD (Young 1979); PERU (Martins et al. 1978; Fraiha et al. 1980a; Young et al. 1985); BOLIVIA (Young & Morales 1987); ARGENTINA (Shannon & Del Ponte 1927); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986).

Remarks. We place *L. sordellii* in the subgenus *Sciopemyia* because of similarities of female character states, especially the cibarial armature, broad head, spermathecae and long flagellomeres. The male differs from others in this group by lacking persistent setae on the coxite but this is not a significant difference when other characters are considered. Ryan et al. (1987a) isolated trypanosomes from *L. sordellii* (as *L. nordestina*) captured in Brazil.

Young & Morales (1987) studied and figured the male lectotype of *L. sordellii*, noting that one style bears 5 spines. Normally, there are 4 large spines on each style.

Lutzomyia vattierae Le Pont & Desjeux

Lutzomyia vattierae Le Pont & Desjeux 1992b: 263 (♂, ♀, Yucumo, La Paz, Bolivia).

Distribution (Map 13). BOLIVIA (type locality).

Remarks. We were not aware of the description of this species until shortly before the present manuscript was sent to press. Le Pont & Desjeux (1992b) should be consulted for information on this species.

Lutzomyia (Sciopemyia) fluviatilis (Floch & Abonnenc)
Fig. 48

Phlebotomus fluviatilis Floch & Abonnenc 1944a: 7 (♂, Canori, French Guiana); 1944b: 1 (♀).
Lutzomyia fluviatilis: Theodor 1965: 196 (listed). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 163 (refs., dist.). Ready et al. 1983a: 780 (Pará, Brazil). Young & Arias 1984: 427 (figs., refs.). Ryan 1986: 118 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).
Psychodopygus fluviatilis: Forattini 1971a: 105 (listed); 1973: 416 (figs., tax.).

Distribution (Map 13). FRENCH GUIANA (Léger et al. 1977, Martins et al. 1978); BRAZIL (Ready et al. 1983).

Remarks. Floch & Abonnenc (1946b) reported *L. fluviatilis* females biting man and redescribed both sexes in 1952. The *fluviatilis*-like female from Acre State, Brazil (Arias & Frietas 1982) may represent another *microps* group species. Trypanosomes were isolated from a single female of *L. fluviatilis* collected at Jari, Pará, Brazil (Ryan et al. 1987c).

Lutzomyia (Sciopemyia) preclara Young & Arias
Fig. 49

Lutzomyia preclara Young & Arias 1984: 429 (♂, Leticia, Amazonas, Colombia). Young & Morales 1987: 658 (♂ figs., ♀ descript.).
Lutzomyia sp. Young & Arias 1984: 426 (Colombia).
Lutzomyia sp. near *L. microps* Young et al. 1985: 145 (Peru).

Distribution (Map 14). COLOMBIA (Young & Arias 1984; Young & Morales 1987); PERU (Young et al. 1985).

Lutzomyia (Sciopemyia) pennyi Arias & Freitas
Fig. 50

Lutzomyia pennyi Arias & Frietas 1981: 847 (♂, E of Manaus, Amazonas, Brazil). Young & Arias 1984: 430 (♂ fig.).

Distribution (Map 15). BRAZIL (Arias & Freitas).

Lutzomyia (Sciopemyia) nematoducta Young & Arias
Fig. 51

Lutzomyia nematoducta Young & Arias 1984: 428 (♂, ♀ near Manaus, Amazonas, Brazil).

Distribution (Map 14). BRAZIL (Young & Arias 1984).

Lutzomyia (Sciopemyia) servulolimai (Damasceno & Causey)
Fig. 52 A & D

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

Lutzomyia servulolimai: Theodor 1965: 182 (listed). Llanos 1973: 34 (♂ figs., Peru). Martins et al. 1978: 168 (dist.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Young & Arias 1984: 426 (full refs., fig.). Ryan 1986: 49 (♂ fig., Pará, Brazil).

Distribution (Map 15). BRAZIL (Martins et al. 1978; Biancardi et al. 1982); PERU (Llanos 1973); BOLIVIA (Young & Arias 1984).

Lutzomyia (Sciopemyia) microps (Mangabeira)
Fig. 52 B,C,E,F

Flebotomus microps Mangabeira 1942a: 169 (♂, Municip. Nova Iguaçu, Rio de Janeiro, Brazil).

Lutzomyia microps: Theodor 1965: 182 (listed). Martins et al. 1975b: 259 (♀ descript., dist.); 1978: 163 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Young & Arias 1984: 425 (♂ figs., refs.). Aguiar & Soucasaux 1984: 199 (biting man, Brazil). Aguiar et al. 1985a: 187; 1985b: 340; 1985c: 467; 1987: 585 (coll. data, Brazil). Aguiar & Vilela 1987: 585 (resting in animal burrows, Rio de Janeiro, Brazil).

Psychodopygus microps: Forattini 1973: 473 (figs., tax.).

Distribution (Map 14). BRAZIL (Martins et al. 1978; Aguiar et al. 1985a).

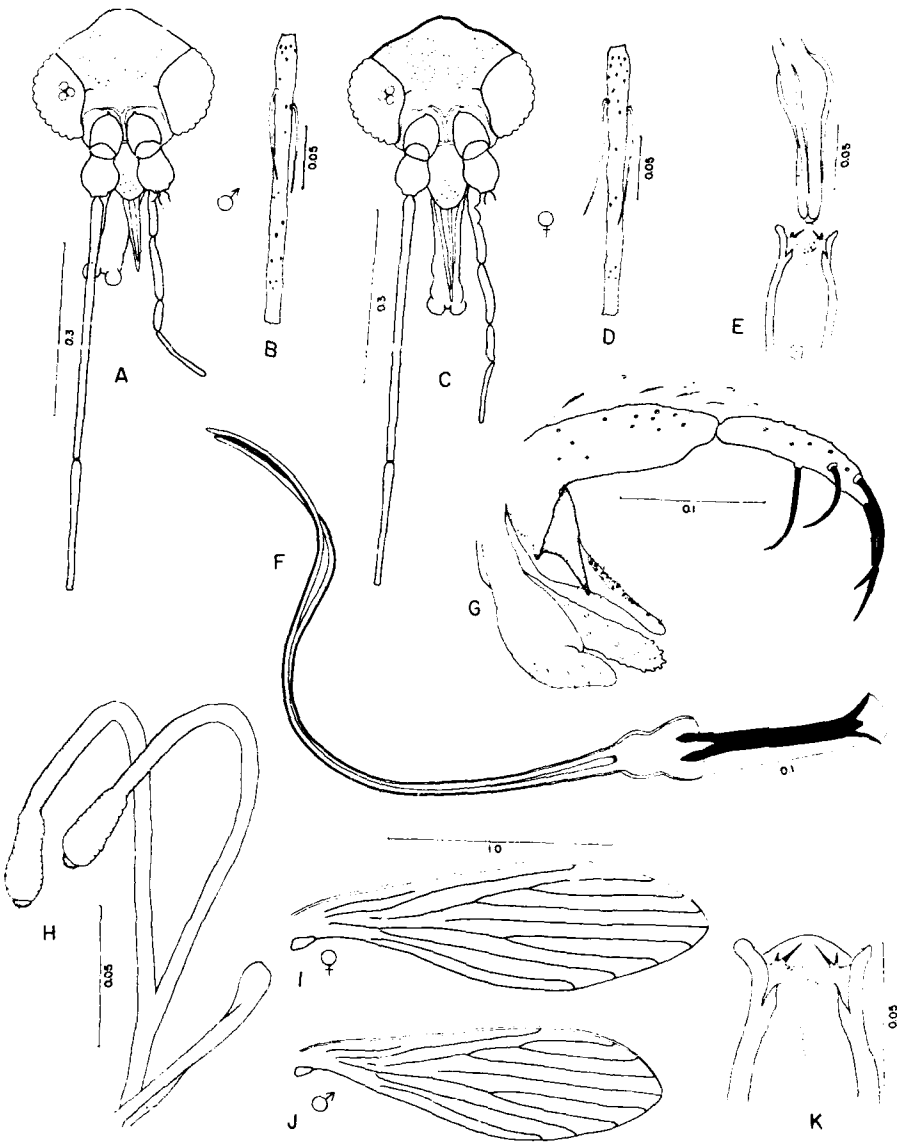


FIG. 47. ***Lutzomyia sordellii***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

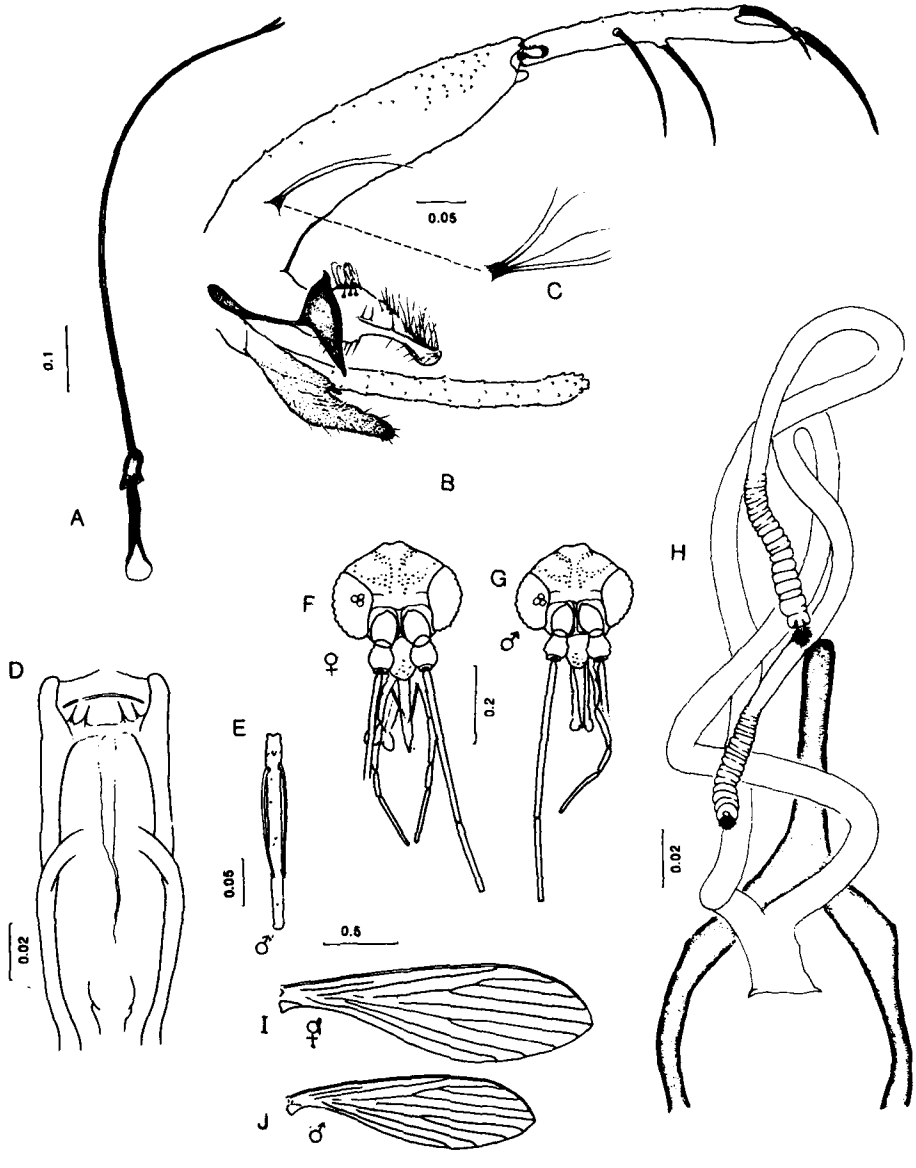


FIG. 48. ***Lutzomyia fluviatilis***. A. Genital pump & filaments; B. Male terminalia; C. Coxite tuft; D. Female cibarium; E. Female flagellomere II; F. Female head; G. Male head; H. Spermathecae; I. Female wing; J. Male wing (from Young & Arias 1984).

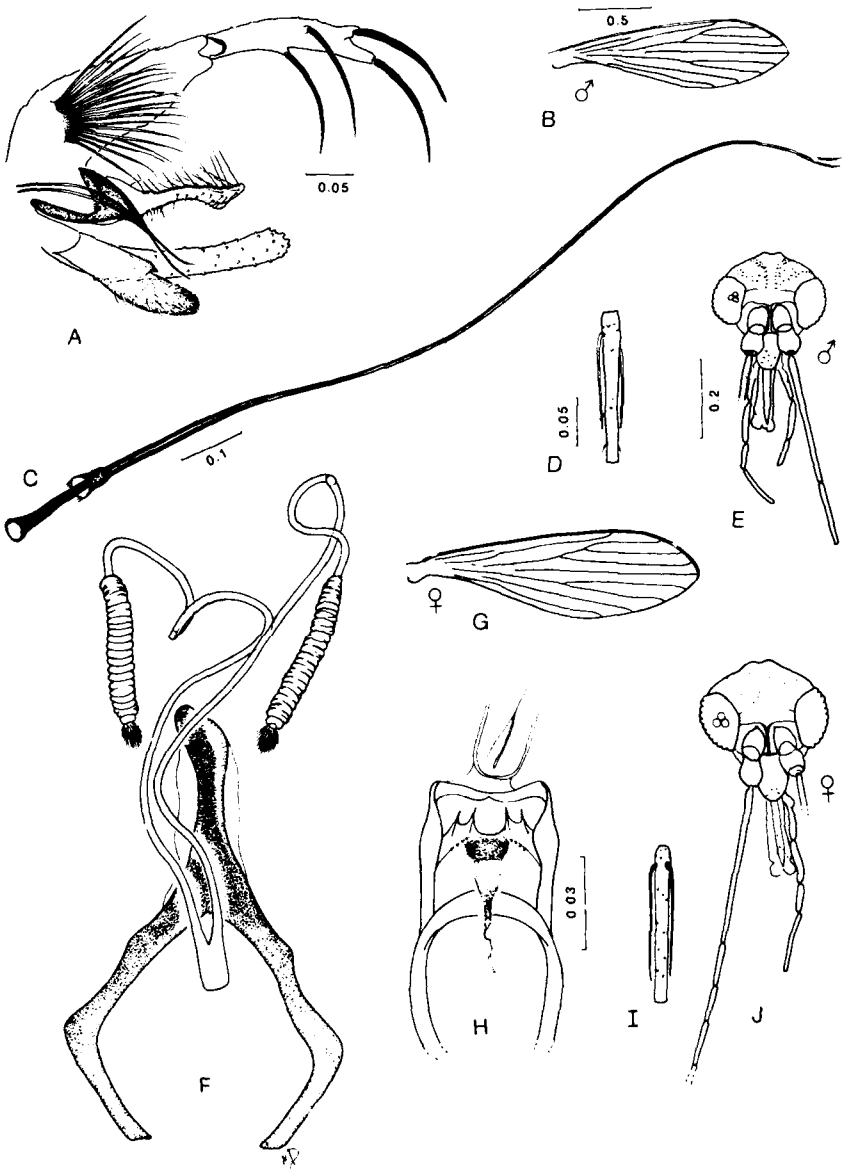


FIG. 49. ***Lutzomyia preclara***. A. Male terminalia; B. Male wing; C. Genital pump & filaments; D. Male flagellomere II; E. Male head; F. Spermathecae; G. Female wing; H. Female cibarium; I. Female flagellomere II; J. Female head (from Young & Morales 1987).

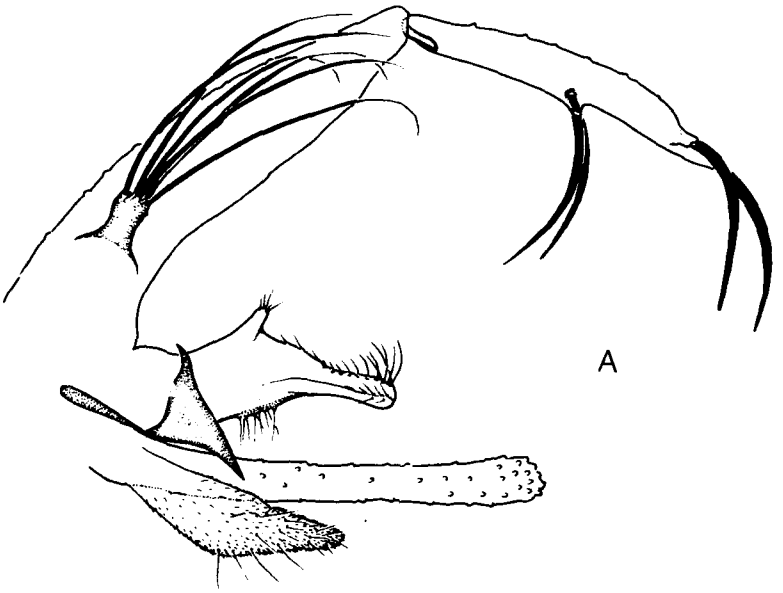


FIG. 50. ***Lutzomyia pennyi.*** A. Male terminalia (from Young & Arias 1984).

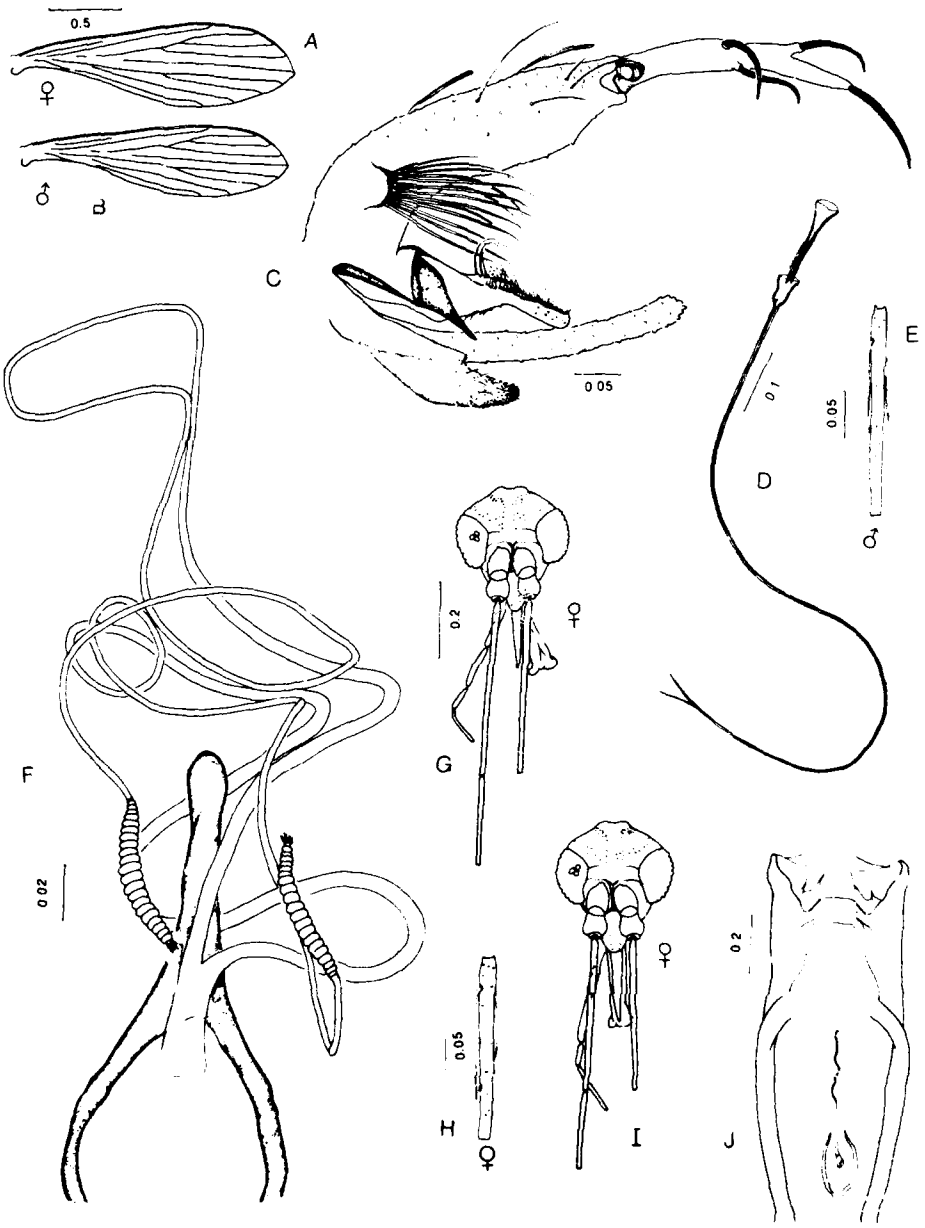


FIG. 51. ***Lutzomyia nematoducta.*** A. Female wing; B. Male wing; C. Male terminalia; D. Genital pump & filaments; E. Male flagellomere I; F. Spermathecae; G. Female head; H. Female flagellomere I; I. Female head; J. Female cibarium (from Young & Arias 1984).

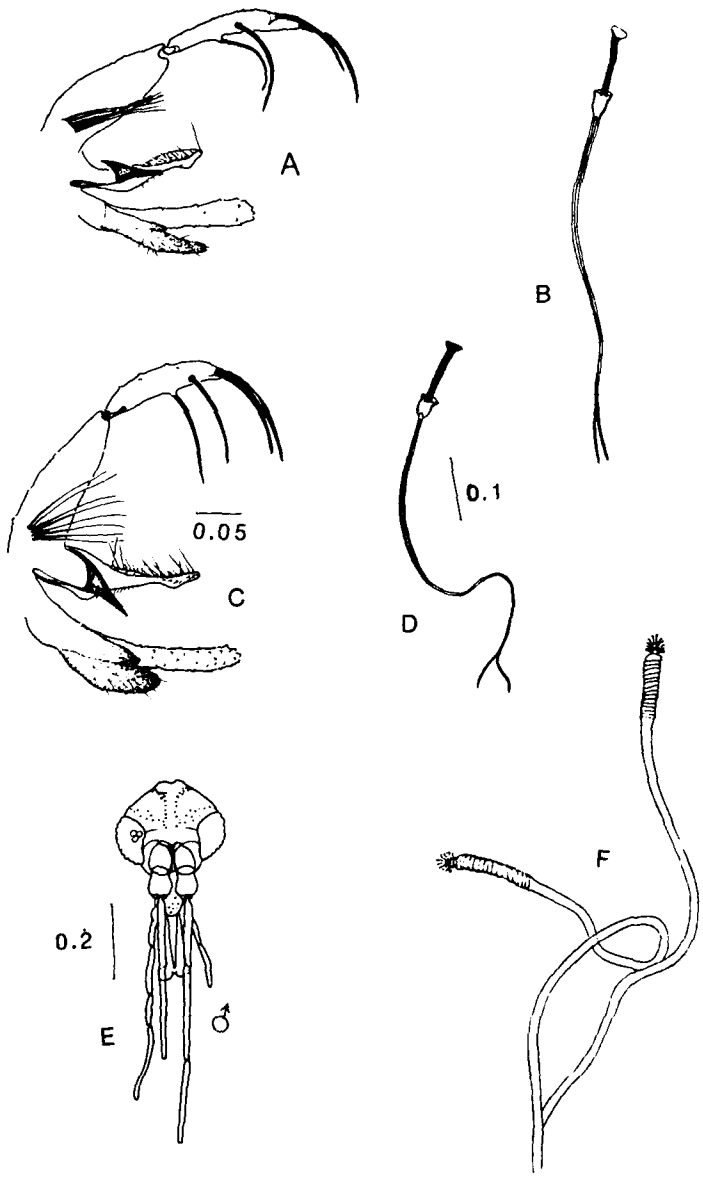
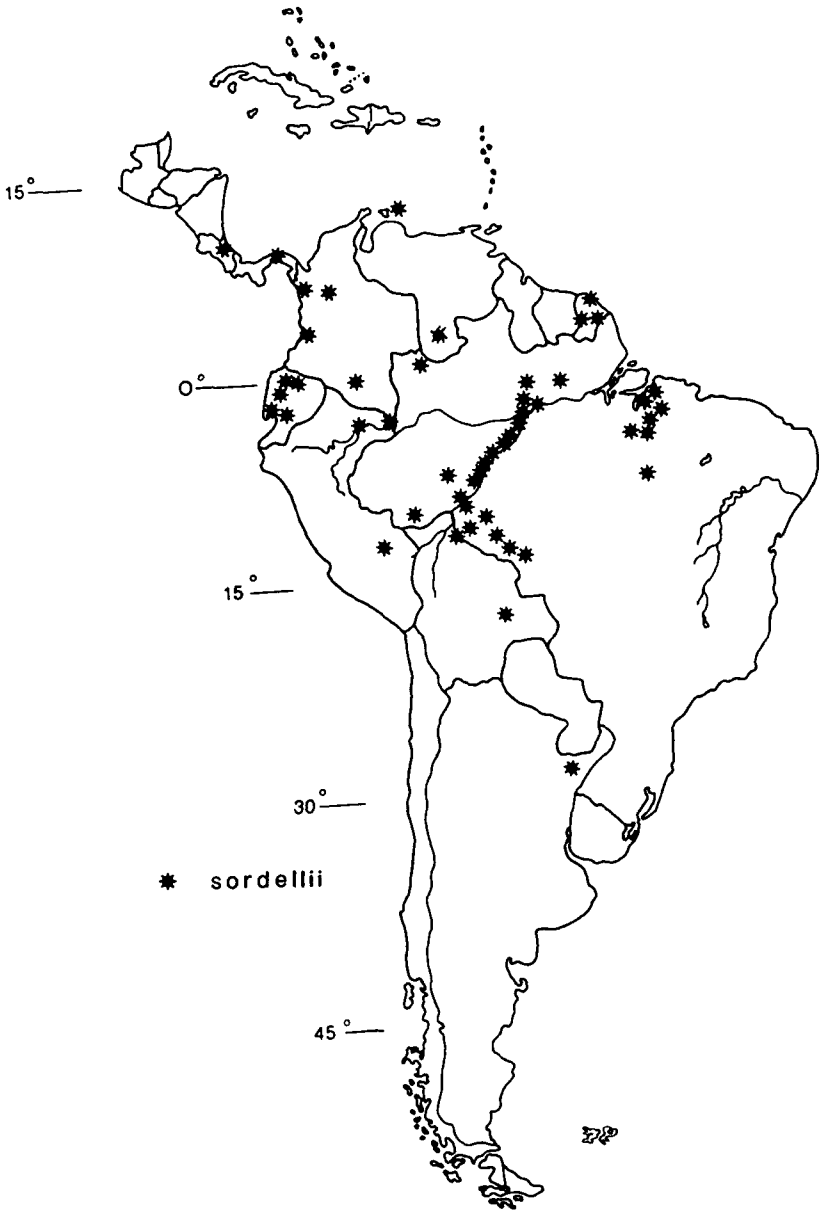
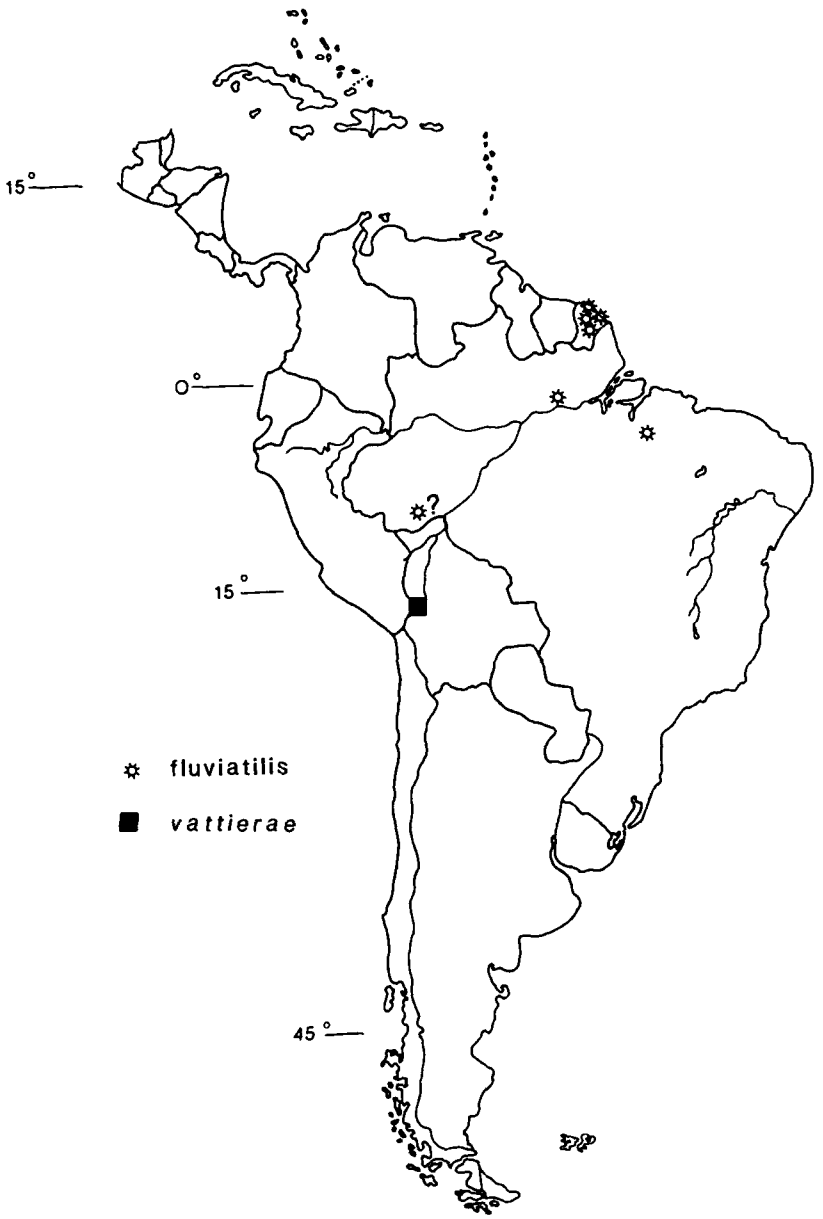


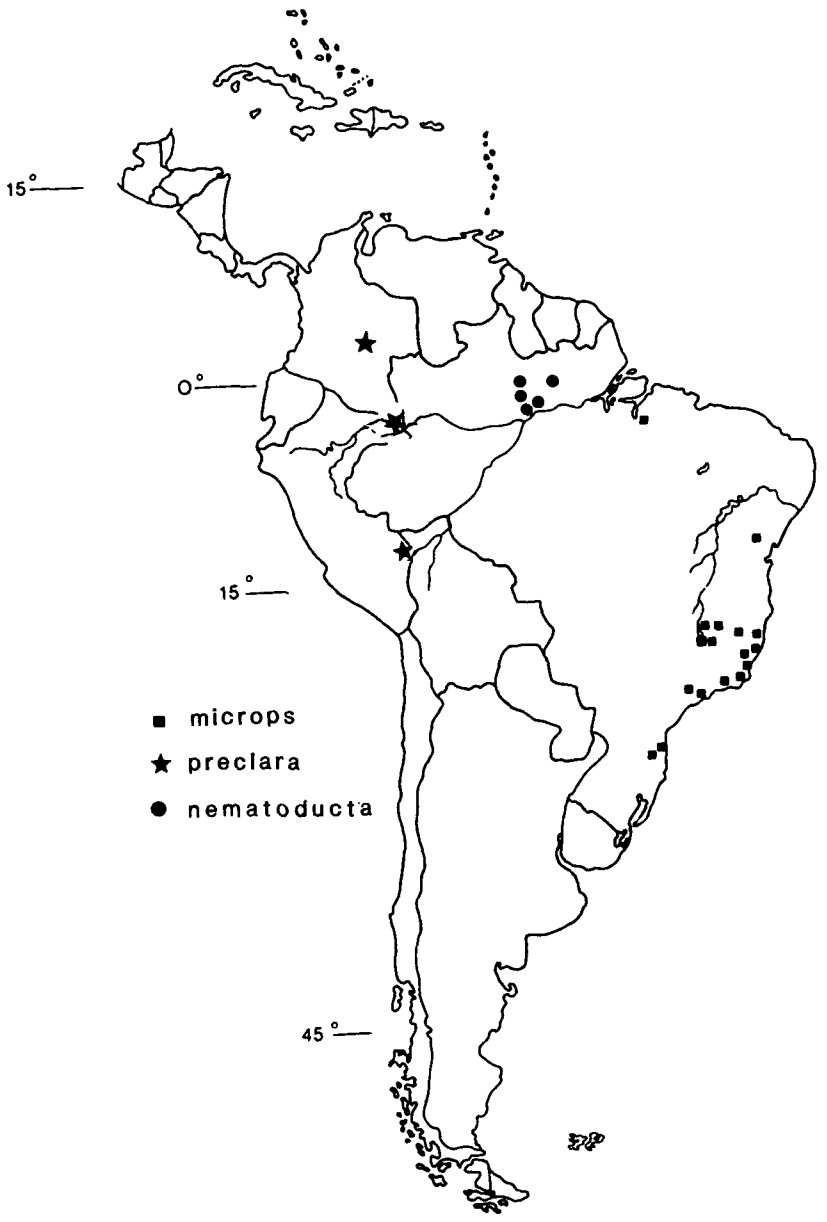
FIG. 52. ***Lutzomyia servulolimai***. A. Male terminalia; D. Genital pump & filaments (from Young & Arias 1984).
Lutzomyia microps. B. Genital pump & filaments C. Male terminalia; E. Male head; F. Spermathecae (figs. A-E from Young & Arias 1984; fig. E from Martins et al. 1975b).



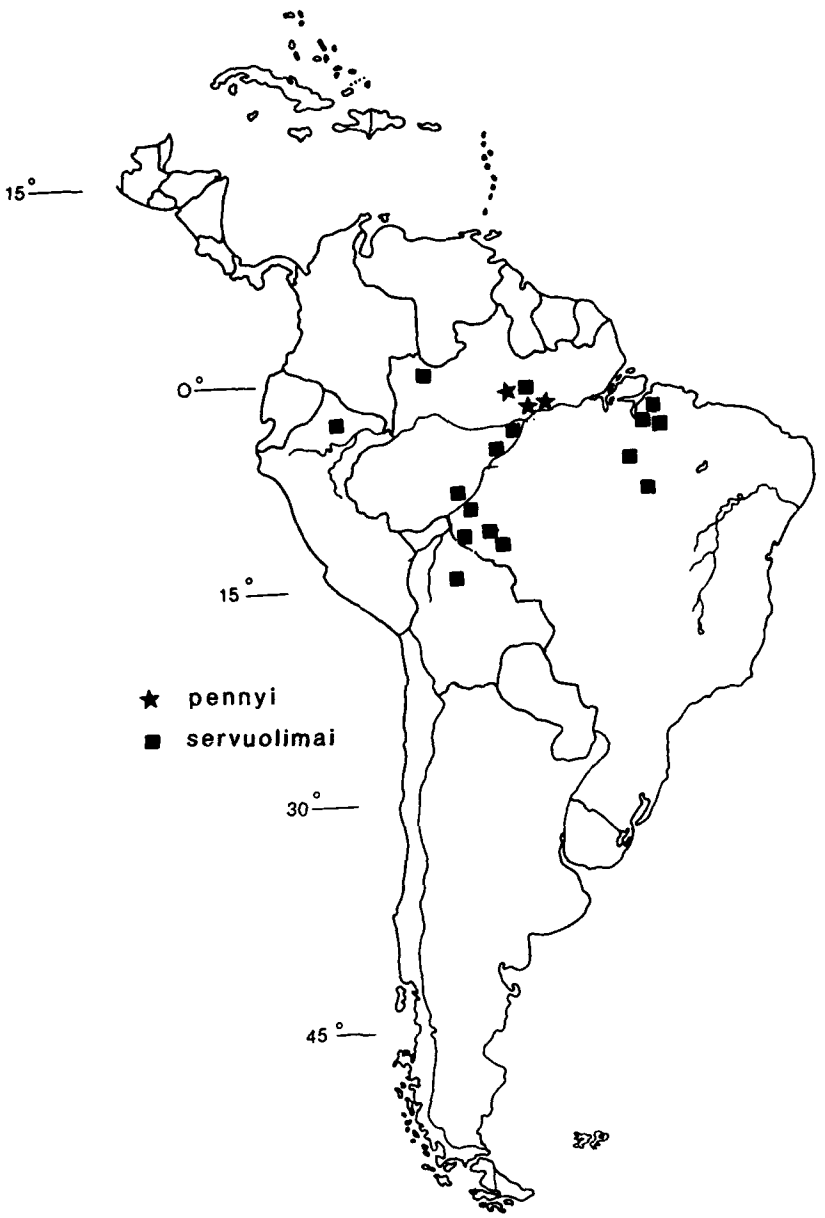
Map 12



Map 13



Map 14



Map 15

SPECIES GROUP *MIGONEI*

Flebotomus, subgenus *Castromyia* Mangabeira 1942a: 185 (type species: *Phlebotomus castroi* Barretto & Coutinho by orig. designation).

Lutzomyia species group *migonei* Theodor 1965: 182 (in part). Martins et al. 1978: 135.

Lutzomyia, subgenus *Barrettomyia* Martins & Silva 1968: 3 (type species: *Flebotomus tupynambai* Mangabeira by orig. designation). Forattini 1971a: 102; 1973: 343. Artemiev 1991: 73.

Lutzomyia, subgenus *Coromyia*: Forattini 1971a: 101; 1973: 273 (in part).

Identification. Coloration pale to dark. Antennal ascoids simple. Palpomere 5 longer than palp. 3. ♀ cibarium with 4 horizontal teeth; number of vertical teeth variable; arch complete; pigment patch variable in size, shape & intensity. Pharynx unarmed. Spermathecae annulated or not, ducts variable in length. ♂ *genitalia*. Coxite with 1 or more groups of persistent setae. Style with 4 spines (exception is *L. bahiensis* with 4-8) & small subterminal seta. Paramere simple or divided. Aedeagus either simple or with dorsal projection. Genital filament tips simple or modified. Lateral lobe not inflated, without modified setae.

Theodor (1965) divided the *migonei* group species into 2 series (*migonei* and *evandroi*) but subsequent discoveries of additional species and previously unknown females have shown that these divisions should not be recognized. We include the species related to *L. costalimai* in the *migonei* group, in contrast to Martins et al. (1978) and Artemiev (1991) who prefer to separate them in the subgenus *Barrettomyia*. The greatly expanded spermathecae of these females may have been derived from *L. dubitans*-like stock.

Medical Importance: Unknown; several species have been observed biting man and *L. migonei* females have been found naturally-infected with unidentified flagellates. An unidentified, wild-caught female, resembling *L. tupynambai*, was found infected with *Leishmania braziliensis* in Brazil (see Ryan et al. 1987c).

Key to the Males of the Species Group *Migonei**

1. Paramere divided or bifurcate 2
   Paramere undivided 3

2. Genital filament tips elongate, spear-shaped; modification comprises about 1/8 total length of filament . . . . . *L. lenti* (Fig. 53D)
   Genital filament tips otherwise, comprising ca. 1/20 total length of filament . . . . . *L. carmelinoi* (Fig. 53C)

*The male of *Lutzomyia* sp. of Baduel is not known with certainty.

3. Paramere with dorsal row of 3-5 large setae, modified as shown . . . . . *L. edwardsi* (Fig. 54)
   Paramere without such setae 4

4. Genital filaments 5X length of genital pump or longer 5
   Genital filaments shorter than 5X length of pump 6

5. Paramere with median group of 5-8 persistent setae. Genital filaments longer than 6.5X genital pump . . . . . *L. pacae* (Fig. 55)
   Paramere with median group of 2-4 persistent setae. Genital filaments shorter than 6X genital pump . . . . . *L. gruta* (Fig. 56)

6. Genital filament tips simple, not inflated or otherwise modified 7
   Genital filament tips modified or inflated 11

7. Coxite with setae of basal tuft obviously much shorter than maximum width of coxite 8
   Coxite with setae of basal tuft longer than maximum width of coxite 9

8. Coxite with tuft of 12-15 setae. Genital filaments shorter than 3X pump length . . . . . *L. rabelloi* (Fig. 57)
   Coxite with tuft of 3-9 setae. Genital filaments longer than 3.5X pump length . . . . . *L. migonei* (Fig. 58)

9. Paramere with dorsal setae covering at least distal half of structure . . . 10
   Paramere with dorsal setae restricted to distal fourth of structure . . . . . *L. sallesi* (Fig. 59F)

10. Genital filaments longer than 2.5X pump length . *L. corumbaensis* (Fig. 60)
    Genital filaments shorter than 2.5X pump length . . . *L. cortelezzii* (Fig. 59)

11. Paramere with ventral hump or acute projection 12
    Paramere without such ventral projection 18

12. Genital filaments longer than 2X length of genital pump. Coxite tuft with most of setae implanted on a common tubercle (series *costalimai*) 13
    Genital filaments shorter than 2X length of genital pump. Coxite tuft of thinner setae not borne on a common tubercle 17

13. Coxite with basal tuft of 3 long setae, 2-3 much shorter setae present . . . . . *L. tupynambai* (Fig. 61A)
    Coxite with basal tuft of 6 or more long setae 14

14. Coxite tuft & paramere as shown; style usually with 5 or more spines (rarely 4) . . . . . *L. bahiensis* (Fig. 61H)
Coxite tuft & paramere otherwise; style with 4 spines 15

15. Paramere with isolated seta on dorsal margin 16
Paramere with numerous (8+) setae on dorsal margin . . . . . *L. callipyga* (Fig. 62F)

16. Paramere with isolated seta implanted on a distinct tubercle . . . . . *L. costalimai* (Fig. 62D)
Paramere with isolated seta not implanted on a distinct tubercle . . . . . *L. petropolitana* (Fig. 62A)

17. Aedeagus with dorsal projection. Genital filament tips modified as shown . . . . . *L. williamsi* (Fig. 63)
Aedeagus simple, lacking such a projection. Genital filament tips modified otherwise . . . . . *L. termitophila* (Fig. 64)

18. Paramere with 1-2 isolated dorsal setae near middle of structure. Genital filament tips as shown . . . . . *L. sericea* (Fig. 65)
? *L.* sp. of Baduel (Fig. 66)
L. andersoni (Fig. 67)
Paramere without isolated setae. Genital filament tips otherwise 19

19. Paramere with dorsal, setose lobe at level of aedeagus. Coxite tuft of 6-8 thin setae . . . . . *L. evandroi* (Fig. 68)
Paramere without such a dorsal lobe. Coxite tuft of 10 or more setae . . 20

20. Coxite tuft of relatively wide setae as shown. Genital filament tips with a subterminal notch, not inflated . . . . . *L. firmatoi* (Fig. 69)
Coxite tuft of much thinner setae. Genital filament tips inflated 21

21. Genital filament tips shaped like a buttonhook, lacking an inner tooth-like structure. Aedegus & paramere as shown . . . . . *L. baculus* (Fig. 70)
Genital filament tips subspherical with distinct inner tooth-like structure. Aedeagus & paramere otherwise 22

22. Aedeagus simple. Style with proximal spines paired or nearly paired. Genital filaments longer, ca. 2X length of genital pump . . *L. dubitans* (Fig. 71)
Aedeagus with dorsal projection. Style with isolated proximal spine. Genital filaments shorter than 2X length of pump . . . . . *L. walkeri* (Fig. 72)

Key to the Females of the Species Group *Migonei*

1. Spermathecae more or less cylindrical, at least 2X longer than wide 2

Spermathecae otherwise, subspherical, ovoid or capsule-like, length less than 2X width 6

2. Spermathecae or individual ducts annulated in part or whole 3
Spermathecae and individual ducts not annulated 5

3. Common sperm duct subequal to, or much longer than, individual duct. *Spermathecae mostly annulated* 4
Common sperm duct much shorter than individual duct. Most of spermathecae smooth-walled, non-annulated . . . . . *L. rabelloi* (Fig. 57)

4. Common & individual sperm ducts short, subequal in length, without convolutions; spermathecae with terminal knob arising subapically . . . . . *L. termitophila* (Fig. 64)
Common sperm duct 5 or more times longer than convoluted individual ducts; spermathecae with apical terminal knob . . . . . *L. gruta* (Fig. 56)

5. Common sperm duct 5 or more times length of individual duct; spermathecae wider as shown . . . . . *L. pacae* (Fig. 55)
Common sperm duct considerably shorter than individual ducts; spermathecae but slightly wider than individual duct width . . . . *L. migonei* (Fig. 58)

6. Individual sperm ducts greatly expanded, sac-like in part or whole . . . . . *L. tupynambai* (Fig. 61B)
L. bahiensis
L. callipyga
L. costalimai
L. petropolitana
Individual sperm ducts not expanded 7

7. Spermathecae with distinct terminal knob 8
Spermathecae without terminal knob, the "hairs" (ducts) arising directly from spermathecae . . . . . *L. firmatoi* (Fig. 69)

8. Common & individual sperm ducts subequal in length 9
Common duct much shorter than individual ducts 10

9. Individual sperm ducts about half as wide as common duct width . . . . . *L. dubitans* (Fig. 71)
Individual sperm ducts more slender, about one third as wide as common duct . . . . . *L. walkeri* (Fig. 72)

10. Individual sperm ducts tapered, width near spermathecae much less than width near junction with common duct 11
Individual sperm ducts more or less subequal in width throughout 13

11. Spermathecae relatively small, maximum width = to or less than maximum width of individual duct . . . . . *L. sericea* (Fig. 65)
L. andersoni (Fig. 67)
Spermathecae wider than maximum width of individual duct 12

12. Spermathecae somewhat pear-shaped; terminal knob arises off-center when viewed at certain angles . . . . . *L. baculus* (Fig. 70)
Spermathecae otherwise; terminal knob arises centrally from spermathecae . . . . . *L. edwardsi* (Fig. 54)
Lutzomyia sp. of Baduel (Fig. 66)

13. Common duct width subequal to width of genital fork stem 14
Common duct much wider than width of genital fork stem 15

14. Individual sperm ducts thin; longer than 9X width of spermatheca . . . . . *L. corumbaensis* (Fig. 60)
Individual sperm ducts wider & shorter, less than 8X width of spermatheca . . . . . *L. sallesi* (Fig. 59A)
L. cortelezzii

15. Spermatheca relatively large, its length subequal to width of common duct . . . . . *L. williamsi* (Fig. 63)
Spermatheca smaller, its length obviously much less than width of common duct 16

16. Common sperm duct shorter than 1/6 length of individual duct; spermathecae subspherical . . . . . *L. evandroi* (Fig. 68)
Common sperm duct longer than 1/3 length of individual duct; spermathecae wider at base than apically, somewhat bell-shaped . . . . . *L. carmelinoi* (Fig. 53B)
L. lenti

Lutzomyia lenti (Mangabeira)
Fig. 53D

Flebotomus lenti Mangabeira 1938: 350 (♂, Lassance, Minas Gerais, Brazil). Barretto 1947a: 207 (refs.).

Phlebotomus lenti: Floch & Abonnenc 1952: 33 (figs., keyed). Deane & Deane 1957: 226 (Ceará, Brazil). Sherlock 1957a: 78 (♀, immatures). Carnheiro & Sherlock 1964: 315 (pupa, keyed). Mangabeira 1969: 21 (♂ fig.).

Lutzomyia lenti: Martins et al. 1962c: 380 (Goias, Brazil). Theodor 1965: 182. Lewis 1967a: 131 (♀ figs., tax.). Forattini 1973: 287 (figs., review). Velasco & Trapido 1974: 433 (cf. to *boliviana*). Lewis 1975a: 500 (mouthpart morphol.). Martins et al. 1978: 133 (dist.). Mayrink et al. 1979: 131 (nat. bacterial infection, Brazil). Ryan et al. 1986a: 326 (figs., keyed).

Lutzomyia lentiodes Forattini 1971a: 103 (new name for *pinottii* Lucena, not *pinottii* Damasceno & Arouck). Martins et al. 1978: 134 (as synonym of *lenti*).

Distribution (Map 16). BRAZIL (Martins et al. 1978).

Remarks. Ryan et al. (1986a) noted variation in the length of the genital filaments, concluding that it is probable that *L. lenti* is a senior synonym of *L. lentiodes* Forattini, first described as *P. pinottii* by Lucena (1960). This latter name, however, was applied first to another sand fly in the subgenus *Evandromyia*.

Lutzomyia carmelinoi Ryan, Fraiha, Lainson & Shaw
Fig. 53 A-C

Lutzomyia sp. n. 222.12 Ryan 1986: 54 (♂, ♀ figs.).
Lutzomyia carmelinoi Ryan, Fraiha, Lainson & Shaw 1986a: 323 (♂, ♀, Santarém, Pará, Brazil). Kreutzer et al. 1988: 453 (karotyping).

Distribution (Map 16). BRAZIL (type locality).

Remarks. Slight differences in the length and shape of the genital filament tips are used to distinguish males of this species from *L. lenti*. The females are very similar in structure; Ryan et al. (1986a) separate them by the ratio of the widths of the common and individual sperm ducts but we key *L. lenti* and *L. carmelinoi* together in the same couplet to emphasize that associated males must be on hand before definitive identifications can be made.

Lutzomyia edwardsi (Mangabeira)
Fig. 54

Flebotomus edwardsi Mangabeira 1941a: 201 (♂, ♀, Nova Iguassú, Rio de Janeiro, Brazil). Barretto 1947a: 197 (refs.).
Phlebotomus edwardsi: Barretto 1950a: 106 (keyed).
Lutzomyia edwardsi: Theodor 1965: 182. Forattini 1973: 284 (figs., tax.). Léger et al. 1977: 220 (? probably misident.). Martins et al. 1978: 137 (dist.). Mayrink et al. 1979: 131 (nat. trypanosome infections, Minas Gerais, Brazil). Gomes et al. 1986: 282 (São Paulo, Brazil). Aguiar & Vilela 1987: 585 (resting sites).

Distribution (Map 17). BRAZIL (Martins et al. 1978).

Remarks. Léger et al. (1977) illustrated a female from French Guiana, identifying it as *L. edwardsi*, but this record is well outside the geographic range of *L. edwardsi* and no males were reported. We consider its presence in French Guiana as doubtful.

Lutzomyia pacae (Floch & Abonnenc)
Fig. 55

Phlebotomus pacae Floch & Abonnenc 1943a: 1 (♂, ♀, Montabo, Cayenne, French Guiana); 1952: 101 (♂, ♀, redescript.). Wijers & Linger 1966: 505 (Suriname, biting man).

Flebotomus ferreirai Causey & Damasceno 1945b: 668 (♂, Peixe-Boi, Pará, Brazil). Barretto 1950c: 221 (as synonym of *pacae*).

Lutzomyia pacae: Martins et al. 1963: 334 (Roraima, Brazil). Theodor 1965: 182 (listed). Forattini 1971a: 101; 1973: 288 (♂, ♀ figs., tax.). Shaw & Lainson 1972: 711 (Pará, Brazil). Ward et al. 1973b: 178 (♀♀ attracted to rodent bait, Brazil). Lewis 1975a: 500 (mouthpart morphol.). Léger et al. 1977: 218 (French Guiana). Arias & Freitas 1977b: 511 (Amazonás, Brazil); 1978: 391 (neg. for flagellates). Martins et al. 1978: 139 (refs., dist.). Lainson et al. 1979: 241 (neg. for flagellates, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ready et al. 1986: 29 (Pará, Brazil). Ryan 1986: 57 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 18). SURINAME (Wijers & Linger 1966); FRENCH GUIANA (Martins et al. 1978; Léger et al. 1977); BRAZIL (Martins et al. 1978; Arias & Freitas 1977b, 1978; Ryan 1986).

Remarks. Females of *L. pacae* are regarded as rodentophilic (Ready et al. 1983a) but will occasionally bite man.

Lutzomyia gruta Ryan
Fig. 56

Lutzomyia gruta Ryan 1986: 109 (♂, ♀, Serra dos Carajás, Pará, Brazil).

Distribution (Map 17). BRAZIL (type locality).

Remarks. Ryan (1986) assigned *L. gruta* to the *verrucarum* species group, presumably on the basis of the finely annulated spermathecae, cibarial armature and some features of the male terminalia which, nevertheless, greatly resembles that of *L. pacae* in the *migonei* group. Apart from the annulated spermathecae of *L. gruta*, the females of these species are structurally similar and indicate that *L. gruta* should be included in the *migonei* species group.

Lutzomyia rabelloi Galati & Gomes
Fig. 57

Lutzomyia rabelloi Galati & Gomes 1992: 457 (♂, ♀; holotype ♀, Iguape, São Paulo, Brazil).

Distribution (Map 26). BRAZIL (Galati & Gomes 1992).

Remarks. Both sexes of *L. rabelloi* resemble those of *L. migonei* but differ by genitalic characters given in the *migonei* group key. We have not seen specimens of this newly described species, known only from several localities in the Ribeira Valley, São Paulo State, Brazil.

Lutzomyia migonei (França)
Fig. 58

Phlebotomus migonei França 1920: 230 (♂, Asunción, Paraguay).
Phlebotomus rangeli Nuñez-Tovar 1924: 45 (♂, ♀, Aragua, Venezuela). Dyar 1929: 120 (as synonym of *migonei*).
Phlebotomus araozi Paterson & Shannon 1926a: 236 (♂, ♀, Argentina). Dyar 1929: 120 (as synonym of *migonei*).
Flebotomus migonei: Barretto 1947a: 211 (full refs., synonyms).
Lutzomyia migonei: Forattini 1973: 274 (figs., tax., gen. review). Mogollon et al. 1977: 209 (Venezuela). Martins et al. 1978: 138 (figs., dist., refs.). Ramirez Pérez et al. 1978: 52 (figs., Aragua, Venezuela); 1981: 124 (Venezuela); 1982a: 14 (figs., Sucre, Venezuela). Young 1979: 63 (refs., figs.). Mayrink et al. 1979: 131 (bacterial, fungal infections, Brazil). Feliciangeli 1980: 246 (figs., keyed). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Llanos 1983: 183 (Peru). Arias & Freitas 1982: 402 (Acre, Brazil). Bonfante-Garrido 1983: 740; 1984: 850 (Venezuela). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Barros et al. 1985: 150 (Espirito Santo, Brazil). Gomes et al. 1986: 282 (ecology, Brazil). Ryan 1986: 56 (figs., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Feliciangeli 1988: 104 (Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Gomes et al. 1989a: 32 (biting activity, Brazil). Brazil et al. 1991: 113 (resting, chicken coops). Hashiguchi et al. 1992: 139 (Paraguay, coll. data).

Distribution (Map 19). COLOMBIA (Young 1979); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1981; 1982a; Bonfante-Garrido 1983; Feliciangeli 1988); BRAZIL; ARGENTINA; PARAGUAY (Martins et al. 1978; Galati & Gomes 1992; Hashiguchi et al. 1992); PERU (Llanos 1981; Young et al. 1985); TRINIDAD (Young 1979).

Remarks. Forattini (1973) reviewed the habits of this anthropophilic species which has been found naturally infected with unidentified flagellates in Venezuela and Brazil (see Johnson et al. 1963).

Lutzomyia cortelezzii (Brèthes)
Fig. 59C

Phlebotomus cortelezzii Brèthes 1923: 361 (♂, ♀, La Plata, Argentina). Theodor 1932: 21 (figs., tax.).
Flebotomus cortelezzii: Barretto 1947a: 194 (refs.).
Lutzomyia cortelezzii: Theodor 1965: 182 (listed). Galati et al. 1989: 465 (tax., figs.). Queiroz et al. 1991: 159 (coll. data, Ceará, Brazil). Hashiguchi et al. 1992: 139 (coll. data, Paraguay).

Distribution (Map 20). ARGENTINA; URUGUAY; ? PERU (Martins et al. 1978, in part; Hashiguchi et al. 1992); BRAZIL (Galati et al. 1989).

Remarks. Theodor (1932) redescribed the male and female of *L. cortelezzii* from specimens taken in Argentina. Later, *L. sallesi* was described from Brazil by Galvão & Coutinho (1939). Several authors consider the taxa to be conspecific (Forattini 1973), but we follow Martins et al. (1978) and Galati et al. (1989) who treat them as distinct species.

These species and *L. corumbaensis* form a species complex. Differences among them are slight and Galati et al. (1989) should be consulted for details on taxonomy and distribution.

Lutzomyia sallesi (Galvão & Coutinho)
Fig. 59 A-B, D-F

Flebotomus sallesi Galvão & Coutinho 1939: 125 (♂, ♀, Araçatuba, São Paulo, Brazil). Barretto 1947a: 221 (full refs.).
Lutzomyia sallesi: Martins et al. 1962c: 381 (Goiás, Brazil); Martins & Silva 1964: 129 (Acre, Brazil). Velasco 1973: 75 (♂, ♀, Bolivia). Forattini 1973: 284 (in part, as junior synonym of *cortelezzii*). Martins et al. 1978: 139 (dist.). Mayrink et al. 1979: 131 (♀, nat. infection *Trypanosoma*, Brazil). Galati et al. 1989: 465 (tax., figs.). Queiroz et al. 1991: 159 (coll. data, Ceará, Brazil). Alexander et al. 1992a: 36 (Ecuador); 1992c:124.
Lutzomyia cortelezzii, not *cortelezzii* Brethes): Llanos 1973: 31 (♂, ♀ figs., Peru). ? Martins et al. 1976a: 488 (Huánuco, Peru).

Distribution (Map 22). BRAZIL (Martins et al. 1978; Galati et al. 1989); BOLIVIA (Velasco 1973); ARGENTINA (1 ♂, El Palmar, Salta, 1960, Garcia, coll.); PARAGUAY (? ♀, Acá-Poi, San Pedro, 1950, M. Hertig); PERU (Llanos 1973; ? Llanos 1981). ECUADOR (Alexander et al. 1992a,c).

Remarks. Arzube (1960) reported *L. sallesi* from Guayas Prov., Ecuador and later, Alexander et al. (1992a) confirmed its presence in that country.

Lutzomyia corumbaensis Galati, Nunes, Oshiro & Rego
Fig. 60

Lutzomyia corumbaensis Galati, Nunes, Oshiro & Rego 1989: 465 (♂, ♀, Lagoa do Tamengo, Corumbá, Mato Grosso do Sol, Brazil.

Lutzomyia cortelezzii (not *cortelezzii* Brèthes): Galati et al. 1985: 261 (listed Mato Grosso do Sol, Brazil).

Distribution (Map 18). BRAZIL (Galati et al. 1989).

Remarks. See *L. cortelezzii*.

Lutzomyia tupynambai (Mangabeira)
Fig. 61 A-D

Flebotomus tupynambai Mangabeira 1942a: 181 (♂, Cardoso Moreira, Rio de Janeiro, Brazil).

Phlebotomus tupynambai: Mangabeira & Sherlock 1961: 268 (cf. to *bahiensis*). Sherlock & Carnheiro 1962: 423 (♀). Carneiro & Sherlock 1964: 314 (pupa).

Sergentomyia tupynambai: Barretto et al. 1956: 49 (variation).

Lutzomyia tupynambai: Theodor 1965: 191 (♂, ♀ figs.). Martins & Silva 1965: 273; 1968: 12 (♂ keyed). Forattini 1973: 347 (figs., tax.). Martins et al. 1973b: 422. Lewis 1975a: 503 (mouthpart morphol.). Martins et al. 1978: 120 (♂, ♀ figs., dist.). Mayrink et al. 1979: 131 (on human bait, Minas Gerais, Brazil). Vexenat et al. 1986b: 296 (Bahia, Brazil).

Distribution (Map 23). BRAZIL (Martins et al. 1978; Vexenat et al. 1986b).

Remarks. The spermathecae were drawn from a female taken near Três Braços, Bahia, Brazil, where males of both *L. bahiensis* and *L. tupynambai* have been reported. It is impossible to identify this female to species because it was captured without males and, structurally, the females of these taxa are indistinguishable.

Lutzomyia bahiensis (Mangabeira & Sherlock)
Fig. 61 E-J

Phlebotomus bahiensis Mangabeira & Sherlock 1961: 266 (♂, Salvador, Bahia, Brazil). Sherlock & Carneiro 1962: 423 (♀); 1963: 491 (immatures). Sherlock 1963: 50 (♂ variation). Carneiro & Sherlock 1964: 315 (pupa).

Lutzomyia bahiensis: Theodor 1965: 191. Martins & Silva 1968: 5 (class.). Forattini 1973: 344 (review, figs.). Martins et al. 1978: 118 (dist.). Vexenat et al. 1986b: 296 (Bahia, Brazil).

Distribution (Map 20). BRAZIL (Martins et al. 1978).

Remarks. The males of *L. bahiensis* show considerable variation in the number of spines on their styles, with 80% of specimens having 6 and the remaining 20% having 4 to 8 (Sherlock 1963).

Lutzomyia callipyga Martins & Silva
Fig. 62 F-H

Lutzomyia callipyga Martins & Silva 1965: 272 (♂, ♀, Peçanha, Minas Gerais, Brazil); 1968: 12 (♂ keyed). Martins & Morales-Farias 1972: 367. Forattini 1973: 346. Martins et al. 1978: 118 (dist.).

Distribution (Map 20). BRAZIL (Martins et al. 1978).

Lutzomyia costalimai (Mangabeira)
Fig. 62 D & E

Flebotomus costalimai Mangabeira 1942a: 177 (♂, Cardoso Moreira, Rio de Janeiro, Brazil).
Phlebotomus costalimai: Vargas & Nájera: 22 (cf. to *pratti*). Mangabeira & Sherlock 1961: 268 (cf. to *bahiensis*). Sherlock & Carneiro 1962: 426. Llanos 1964: 381.
Lutzomyia costalimai: Theodor 1965: 191. Martins & Silva 1968: 10 (♀). Martins & Morales-Farias 1972: 367. Forattini 1973: 347. Martins et al. 1978: 118 (dist.).

Distribution (Map 24). BRAZIL (Martins et al. 1978).

Lutzomyia petropolitana Martins & Silva
Fig. 62 A-C

Lutzomyia petropolitana Martins & Silva 1968: 6 (♂, ♀, Meio da Serra, Petropolis, Rio de Janeiro, Brazil. Forattini 1973: 347 (♂ fig.). Martins et al. 1978: 118.

Distribution (Map 20). BRAZIL (type locality).

Lutzomyia williamsi (Damasceno, Causey & Arouck)
Fig. 63

Flebotomus williamsi Damasceno, Causey & Arouck 1945: 1 (♂, Tucunduba, Belém, Pará, Brazil). Damasceno et al. 1949: 835.
Phlebotomus williamsi: Fairchild & Hertig 1952: 516; 1961b: 254 (cf. to *walkeri*). Sherlock 1962: 327.
Lutzomyia williamsi: Barretto 1962: 28. Theodor 1965: 182. Lewis 1967a: 134. Martins & Morales-Farias 1972: 367. Martins et al. 1978: 135. Ryan 1986:

60 (♂, ♀ figs.). Ryan et al. 1986a: 325 (♀ descript.). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela).

Distribution (Map 22). BRAZIL (Ryan 1986; ♂, ♀, Ducke Reserve, Amazonas, 1977, J. Arias; ♂, 27 km SE of Marabá, Pará, 1972, D.G. Young); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. The aedeagus of the *L. williamsi* holotype (Fig. 63H) has a pointed dorsal projection, shown arising from the paramere by Ryan (1986). We studied other males from Amazonas, Brazil (Labrea, Oct. 1972, D.G. Young), and Madre de Dios, Peru (Tambopata Reserve, Nov. 1983, T. Erwin), that differ from the holotype of *L. williamsi* in having a shorter projection of the aedeagus and an acute, not rounded, ventral projection of the paramere. We refrain from naming this form until more material, especially associated females, becomes available.

The sexes of *L. williamsi* are properly associated following Ryan (1986) and our own analysis of collections from the Ducke Reserve, Amazonas, Brazil, where males and females have been taken in the absence of closely related species in the *migonei* group.

Lutzomyia termitophila Martins, Falcão & Silva
Fig. 64

Lutzomyia termitophila Martins, Falcão & Silva 1964a: 309 (♂, Confins, Minas Gerais, Brazil); 1965: 4 (Rondônia, Brazil). Martins & Silva 1968: 4. Forattini 1973: 356 (♂ fig.). Martins et al. 1977c: 645 (♀ descript.); 1978: 168 (dist.). Mayrink et al. 1979: 131 (bacterial infection, Minas Gerais, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil).

Distribution (Map 25). BRAZIL (Martins et al. 1978; Biancardi et al. 1982; ♀♀, Três Braços, Bahia, 1985-1986, A.L. Hoch).

Lutzomyia sericea (Floch & Abonnenc)
Fig. 65

Phlebotomus sericeus Floch & Abonnenc 1944a: 6 (♂, Baduel, French Guiana); 1952: 95 (redescript.).

Flebotomus deanei Damasceno, Causey & Arouck 1945: 5 (♂, Pará, Brazil). Theodor 1965: 181 (as synonym of *sericea*).

Lutzomyia sericea: Barretto 1962: 98 (listed). Martins & Silva 1964: 129 (Acre, Brazil). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 134 (dist.). Arias & Freitas 1982: 401 (Acre, Brazil). Young & Rogers 1984: 599 (Ecuador). Ryan 1986: 58 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1986a: 325 (♂, ♀ figs.). Lebbe et al. 1987: 29 (computer aided ident.). Young & Morales

1987: 664 (♂ fig.). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Queiroz et al. 1991: 159 (coll. data, Ceará, Brazil). Alexander et al. 1992c: 124 (Ecuador).

Distribution (Map 24). FRENCH GUIANA (Legér et al. 1977; Martins et al. 1978); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986; ♂♂, ♀♀, vicinity of Manaus, Amazonas, 1977-1981, J. Arias); ECUADOR (Young & Rogers 1984); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. The female of *L. sericea*, figured by Ryan (1986), appears to be correctly associated with the male. Similar females were captured with only males of *L. sericea* near Manaus, Brazil, in horse-bait collections (J. Arias, pers. comm.).

It remains to be established whether *Lutzomyia* sp. of Baduel (Floch & Abonnenc) is conspecific with *L. sericea*.

Lutzomyia sp. of Baduel (Floch & Abonnenc)
Fig. 66

Phlebotomus sp. de Baduel of Floch & Abonnenc 1945b: 1 (♀, Baduel, French Guiana); 1952: 190 (redescript.). Forattini 1960a: 480 (Amapá, Brazil).

Lutzomyia sp. de Baduel: Theodor 1965: 196 (listed). Martins et al. 1965: 4 (Rondônia & Maranhão, Brazil). Léger et al. 1977: 222 (as ♀ of *sericea*). Martins et al. 1978: 135. Young 1979: 66 (? ♀, Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil); Ready et al. 1983a: 780 (Pará, Brazil). Ryan 1986: 58 (mention). Ryan et al. 1986a: 329 (as probable ♀ of *sericea*).

Distribution (Map 26). FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); BRAZIL (above refs.); COLOMBIA (? Osorno-Mesa et al. 1972b); SURINAME (♀♀, Patamacca Dist., at Marowyne, March 1984).

Remarks. The status of *Lutzomyia* sp. of Baduel remains uncertain and some of the literature citations given here may not represent this informally named species. A female from Vichada Department, Colombia, listed by Osorno-Mesa et al. (1972b) and illustrated by Young (1979) more closely resembles *L.* sp. of Baduel than does the female of *L. sericea*, also figured by Ryan et al. 1986a. The Colombian female may be conspecific with an unnamed male, very similar to *L. sericea*, captured near Vichada and figured by Young & Morales (1987) in the present manual.

According to F. Le Pont (pers. comm.) the *L. sericea* female (Ryan 1986b) "has never been collected in French Guiana where the male of *L. sericea* was described. . . . the spermathecae of the *L. sericea* female and *L.* sp. de Baduel are very distinct."

Lutzomyia andersoni Le Pont & Desjeux
Fig. 67

Lutzomyia andersoni Le Pont & Desjeux 1988: 421 (♂, ♀, Serrania de Marimonos, La Paz Dept., Bolivia).

Distribution (Map 23). BOLIVIA (type locality).

Remarks. This species closely resembles *L. sericea* and may be conspecific with it. There are no apparent structural differences, aside from questionable metrical values, that can be used to distinguish these species.

Lutzomyia evandroi (Costa Lima & Antunes)
Fig. 68

Phlebotomus evandroi Costa Lima & Antunes 1936: 419 (♂, ♀, Macejana, Ceará, Brazil). Lucena 1953: 92 (♂, ♀, redescript.). Deane & Deane 1957: 226. Mangabeira 1969: 21 (Ceará, Brazil, figs.).

Lutzomyia evandroi: Martins et al. 1962c: 381 (♂, redescript., figs.). Theodor 1965: 182 (fig., spermatheca). Lewis 1967a: 131. Forattini 1973: 286 (figs., tax.). Lewis 1975a: 500 (mouthpart morphol.). Martins et al. 1978: 132 (dist.). Brazil & Ryan 1984: 375 (nat. gregarine infection). Ryan 1986: 55 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Queiroz et al. 1991: 159 (coll. data, Ceará, Brazil).

Distribution (Map 21). BRAZIL (Martins et al. 1978; Brazil & Ryan 1984; Ryan 1986).

Lutzomyia firmatoi (Barretto, Martins & Pellegrino)
Fig. 69

Sergentomyia firmatoi Barretto, Martins & Pellegrino 1956: 50 (♂, Jampruca, Minas Gerais, Brazil, no figs.); 1958: 185 (duplicate descript., with figs.).

Lutzomyia firmatoi: Martins et al. 1961c: 310 (Paraná & Santa Catarina, Brazil). Theodor 1965: 182 (provisionally placed in *migonei* group). Forattini 1973: 255 (♂ fig., tax.). Martins et al. 1975b: 262 (♀ descript., dist.); 1978: 163 (refs., dist.). Mayrink et al. 1979: 131 (nat. infections, trypanosomes, gregarines, Minas Gerais, Brazil). Gomes et al. 1989a: 32 (man-biting, Brazil).

Distribution (Map 27). BRAZIL (Martins et al. 1978; ♀, Corte de Pedra, Bahia, 1986, A.L. Hoch; Gomes et al. 1989a).

Remarks. The female of *L. firmatoi* lacks a terminal knob of the spermatheca, unlike other species in this group, but resembles them in other structural

features. Diurnal biting activity of *L. firmatoi* was reported by Gomes et al. (1989a) in São Paulo State, Brazil).

Lutzomyia baculus Martins, Falcão & Silva
Fig. 70

Lutzomyia baculus Martins, Falcão & Silva 1965: 10 (♂, Guajará-Mirim, Rondônia, Brazil). Martins et al. 1978: 161 (dist.). Ryan et al. 1986a: 325 (♀ descript., Pará, Brazil).

Lutzomyia bacula: Forattini 1973: 349 (♂ fig.). Biancardi et al. 1982: 171 (Rondônia, Brazil). Ryan 1986: 53 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 20). BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986; ♂♂, ♀♀, Ducke Reserve, Amazonas, 1978, J. Arias).

Lutzomyia dubitans (Sherlock)
Fig. 71

Phlebotomus dubitans Sherlock 1962: 324 (♂, San Vicente de Chucuri, Santander, Colombia). Forattini 1973: 292 (as synonym of *walkeri*, *marajoensis*).

Phlebotomus marajoensis (not *marajoensis* Damasceno & Causey): Fairchild & Hertig 1961b: 250 (tax., ♂, ♀ figs.).

Lutzomyia marajoensis (not *marajoensis* Damasceno & Causey): Theodor 1965: 182 (listed). Martins et al. 1978: 134 (dist.). Ramirez Pérez et al. 1978: 49 (♂, ♀ figs., Aragua, Venezuela); 1981: 124 (Venezuela); 1982a: 14 (figs., Sucre, Venezuela). Young 1979: 63 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (figs., keyed). Murillo & Zeledón 1985: 68 (♂, ♀ figs., Costa Rica).

Lutzomyia dubitans: Theodor 1965: 182 (listed). Feliciangeli 1985: 307 (tax., figs., as valid species). Morales et al. 1987: 93 (Colombia record). Ryan et al. 1986a: 328 (keyed, figs.). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Carabobo, Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela).

Distribution (Map 26). COSTA RICA (Murillo & Zeledón); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales et al. 1987); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1978; 1981; 1982b); TRINIDAD (Fairchild & Hertig 1961b); BRAZIL (Feliciangeli 1985).

Remarks. Feliciangeli (1985) carefully studied *L. walkeri* and related taxa in the *migonei* group, concluding that *L. marajoensis* is a junior synonym of *L. walkeri*. Furthermore, she correctly resurrected *L. dubitans* (Sherlock), a species previously considered to be conspecific with *L. marajoensis* by most authors.

Lutzomyia walkeri (Newstead)
Fig. 72

Phlebotomus walkeri Newstead 1914: 188 (♂, ♀, Rio Abuna, Bolivia-Brazil boundary).

Phlebotomus marajoensis Damasceno & Causey 1944: 339 (♂, Ilha do Marajó, Brazil). Forattini 1973: 292 (as synonym of *walkeri*).

Lutzomyia marajoensis: Barretto 1962: 98. Martins et al. 1963: 334 (Brazil records). Feliciangeli 1985: 307 (as synonym or *walkeri*, refs., figs.). Bonfante-Garrido et al. 1991: 99 (? Venezuela).

Phlebotomus gasti Sherlock 1962: 326 (♂, San Vicente de Chucuri, Santander, Colombia).

Lutzomyia walkeri: Barretto 1962: 98 (listed). Llanos 1973: 31 (figs., Peru). Martins et al. 1978: 135 (dist.). Léger et al. 1977: 217 (? French Guiana). Young 1979: 67 (refs., figs.). Morales et al. 1981: 201 (Tolima, Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 402 (Acre, Brazil). Morales et al. 1984: 37 (lab. rearing). Young & Rogers 1984: 597 (listed, Ecuador). Feliciangeli 1985: 307 (tax., figs.). Ryan 1986: 59 (figs., Pará, Brazil). Ryan et al. 1986a: 326 (figs., keyed). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Kreutzer et al. 1988: 453 (karyotyping). Hashiguchi et al. 1992: 139 (coll. data, Paraguay). Alexander et al. 1992c: 124.

Lutzomyia gasti: Martins et al. 1978: 133 (dist.).

Distribution (Map 28). PANAMA (Christensen 1972a); COLOMBIA (Young 1979; Morales & Minter 1981? Caqueta, Colombia; Morales et al. 1981); VENEZUELA (Feliciangeli 1985; Añez et al. 1988; Feliciangeli et al. 1988a); TRINIDAD (Young 1979); FRENCH GUIANA (Léger et al. 1977); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); ECUADOR (Young 1979); PERU (Llanos 1983; Pérez et al. 1991); BOLIVIA; PARAGUAY (Martins et al. 1978; Hashiguchi et al. 1992).

Remarks. The relatively broad dorsal projection of the aedeagus of *L. walkeri* is characteristic of this species. Both sexes are often found in large numbers near chickens. Bonfante-Garrido et al. (1991) reported "*L. marajoensis*" from Lara State, Venezuela (17 ♀♀); these were dissected and examined for flagellates, with negative results, but it is not clear whether the sand flies represented *L. walkeri* or *L. dubitans*.

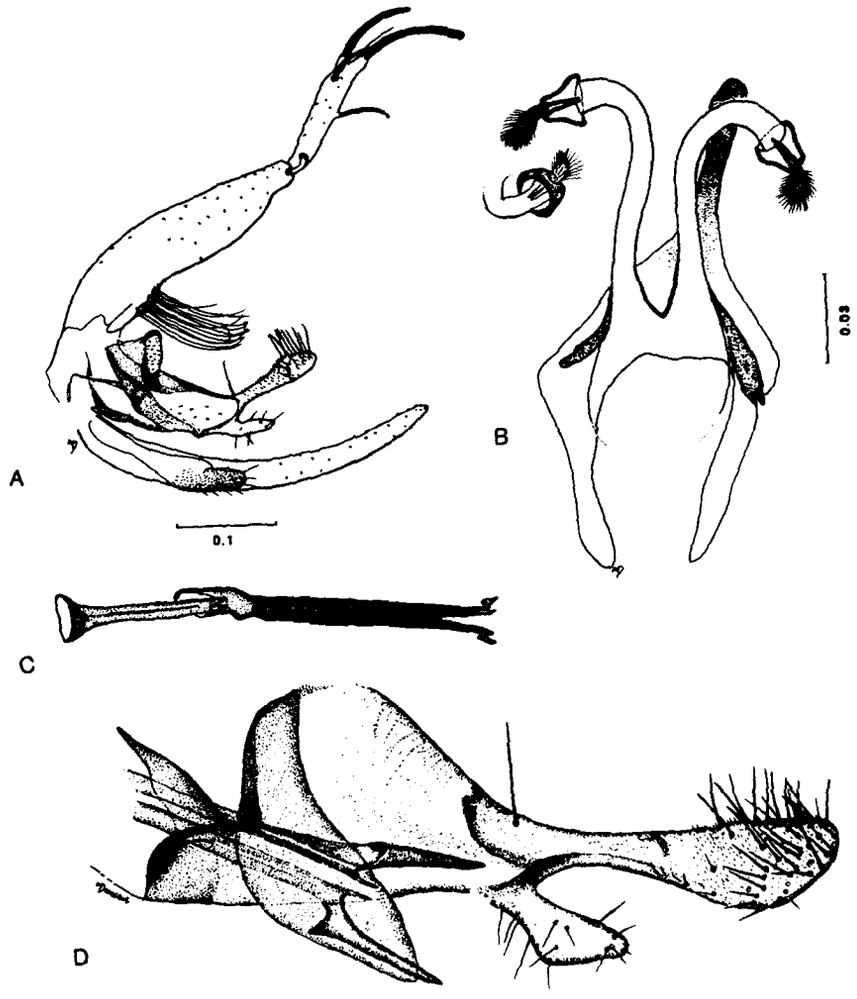


FIG. 53. ***Lutzomyia carmelinoi***. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments.
Lutzomyia lenti. D. Paramere & tips of genital filaments.

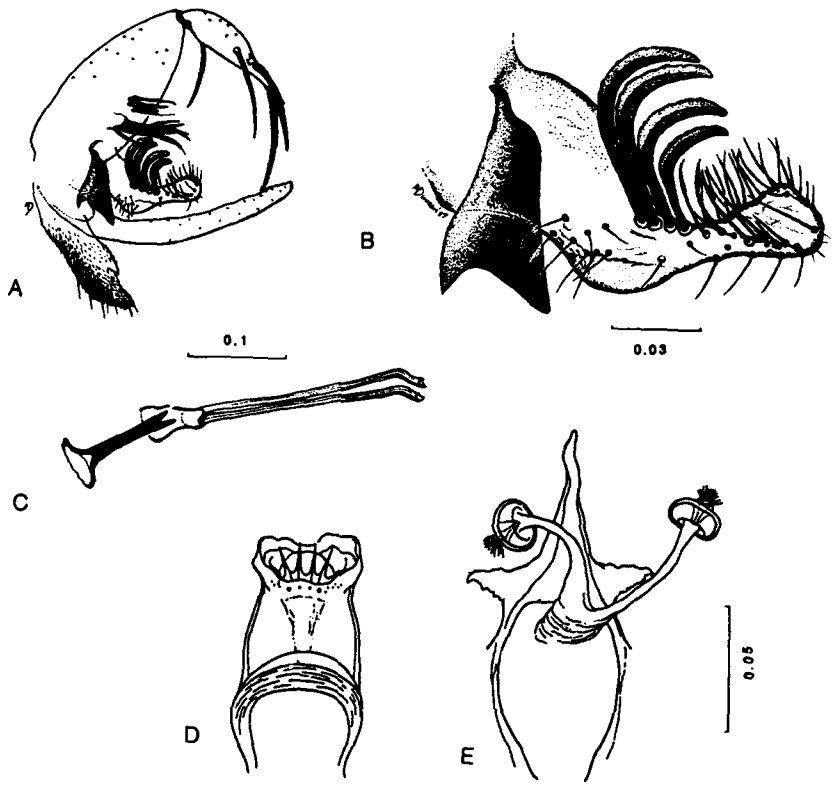


FIG. 54. ***Lutzomyia edwardsi***. A. Male terminalia. B. Paramere; C. Genital pump & filaments; D. Female cibarium; E. Spermathecae (figs. D & E from Mangabeira 1941a).

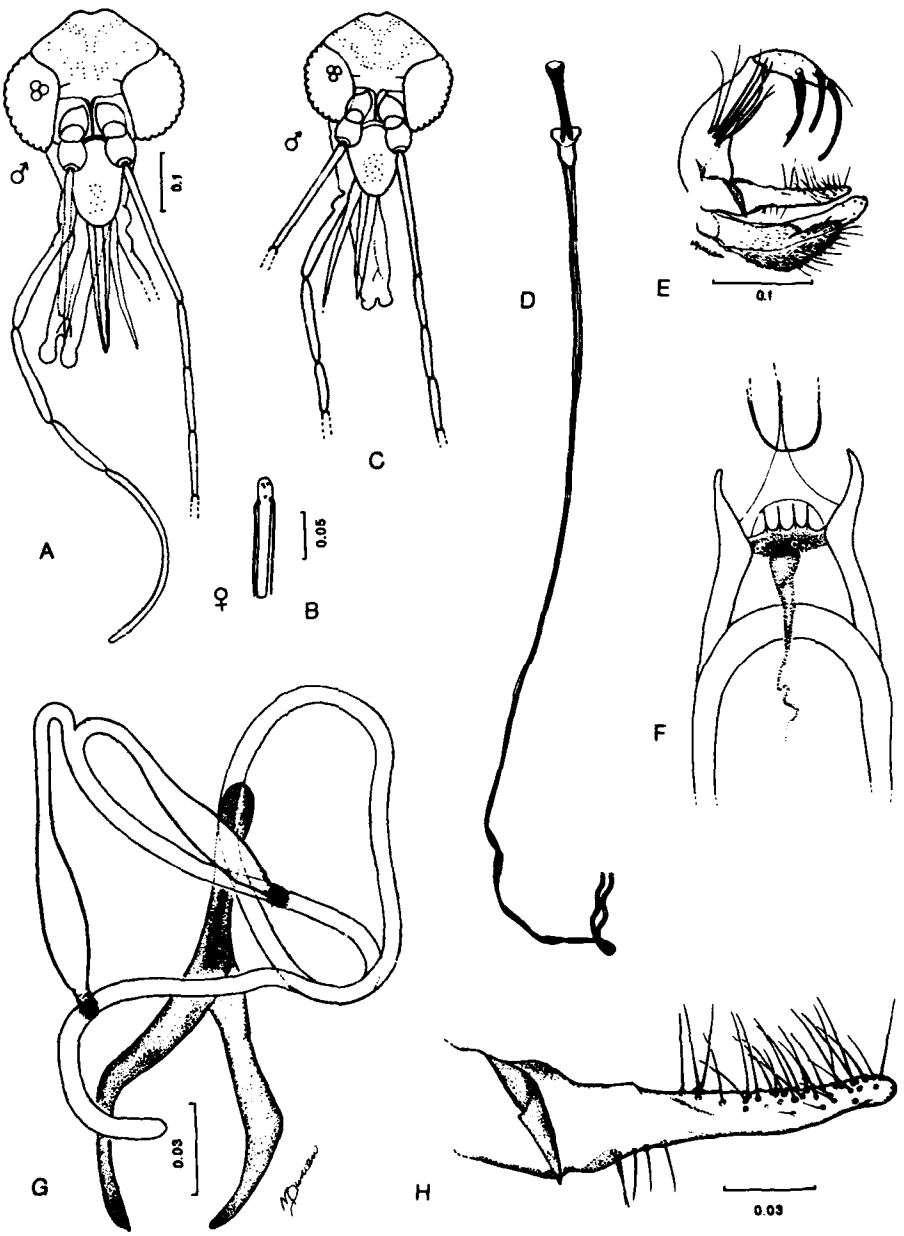


FIG. 55. ***Lutzomyia pacae.*** A. Female head; B. Female flagellomere II; C. Male head; D. Genital pump & filaments; E. Male terminalia; F. Female cibarium; G. Spermathecae; H. Paramere.

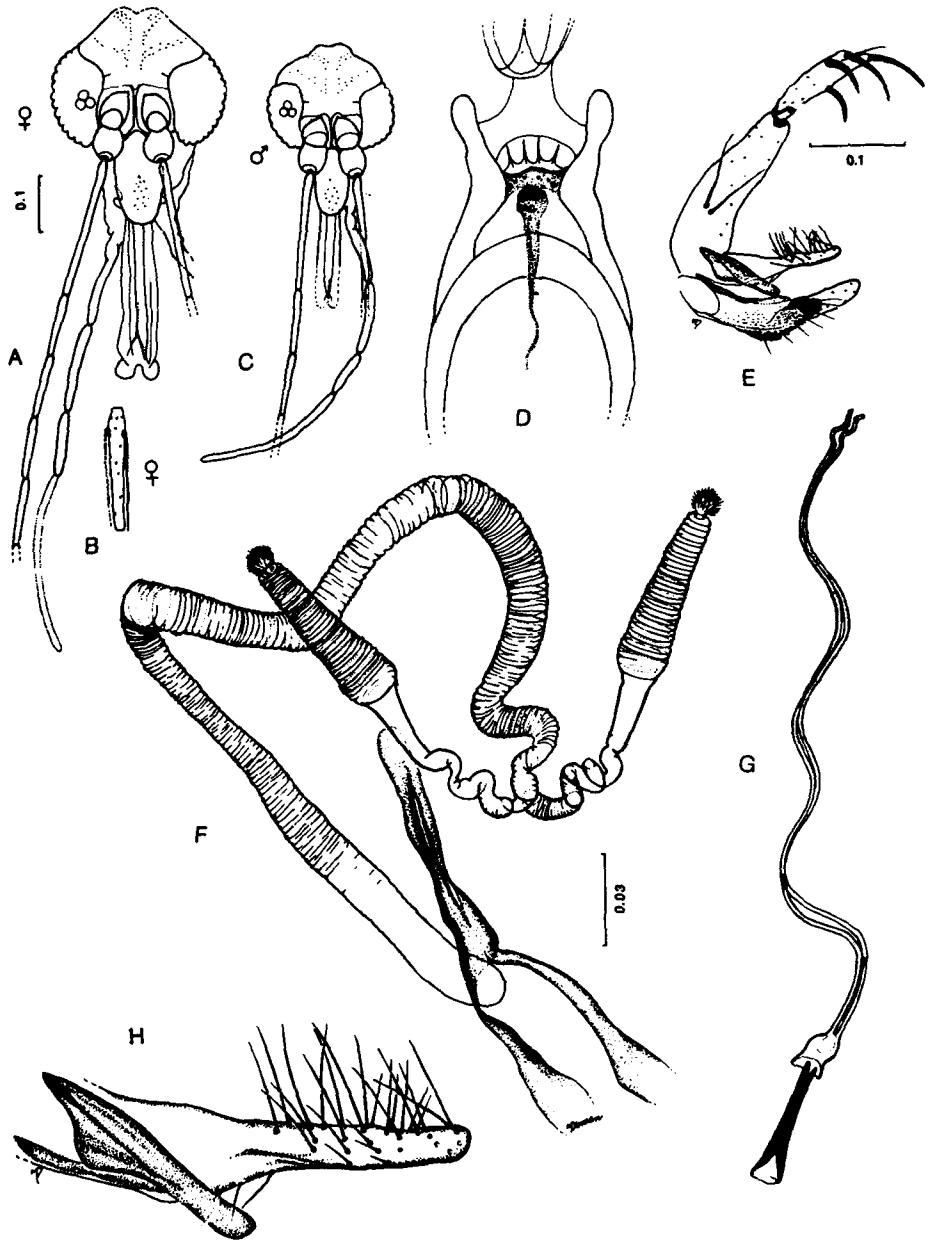


FIG. 56. ***Lutzomyia gruta.*** A. Female head; B. Female flagellomere II; C. Male head; D. Female cibarium; E. Male terminalia; F. Spermathecae; G. Genital pump & filaments; H. Paramere.

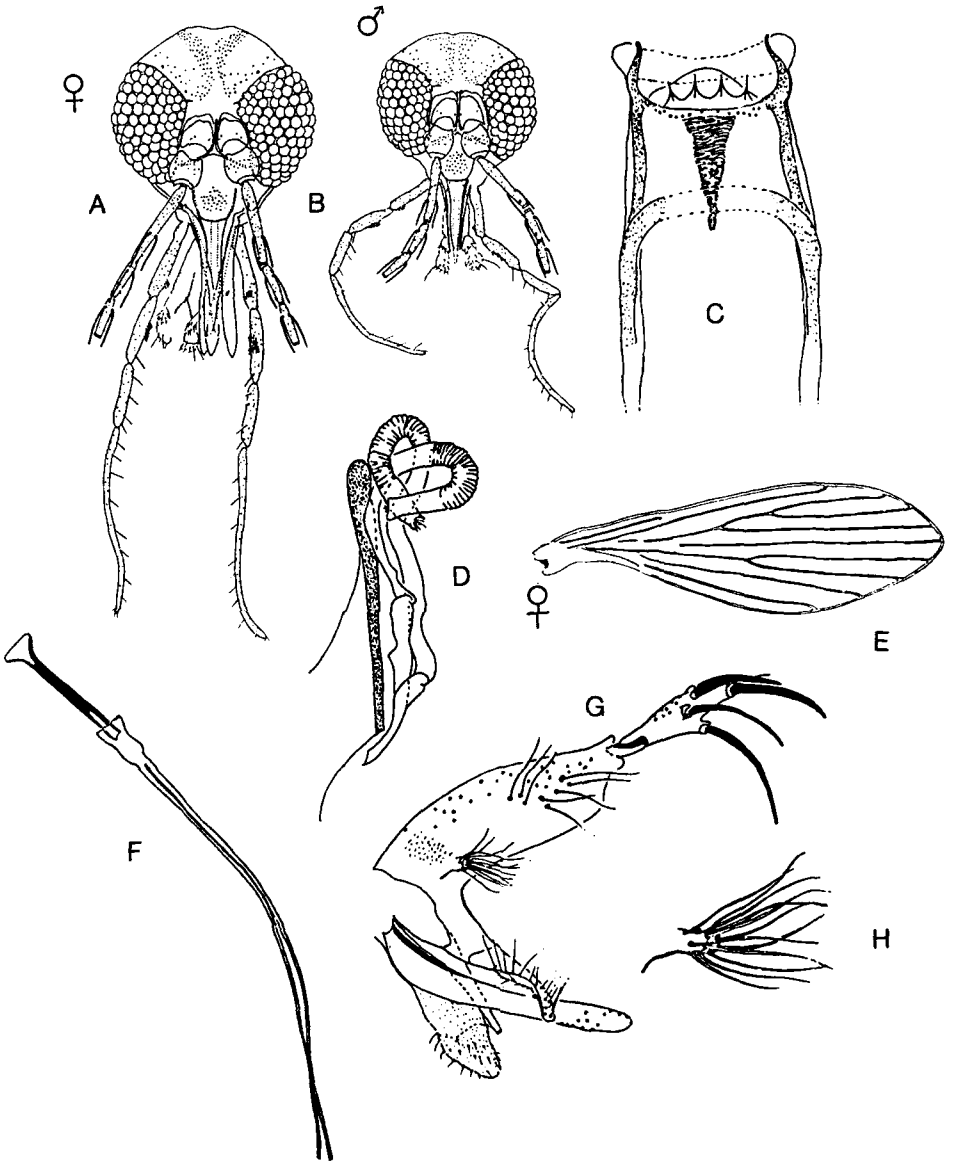


FIG. 57. ***Lutzomyia rabelloi.*** A. Female head; B. Male head; C. Female cibarium; D. Spermathecae; E. Female wing; F. Genital pump & filaments; G. Male terminalia; H. Coxite tuft.

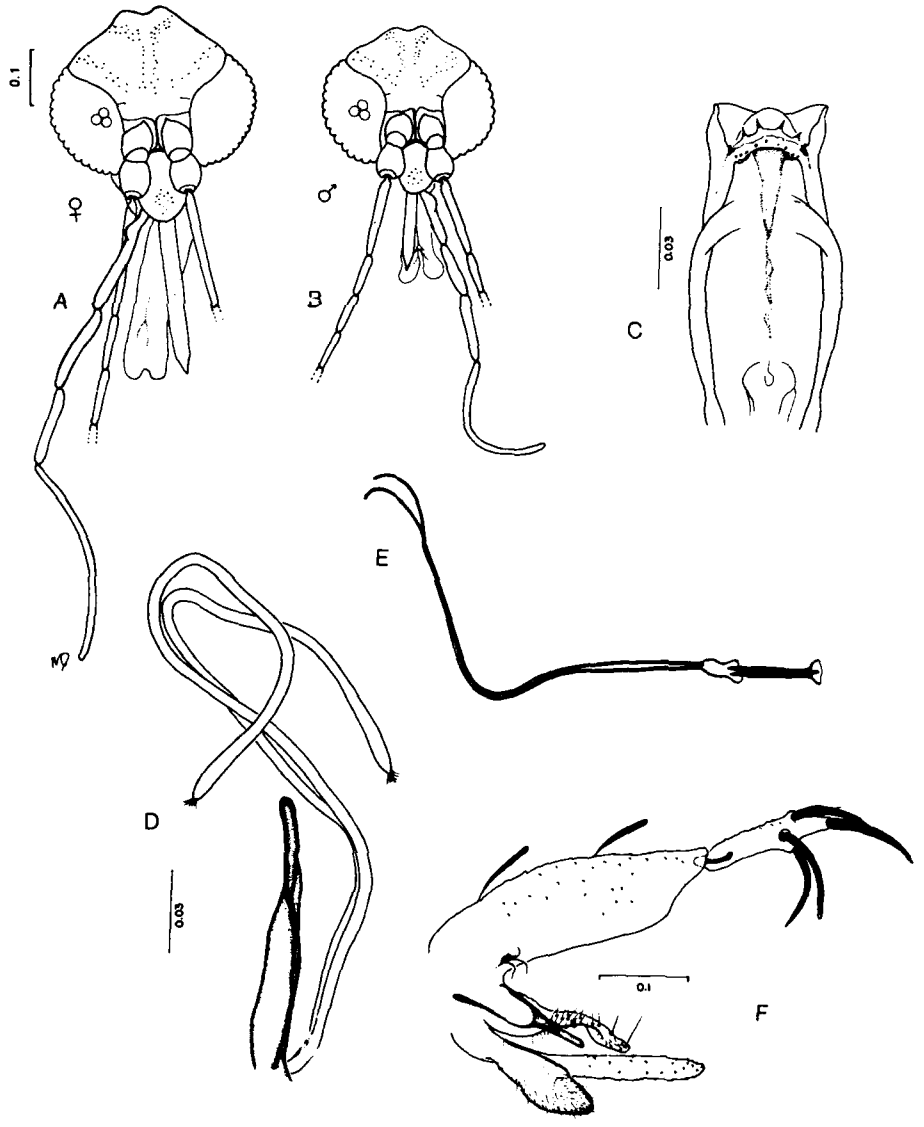


FIG. 58. ***Lutzomyia migonei***. A. Female head; B. Male head; C. Female cibarium; D. Spermathecae; E. Genital pump & filaments; F. Male terminalia (figs. C, D, & F after Young 1979).

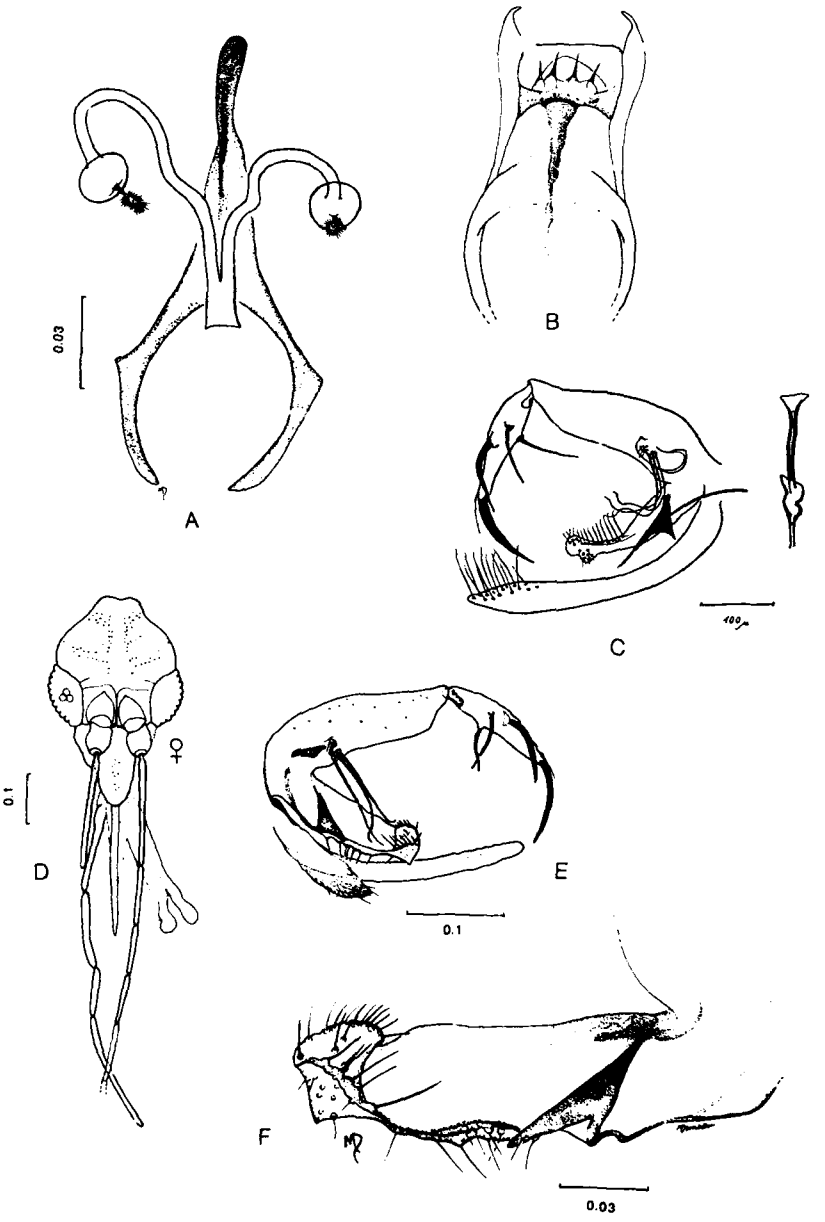


FIG. 59. ***Lutzomyia sallesi***. A. Spermathecae; B. Female cibarium; D. Female head; E. Male terminalia; F. Paramere.
Lutzomyia cortelezzii. C. Male terminalia & genital pump (after Theodor 1932).

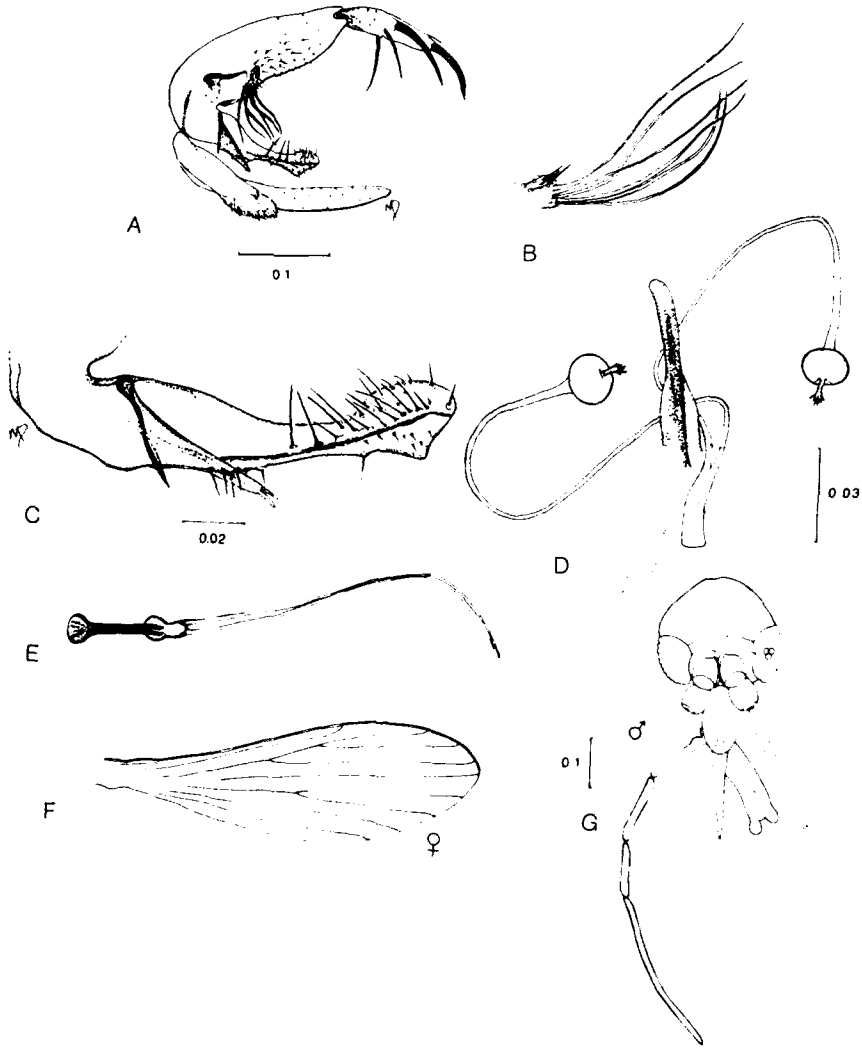


Fig. 60. ***Lutzomyia corumbaensis.*** A. Male terminalia; B. Setal tuft from coxite, enlarged; C. Paramere; D. Spermathecae; E. Genital pump & filaments; F. Female wing; G. Male head.

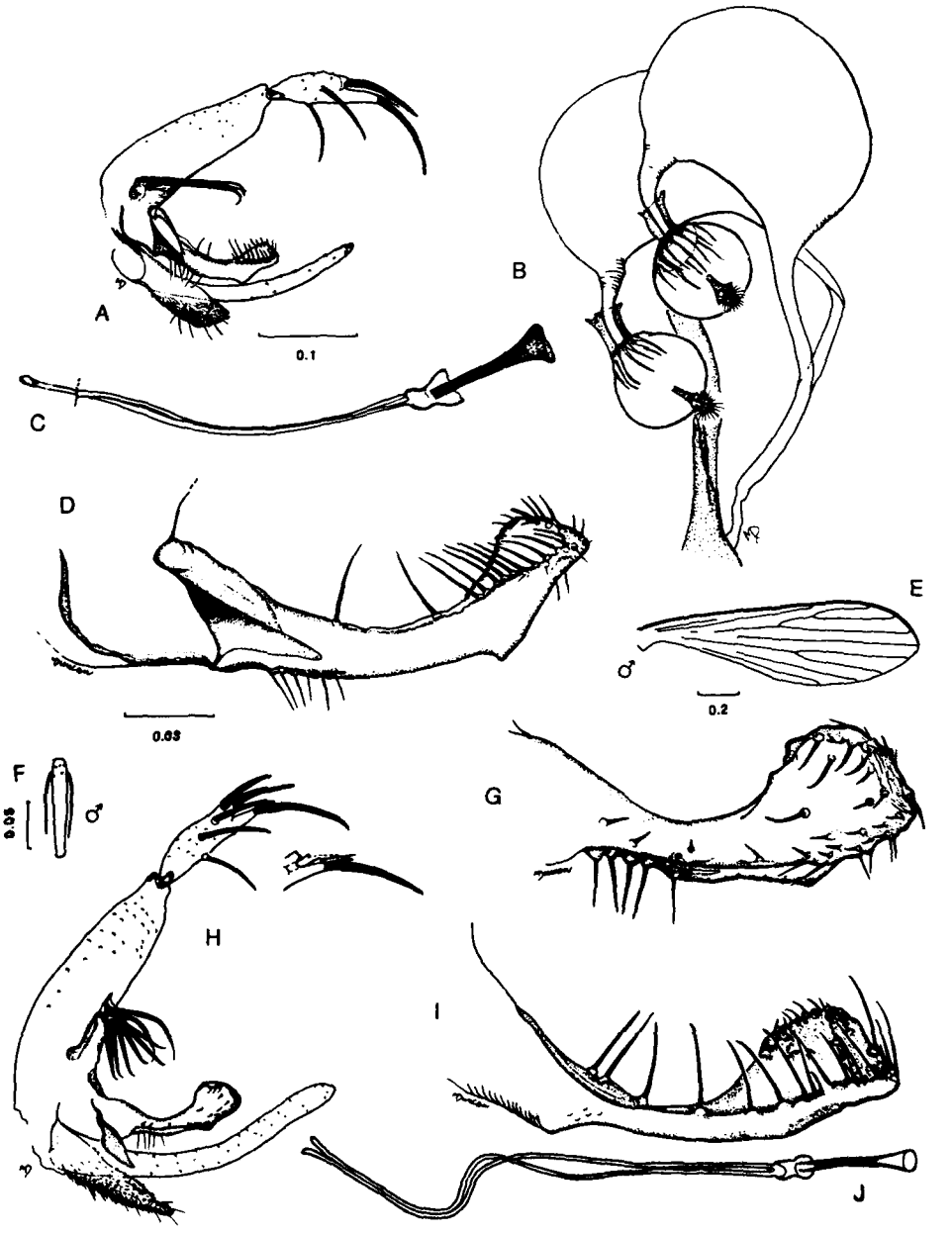


FIG. 61. ***Lutzomyia tupynambai.*** A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Paramere. ***Lutzomyia bahiensis.*** E. Male wing; F. Male flagellomere II; G. Paramere; H. Male terminalia; I. Paramere; J. Genital pump & filaments.

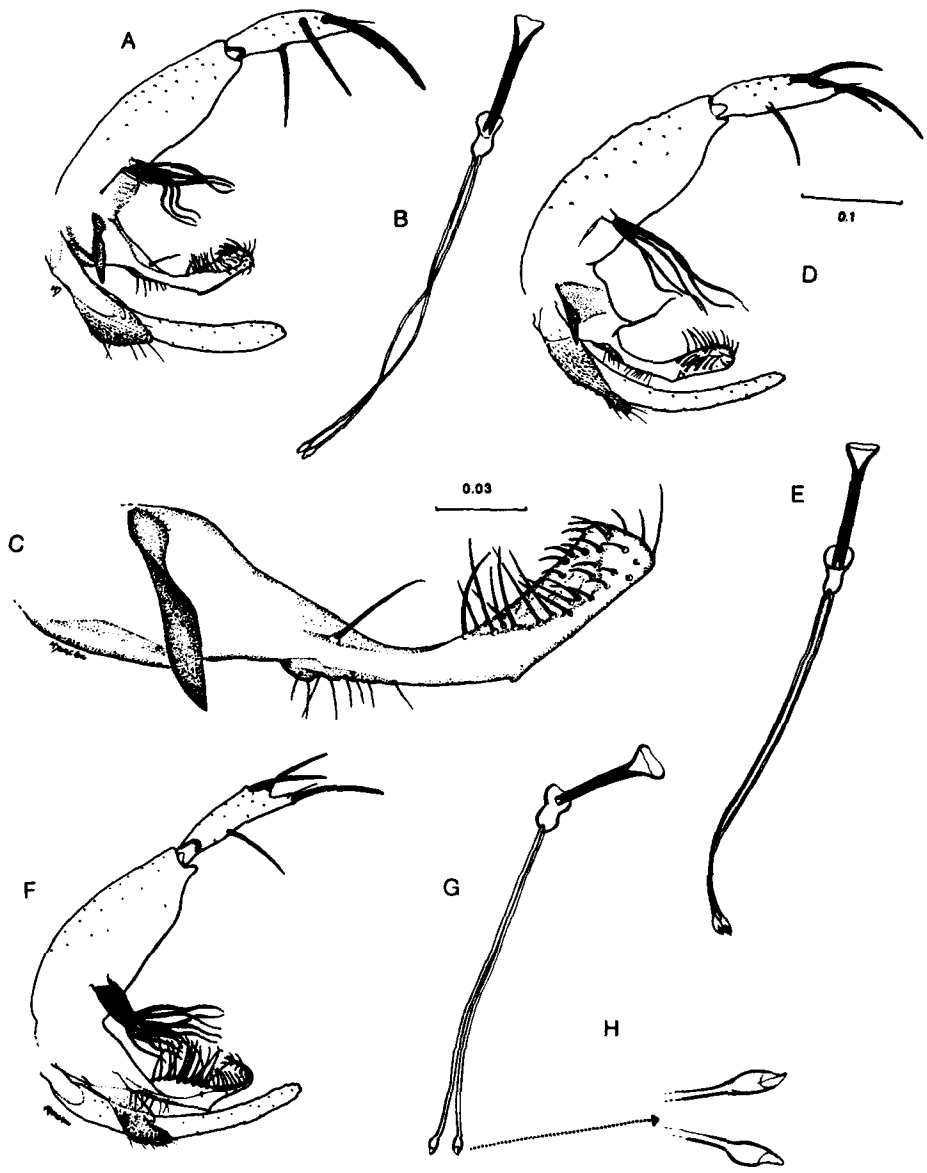


FIG. 62. ***Lutzomyia petropolitana***. A. Male terminalia; B. Genital pump & filaments; C. Paramere.
Lutzomyia costalimai. D. Male terminalia; E. Genital pump & filaments.
Lutzomyia callipyga. F. Male terminalia; G. Genital pump & filaments; H. Tips of genital filaments.

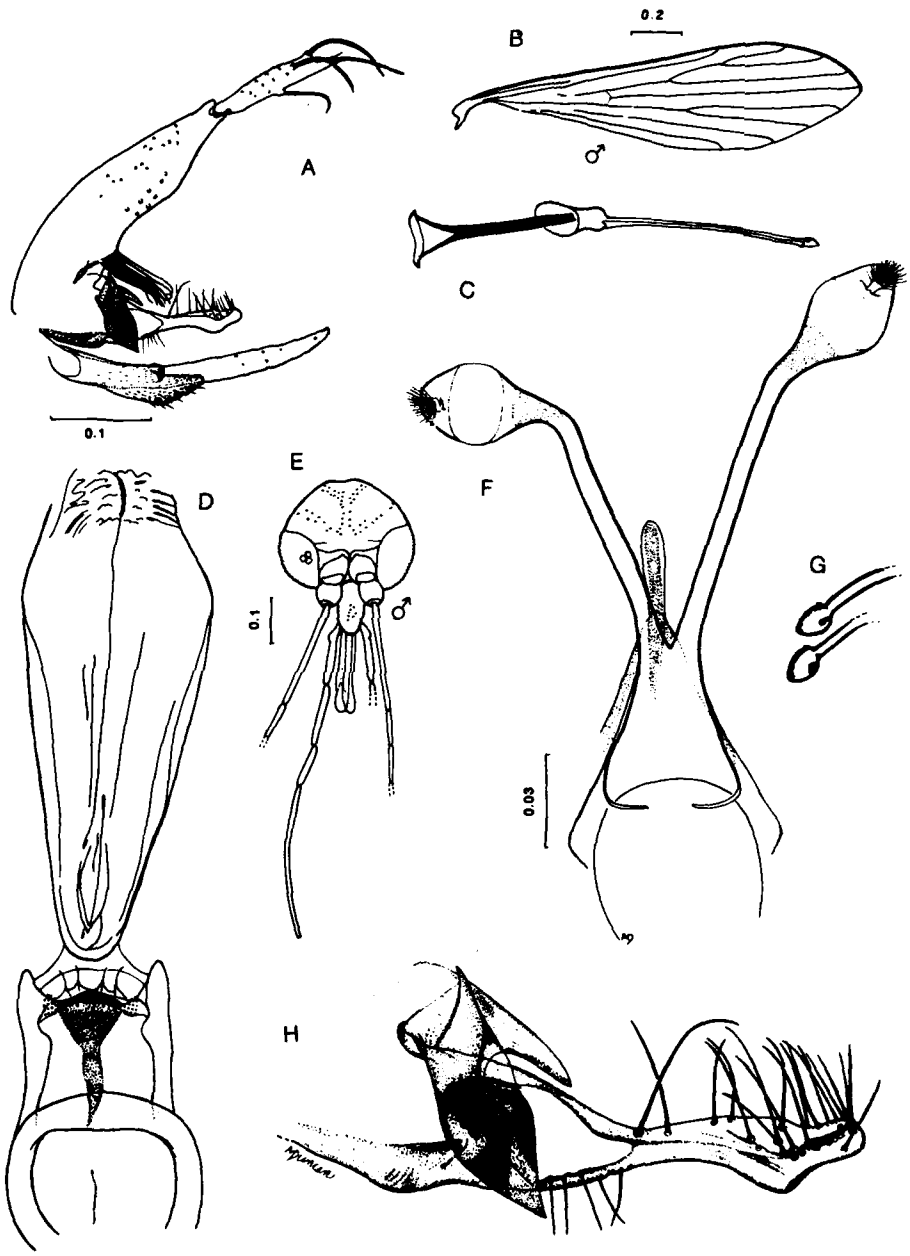


FIG. 63. ***Lutzomyia williamsi***. A. Male terminalia; B. Male wing; C. Genital pump & filaments; D. Female cibarium & pharynx; E. Male head; F. Spermathecae; G. Tips of genital filaments; H. Paramere.

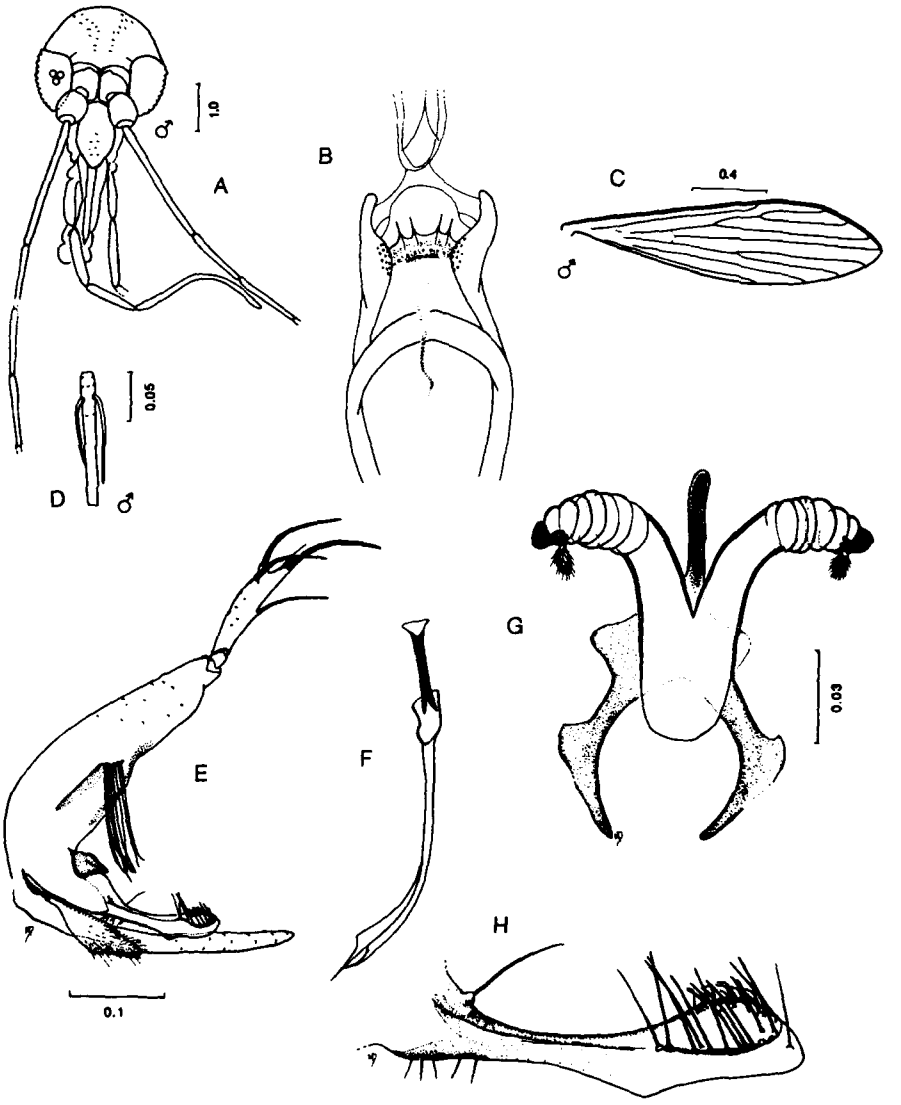


FIG. 64. ***Lutzomyia termitophila.*** A. Male head; B. Female cibarium; C. Male wing; D. Male flagellomere II; E. Male terminalia; F. Genital pump & filaments; G. Spermathecae; H. Paramere.

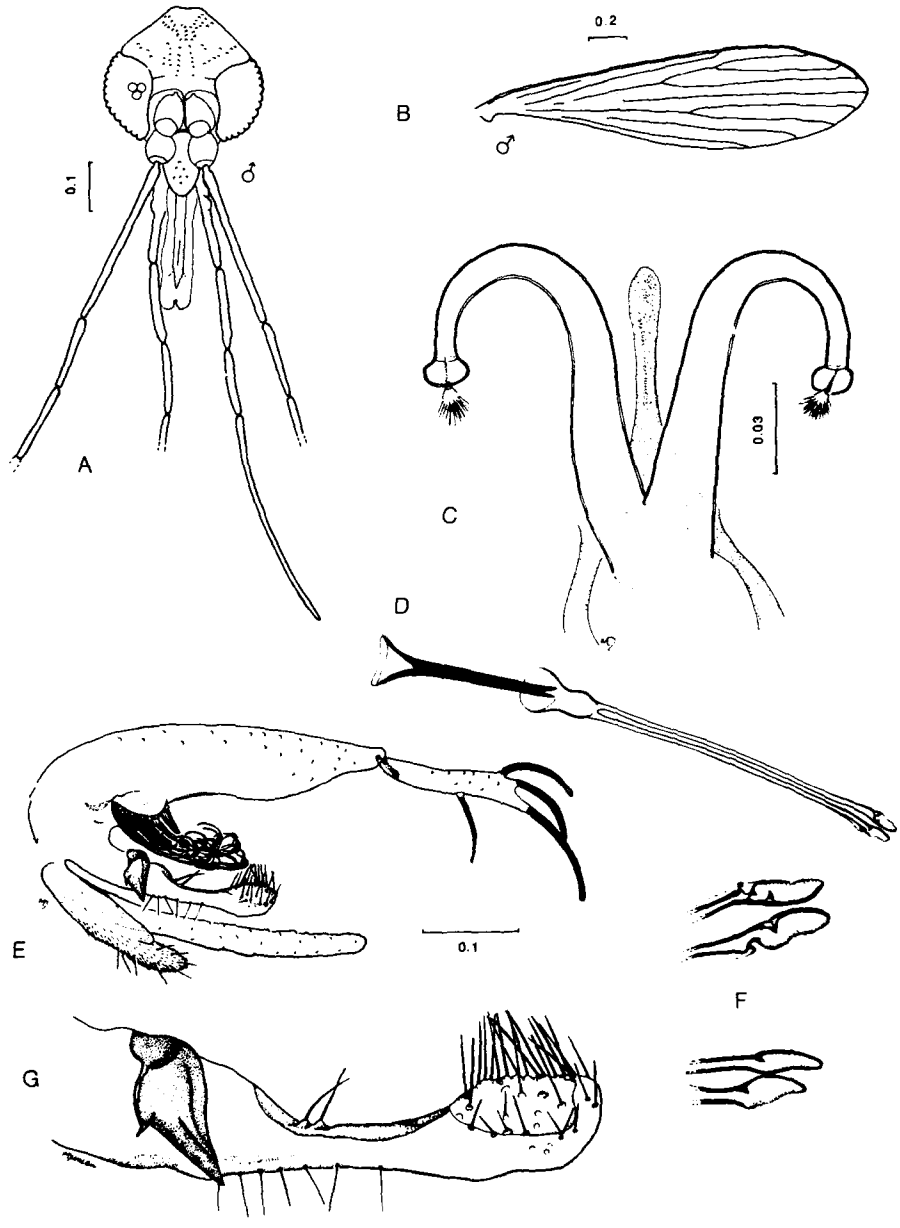


FIG. 65. ***Lutzomyia sericea.*** A. Male head; B. Male wing; C. Spermathecae; D. Genital pump & filaments; E. Male terminalia; F. Tips of genital filaments; G. Paramere.

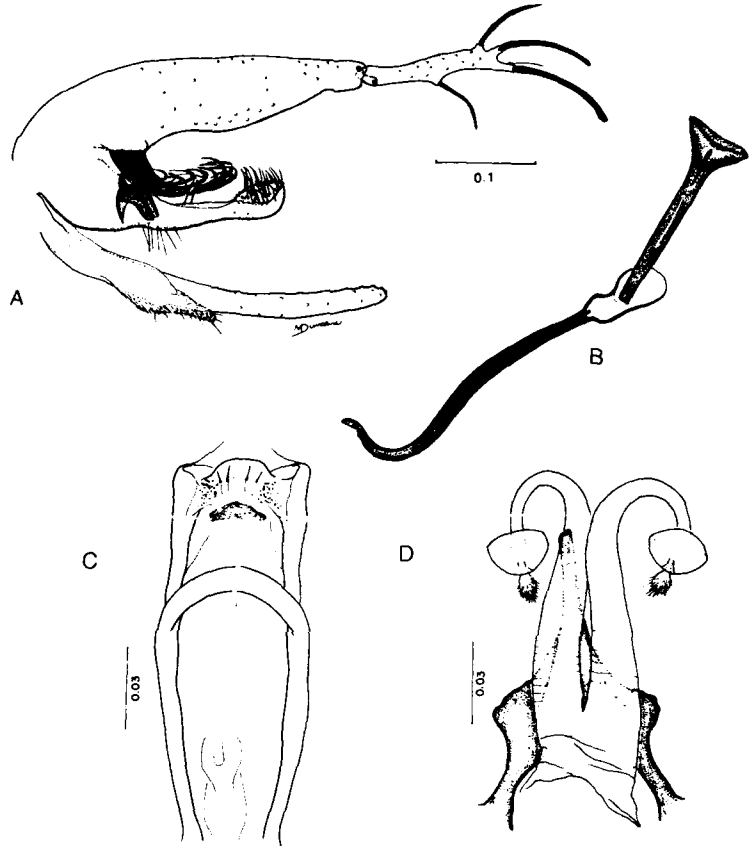


FIG. 66. ***Lutzomyia*** **sp. of Baduel.** A. Male terminalia; B. Genital pump & filaments; C. Female cibarium; D. Spermathecae (male figs. from Young & Morales 1987; female figs. from Young 1979).

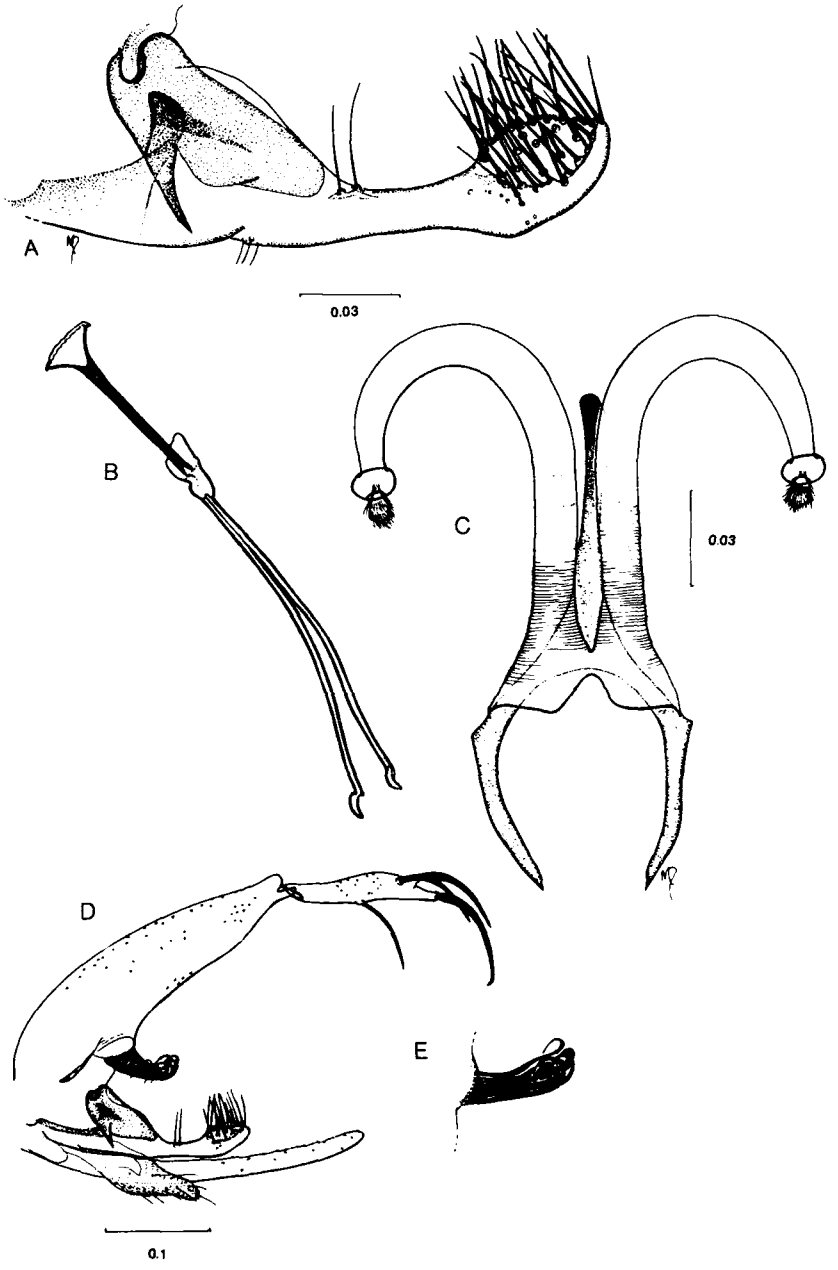


FIG. 67. ***Lutzomyia andersoni.*** A. Paramere & aedeagus; B. Genital pump & filaments; C. Spermathecae; D. Male terminalia; E. Setal tuft on coxite.

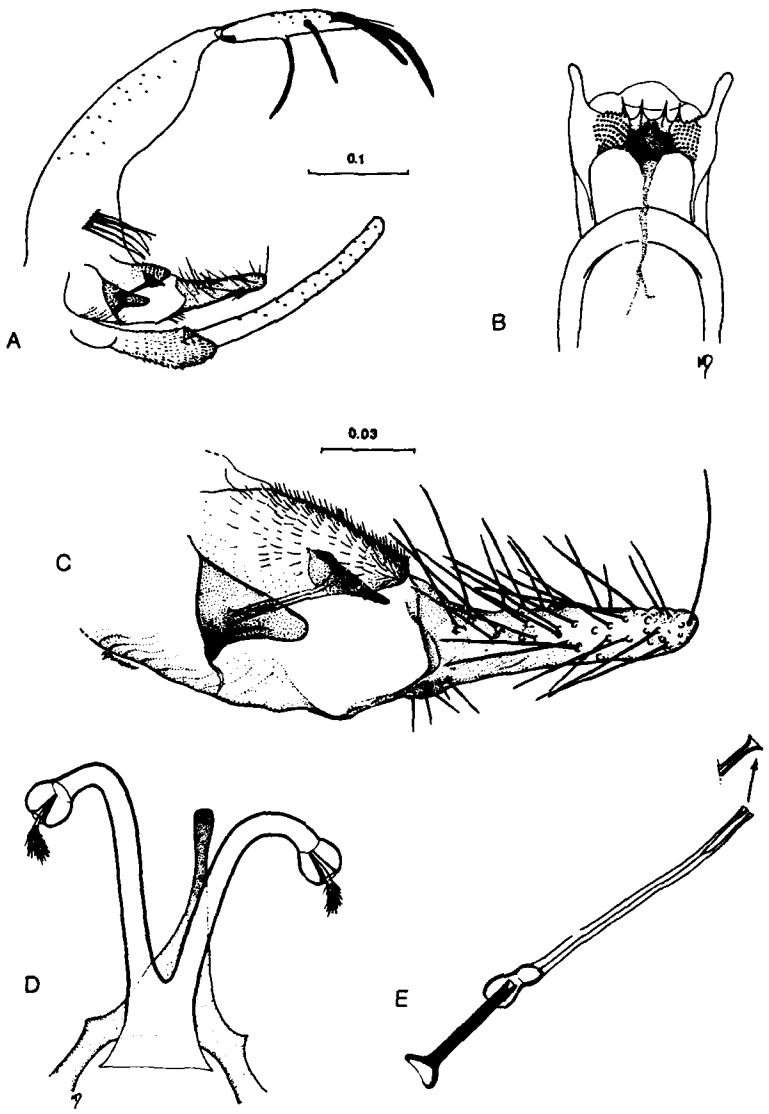


FIG. 68. ***Lutzomyia evandroi.*** A. Male terminalia; B. Female cibarium; C. Paramere; D. Spermathecae; E. Genital pump & filaments.

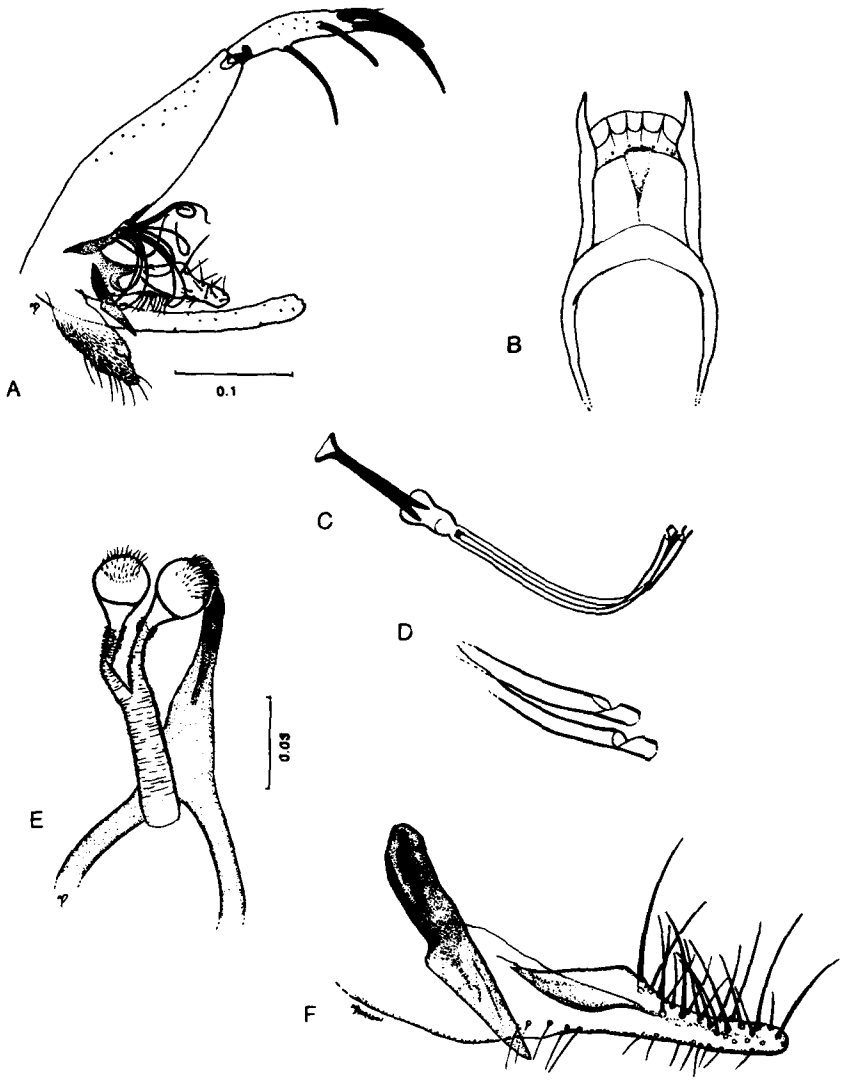


FIG. 69. ***Lutzomyia firmatoi.*** A. Male terminalia; B. Female cibarium; C. Genital pump & filaments; D. Tips of genital filaments; E. Spermathecae; F. Paramere & aedeagus.

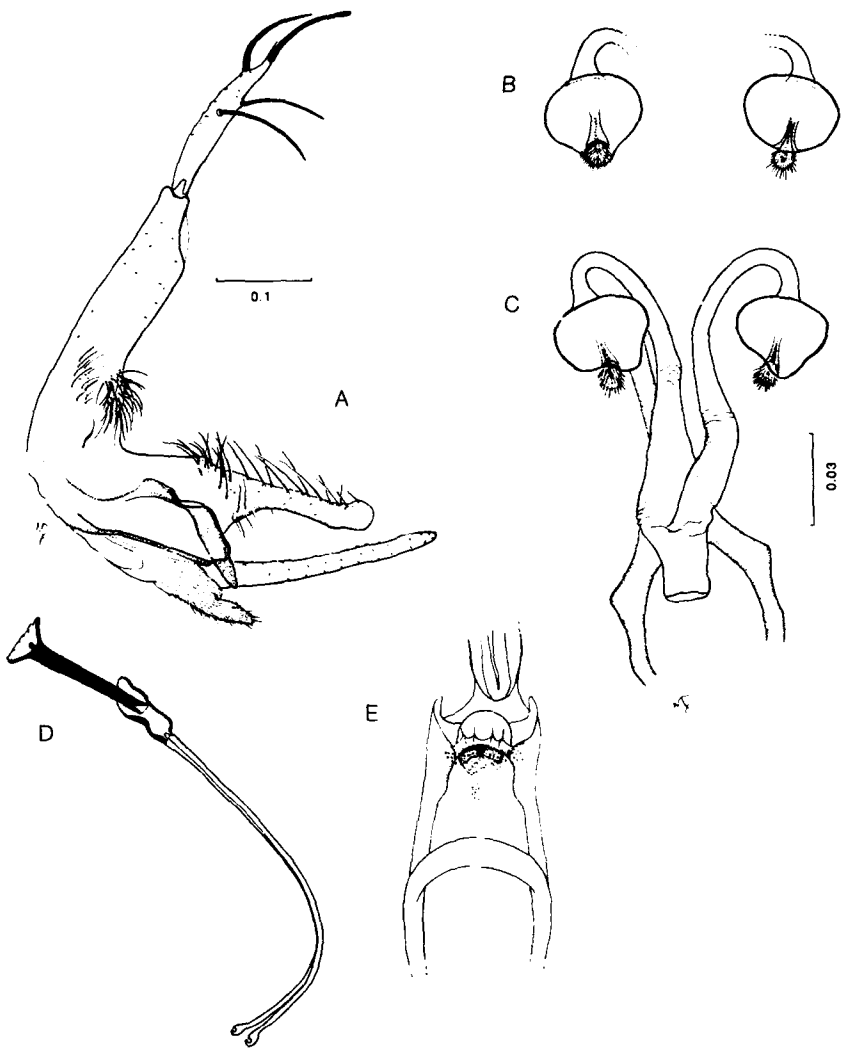


FIG. 70. ***Lutzomyia baculus***. A. Male terminalia; B. Spermathecae; C. Spermathecae; D. Genital pump & filaments; E. Female cibarium.

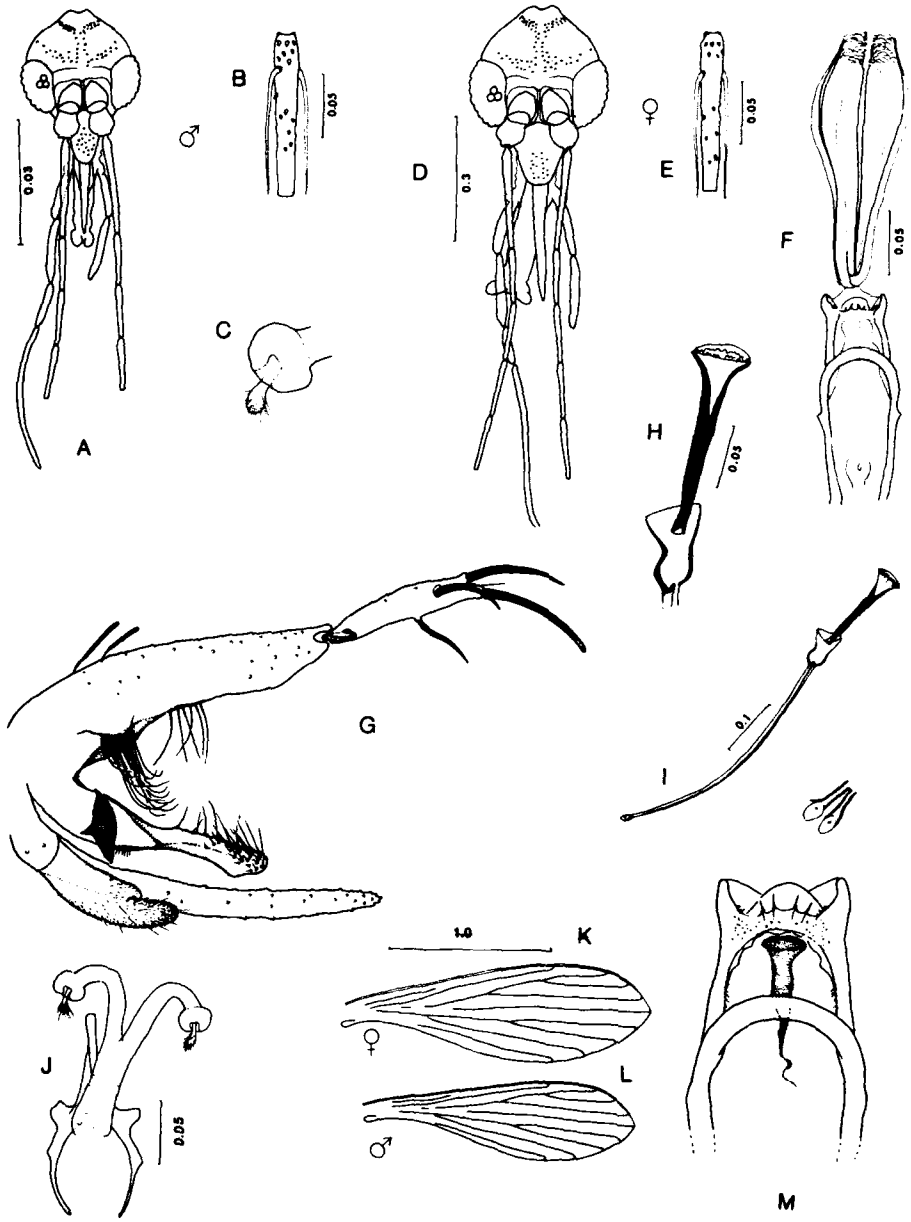


FIG. 71. ***Lutzomyia dubitans.*** A. Male head; B. Male flagellomere II; C. Spermatheca; D. Female head; E. Female flagellomere II; F. Female cibarium & pharynx; G. Male terminalia; H. Genital pump; I. Genital pump & filaments; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium (from Young 1979).

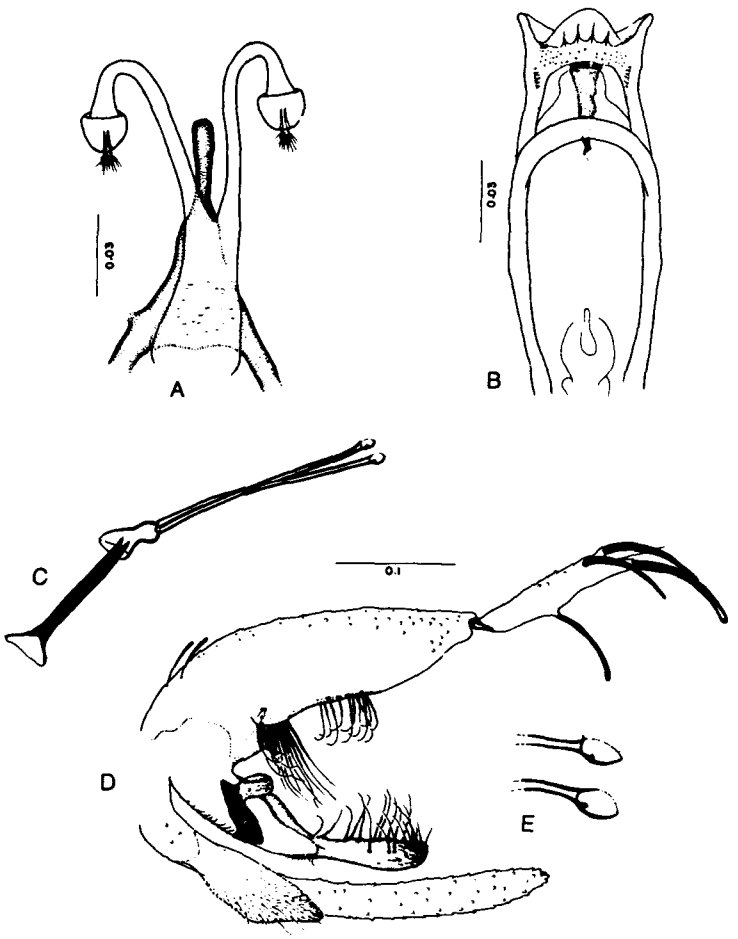
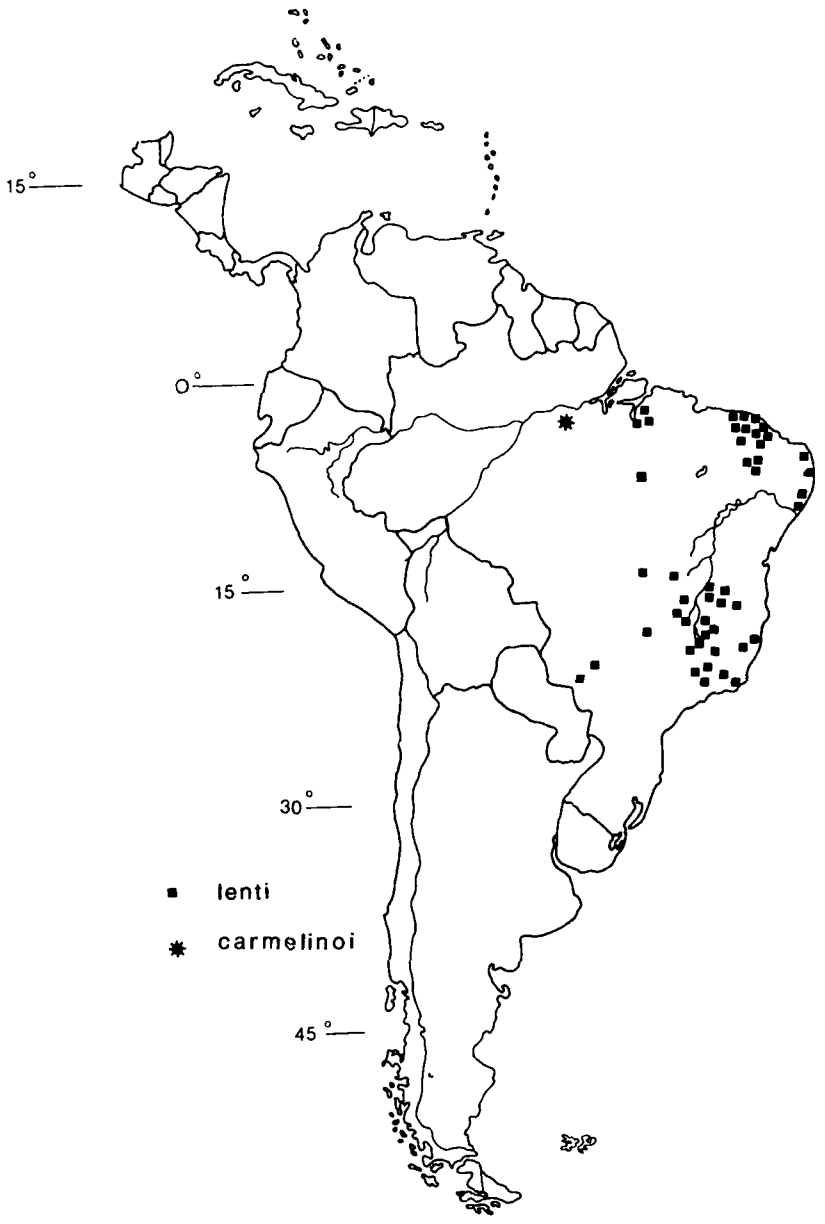
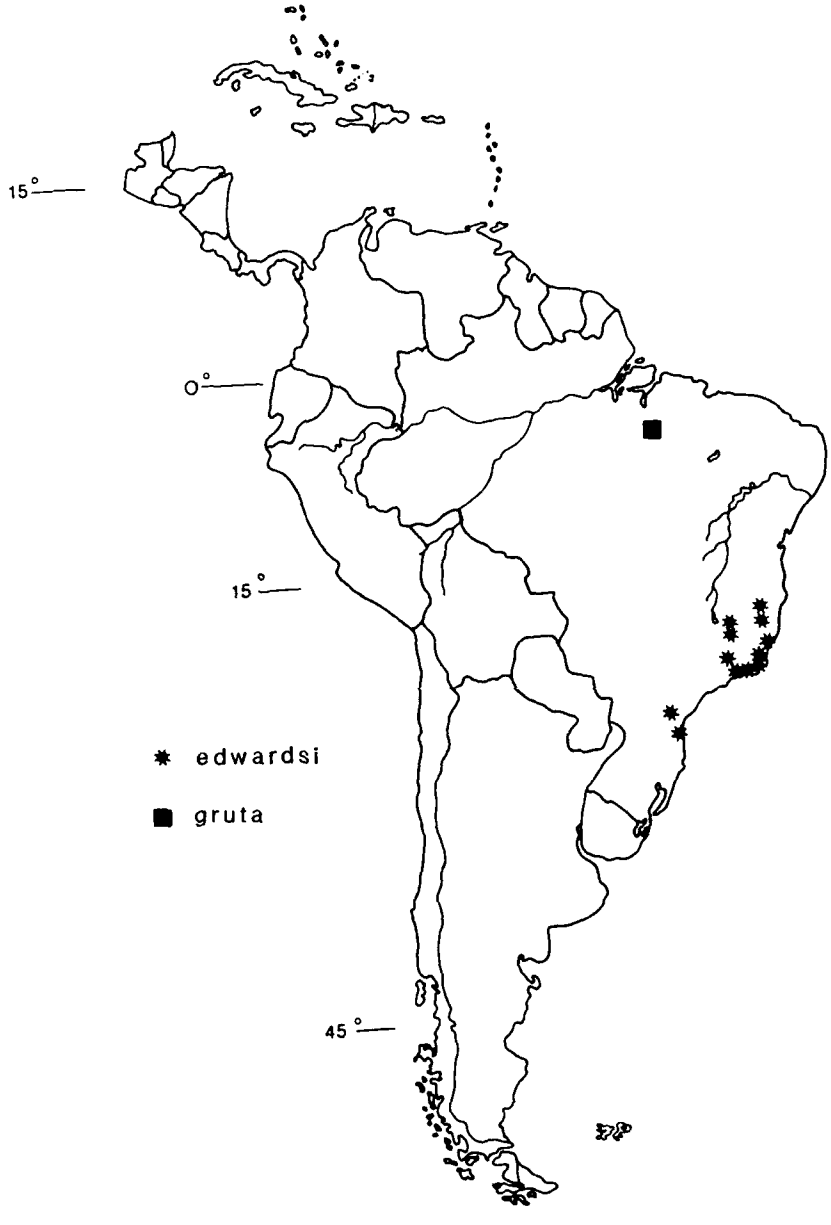


FIG. 72. ***Lutzomyia walkeri.*** A. Spermathecae; B. Female cibarium; C. Genital pump & filaments; D. Male terminalia; E. Tip of genital filament (Figs. A, B & C from Young 1979).

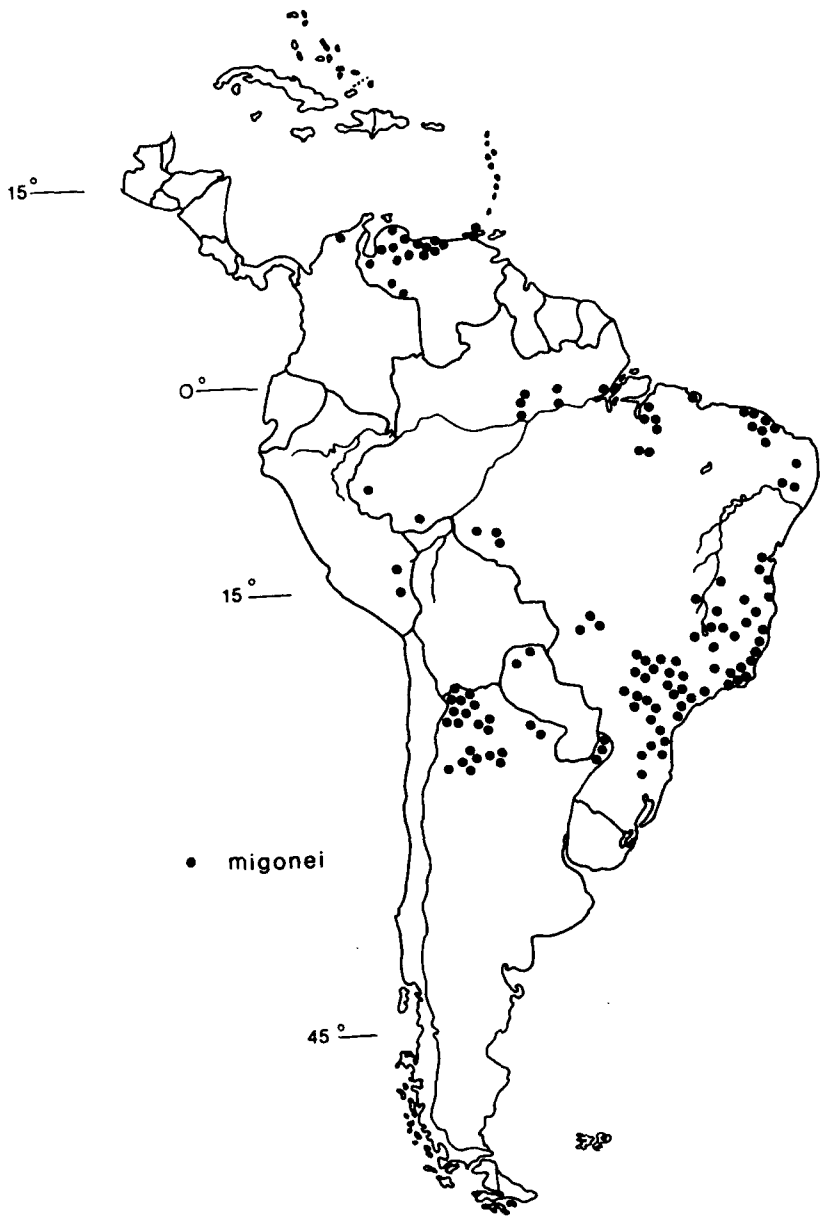


Map 16

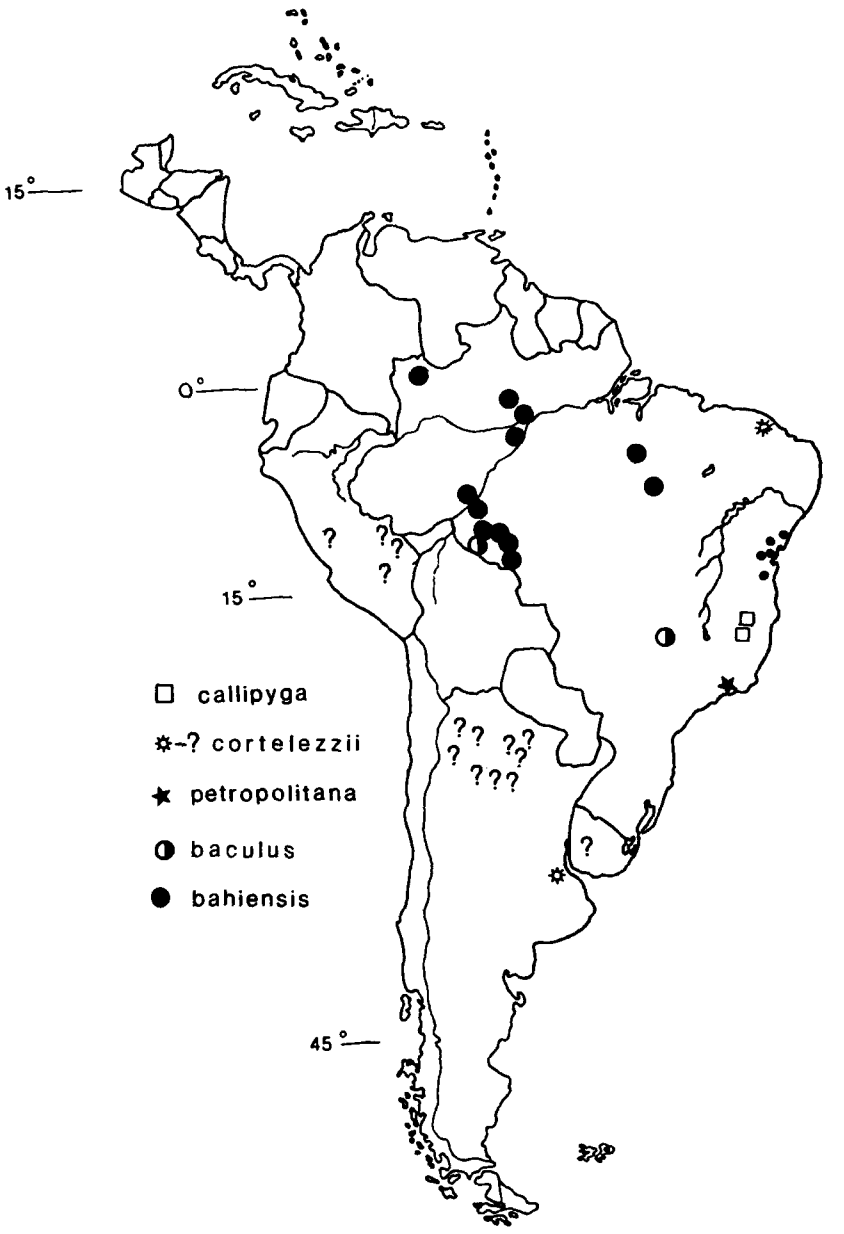


Map 17

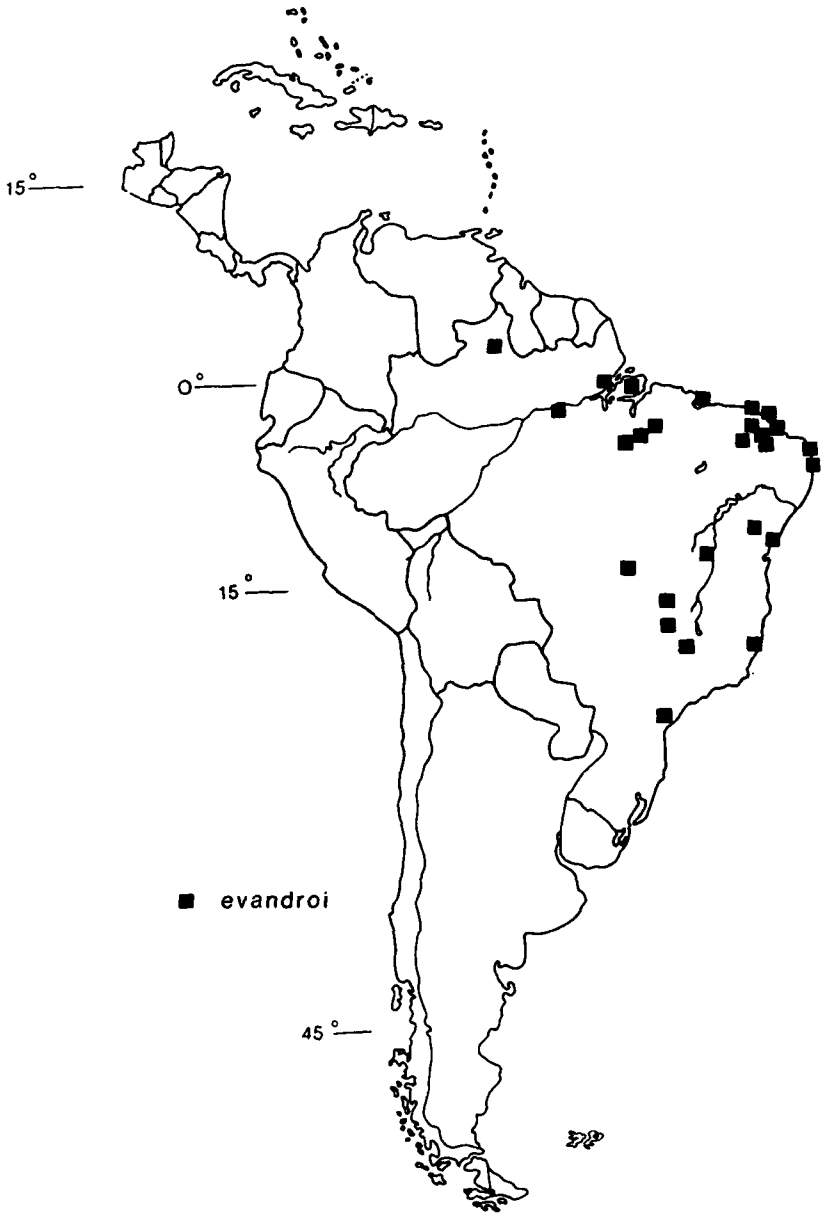
Map 18



Map 19


15°
0°
15°
45°
callipyga
?- cortelezzii
petropolitana
baculus
bahiensis

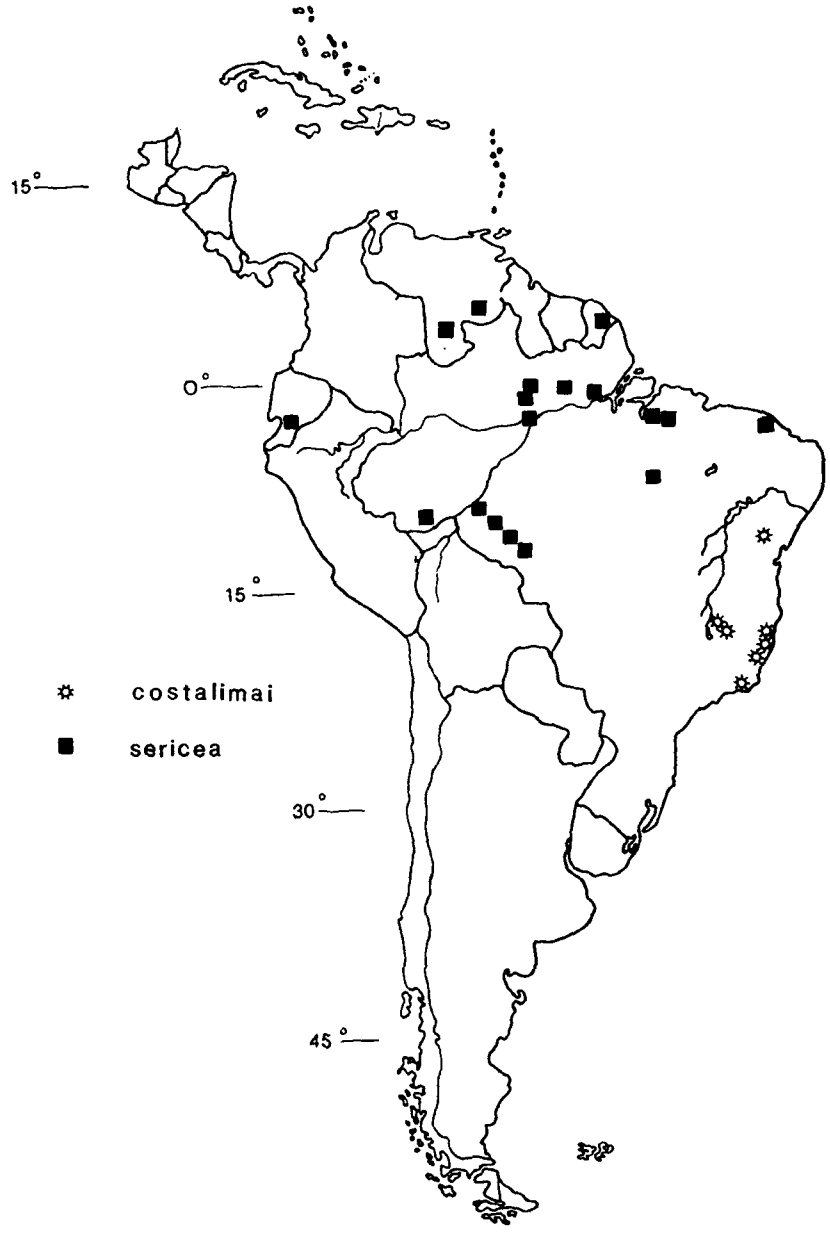
Map 20



Map 21

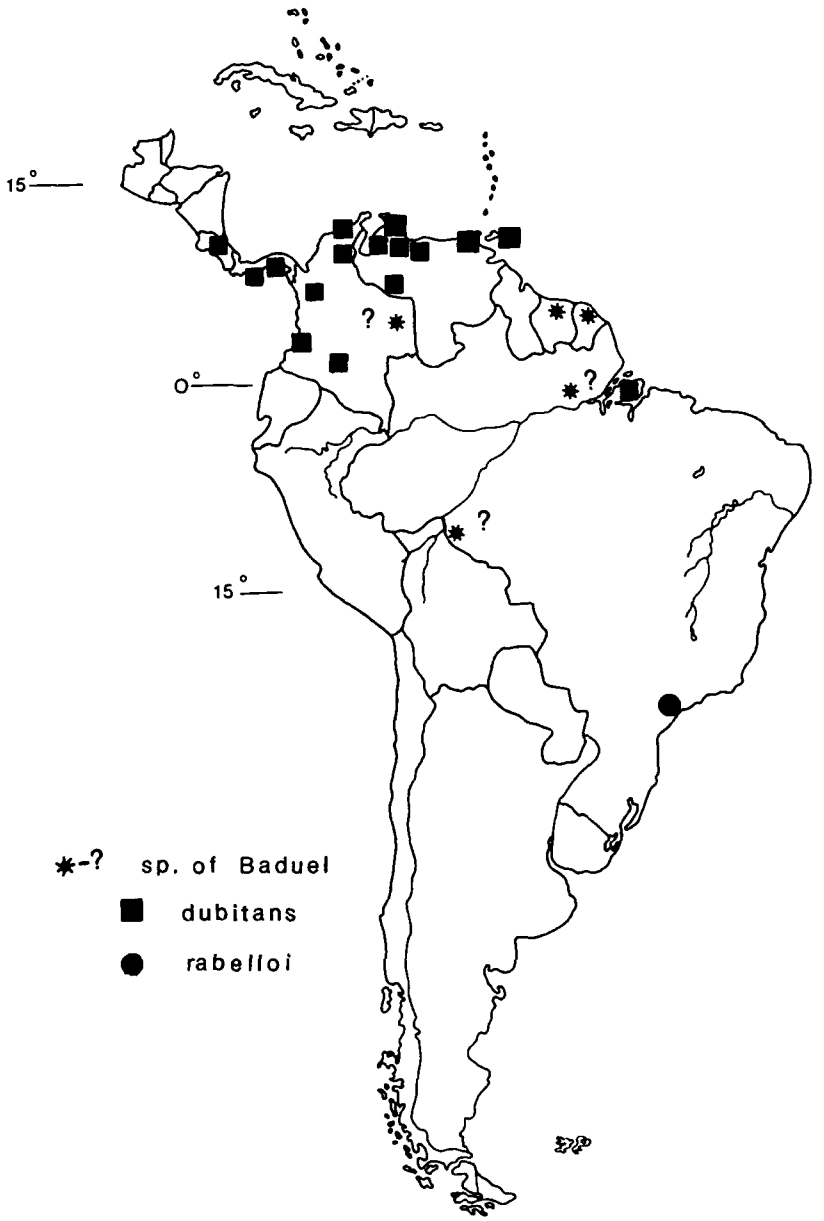
Map 22

Map 23



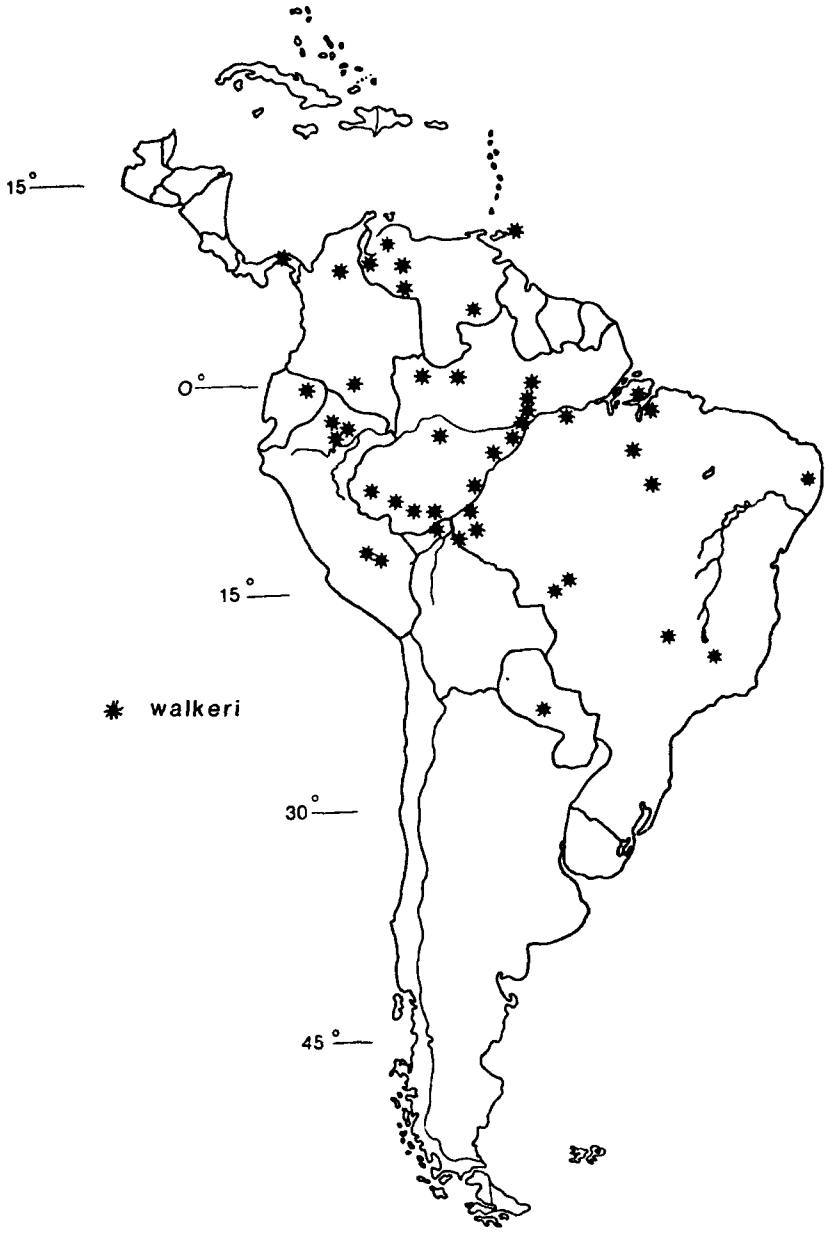
Map 24

Map 25



Map 26

Map 27



Map 28

SPECIES GROUP *VERRUCARUM*

Lutzomyia, subgenus *Coromyia* Barretto 1962: 97. Martins et al. 1978: 88 (in part). Artemiev 1991: 74 (in part).

Phlebotomus, subgenus *Pifanomyia* Ortiz & Scorza 1963: 344 (type species: *Phlebotomus serranus* Damasceno & Causey by orig. designation).

Lutzomyia species group *verrucarum* Theodor 1965: 183 (defined). Lewis et al. 1977: 325. Martins et al. 1978: 124 (in part, defined). Feliciangeli et al. 1992: 729.

Lutzomyia, subgenus *Lutzomyia*: Forattini 1973: 212.

Identification. Coloration pale to dark. Antennal ascoids simple. Palpomere 5 longer than palp. 3. ♀ cibarium with 4 horizontal teeth & 1-2 transverse rows of vertical teeth; arch nearly complete or complete; pigment patch conspicuous. Pharynx unarmed. Spermathecae variable, usually sac-like with incomplete or complete annulations or striations. ♂ *genitalia*. Coxite with or without persistent setae (only *L. nevesi*). Style with 3 or 4 large spines; subterminal seta present or absent. Paramere simple, without arms or extensions.

We divide this species group into 3 series - *serrana* and *verrucarum*, as defined by Theodor (1965) and the series *townsendi* as discussed by Garcia (1988, as the *townsendi* complex), Kreutzer et al. (1990) and Feliciangeli et al. (1992). These series are based on male characters, as indicated in the identification key. Many of the species in this group occur in mountainous areas and have successfully adapted to living in coffee growing areas.

Medical Importance. Considerable; females of *L. verrucarum* are suspected vectors of *Bartonella* and *Leishmania* in Peru. Other species in Venezuela, Colombia and Costa Rica are suspected or proven vectors of *Leishmania* (see Feliciangeli et al. 1992).

Key to the Males of the Species Group *Verrucarum*

1. Style bearing 2 or 3 strong spines & small subterminal seta (series *serrana*). 2
   Style bearing 4 strong spines; subterminal seta present or absent 9

2. Style bearing 3 strong spines 3
   Style bearing 2 strong spines, 1 thin basal spine & subterminal set 6

3. Scutum pale 4
   Scutum dark 5

4. Coxite with 20+ setae implanted on raised, circular base. Genital filament tips expanded & modified (Hispaniola) . . . . . *L. christophei* (Fig. 73J-P)
   Coxite with fewer setae, not borne on circular base. Genital filament tips not expanded or modified (Cuba & other W.I. islands) . . . . . *L. orestes* (Fig. 73A-I)

5. Coxite with one basal group of 10-12 persistent setae . . . . . *L. diazi*
   Coxite with two median groups of persistent setae . . . . . *L. novoae*

6. Coxite with basal setae implanted in a single row 7
   Coxite with basal setae not implanted in a single row 8

7. Coxite with upturned, curved basal setae . . . . . *L. serrana* (Fig. 74)
   Coxite with straight, more slender basal setae . . . . . *L. oresbia* (Fig. 75)

8. Coxite with ca. 7 basal setae, most or all markedly recurved apically. . . . . *L. odax* (Fig. 76)
   Coxite with 3-4 setae with straight, slender tips . . . . *L. ottolinai* (Fig. 77)

9. Style with isolated basal spine (series *townsendi*) 10
   Style with paired basal spines 18

10. Style with terminal spine relatively thick & crooked . . . . . *L. spinicrassa* (Fig. 78)
    Style with terminal spine more slender, not crooked, but gently curved . 11

11. Coxite tuft of 15 or fewer setae, all more or less straight. Paramere setation as shown . . . . . *L. nadiae* (Fig. 79)
    Coxite tuft of 18 or more setae, many distinctly curved upwards. Paramere otherwise 12

12. Paramere with 7 or more long thin subterminal setae in addition to group of shorter, thicker setae . . . . . *L. torvida* (Fig. 80)
    Paramere without such a group of long setae 13

13. Coxite with longest setae of basal tuft reaching or surpassing apex of paramere 14
    Coxite with all setae of basal tuft ending well before apex of paramere . 15

14. Paramere with lateral median group of ca. 6 short, thin setae; distal third of structure with row of ca. 12 spine-like dorsal setae & with relatively thin setae at apex . . . . . *L. longiflocosa* (Fig. 81)
    Paramere with lateral median group of 4-6 relatively long, stronger setae; distal third of structure with row of hair-like setae & with ca. 9 thicker dorsal setae at apex . . . . . *L. amilcari* (Fig. 82)

15. Paramere with dorsal setae at middle third of structure 16
Paramere without dorsal setae at middle third of structure 17

16. Paramere with most dorsal setae markedly curved and thick . . . . . *L. sauroida* (Fig. 83)
Paramere with thinner, straighter dorsal setae . . . . . *L. townsendi* (Fig. 84)

17. Paramere with row of ca. 8 dorsal setae, subequal in size, at distal third of structure; 3-4 similar setae & smaller hairs near end of paramere . . . . . *L. quasitownsendi* (Fig. 85)
Paramere with a row of ca. 8 dorsal setae, proximal setae larger than others, at distal third of structure; only smaller hairs near end of paramere . . . . . *L. youngi* (Fig. 86)

18. Style with basal spines inserted on well defined, long tubercles. Genital filament tips inflated 19
Style with basal paired spines inserted directly on style, not implanted on tubercles. Genital filament tips inflated or not 21

19. Coxite with most setae of basal tuft as wide as that of median portion of genital filament. Style lacking small subterminal seta. Paramere with ventral heel . . . . . *L. moralesi* (Fig. 87)
Coxite with tuft of thin setae, their width much less than that of genital filaments. Style with small subterminal seta. Paramere without ventral heel 20

20. Style with shorter basal spine expanded distally, appearing truncate as shown . . . . . *L. andina* (Fig. 88)
Style with shorter basal spine without such modification . . . . . *L. aulari* (Fig. 89)

21. Paramere with dorsal setae restricted to distal third of structure; 1 isolated dorsal seta may also be present at basal fourth of paramere 22
Paramere with dorsal setae covering more of structure 24

22. Coxite tuft of fewer than 7 setae. Flagellomere I and labrum subequal in length . . . . . *L. ovallesi* (Fig. 90)
Coxite tuft of 10 or more setae. Flagellomere I considerably longer than labrum 23

23. Paramere strongly clubbed; lacking small isolated dorsal seta near base. Coxite without subapical group of ventral setae . . . . *L. columbiana* (Fig. 91)
Paramere otherwise, less clubbed but with small dorsal seta near base. Coxite with group of ventral setae . . . . . *L. verrucarum* (Fig. 92)

24. Paramere slightly clubbed subapically & ending in a slender finger-like projection. Coxite with tuft of 15 or more setae . . . . . *L. disiuncta* (Fig. 93)
Paramere not clubbed, distal half nearly uniform in width or becoming more slender towards tip or upturned. Coxite with tuft of 0 to 12 setae . . 25

25. Coxite lacking persistent setae . . . . . *L. nevesi* (Fig. 94)
Coxite with basal group of setae 26

26. Genital filaments longer than 4X length of pump; paramere as shown . . . . . *L. evansi* (Fig. 95)
Genital filaments shorter than 4X pump; paramere otherwise 27

27. Aedeagus strongly arched. Paramere with dorsal setae thicker than those at upturned apex . . . . . *L. deorsa* (Fig. 97)
Aedeagus simple, straight. Paramere with dorsal setae subequal in size . . . . . *L. nuneztovari* (Fig. 96)

Key to the Females of the Species Group *Verrucarum*

1. Scutum dusky or pale, not contrasting with pleura 2
Scutum darker than pleura 3

2. Spermathecae as shown; common sperm duct wide, maximum width greater than 3X width of genital fork stem (Hispaniola) . *L. christophei* (Fig. 73J-P)
Spermathecae otherwise; common sperm duct slender, maximum width subequal to width of genital fork stem (Cuba, Cayman Islands) . . . . . *L. orestes* (Fig. 73A-I)

3. Spermathecae similar to those in Fig. 73I (Cuba) 4
Spermathecae otherwise 5

4. Cibarium with very wide pigment patch, stretching across cibarium at level of horizontal teeth . . . . . *L. novoae*
Cibarium with narrow pigment patch, restricted to median strip & similar to that in Fig. 103 . . . . . *L. diazi*

5. Flagellomere I subequal to or much longer than labrum 6
Flagellomere I shorter than labrum 9

6. Spermathecae with terminal knob about as long as wide, not deeply embedded in spermathecae 7
Spermathecae with terminal knob about 4X as long as broad, most of structure deeply embedded in spermathecae 8

7. Common and individual sperm ducts subequal in length. Flagellomere I >0.35 mm . . . . . *Lutzomyia nadiae* (Fig. 79)
   Common sperm duct much longer than individual sperm duct. Flagellomere I <0.35 mm . . . . . *L. columbiana* (Fig. 91)
   L. disiuncta (Fig. 93)

8. Spermatheca with large terminal annulus, its length about 1/3 total length of spermatheca . . . . . *L. oresbia* (Fig. 75)
   Spermatheca with smaller terminal annulus, its length less than 1/3 total length of spermathecae . . . . . *L. odax* (Fig. 76)
   L. serrana (Fig. 74)
   L. ottolinai (Fig. 77)

9. Common sperm duct long, 3 or more times length of individual duct . . 10
   Common sperm duct shorter than 3 times length of individual duct 11

10. Spermathecae elongate with median constriction. Flagellomere I shorter than 0.20 mm . . . . . *L. ovallesi* (Fig. 90)
    Spermathecae without median constriction. Flagellomere I >0.25 mm . . . . . *L. verrucarum* (Fig. 92)
    L. moralesi (Fig. 87)

11. Individual sperm ducts very long, at least 3X length of common duct . . . . . *L. evansi* (Fig. 95)
    Individual sperm ducts shorter, less than 3X length of common duct . . . 12

12. Spermathecae and common duct subequal in width 13
    Spermathecae distinctly broader than common duct . . . *L. andina* (Fig. 88)
    L. aulari (Fig. 89)

13. Spermathecae with protruding terminal knob 14
    Spermathecae with recessed terminal knob . . . . . *L. nuneztovari* (Fig. 96)

14. Labrum <0.28 mm. Spermathecae with terminal knob directed sideways, terminal annulus not "button-like" . . . . . *L. nevesi* (Fig. 94)
    Labrum >0.30 mm. Spermathecae with terminal knob directed forward, not slanted & situated within a distinct button-shaped terminal annulus (series *townsendi*) . . . . . *L. amilcari* (Fig. 82)
    L. longiflocosa (Fig. 81)
    L. quasitownsendi (Fig. 85)
    L. sauroida (Fig. 83)
    L. spinicrassa (Fig. 78)
    L. torvida (Fig. 80)
    L. townsendi (Fig. 84)
    L. youngi (Fig. 86)

Lutzomyia christophei (Fairchild & Trapido)
Fig. 73 J-P

Phlebotomus christophei Fairchild & Trapido 1950: 409 (♂, ♀, Hato Mayor & Colonia San Rafael, Seibo, Dominican Republic).

Lutzomyia christophei: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Lewis 1967b: 74 (cf. to *orestes* ♀). Forattini 1973: 252 (♂, ♀ figs.). Martins et al. 1978: 93 (refs., dist.). Zeledón et al. 1985: 881 (coll. data). Young & Lawyer 1987: 56 (habits, Dominican Republic). Johnson et al. 1992: 282 (dist., biol., as vector of *Leishmania*)

Distribution (Map 29). HISPANIOLA (Fairchild & Trapido 1950; Johnson 1984; Johnson et al. 1992).

Remarks. Johnson (unpub. data) and Johnson et al. (1992) studied the distribution, habits and disease relationships of sand flies from the Dominican Republic. *Lutzomyia christophei* was rarely encountered, but is the suspected vector of *Leishmania* because it is anthropophilic, unlike *L. cayennensis* which is the only other sand fly species occurring on the island. Furthermore, Johnson demonstrated that reared females can experimentally transmit the endemic *Leishmania* (Isabel strain) to hamsters.

Lutzomyia orestes (Fairchild & Trapido)
Fig. 73 A-I

Phlebotomus orestes Fairchild & Trapido 1950: 410 (♂, near Minas, Camaguey, Cuba).

Phlebotomus sp. Garcia et al. 1969: 3 (biting man, Cuba).

Lutzomyia orestes: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Lewis 1967b: 74 (♂, ♀ figs., Cayman Brac, West Indies). Gonzalez & Garcia 1981: 47 (tax., figs., ecology). Mendoza et al. 1983a: 172 (biology); 1983b: 257 (feeding behavior, Cuba).

Distribution (Map 30). CUBA (Fairchild & Trapido 1950; Gonzalez & Garcia 1981; Mendoza et al. 1983a,b); CAYMAN BRAC, W.I. (Lewis 1967b).

Remarks. *Lutzomyia orestes* is structurally similar to *L. christophei* and has been found in Don Martin cave, Boca de Jaruco, Havana Prov., Cuba, where Garcia et al. (1969) and Mendoza et al. (1983a,b) observed females attacking man in the daytime. Females also feed on lizards and are gonotrophically disconcordant. Mendoza et al. (1983a) reared this species and provided photographs of the pupa and mature larva.

Lutzomyia diazi Gonzalez & Garcia

Lutzomyia diazi Gonzalez & Garcia 1981: 39 (♂, ♀, Cuba).

Distribution (Map 29). CUBA (Gonzalez & Garcia).

Remarks. This species has been collected at 3 localities in Cuba but a specific type locality was not given in the original description. We have not seen specimens referable to this species.

Lutzomyia novoae Gonzalez & Garcia

Lutzomyia novoae Gonzalez & Garcia 1981: 31 (♂, ♀, Cuba).

Distribution (Map 31). CUBA (Gonzalez & Garcia 1981).

Remarks. This species closely resembles *L. orestes* in structure but has a dark scutum. Specimens were taken at 5 Cuban localities, mostly within caves.

Lutzomyia serrana (Damasceno & Arouck)
Fig. 74

Flebotomus serranus Damasceno & Arouck 1949: 843 (♂, Serra da Piriabas, Pará, Brazil).

Phlebotomus guayasi Rodríguez 1956: 76 (♂, ♀, Guayas, Ecuador). Fairchild & Hertig 1961b: 237 (as synonym of *serranus*, refs.).

Lutzomyia serrana: Barretto 1962: 97 (listed). Forattini 1973: 269 (figs., tax.). Léger et al. 1977: 222 (♂ fig., French Guiana). Martins et al. 1978: 117 (figs., refs., dist.). Young 1979: 73 (refs., figs.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 404 (Acre, Brazil). Ramirez Pérez et al. 1982b: 58 (Tachira, Venezuela, figs.). Young & Rogers 1984: 599 (Ecuador). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Hashiguchi et al. 1985b: 442 (Ecuador). Murillo & Zeledón 1985: 75 (♂, ♀ figs., Costa Rica). Ryan 1986: 113 (figs., Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Alexander 1987: 554 (dispersal data, Colombia). Young et al. 1987: 588 (neg. for flagellates, Colombia). Lebbe et al. 1987: 30 (computer aided ident.). Feliciangeli 1988: 99 (dist., Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Kreutzer et al. 1990: 1 (isozyme data). Rowton et al. 1991: 501 (Guatemala). Eshita et al. 1992: 22 (Ecuador). Alexander et al. 1992a: 35; 1992c: 124 (Ecuador). Feliciangeli et al. 1992: 729 (dist., Venezuela).

Distribution (Map 30). MEXICO; HONDURAS; NICARAGUA (Martins et al. 1978); COSTA RICA (Murillo & Zeledón 1985); GUATEMALA (Rowton et al. 1991); PANAMA (Fairchild & Hertig 1961a, localities in Panama Canal

Zone & Provinces of Chiriqui, Bocas del Toro & Panama); COLOMBIA (Young 1979; Young et al. 1987); VENEZUELA (Ramirez Pérez et al. 1982b; Feliciangeli et al. 1992); FRENCH GUIANA (Léger et al. 1977); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); ECUADOR (Rodríguez 1956; Hashigushi et al. 1985b; Alexander et al. 1992a,c); PERU (Llanos 1983); BOLIVIA (Martins et al. 1978; Le Pont & Desjeux 1986).

Remarks. *Lutzomyia serrana* has a widespread geographic distribution and in Colombia, at least, is more abundant at elevations from 700 to 1,200 m a.s.l. than in lowland forests. Hanson (1968) described and figured the larva and pupa of *L. serrana* from reared specimens. He collected immatures in soil taken between buttressed roots in Panama. Females of this species are anthropophilic but have not been found naturally infected with *Leishmania*. Neither Rowton et al. (1991) in Guatemala nor Young et al. (1987) in Colombia observed flagellates in dissected females.

Lutzomyia oresbia (Fairchild & Hertig)
Fig. 75

Phlebotomus oresbius Fairchild & Hertig 1961b: 240 (♂, ♀, Santa Clara, Chiriqui, Panama).

Lutzomyia oresbia: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Forattini 1973: 263 (figs.). Martins et al. 1978: 116 (dist.). Christensen et al. 1983: 466 (listed, Panama). Murillo & Zeledón 1985: 71 (figs., Costa Rica).

Distribution (Map 29). PANAMA (Fairchild & Hertig 1961b); COSTA RICA (Murillo & Zeledón 1985).

Lutzomyia odax (Fairchild & Hertig)
Fig. 76

Phlebotomus odax Fairchild & Hertig 1961b: 238 (♂, ♀, Almirante, Bocas del Toro, Panama).

Lutzomyia dubia Martins, Falcão & Silva 1965: 4 (♂, Abuna, Rôndonia, Brazil). Forattini 1973: 261 (as synonym of *odax*, figs., tax.).

Lutzomyia odax: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Léger et al. 1977: 222 (French Guiana). Martins et al. 1978: 115 (dist.). Young 1979: 73 (♂ fig., refs.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Murillo & Zeledón 1985: 71 (♂, ♀, Costa Rica). Lebbe et al. 1987: 30 (computer aided ident.). Feliciangeli 1988: 108 (Venezuela). Rowton et al. 1991: 501 (biting man, Guatemala). Feliciangeli et al. 1992: 729.

Distribution (Map 31). HONDURAS; NICARAGUA (Martins et al. 1978); COSTA RICA (Murillo & Zeledón 1985); GUATEMALA (Rowton et al. 1991);

PANAMA; BRAZIL (Martins et al. 1978); FRENCH GUIANA (Léger et al. 1977); VENEZUELA (Feliciangeli 1988).

Remarks. We have not seen males of *L. odax* from Brazil but Forattini (1973) and Martins et al. (1978) consider *L. dubia*, described from there, to be a junior synonym of *L. odax*. Rowton et al. (1991) dissected 89 wild caught females in Guatemala, captured on human bait, but observed no flagellates.

Lutzomyia ottolinai (Ortiz & Scorza)
Fig. 77

Phlebotomus ottolinai Ortiz & Scorza 1963: 345 (♂, ♀, Rancho Grande, Aragua, Venezuela).

Lutzomyia ottolinai: Theodor 1965: 183 (listed). Forattini 1973: 265 (♂ fig.). Martins et al. 1978: 116 (refs.). Ramirez Pérez et al. 1978: 52 (♂, ♀ figs., Aragua, Venezuela). Feliciangeli 1980: 246 (figs., keyed); 1988: 108 (listed. Feliciangeli et al. 1992: 729 (mention).

Distribution (Map 32). VENEZUELA (type locality).

Remarks. *Lutzomyia ottolinai* is uncomfortably close to *L. serrana* and the illustrations of both sexes of the former species by Ramirez Pérez et al. (1978) support the possibility that the species are conspecific. More specimens, preferably topotypes, of *L. ottolinai* are needed to clarify its status. The type material is lost (Feliciangeli et al. 1992).

Lutzomyia spinicrassa Morales, Osorno-Mesa, Osorno & Hoyos
Fig. 78

Lutzomyia spinicrassa Morales, Osorno-Mesa, Osorno & Hoyos 1969b: 383 (♂, ♀, Boyaca, Colombia). Young 1979: 86 (figs., refs.). Alexander 1987: 554 (dispersal study). Kreutzer et al. 1987: 610 (brain cell karotypes). Young et al. 1987: 588 (naturally infected with *Leishmania braziliensis*, Norte de Santander, Colombia). Garcia 1988: 15 (speciation). Feliciangeli 1988: 108 (Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Kreutzer et al. 1990: 1 (isozyme profiles). Feliciangeli 1991: 229 (vector status, Venezuela). Adamson et al. 1991: 45 (ident. by DNA probes). Feliciangeli et al. 1992: 729 (full refs., tax., figs.); 1993: 652 (egg morphol.).

Lutzomyia townsendi (not *townsendi* Ortiz): Ramirez Pérez et al. 1982b: 53 (Tachira, Venezuela).

Distribution (Map 31). COLOMBIA (Young et al. 1987); VENEZUELA (Ramirez Pérez et al. 1982b; Añez et al. 1988; Feliciangeli et al. 1992).

Remarks. This species, regarded as a suspected vector of *Leishmania braziliensis* in Norte de Santander, Colombia (Young et al. 1987), is locally abundant in coffee plantations at Arboledas, Durania and nearby localities. Females are aggressive man-biters throughout most of the year. This species has also been found naturally infected with *Leishmania* in Venezuela (M.D. Feliciangeli, pers. comm.).

Lutzomyia nadiae Feliciangeli, Arredondo & Ward 1992
Fig. 79

Lutzomyia nadiae Feliciangeli, Arredondo & Ward 1992: 731 (♂, ♀, Yacambú, Zanare, Lara, Venezuela).

Distribution (Map 34). VENEZUELA (type locality).

Remarks. This recently described species clearly belongs in the series *townsendi* but, unlike most other members, has yet to be recorded attacking people.

Lutzomyia torvida Young, Morales & Ferro, n.sp.
Fig. 80

Lutzomyia sp. de Reventones: Ferro & Morales 1988: 69 (listed). Kreutzer et al. 1990: 1 (isozyme analysis, as *Lutzomyia* sp. A).

Holotype ♂ (measurements in mm). Wing length 1.78, width 0.51. Whole insect moderately infuscated, pleura paler than scutum. Head height from vertex to tip of clypeus 0.34, head width 0.35. Eyes large, separated by 0.11 or by distance equal to 5.9 facet diameters. Flagellomere I 0.24 long, II + III 0.22; ascoids on II ending just beyond middle of flagellomere, on flagellomeres I-XI. Labrum 0.23 long. Length of palpomeres: 1, 0.038; 2, 0.125; 3, 0.134; 4, 0.098; 5, 0.35; palpal sensilla visible on palp. II only. cibarium unarmed; pigment patch small, triangular, distinct; arch well developed, complete. Pharynx 0.14 long, unarmed. Pleura with 6-7 upper & 4-5 lower episternal setae. Length of wing vein sections: α, 0.51; β, 0.16; δ, 0.15; γ, 0.31. Length of femora, tibiae & basitarsi: foreleg, 0.68, 0.74, 0.44; midleg, 0.95, 0.88, 0.54; hindleg, 0.76, 1.13, 0.64. *Genitalia.* Style 0.13 long, with isolated basal spine, 3 large distal spines inserted at different levels & small subterminal seta. Coxite 0.32 long, with compact basal tuft of ca. 18 setae as shown). Paramere wider apically than at middle, its longest setae also near apex; shape variable according to view. Aedeagus subtriangular, heavily infuscated. Genital pump 0.11 long, each filament 0.35 long or 3.18X length of pump; filament tips slightly expanded, transverse striations most obvious towards tips. Lateral lobe 0.31 long.

Allotype ♀. Wing length 2.08, width 0.24. Coloration as in male. Head height 0.39, head width, 0.35. Eyes separated by 0.13 or by distance equal to 6.25 facet diameters. Flagellomere I 0.20 long; II + III = 0.19; ascoids simple, slightly longer in male, on all flagellomeres except terminal two (XIII-XIV). Labrum 0.34 long. Length of palpomeres: 1, 0.048; 2, 0.189; 3, 0.159; 4, 0.113; 5, 0.40; peg in sensilla in groups on middle to distal third of palp. 3. Cibarium with 4 sharp, equidistant horizontal teeth & single row of ca. 8 rather small vertical teeth; pigment patch moderately infuscated; arch complete & well defined. Pharynx 0.18 long, unarmed. Pleura with 11 upper & 2 lower episternal setae. Length of wing vein sections: α, 0.57; β, 0.22; δ, 0.20; γ, 0.36. Length of femora, tibiae & basitarsi: foreleg, 0.72, 0.70, 0.42; midleg, 0.72, 0.87, 0.50; hindleg, 0.76, 1.18, 0.58. Spermathecae sac-like, individual & common ducts smooth walled & subequal in length.

Type material. (Map 33). *Holotype* ♂. **Colombia**, Cundinamarca, Reventones (4°45'N,74°10'W), 1657 m a.s.l., 5 Feb. 1986, human bait, A. Morales, D.G. Young, R.B. Tesh et al. *Allotype* ♀, same data. *Paratypes*, 4 ♂♂, 8 ♀♀, same data; 12 ♀♀, same data but 7 Feb. 1987.

Remarks. The male of *L. torvida* n.sp. differs from others in the series *townsendi* by the shape and setation of the parameres. Isozyme profiles also support its status as a distinct species (Kreutzer et al. 1990, as *Lutzomyia* sp. A).

Like most other females in this series, that of *L. torvida* is anthropophilic. It is the dominant man-biter at Reventones, Colombia - a mountainous, coffee-growing site where *Leishmania braziliensis* is endemic. The females are morphologically inseparable from others in the complex.

The holotype and allotype will be deposited in the collection of the National Institute of Health, Bogotá, Colombia. Paratypes will also be stored there and in the Florida State Collection of Arthropods, Gainesville, Florida.

The specific name, *torvida*, means "wild" or "fierce" and refers to the aggressive biting behavior of females.

Lutzomyia longiflocosa Osorno-Mesa, Morales, Osorno & Hoyos
Fig. 81

Lutzomyia longiflocosa Osorno-Mesa, Morales, Osorno & Hoyas 1970: 1 (♂, ♀, Tello, Huila, Colombia). Martins et al. 1978: 127. Young 1979: 80 (♂ fig.). Feliciangeli & Murillo 1987: 144 (cf. to *youngi*). Garcia 1988: 15 (speciation). Kreutzer et al. 1990: 1 (isozyme profiles). Feliciangeli et al. 1992: 737 (mention).

Distribution (Map 31). COLOMBIA (type locality & ♂♂, Rovira, Tolima, A. Morales).

Remarks. Kreutzer et al. (1990) suggest that *L. longiflocosa* may be conspecific with *L. sauroida* and *L. quasitownsendi* based on enzyme differences but there are morphological differences in the males and we continue to treat them as distinct species. Females are aggressive man-biters at the type locality.

Lutzomyia amilcari Arredondo
Fig. 82

Lutzomyia amilcari Arredondo 1984: 63 (♂, Yacambú National Park, Lara, Venezuela). Feliciangeli & Murillo 1987: 144 (cf. to *youngi*, ♂ fig.). Arredondo et al. 1988: 227 (♀ descript.). Feliciangeli 1988: 108 (listed).

Distribution (Map 35). VENEZUELA (type locality).

Remarks. The original illustration of the male genitalia (Arredondo 1984) was based on specimens unduly flattened on the microslide by the weight of the coverslip. Nevertheless, the structure of the paramere appears to be distinctive and serves to separate this species from others in the *verrucarum* species group.

Lutzomyia sauroida Osorno-Mesa, Morales & Osorno
Fig. 83

Lutzomyia sauroida Osorno-Mesa, Morales & Osorno 1972a: 433 (♂, Vereda San Pedro, Boyacá, Colombia). Martins et al. 1978: 128. Young 1979: 86 (♂ fig.). Garcia 1988: 15 (speciation). Kreutzer et al. 1990: 1 (isozyme profiles). Feliciangeli et al. 1992: 737 (listed).
Lutzomyia sauroidea: Feliciangeli & Murillo 1987: 144 (cf. to *youngi*).
Lutzomyia townsendi (not *townsendi* Ortiz): Adamson et al. 1991: 45 (Tachira, Venezuela).

Distribution (Map 36). COLOMBIA (Osorno-Mesa et al. 1972b; 4 ♂♂, Arboledas, Norte de Santander); VENEZUELA (Adamson et al. 1991).

Remarks. *Lutzomyia sauroida* resembles *L. townsendi* (Ortiz) in details of the terminalia (Young 1979), but the males can be easily separated by the setation of the parameres. The females are indistinguishable in coloration and structure. We examined males of *L. sauroida* from Tachira State, Venezuela, kindly made available by M.D. Feliciangeli who first noted its presence there (pers. comm.). Long term collections of sand flies at, and near, Arboledas, Norte de Santander, Colombia (Young et al. 1987) yielded fewer than 20 males of *L. sauroida*. Nevertheless, this discovery raises suspicion that the female found naturally

infected with *Leishmania braziliensis* (Young et al. 1987) may have represented that of *L. sauroida*, not *L. spinicrassa*.

Lutzomyia townsendi (Ortiz)
Fig. 84

Phlebotomus townsendi Ortiz 1959: 23 (♂, Rancho Grande, Aragua, Venezuela). Ortiz & Scorza 1963: 347 (♂, ♀). Scorza et al. 1967: 179, 1968a-g (ecology, habits).

Lutzomyia townsendi (or *towsendi*): Theodor 1965: 183 (listed). Forattini 1973: 271 (figs.). Ramirez Pérez 1978: 52 (♂, ♀ figs., Aragua, Venezuela). Martins et al. 1978: 129 (refs.). Young 1979: 50 (♂ fig.). Feliciangeli 1980: 246 (keyed, figs.). Feliciangeli & Murillo 1987: 144 (cf. to *youngi*). Garcia 1988: 15 (speciation). Kreutzer et al. 1990: 1 (isozyme profiles). Warburg 1991: 189 (nat. infection of spirurid nematode, Colombia). Warburg et al. 1991b: 9 (biol. disease relationships, Colombia). Feliciangeli et al. 1992: 730 (tax., dist., refs.); 1993: 652 (egg morphol.).

Distribution (Map 35). VENEZUELA (Feliciangeli et al. 1992); COLOMBIA (Warburg et al. 1991b).

Remarks. Records of *L. townsendi* from Tachira and Trujillo States, Venezuela, represent other *verrucarum* group species, not *L. townsendi*. The ecology and habits of this species at Rancho Grande, Venezuela, were studied in detail by J. Scorza and colleagues (1967,1968a-g). Specimens, morphologically inseparable from topotypic *L. townsendi*, were recently discovered in Valle Dept., Colombia by Warburg et al. (1991b) who suggest that this species may be the local vector at one endemic site of *Leishmania braziliensis*.

Lutzomyia quasitownsendi Osorno, Osorno-Mesa & Morales
Fig. 85

Lutzomyia quasitownsendi Osorno, Osorno-Mesa & Morales 1972: 10 (♂, ♀, Barbosa, Santander, Colombia). Martins et al. 1978: 128. Young 1979: 86 (♂ fig.). Feliciangeli & Murillo 1987: 144 (cf. to *youngi*, ♂ fig.). Garcia 1988: 15 (speciation). Kreutzer et al. 1990: 1 (isozyme profiles).

Distribution (Map 35). COLOMBIA (type locality).

Lutzomyia youngi Feliciangeli & Murillo
Fig. 86

Lutzomyia youngi 1985 *in* Murillo & Zeledón 1985: 71 (♂, ♀). Feliciangeli & Murillo 1987: 141 (♂, ♀, figs., dist., tax). Garcia 1988: 15 (speciation). Scorza & Rojas 1988: 114 (vector studies). Cazorla et al. 1988b: 91 (structural

anomalies). Añez et al. 1988: 457 (Mérida State, Venezuela). Rojas & Scorza 1989: 29 (xenodiagnosis). Kreutzer et al. 1990: 1 (isozyme profiles). Rojas & Scorza 1991: 493 (exp. leishmanial infections). Feliciangeli 1991: 229 (review of vector studies). Adamson et al. 1991: 45 (DNA studies). Feliciangeli et al. 1992: 730 (tax., dist., figs.); 1993: 652 (egg morphol.).

Lutzomyia townsendi (not *townsendi* Ortiz): Calderón 1973: 87 (Mérida State, Venezuela, in leishmaniasis endemic area). Carnevali & Scorza 1976: 33 (exp. infected with *Leishmania*). Mogollón et al. 1977: 206 (altitudinal distribution, Trujillo State, Venezuela). Castro & Scorza 1977: 224 (rearing). Valera et al. 1978: 238 (mention). Scorza et al. 1979b: 293 (as possible vector of *Le. garnhami*). Scorza & Carnevali 1981: 229 (infected with *Monocystis chagasi*). Moreno & Scorza 1981: 179 (as exp. host for *Leishmania*). Marquez & Scorza 1982: 229 (age grading). Carnevali & Scorza 1982: 353 (dermal factors influencing sand fly infections). Scorza & Delgado 1982: 217 (as exp. host for *Leishmania*). Scorza & Añez 1984: 139 (as exp. host of *Leishmania garnhami*). Scorza et al. 1984a: 54 (pop. dynamics); 1984b: 21 (nat. leishmanial infection, Venezuela). Añez & Oviedo 1985: 739 (larval food, rearing). Añez et al. 1985: 113 (exp. study as *Leishmania* vector). Killick-Kendrick 1985: 752 (exp. infections with *Leishmania*).

Distribution (Map 32). COSTA RICA (Murillo & Zeledón 1985); VENEZUELA (Feliciangeli & Murillo 1987; Feliciangeli et al. 1992).

Remarks. The name, *L. youngi* (Feliciangeli & Murillo, was first used by Murillo & Zeledón (1985) who illustrated both sexes and compared them with other sand flies in this species group. Therefore, the date of the original description is 1985, not 1987 when a more complex description and diagnosis was given by Feliciangeli & Murillo.

Aside from slight differences in the setation of the parameres, the males of *L. townsendi* and *L. youngi* are virtually impossible to separate by structure. Kreutzer et al. (1990) observed that both males and females of the two species can be separated by their isozyme profiles.

Lutzomyia youngi is a suspected vector of *Leishmania* in Costa Rica and in Venezuela (Feliciangeli et al. 1992) and has been extensively studied by Añez, Scorza and their colleagues in Venezuela.

Lutzomyia moralesi Young
Fig. 87

Lutzomyia moralesi Young 1979: 80 (♂, ♀, near Cali, Valle, Colombia). Feliciangeli et al. 1984b: 595 (cf. to *aulari*); 1992: 737 (mention).

Distribution (Map 35). COLOMBIA (type locality) and ♂♂, Montebello, Antioquia, A. Morales, pers. comm.).

Remarks. There are no man-biting records of this species which, to date, is known only from two Colombian localities.

Lutzomyia andina Osorno, Osorno-Mesa & Morales
Fig. 88

Lutzomyia verrucarum (not *verrucarum* Townsend): Osorno et al. 1967: 36 (Cundinamarca, Colombia).
Lutzomyia andina Osorno, Osorno-Mesa & Morales 1972: 2 (♂, ♀, Charquito, Cundinamarca, Colombia). Young 1979: 75 (♂ figs.). Feliciangeli et al. 1984b: 595 (cf. to *aulari*). Kreutzer et al. 1990: 1 (isozyme profiles). Feliciangeli et al. 1992a: 737 (mention).

Distribution (Map 29). COLOMBIA (Osorno et al. 1972b).

Remarks. The type locality at Charquito near the Rio Bogotá is mountainous with numerous rock croppings which are used by males and females of *L. andina* as resting sites. Females are anthropophilic, biting during the day and night.

The widened end of the shorter basal spine of the male style is unique among the *verrucarum* group species.

Lutzomyia aulari Feliciangeli, Ordonez & Manzanilla
Fig. 89

Lutzomyia aulari Feliciangeli, Ordonez & Manzanilla 1984b: 592 (♂, Loma Abajo, Trujillo, Venezuela; ♀, Trujillo, Venezuela). Feliciangeli 1988: 109 (listed). Feliciangeli et al. 1992: 733 (tax., refs., figs.).
Lutzomyia columbiana (not *columbiana* Ristorcelli & Van Ty): Feliciangeli 1980: 245 (Trujillo, Venezuela).

Distribution (Map 36). VENEZUELA (Feliciangeli 1988; Feliciangeli et al. 1992).

Remarks. Through the kindness of D. Feliciangeli, we examined a series of males and females of *L. aulari* captured in Lara State, Venezuela. The female is morphologically indistinguishable from that of *L. andina*. The males are also very close, but the shorter basal spine of the male style of *L. aulari* is pointed at its tip, unlike that of *L. andina*.

Lutzomyia ovallesi (Ortiz)
Fig. 90

Phlebotomus ovallesi Ortiz 1952: 155 (♂, Duaca, Lara, Venezuela). Lewis & Garnham 1959: 87 (♀, Belize).

Lutzomyia ovallesi: Barretto 1962: 98 (listed). Mogollon et al. 1977: 209 (Venezuela). Ramirez Pérez et al. 1978: 52 (♂, ♀ figs., Venezuela). Martins et al. 1978: 128 (refs., dist.). Young 1979: 84 (♂, ♀ figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Pérez et al. 1981: 124; 1982a: 14; 1982b: 58 (Venezuela). Bonfante-Garrido 1983: 740; 1984: 850 (Venezuela). Murillo & Zeledón 1985: 75 (♂, ♀ figs., Costa Rica). Young et al. 1987: 588 (nat. flagellate infections, Colombia). Alexander 1987: 554 (dispersal study, Colombia). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela). Feliciangeli 1988: 108 (dist., Venezuela). Feliciangeli et al. 1988b: 393 (nat. flagellate infections, Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Bonfante-Garrido et al. 1991: 99 (as vector, Venezuela). Feliciangeli 1991: 229 (nat. leishmanial infections, Venezuela). Rowton et al. 1991: 501 (nat. leishmanial infections, Guatemala); 1992: 465. Feliciangeli et al. 1992: 735 (gen. review, tax., figs.).

Distribution (Map 37). MEXICO; BELIZE; GUATEMALA (Rowton et al. 1991); HONDURAS (Martins et al. 1978); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Young et al. 1987); NICARAGUA (Fairchild & Hertig 1959); VENEZUELA (Mogollon et al. 1977; Martins et al. 1978; Ramirez Pérez et al. 1978, 1981, 1982a,b; Bonfante-Garrido 1983; Feliciangeli 1987a,b; Feliciangeli et al. 1992); TRINIDAD (Aitken et al. 1968).

Remarks. Forattini (1973) mistakenly considered *L. ovallesi* to be conspecific with *L. nuneztovari*.

Females of *L. ovallesi* are locally abundant, anthropophilic and have been found naturally infected with flagellates of unknown identity in Belize, Panama, and Colombia (Williams 1970b; Young et al. 1987). Confirmed, or at least reliable, identifications of *Leishmania braziliensis* found in *L. ovallesi* are given by Feliciangeli in Venezuela (1991) and Rowton et al. (1992) in Guatemala. Bonfante-Garrido et al. (1991) isolated a variant of *Le. panamensis/guyanensis* in Venezuela.

Lutzomyia columbiana (Ristorcelli & Van Ty)
Fig. 91

Phlebotomus columbianus Ristorcelli & Van Ty 1941: 263 (♀, Valle de Capuli, Nariño, Colombia). Rozeboom 1947b: 705 (♂ figs.). Sherlock 1962: 322 (♂, ♀).

Phlebotomus monticolus var. *incarum* Ristorcelli & Van Ty 1941: 266 (♀, Valle de Capuli, Nariño, Colombia). Rozeboom 1947b: 705 (as junior synonym of *columbianus*).

Lutzomyia columbiana: Barretto 1962: 97. Martins et al. 1978: 126 (refs.). Young 1979: 75 (refs., figs.).

Distribution (Map 38). COLOMBIA (Young 1979; ♂♂, Rovira, Tolima, A. Morales, pers. comm.).

Remarks. Females of *L. columbiana* are aggressive man-biters and were implicated as vectors of *Bartonella* during an epidemic of bartonellosis in southern Colombia in the 1930s and early 1940s (Rozeboom 1947b). Populations of this sand fly remain high at Samaniego, Nariño, Colombia (C. Ferro, pers. comm.) but no recent human cases of bartonellosis have been observed or reported.

Lutzomyia verrucarum (Townsend)
Fig. 92

Phlebotomus verrucarum Townsend 1913: 107 (♂, ♀, Verrugas Canyon, Peru). Hertig 1942: 1 et seq. (habits, as vector of *Bartonella*).

Flebotomus verrucarum: Barretto 1947a: 228 (full refs.).

Lutzomyia verrucarum: Barretto 1962: 97 (listed). Theodor 1965: 183 (♂, ♀ figs.). Forattini 1973: 228 (♂, ♀ figs., tax.). Martins et al. 1978: 129 (ref., dist.). Llanos 1983: 183 (dist., Peru). Feliciangeli et al. 1984b: 595 (cf. to *aulari*). Vargas & Pérez 1985: 5 (Ancash, Peru).

Distribution (Map 34). PERU (Martins et al. 1978; Llanos 1983; Vargas & Pérez 1985).

Remarks. Records of *L. verrucarum* from Venezuela (see Feliciangeli 1980) and Colombia (Osorno et al. 1967) represent other *verrucarum* group species, not *L. verrucarum* (Townsend).

Hertig (1942) studied the biology and habits of this important species in Peru where it has been incriminated as a vector of *Bartonella* and is also suspected of transmitting *Leishmania* to man. At present, no natural leishmanial infections have been reported in wild-caught females. Specimens have been collected from elevations as high as 3,300 m above sea level in Ancash, Peru (E. Pérez, pers. comm.).

Lutzomyia disiuncta Morales, Osorno & Osorno-Mesa
Fig. 93

Lutzomyia disiuncta Morales, Osorno & Osorno-Mesa 1974: 443 (♂, ♀, Suba, Cundinamarca, Colombia). Martins et al. 1978: 126. Young 1979: 78 (♂ fig.).

Distribution (Map 32). COLOMBIA (type locality).

Remarks. The type locality of *L. disiuncta* at Suba is a small cloud forest surrounded by pastures close to the city limits of Bogotá.

Lutzomyia nevesi (Damasceno & Arouck)
Fig. 94

Flebotomus nevesi Damasceno & Arouck 1956a: 9 (♂, Rio Capim, Pará, Brazil).
Lutzomyia nevesi: Theodor 1965: 183. Velasco & Martins 1974: 94 (♀, Bolivia). Martins et al. 1978: 127 (refs., dist.). Young 1979: 45 (Ecuador). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Le Pont & Desjeux 1984b: 282 (Bolivia). Young & Rogers 1984: 599 (listed, Ecuador). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 112 (figs., Brazil). Young & Morales 1987: 662 (Amazonas, Colombia). Alexander et al. 1992a: 35; 1992c: 124 (Ecuador). Eshita et al. 1992: 22 (Ecuador).
Lutzomyia evansi (in part, not *evansi* Nuñez-Tovar): Llanos 1973: 47 (♀ figs.).

Distribution (Map 38). COLOMBIA (Young & Morales 1987); ECUADOR (Young 1979; Alexander et al. 1992a,c); PERU (Llanos 1973; Martins et al. 1978); BOLIVIA (Velasco & Martins 1974; Le Pont & Desjeux 1984b, 1986); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986).

Remarks. Forattini (1973) incorrectly treated this species as a junior synonym of *L. pestanai* which belongs in the subgenus *Psathromyia*. Llanos (1973) figured the *L. nevesi* female (incorrectly as *L. evansi*) before it was fully described by Velasco & Martins in 1974.

Arias et al. (1985) reported unidentified flagellate infections in 33 out of 171 females of *L. nevesi* in Brazil.

Lutzomyia evansi (Nuñez-Tovar)
Fig. 95

Phlebotomus evansi Nuñez-Tovar 1924:44 (♂, Mariara, Carabobo, Venezuela).
Flebotomus evansi: Barretto 1947a: 198 (full refs.).
Lutzomyia evansi: Theodor 1965: 183 (listed). Mogollon et al. 1977: 209 (Venezuela). Ramirez Pérez et al. 1978: 49 (♂, ♀ figs., Venezuela). Martins et al. 1978: 126 (refs., dist.). Young 1979: 78 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Pérez et al. 1982a: 14 (♂, ♀ figs., Venezuela). Bonfante-Garrido 1983: 740; 1984: 850 (Venezuela). Navin et al. 1985: 1074 (Honduras). Murillo & Zeledón 1985: 79 (♂, ♀ figs., Costa Rica). Morales et al. 1987: 93 (Colombia record). Feliciangeli 1987a: 122; 1987b:

127 (coll. data, Venezuela); 1988: 108 (dist., Venezuela). Feliciangeli et al. 1988a: 48 (Amazonás, Venezuela). Travi et al. 1990: 676 (as vector of *Leishmania chagasi*, Colombia). Warburg et al. 1991b: 12 (biting man, Colombia). Bonfante-Garrido et al. 1991: 99 (Venezuela record). Feliciangeli et al. 1992: 733 (gen. review); 1993: 652 (egg morphol.).

Distribution (Map 33). GUATEMALA (Fairchild & Hertig 1959); EL SALVADOR; NICARAGUA (Martins et al. 1978); HONDURAS (Young 1979; Navin et al. 1985); COSTA RICA (Murillo & Zeledón 1985); COLOMBIA (Young 1979; Morales et al. 1987; Travi et al. 1990); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1978, 1982; Bonfante-Garrido 1983; Feliciangeli 1988; Feliciangeli et al. 1988).

Remarks. Records of *L. evansi* in Peru (Llanos 1983) are questionable based on the fact that specimens illustrated as "*L. evansi*" by Llanos (1973) represent *L. nuneztovari* (♂) and *L. nevesi* (♀), not *L. evansi* (Nuñez-Tovar). Travi et al. (1990) isolated *Leishmania chagasi* from *L. evansi* at one focus in Colombia.

Lutzomyia nuneztovari (Ortiz)
Fig. 96

Phlebotomus nuneztovari Ortiz 1954: 232 (♂, Duaca, Lara, Venezuela).

Lutzomyia nuneztovari: Theodor 1965: 183 (listed). Forattini 1973: 265 (as synonym of *ovallesi*). Ramirez Pérez et al. 1978: 52 (♂, ♀ figs., Venezuela). Martins et al. 1978: 127. Young 1979: 83 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (keyed). Ramirez Pérez 1982b: 58 (♂, ♀ figs., Venezuela). Christensen et al. 1983: 466 (Panama). Le Pont & Desjeux 1984b: 281 (cf. to *nuneztovari anglesi*). Alexander 1987: 554 (dispersal study, Colombia). Young et al. 1987: 588 (neg. for flagellates, Colombia). Añez et al. 1988: 457 (Mérida, Venezuela). Feliciangeli 1988: 108 (dist., Venezuela). Feliciangeli et al. 1992: 735 (tax., gen. review).

Lutzomyia evansi (in part, not *evansi* Nuñez-Tovar): Llanos 1973: 47 (♂ fig.).

Lutzomyia nuneztovari anglesi Le Pont & Desjeux 1984b: 277 (♂, ♀, Tocania, La Paz, Bolivia). Le Pont et al. 1989a: 277 (as likely vector of cutaneous leishmaniasis); 1989c: 307 (biting habits as related to *Leishmania* transmission); 1989d: 223 (insecticidal control study). **(NEW SYNONYMY)**

Distribution (Map 39). GUATEMALA (1 ♂ no. 426, km 81, Nov. 1949, no other data, Leon coll.); HONDURAS (3 ♂♂, Tela, Lancetilla Valley, June 1953, tree trunk, Hils); PANAMA (4 ♂♂, Santa Clara, Chiriqui, April 1955, tree trunks in coffee plantation, Hartmann); COLOMBIA (Young 1979; Young et al. 1987); PERU (Llanos 1973, as *evansi*, in part); BOLIVIA (Le Pont & Desjeux 1984b); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1978, 1982b; Feliciangeli 1988; 1992).

Remarks. This species has not been previously reported in Guatemala, Honduras or Peru. Llanos (1973) figured a male of "*L. nuneztovari*" from Cusco, Peru, but it was misidentified as *L. evansi*. One of us confirmed this determination in 1988 from study of males and females of *L. nuneztovari* in the collection at the National Institute of Health, Lima. Females are anthropophilic.

Le Pont & Desjeux (1984b) noted that males of *L. nuneztovari* from Bolivia differed from those captured elsewhere by presence of a small subterminal seta on each style, by the longer genital filaments (4.9X length of pump), by the longer lateral lobes that extend well beyond the ends of the parameres, and by other metrical differences.

In comparing Bolivian specimens of *L. nuneztovari* with those found elsewhere, we noted that the presence or absence of the subterminal seta on the style depended on individual specimen, not locality. For example, 1 male from Honduras has this seta; whereas, it was absent from the 2 other males captured at the same site. The Panama males showed similar variation (subterminal seta of style present in 1 male; absent in 3 others). Feliciangeli et al. (1992) also observed this variation in Venezuela.

Two males from Bolivia, kindly sent to us by F. Le Pont, have a shorter genital pump/filament ratio (2.8X) than indicated in the original description and therefore do not differ from other males examined from Colombia and Panama, in this respect.

In view of these observations, we reject the status of the Bolivian specimens as a distinct subspecies. *Leishmania* sp. was reported in *L. nuneztovari* from this country by Le Pont & Desjeux (1984b) and Le Pont et al. (1989a).

Lutzomyia deorsa Pérez, Ogusuku, Monje & Young
Fig. 97

Lutzomyia deorsa Pérez, Ogusuku, Monje & Young 1991: 134 (♂, Abancay, Apurimac, Peru).

Distribution (Map 33). PERU (type locality).

Remarks. *Lutzomyia deorsa*, known from a single male, was captured in a rock crevice at 2,380 m above sea level. Its distinctive, downwardly-curved aedeagus readily separates it from other *verrucarum* group species.

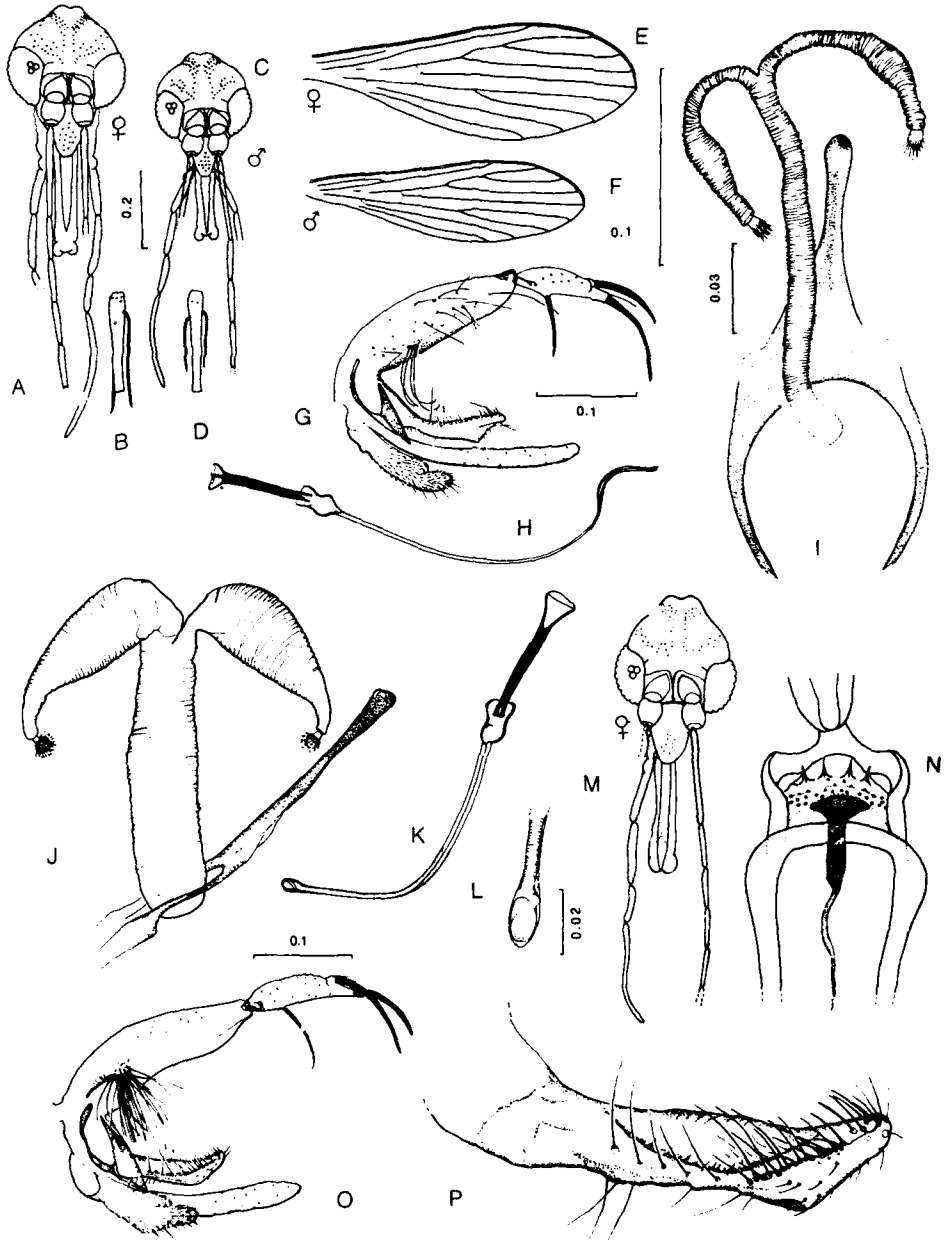


FIG. 73. ***Lutzomyia orestes.*** A. Female head; B. Female flagellomere II; C. Male head. D. Male flagellomere II; E. Female wing; F. Male wing; G. Male terminalia; H. Genital pump & filaments; I. Spermathecae. ***Lutzomyia christophei.*** J. Spermathecae; K. Genital pump & filaments; L. Tip of genital filament; M. Female head; N. Female cibarium; O. Male terminalia; P. Paramere.

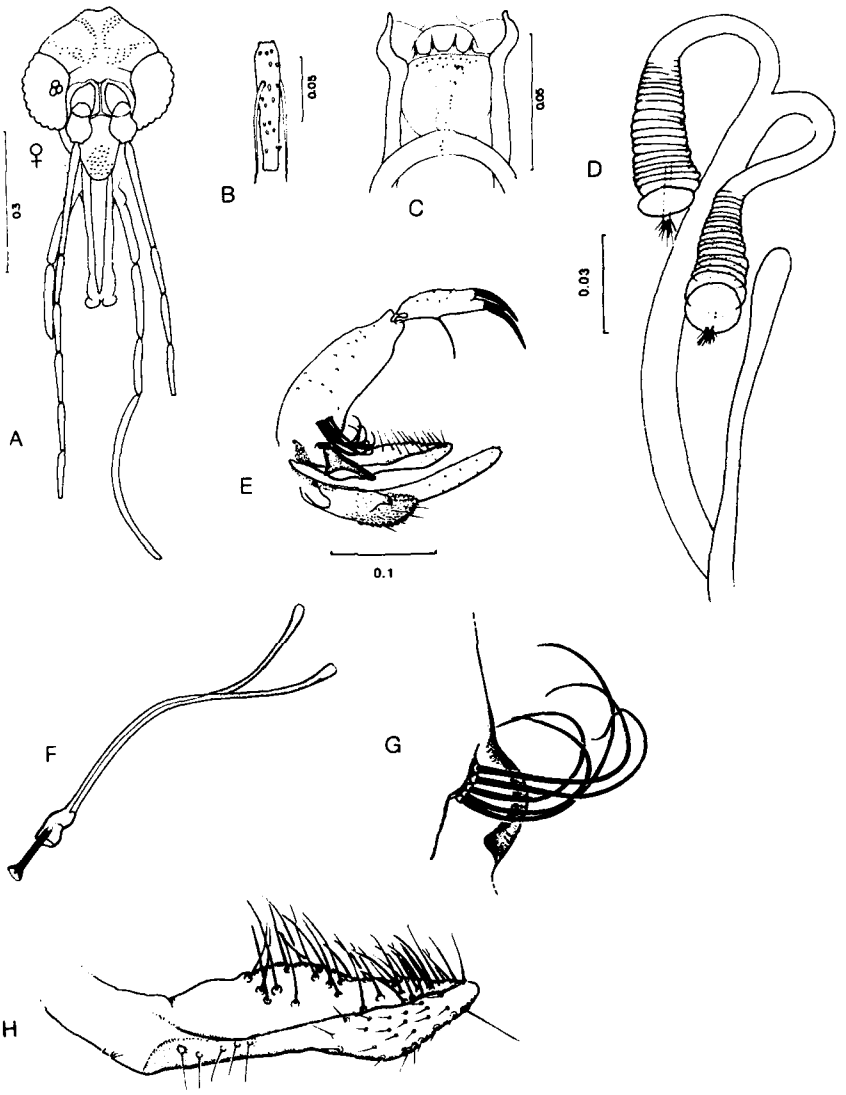


FIG. 74. ***Lutzomyia serrana.*** A. Female head; B. Female flagellomere II; C. Female cibarium; D. Spermathecae; E. Male terminalia; F. Genital pump & filaments; G. Coxite setal tuft; H. Paramere (figs. A-C from Young 1979).

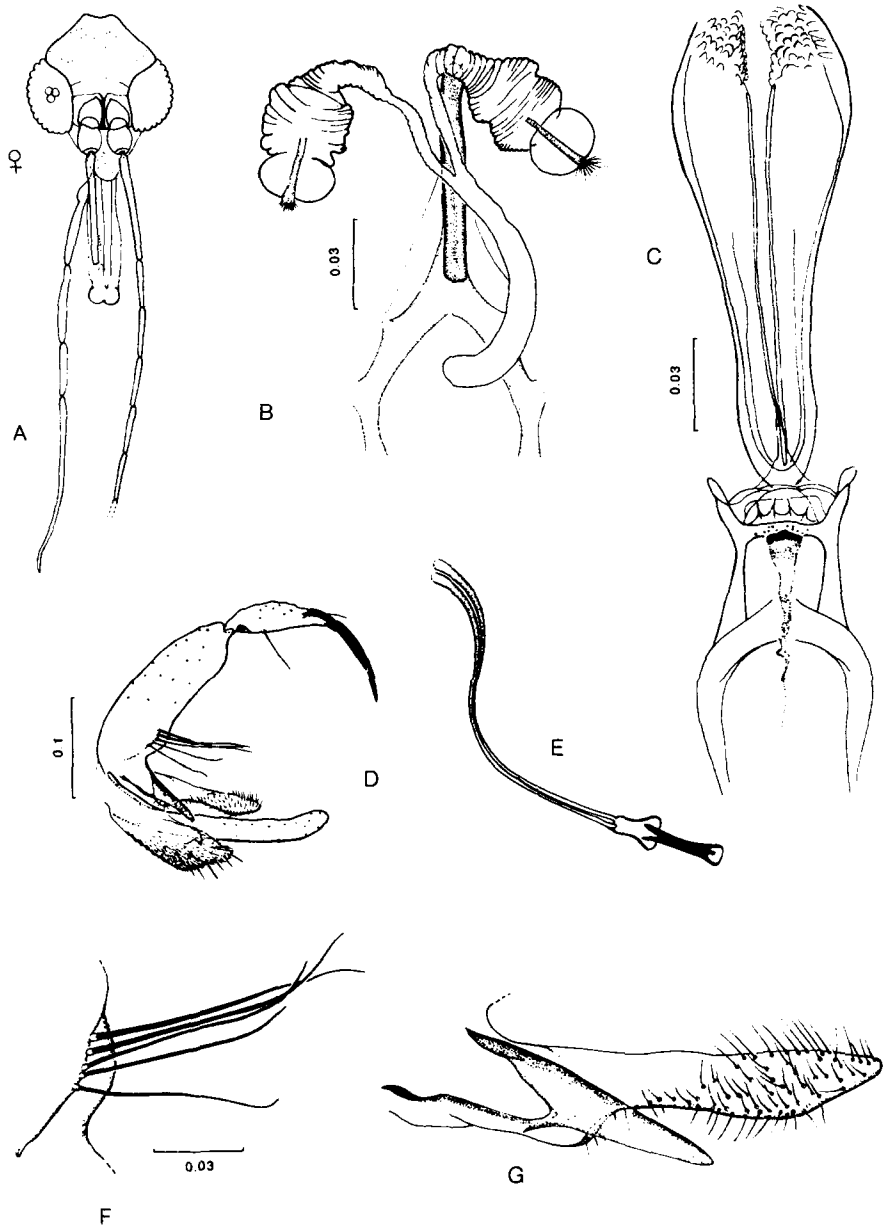


FIG. 75. ***Lutzomyia oresbia.*** A. Female head; B. Spermathecae; C. Female cibarium & pharynx; D. Male terminalia; E. Genital pump & filaments; F. Coxite tuft; G. Paramere & aedeagus.

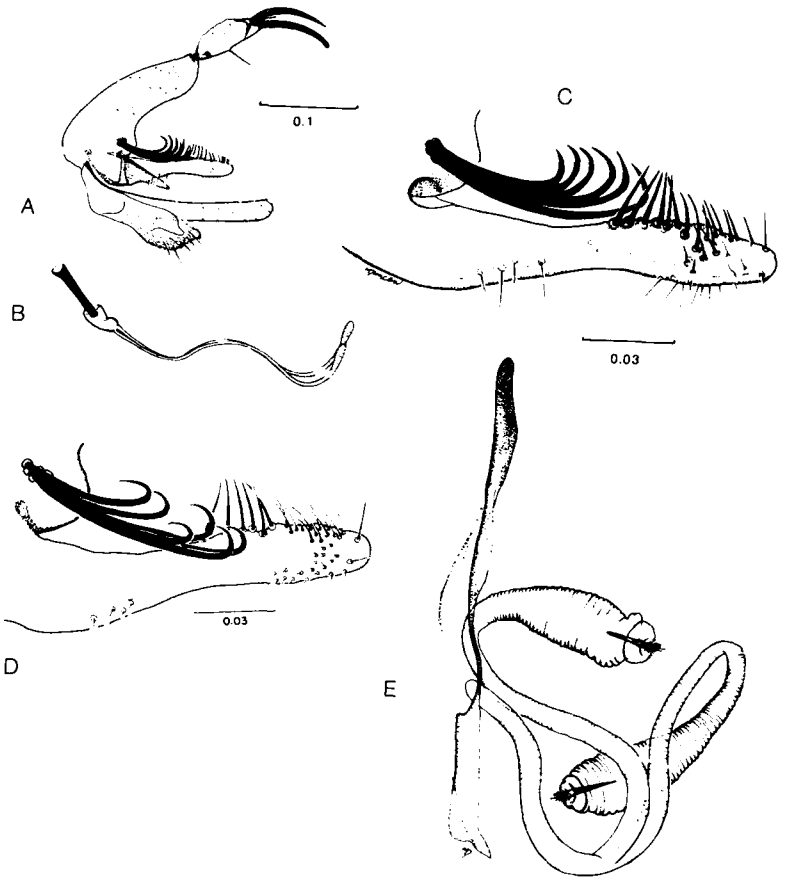


FIG. 76. ***Lutzomyia odax***. A. Male terminalia; B. Genital pump & filaments; C. Paramere; D. Paramere (different aspect); E. Spermathecae (Fig. D from Young 1979).

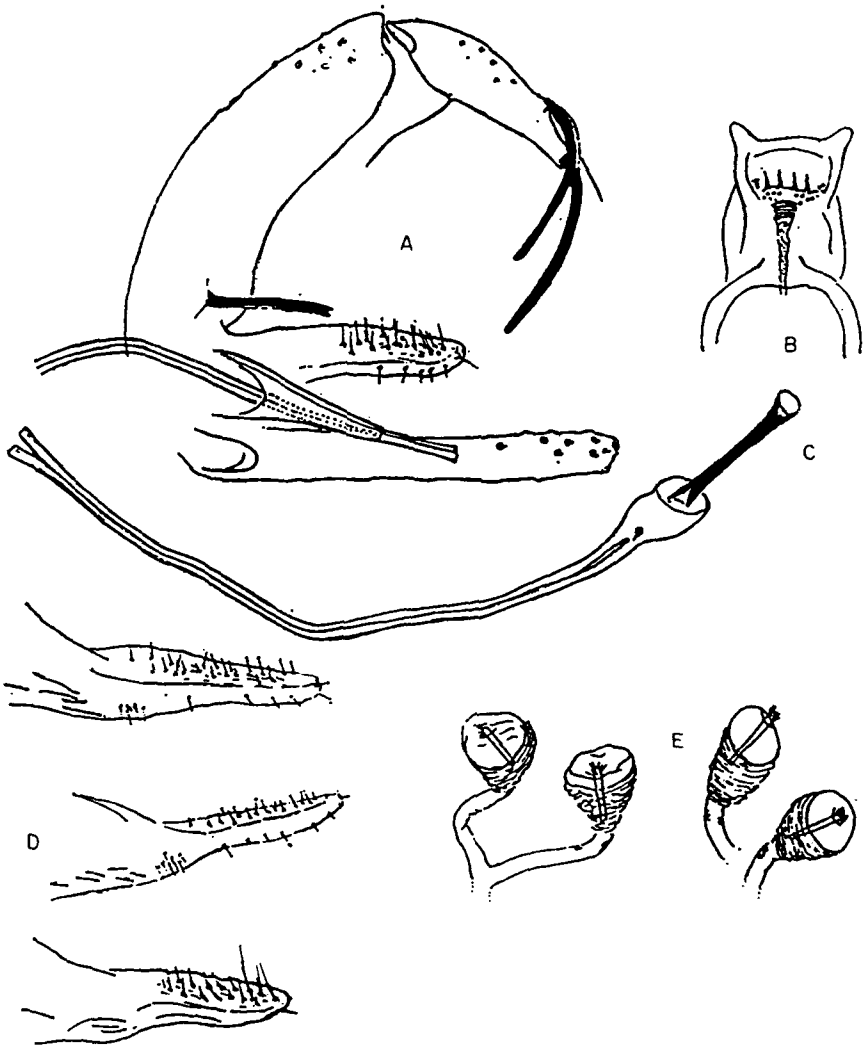


FIG. 77. ***Lutzomyia ottolinai***. A. Male terminalia; B. Female cibarium; C. Genital pump & filaments; D. Parameres, different views; E. Spermathecae (figs. from Ortiz & Scorza 1963).

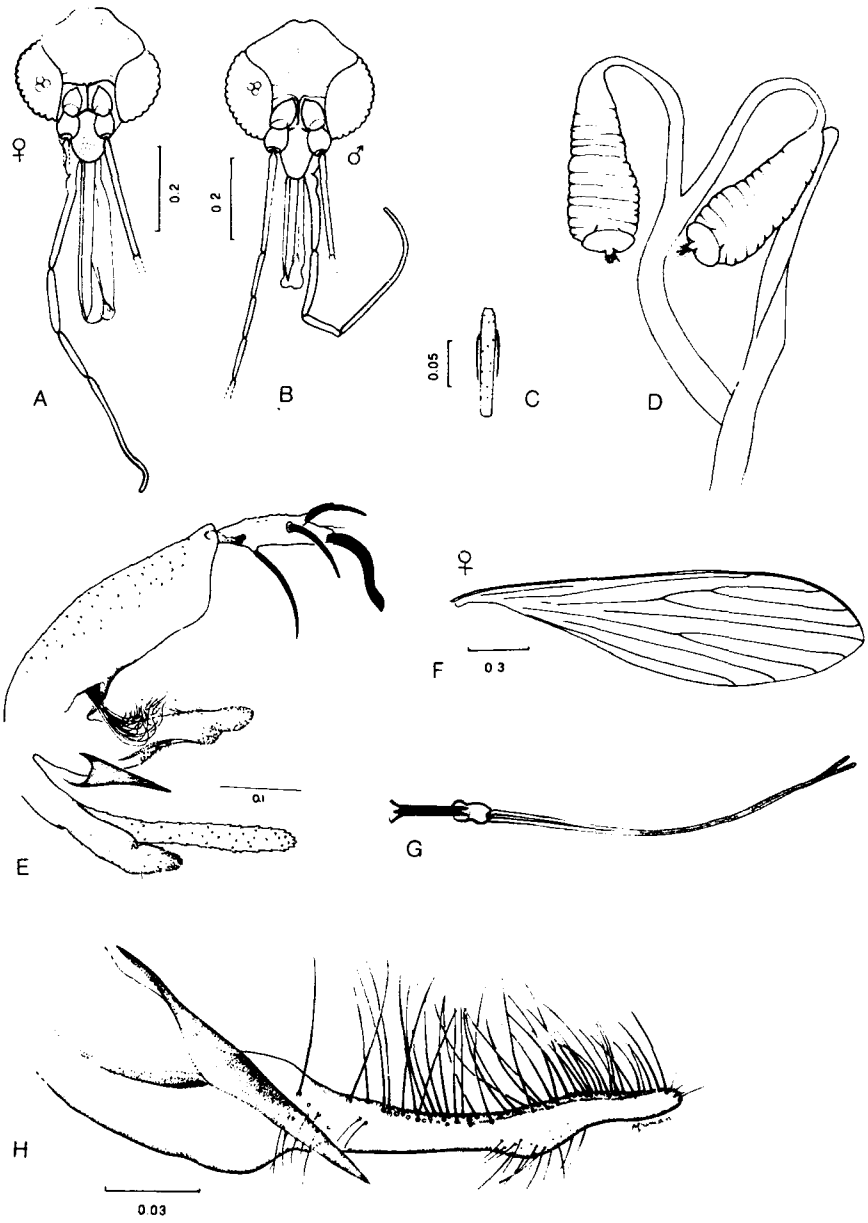


FIG. 78. ***Lutzomyia spinicrassa***. A. Female head; B. Male head; C. Male flagellomere II; D. Spermathecae; E. Male terminalia; F. Female wing; G. Genital pump & filaments; H. Paramere (fig. E from Young 1979).

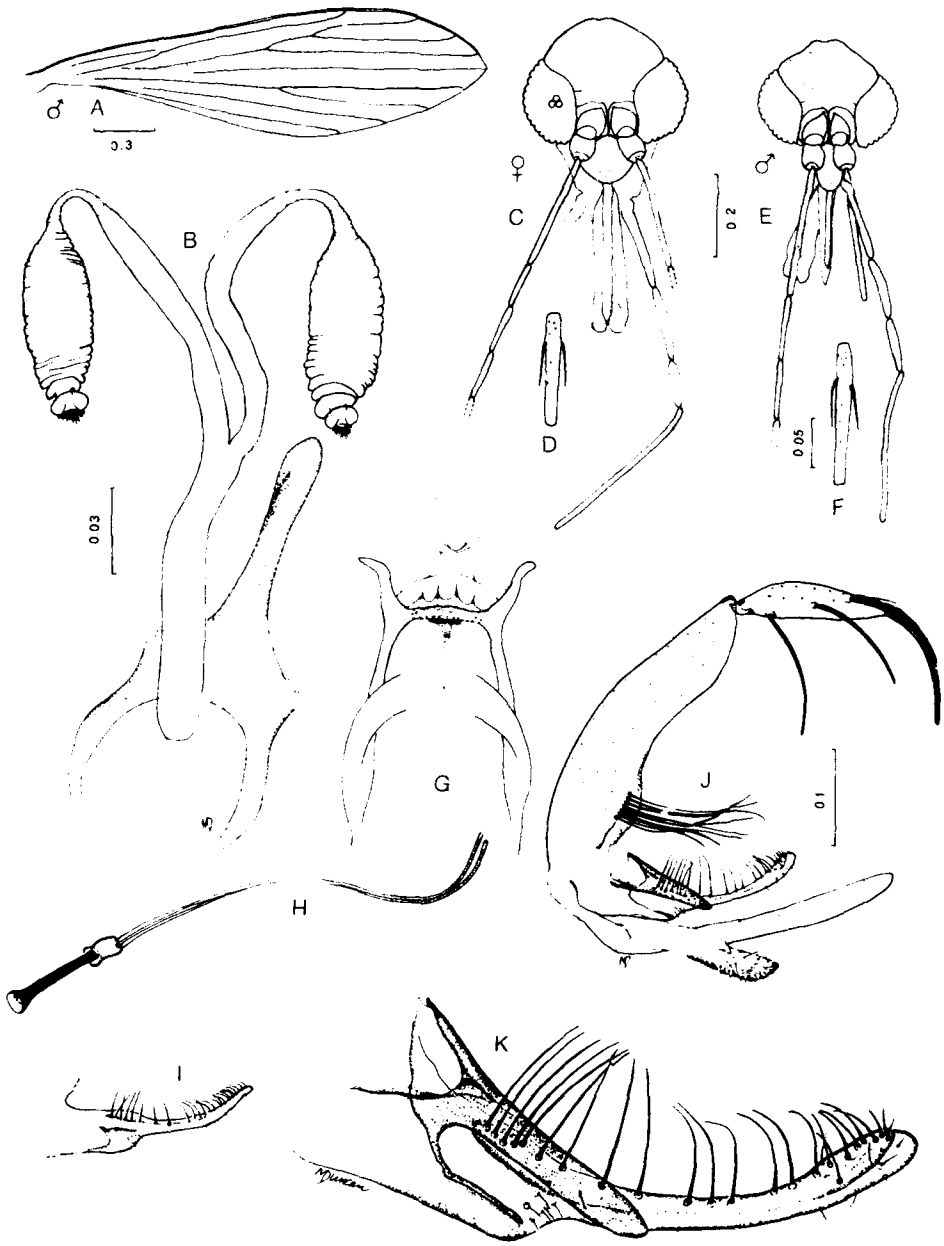


FIG. 79. ***Lutzomyia nadiae.*** A. Male wing; B. Spermathecae; C. Female head; D. Female flagellomere II; E. Male head; F. Male flagellomere II; G. Female cibarium; H. Genital pump & filaments; I. Paramere; J. Male terminalia; K. Paramere. (figs. from Feliciangeli et al. 1992).

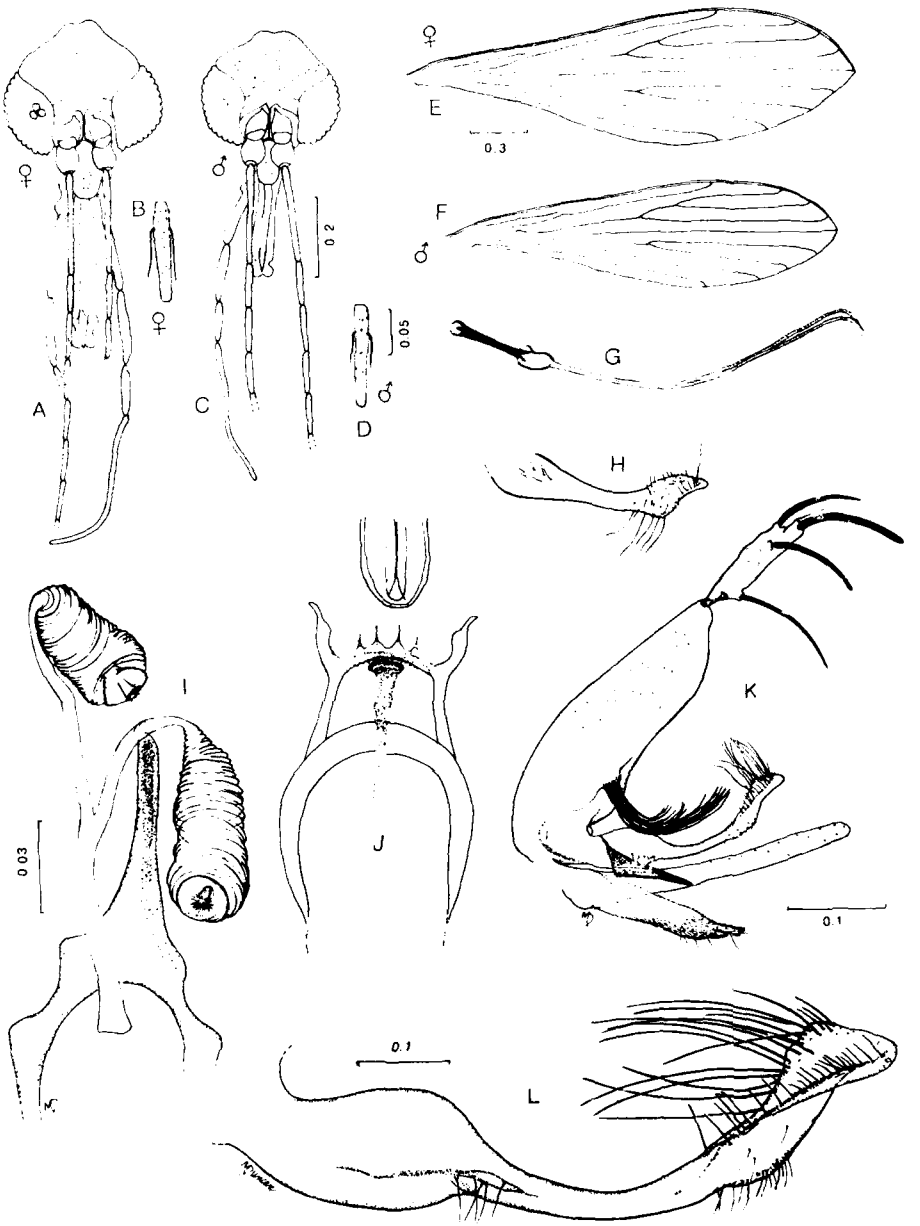


FIG. 80. ***Lutzomyia torvida.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Paramere; I. Spermathecae; J. Female cibarium; K. Male terminalia; L. Paramere.

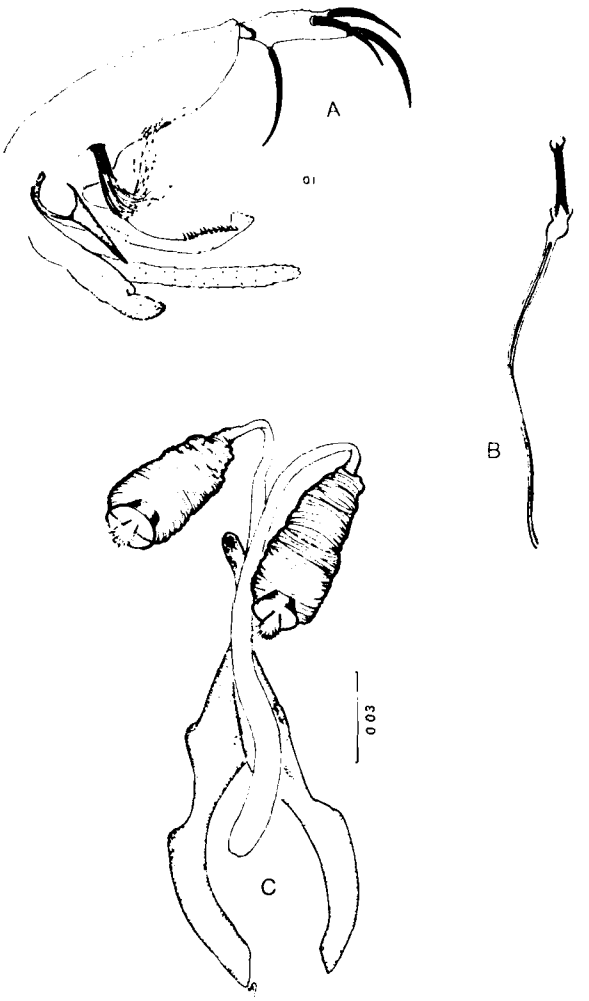


FIG. 81. ***Lutzomyia longiflocosa***. A. Male terminalia; B. Genital pump & filaments; C. Spermathecae (fig. A from Young 1979).

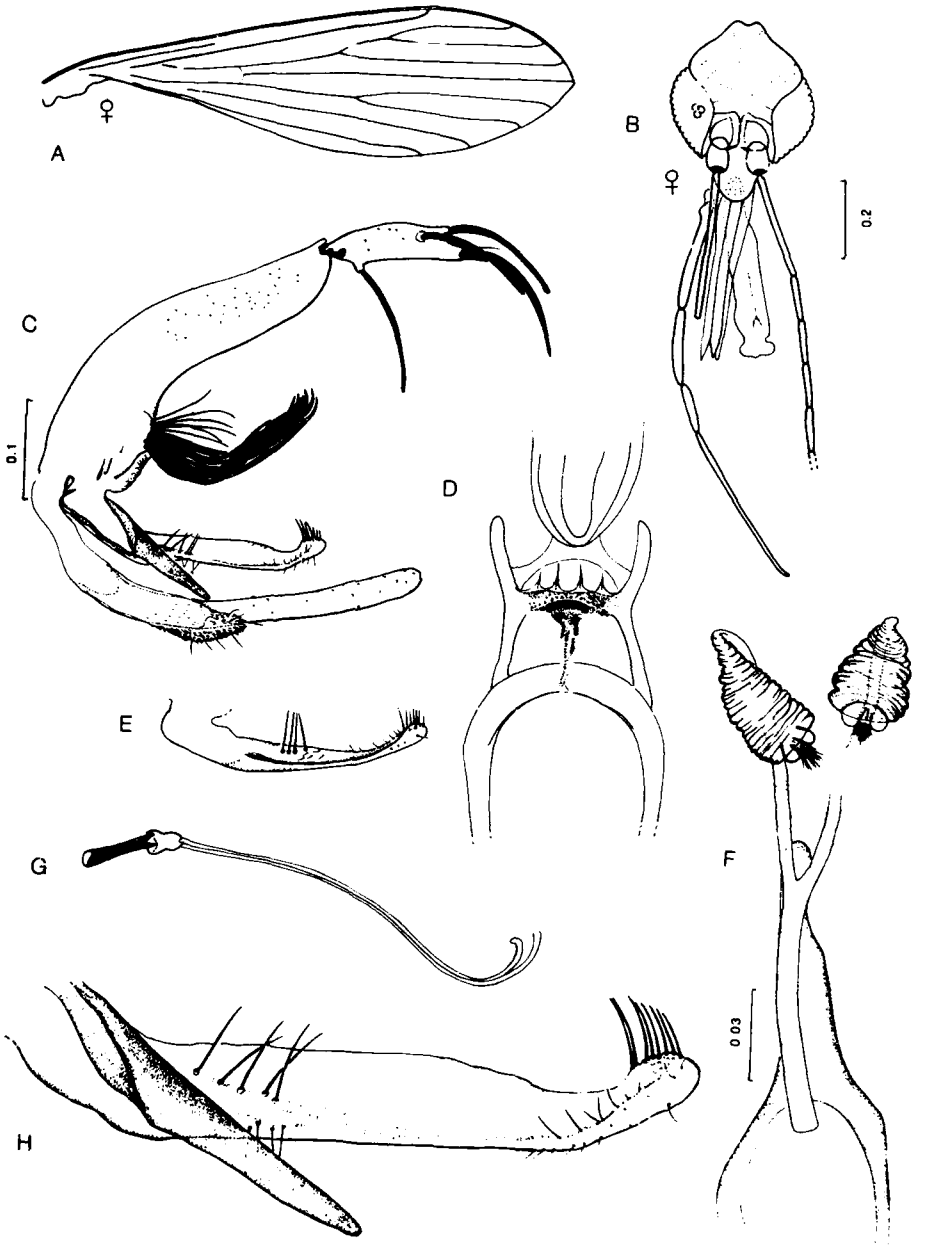


FIG. 82. ***Lutzomyia amilcari.*** A. Female wing; B. Female head; C. Male terminalia; D. Female cibarium; E. Paramere; F. Spermathecae; G. Genital pump & filaments; H. Paramere.

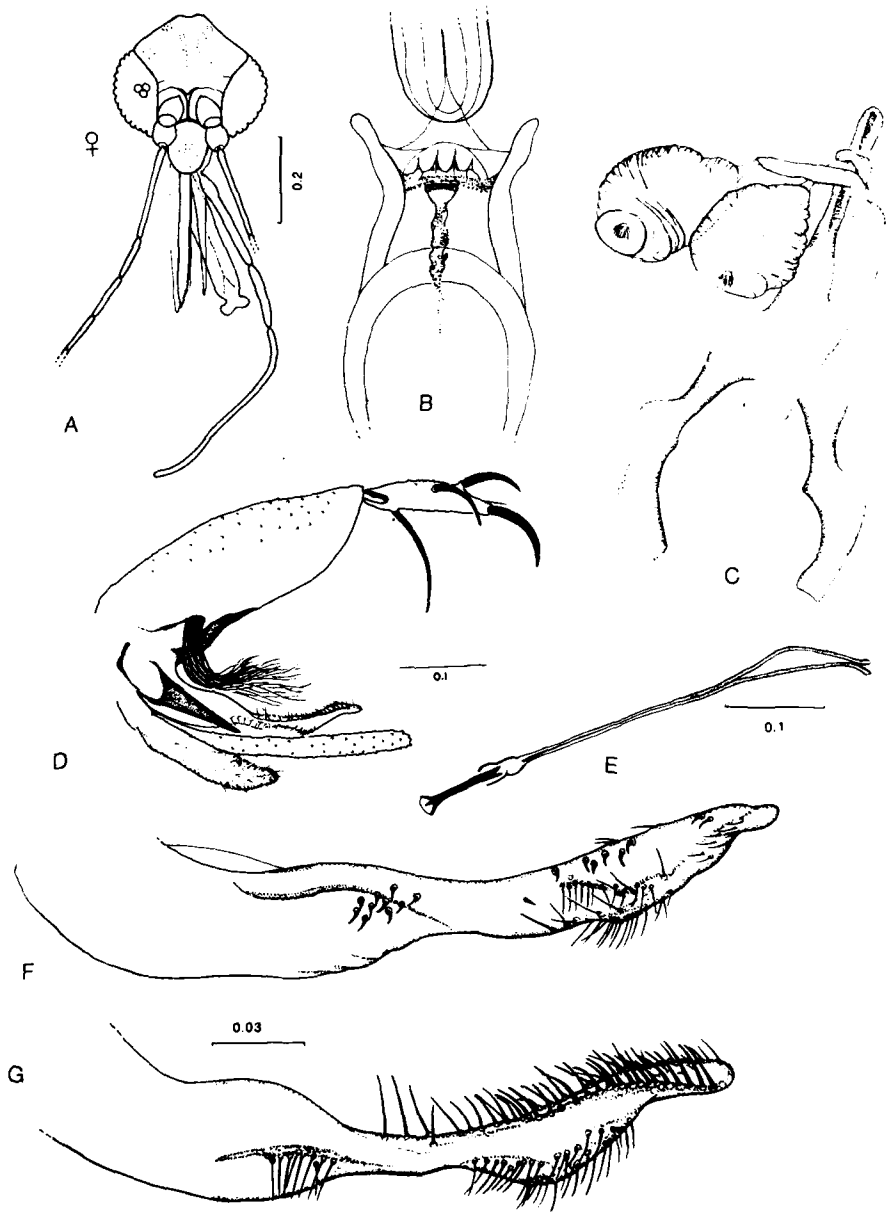


FIG. 83. ***Lutzomyia sauroida.*** A. Female head; B. Female cibarium; C. Spermathecae; D. Male terminalia; E. Genital pump & filaments; F & G. Parameres, different lateral views (Fig. D from Young 1979).

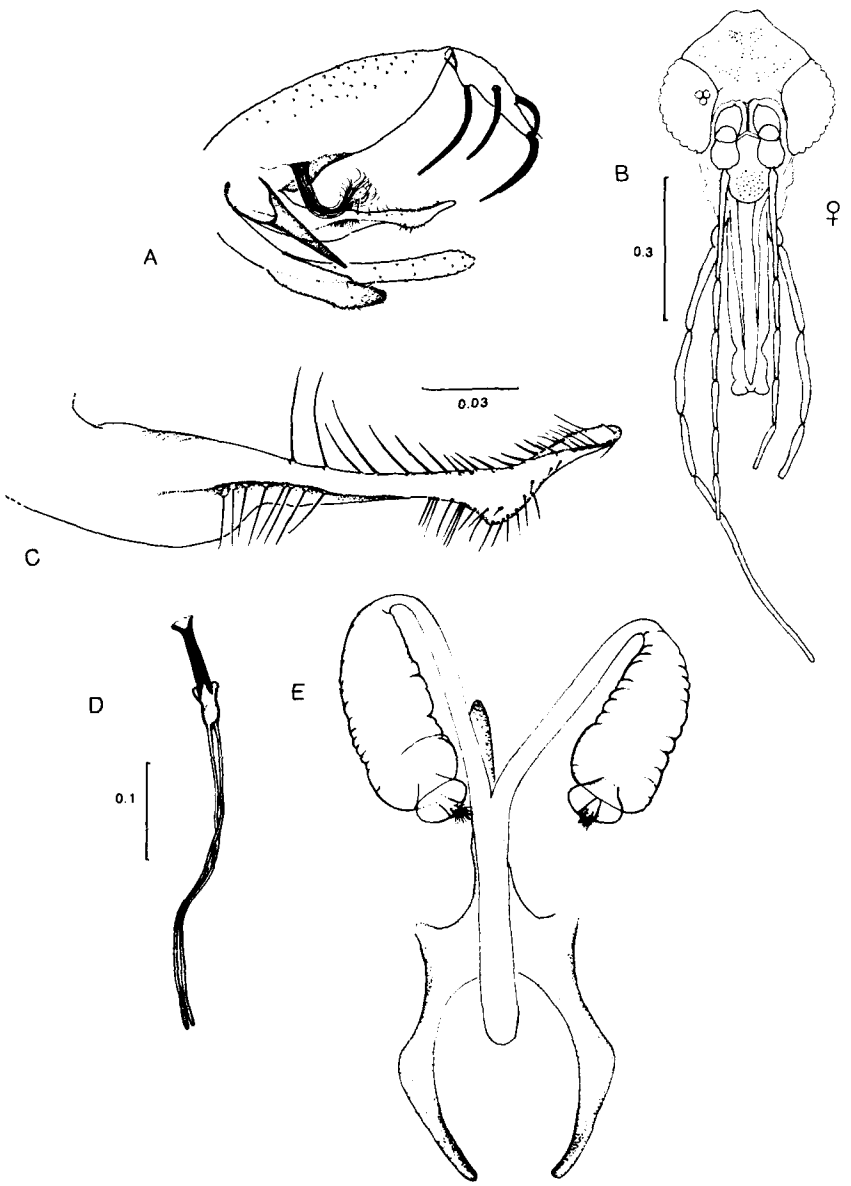


FIG. 84. ***Lutzomyia townsendi.*** A. Male terminalia; B. Female head; C. Paramere; D. Genital pump & filaments; E. Spermathecae.

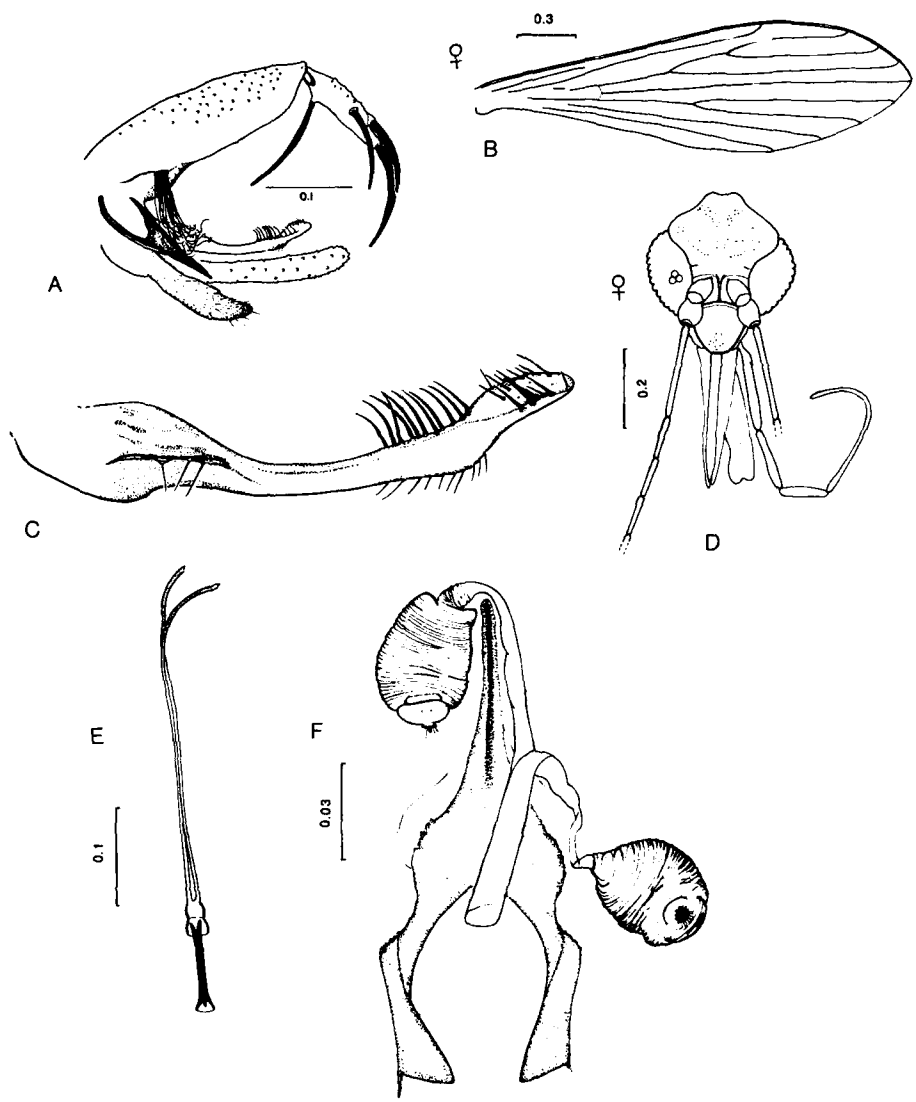


FIG. 85. ***Lutzomyia quasitownsendi***. A. Male terminalia; B. Female wing; C. Paramere; D. Female head; E. Genital pump & filaments; F. Spermathecae (Fig. A from Young 1979).

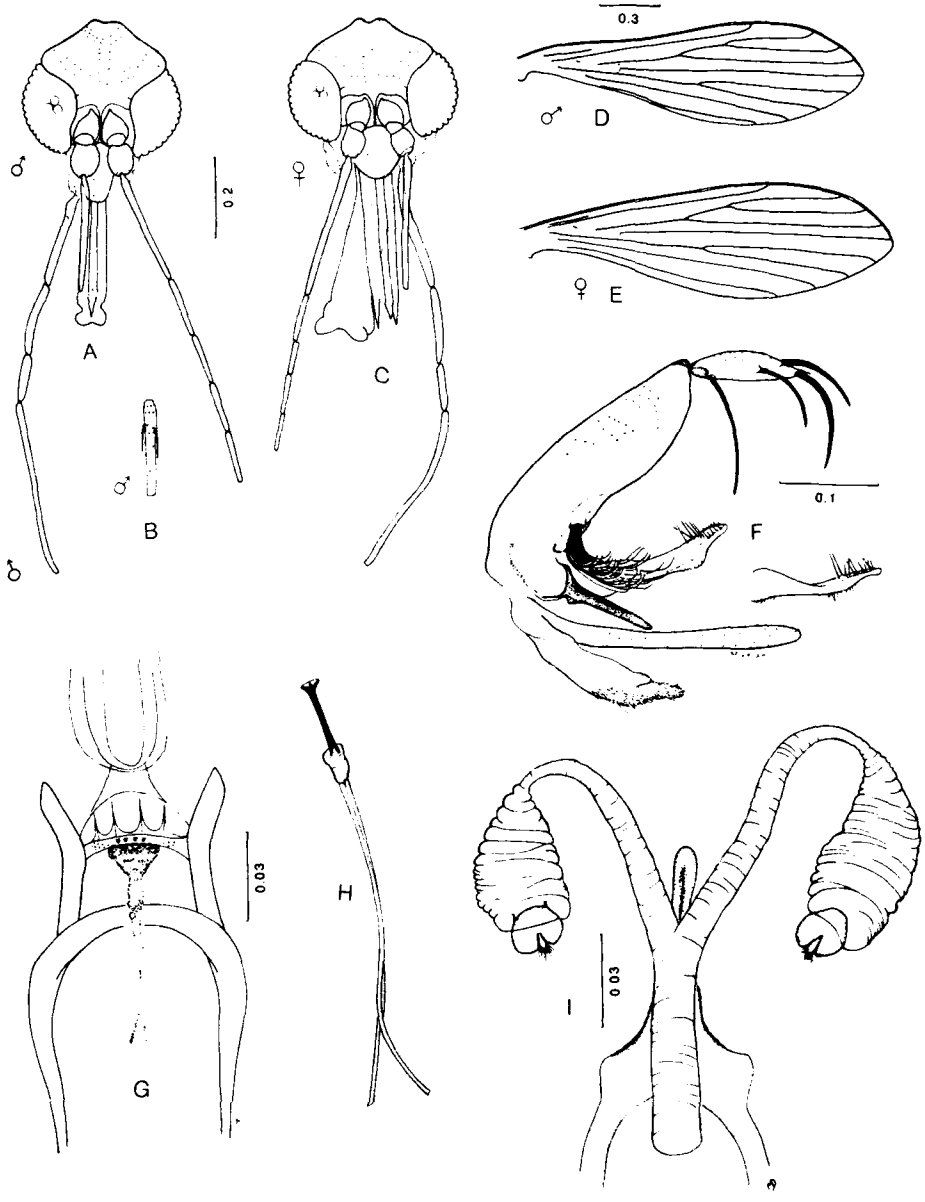


FIG. 86. ***Lutzomyia youngi***. A. Male head; B. Male flagellomere II; C. Female head; D. Male wing; E. Female wing; F. Male terminalia with another view of paramere; G. Female cibarium; H. Genital pump & filaments; I. Spermathecae (after Feliciangeli & Murillo 1987).

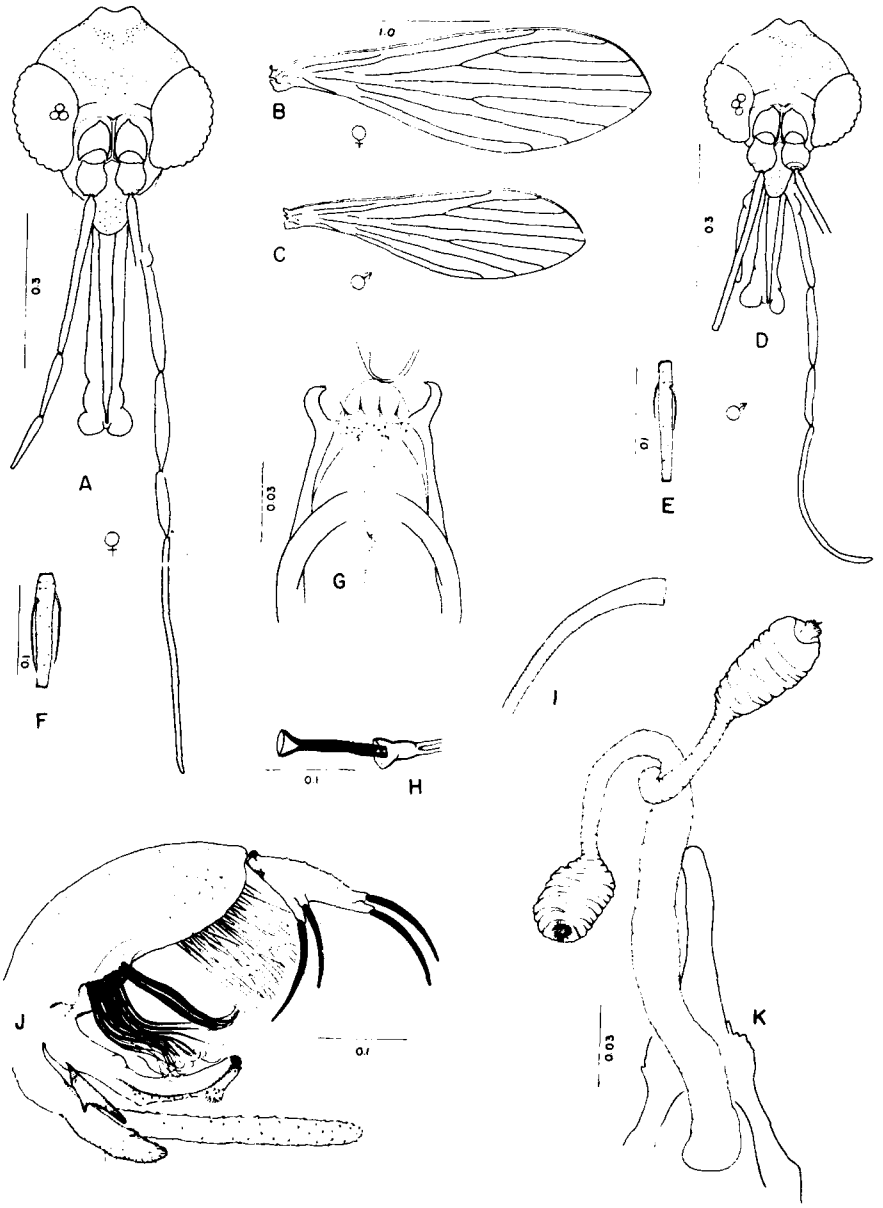


FIG. 87. ***Lutzomyia moralesi***. A. Female head; B. Female wing; C. Male wing; D. Male head; E. Male flagellomere II; F. Female flagellomere II; G. Female cibarium; H. Genital pump; I. Tip of genital filament; J. Male terminalia; K. Spermathecae (from Young 1979).

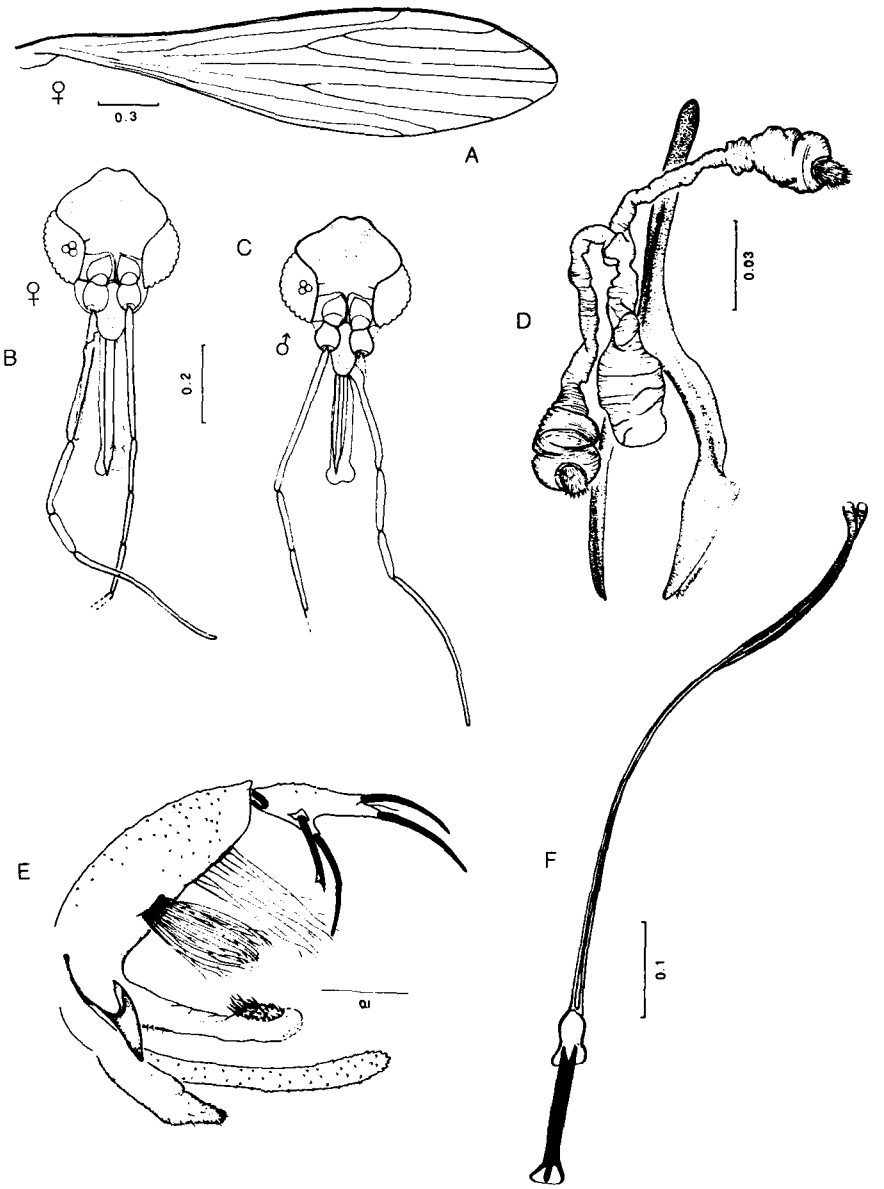


FIG. 88. ***Lutzomyia andina.*** A. Female wing; B. Female head; C. Male head; D. Spermathecae; E. Male terminalia; F. Genital pump & filaments.

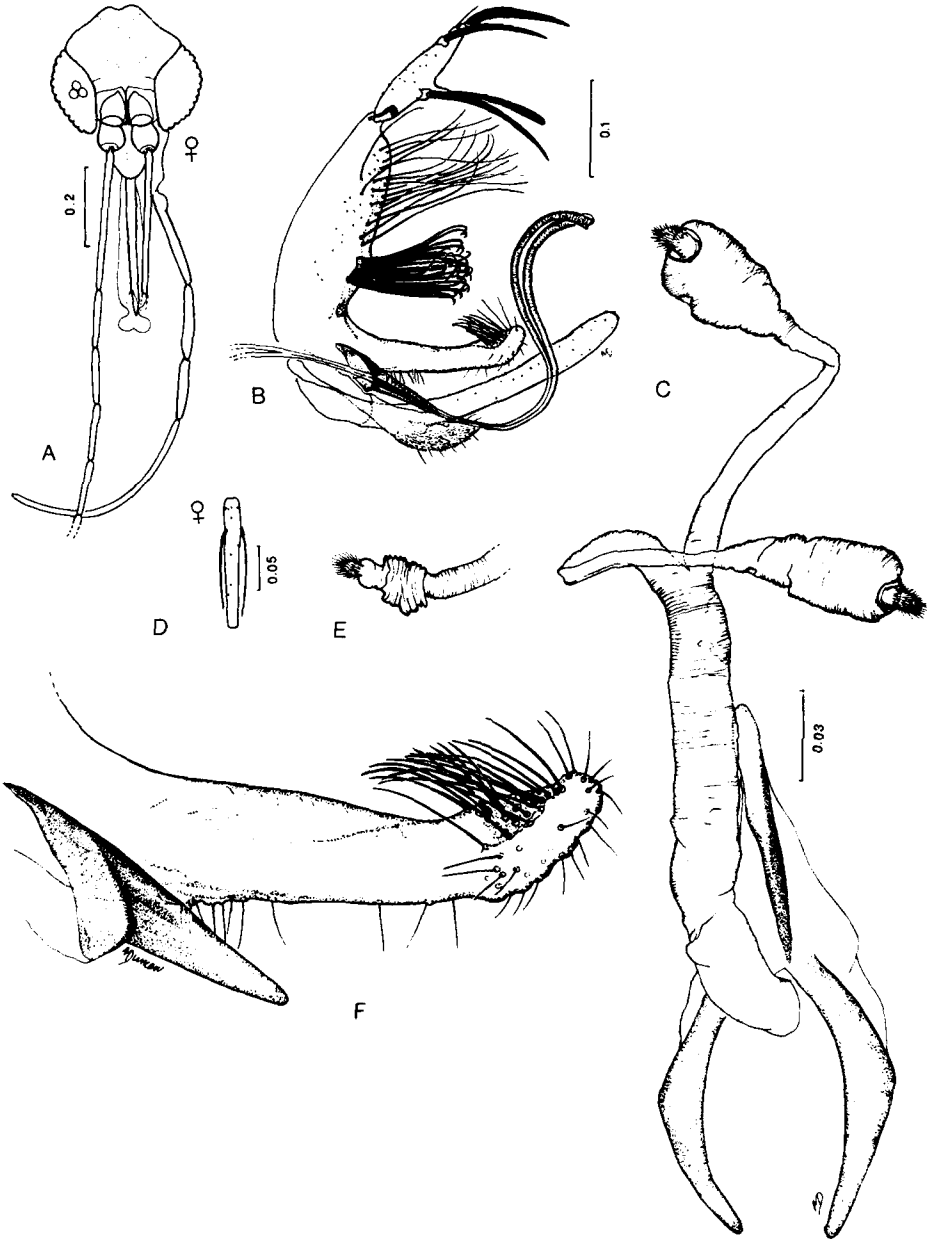


FIG. 89. ***Lutzomyia aulari***. A. Female head; B. Male terminalia; C. Spermathecae; D. Female flagellomere II; E. Spermathecae, contracted; F. Paramere.

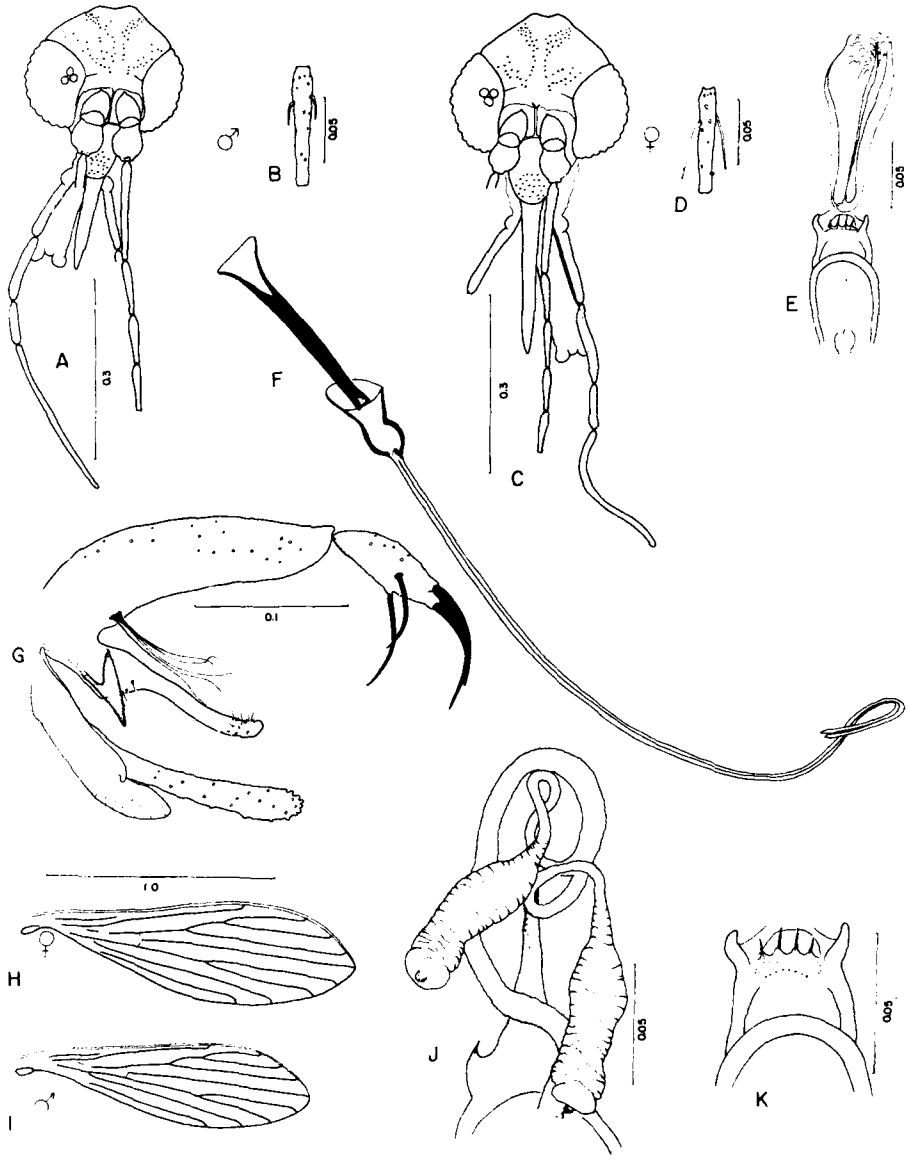


FIG. 90. ***Lutzomyia ovallesi.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Female wing; I. Male wing; J. Spermathecae; K. Female cibarium (from Young 1979).

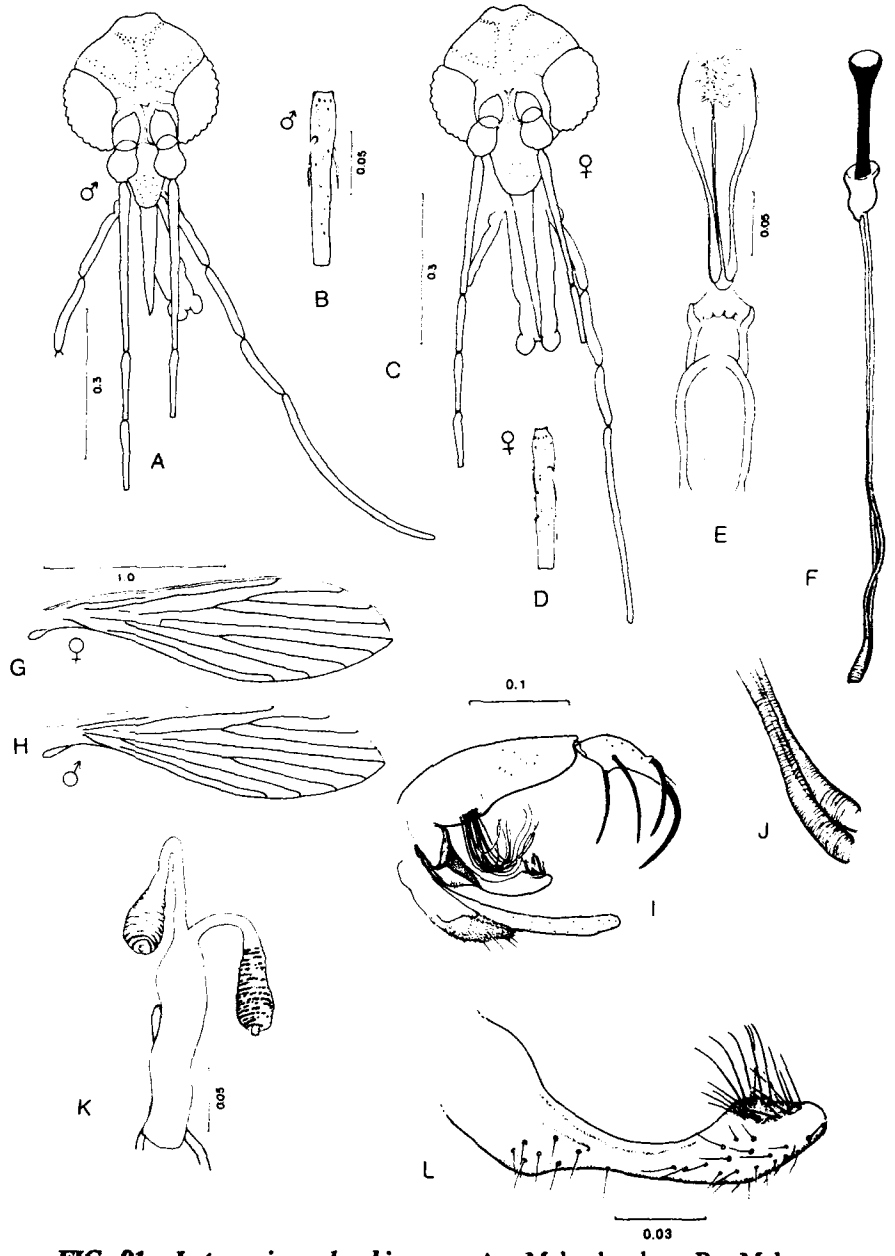


FIG. 91. ***Lutzomyia columbiana***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Female wing; H. Male wing; I. Male terminalia; J. Tip of genital filaments; K. Spermathecae; L. Paramere (Figs. A-H & K from Young 1979).

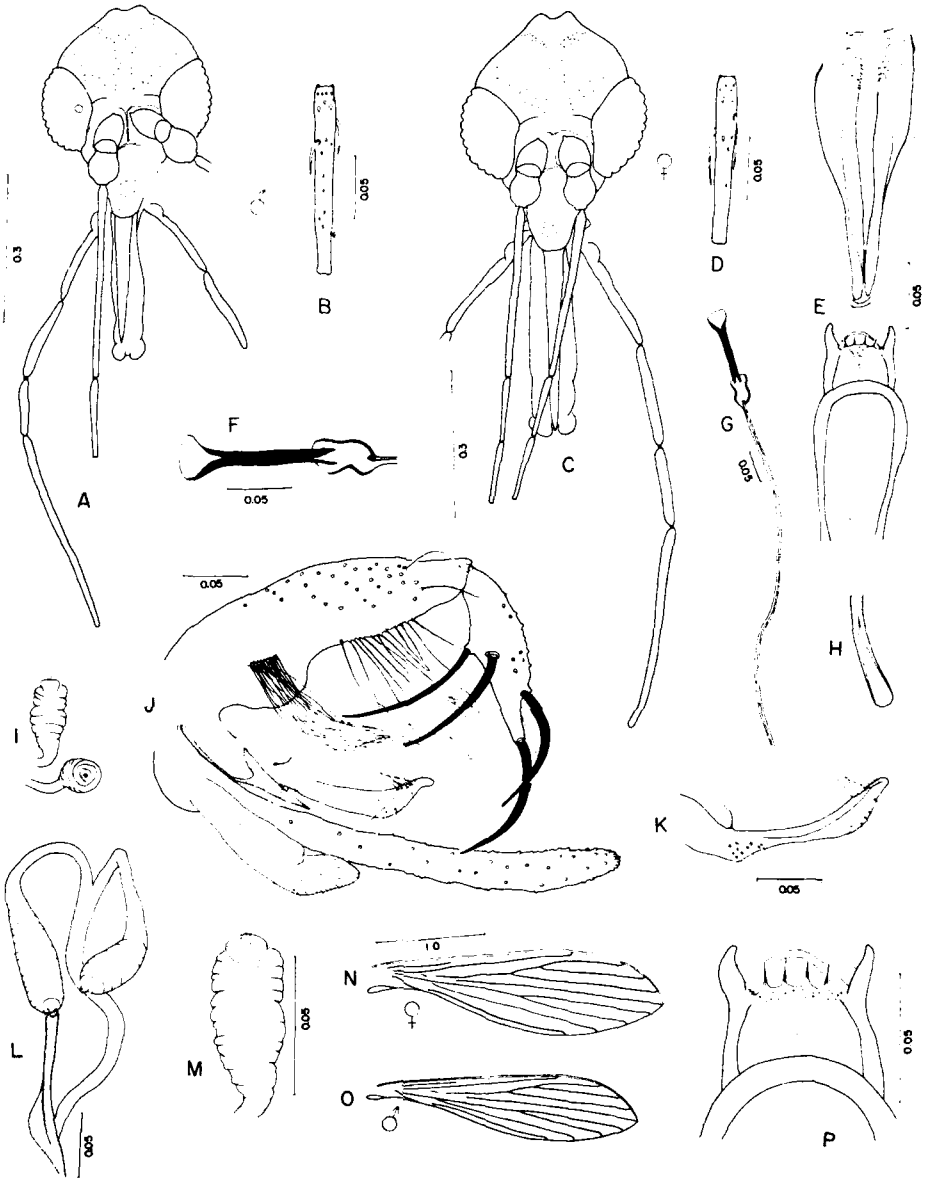


FIG. 92. ***Lutzomyia verrucarum.*** A. Male head; B. Male flagellomere II; C. Female head ; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump; G. Genital pump & filaments; H. Tip of genital filament; I. Spermathecae, partially contracted; J. Male terminalia; K. Paramere; L. Female spermathecae; M. Spermatheca; N. Female wing; O. Male wing; P. Female cibarium.

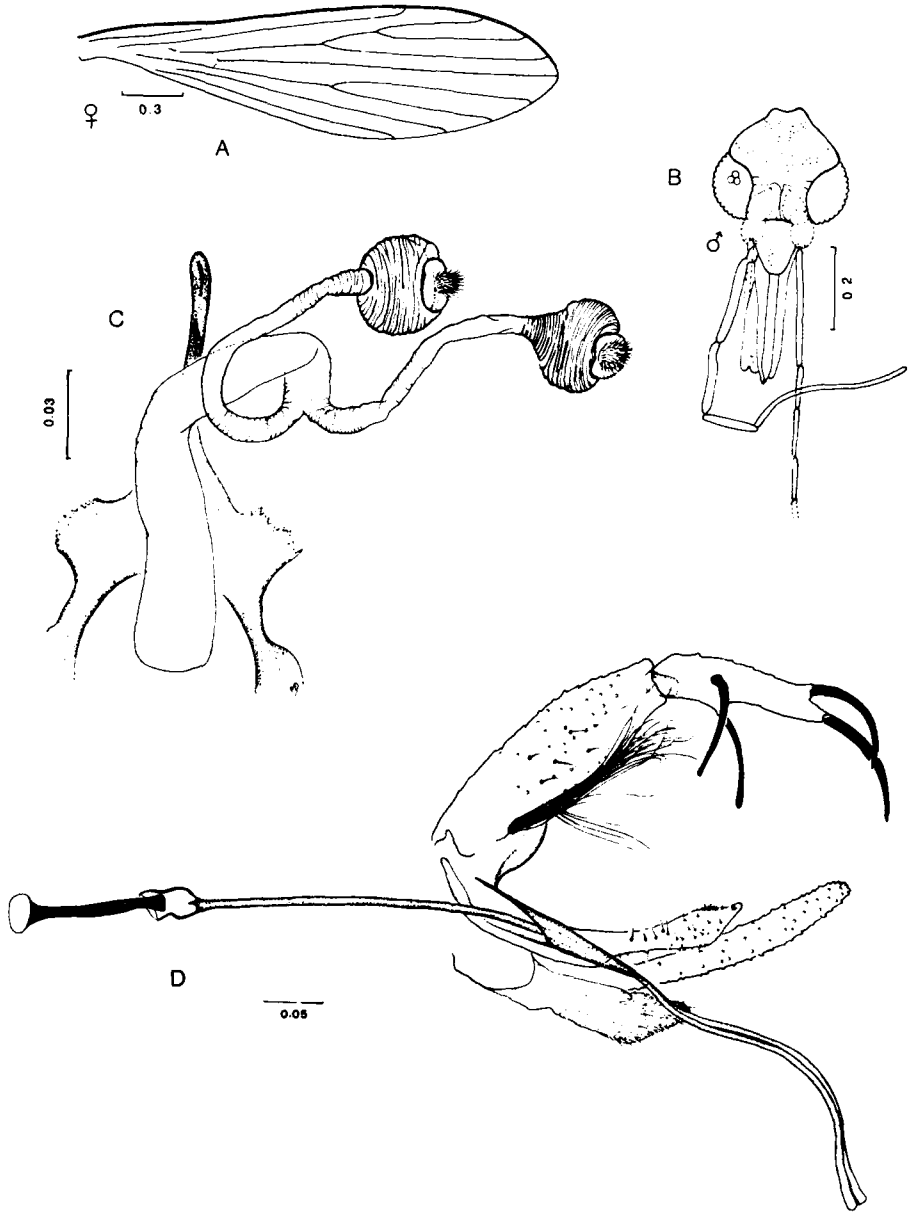


FIG. 93. ***Lutzomyia disiuncta***. A. Female wing; B. Male head; C. Spermathecae; D. Male terminalia (figs. from Young 1979).

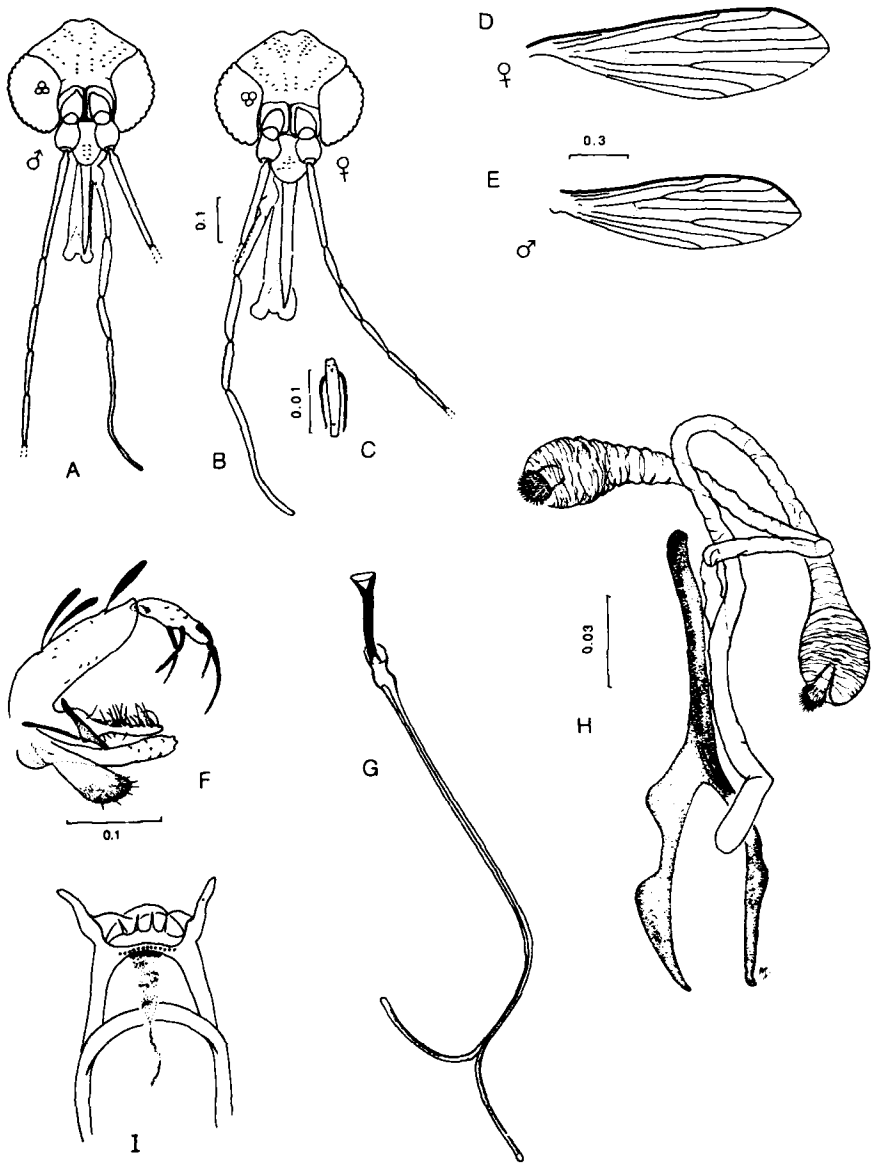


FIG. 94. ***Lutzomyia nevesi.*** A. Male head; B. Female head; C. Female flagellomere II; D. Female wing; E. Male wing; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female cibarium.

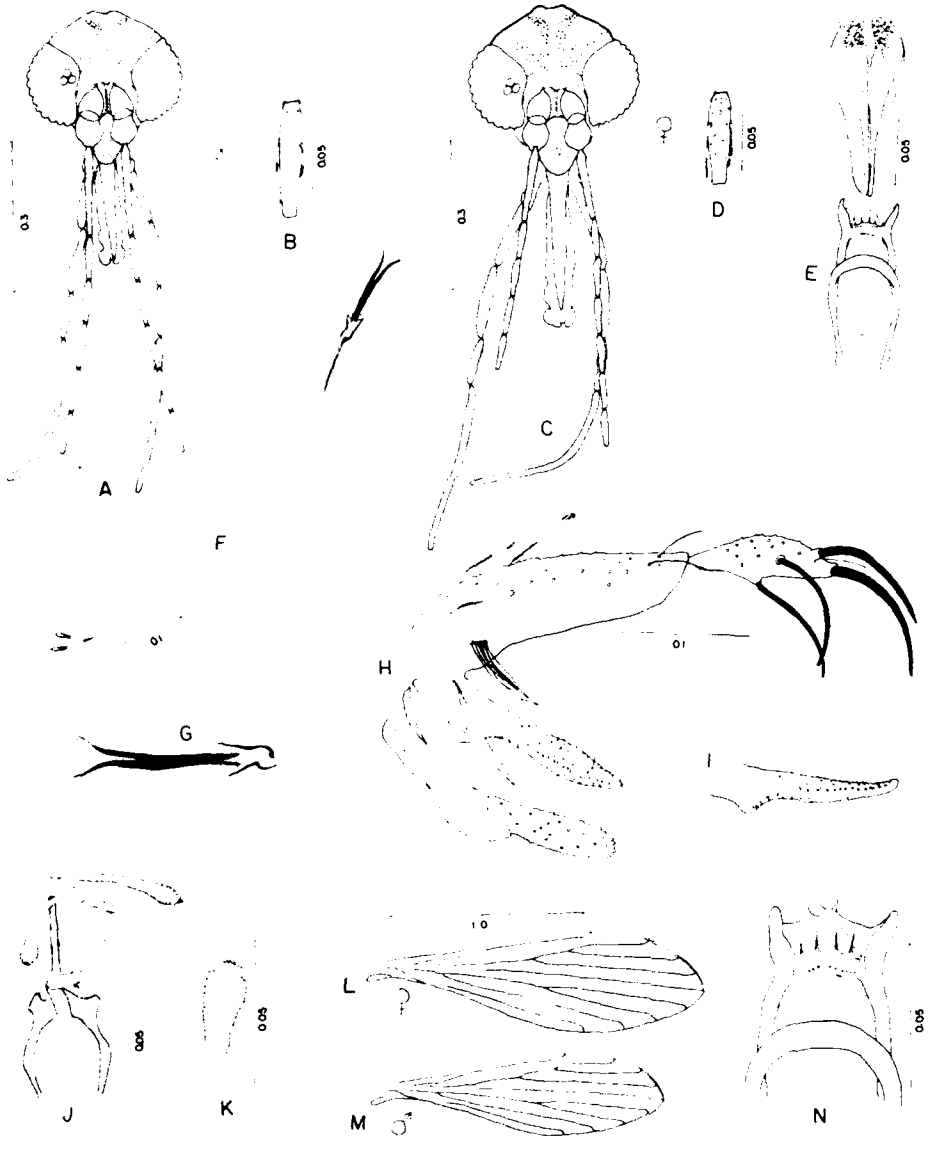


FIG. 95. ***Lutzomyia evansi***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Genital pump, same scale as J; H. Male terminalia; I. Paramere, outer aspect J. Spermathecae; K. Body of spermatheca; L. Female wing; M. Male wing; N. Female cibarium. (from Young 1979).

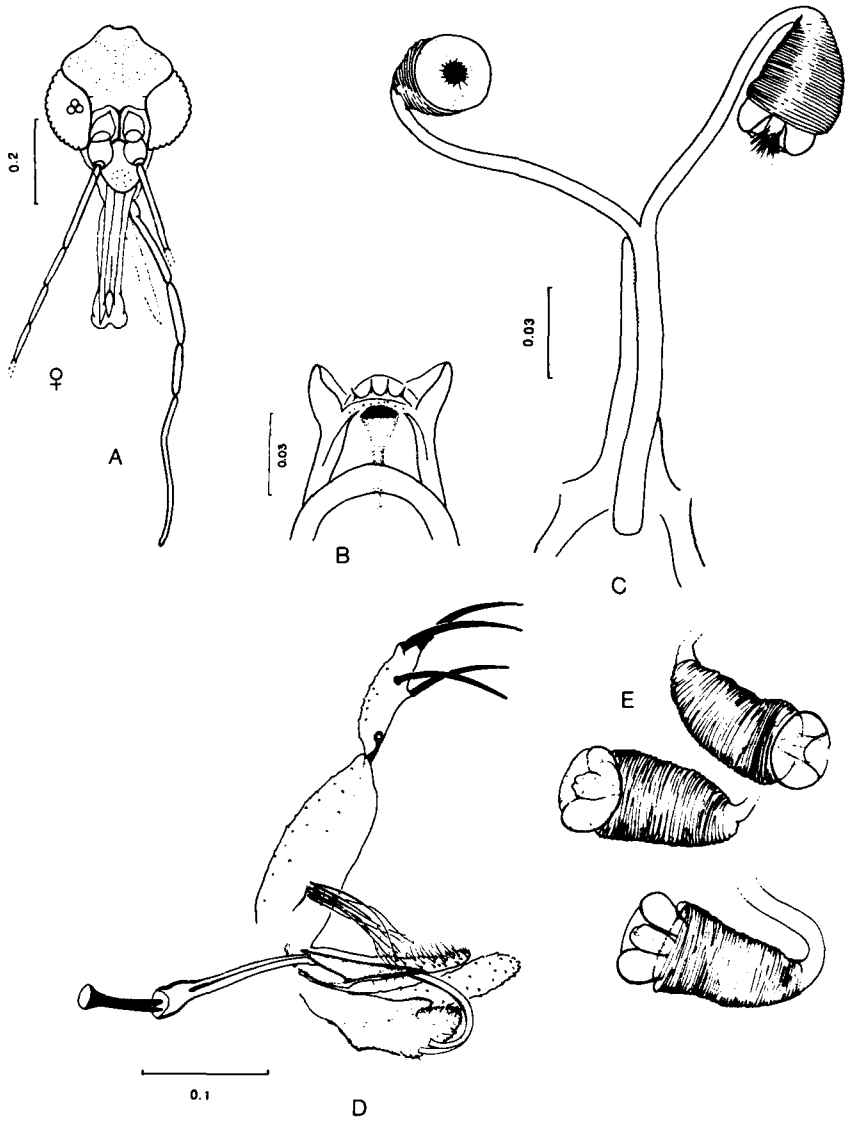


FIG. 96. ***Lutzomyia nuneztovari.*** A. Female head; B. Female cibarium; C. Spermathecae; D. Male terminalia; E. Spermathecae (figs. B & D from Young 1979).

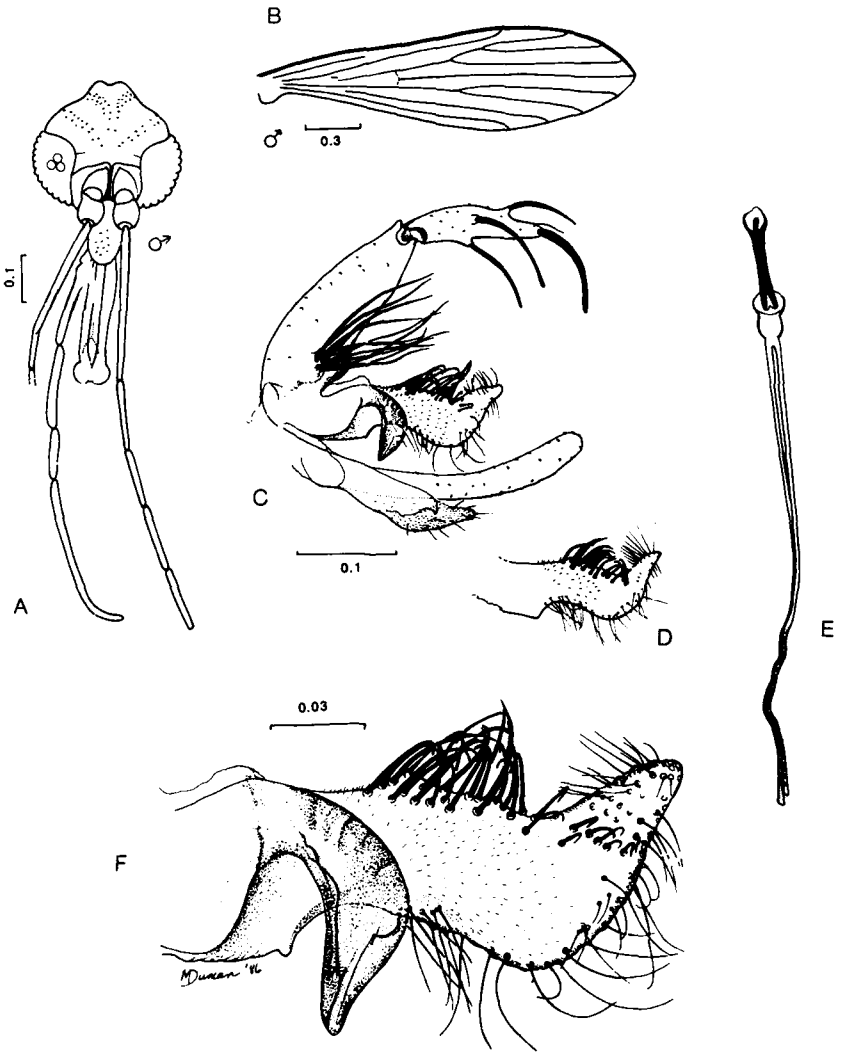
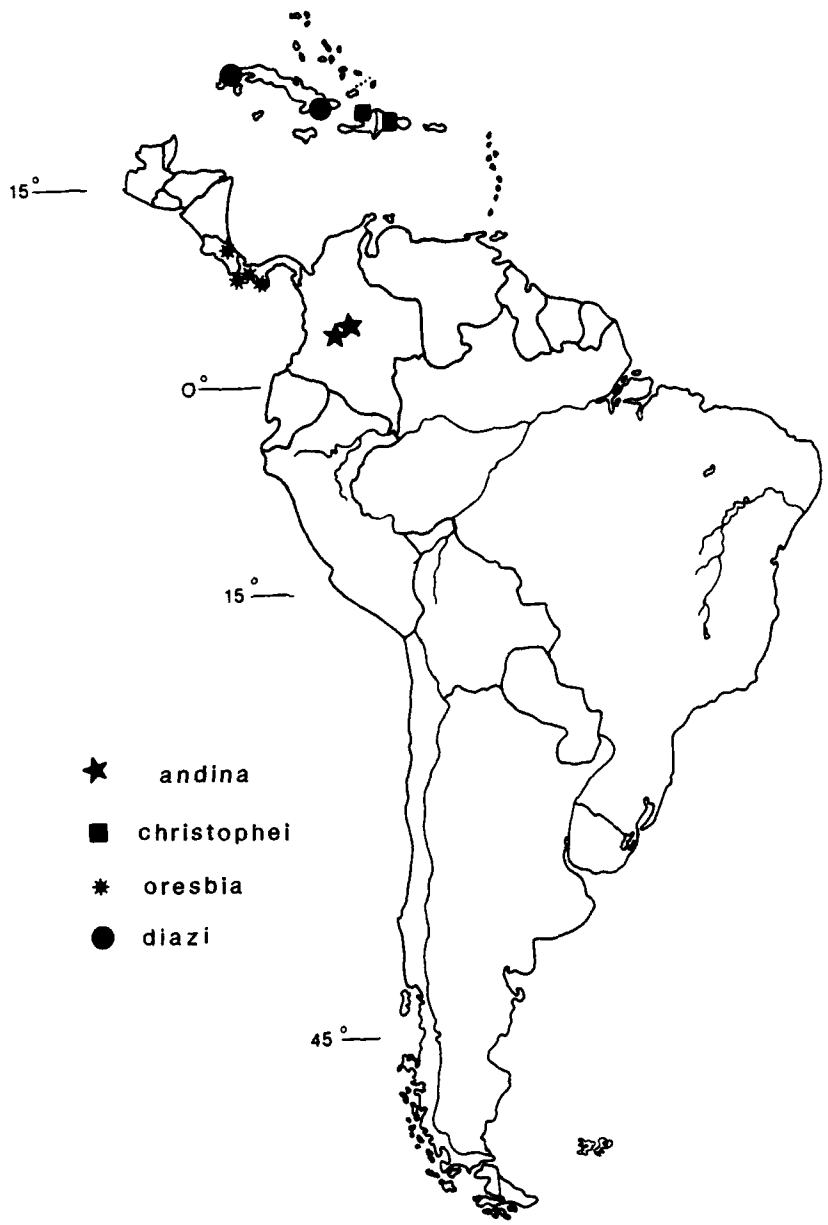


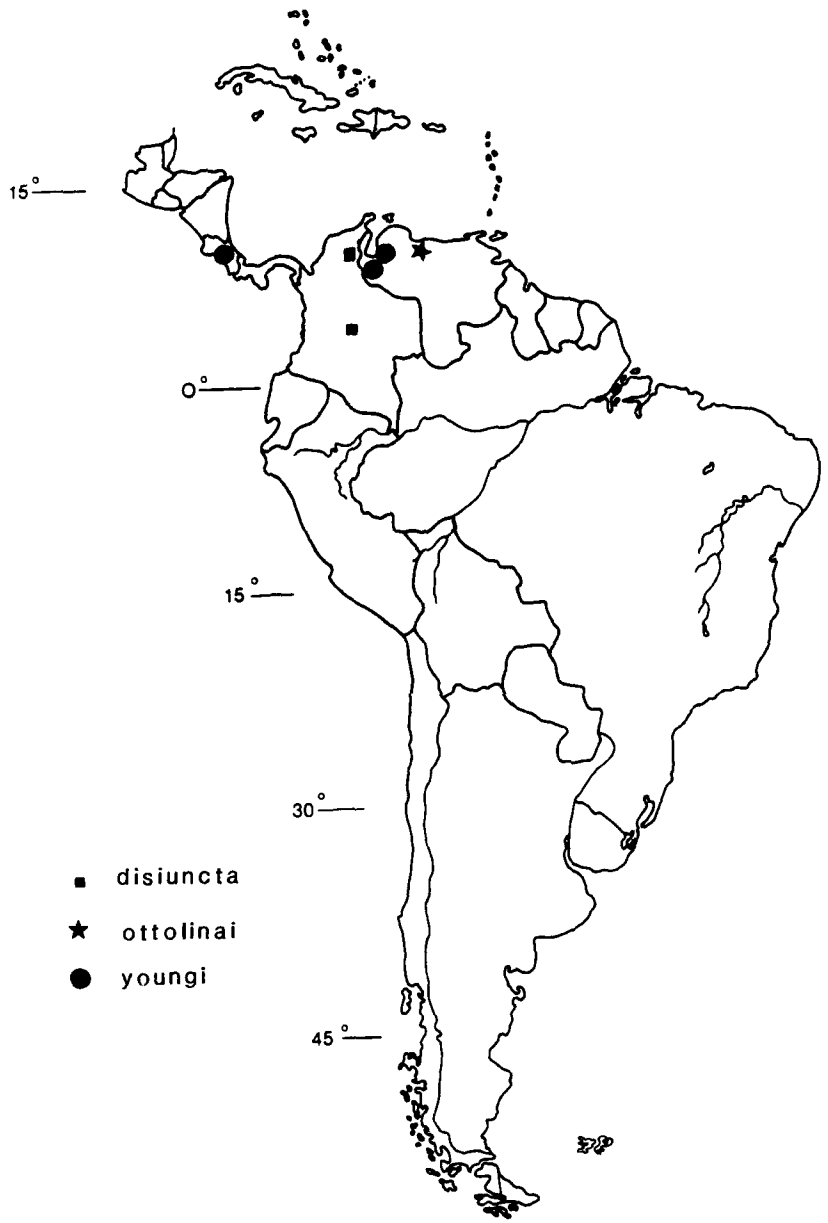
FIG. 97. ***Lutzomyia deorsa.*** A. Male head; B. Male wing; C. Male terminalia; D. Paramere; E. Genital pump & filaments; F. Paramere & aedeagus (from Pérez et al. 1991).



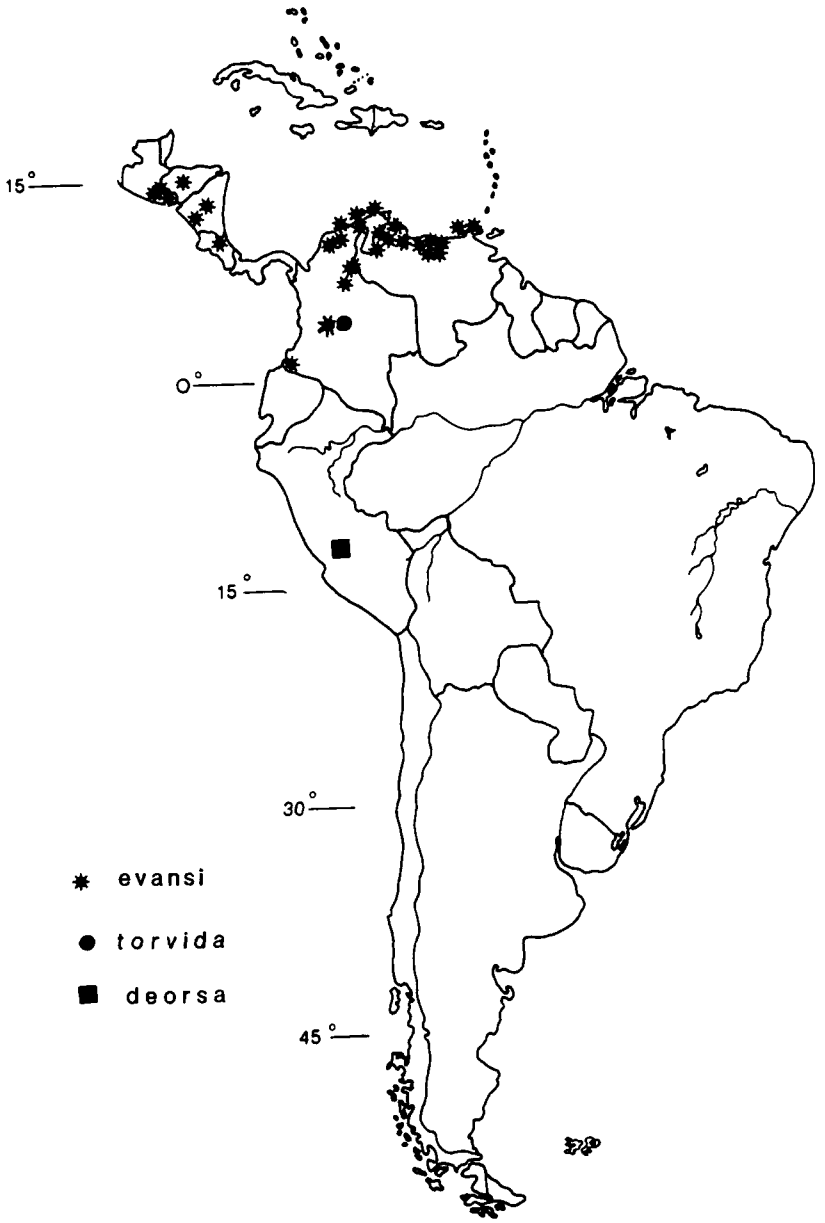
Map 29

Map 30

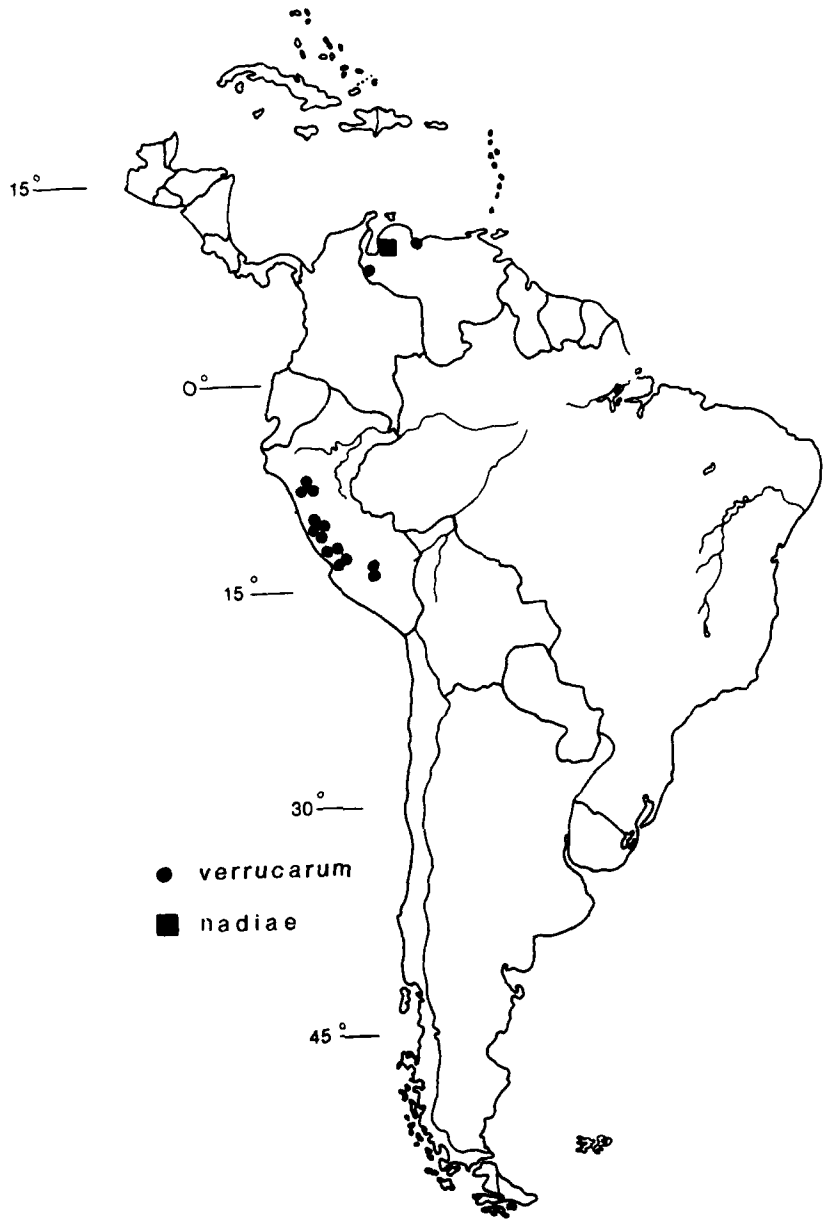
Map 31



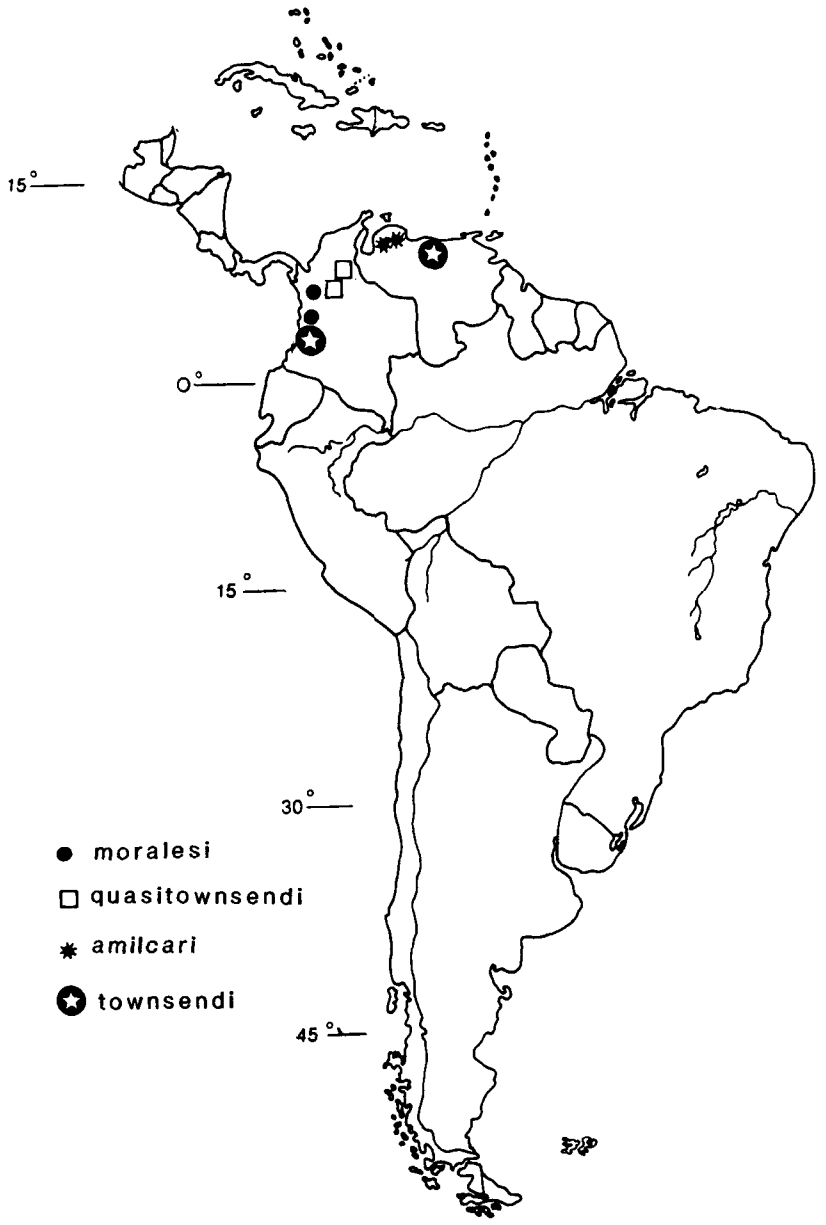
Map 32



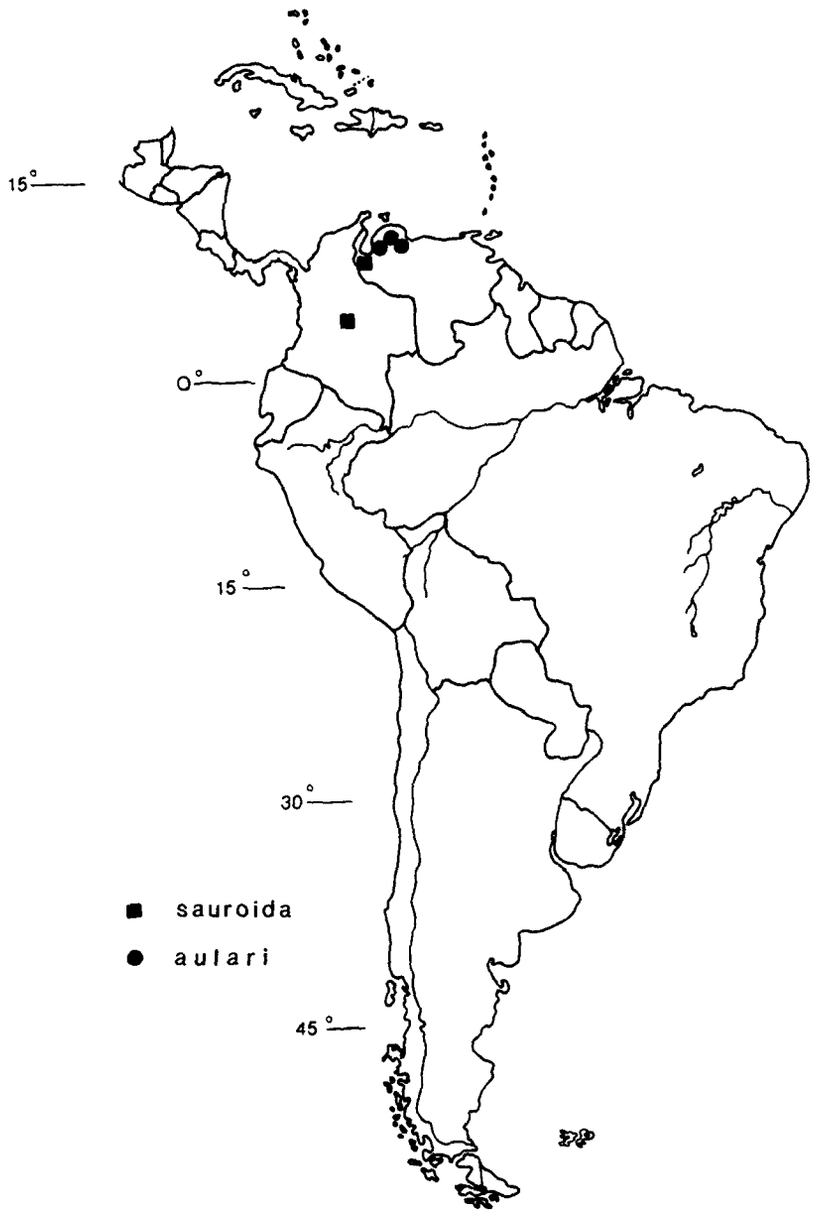
Map 33



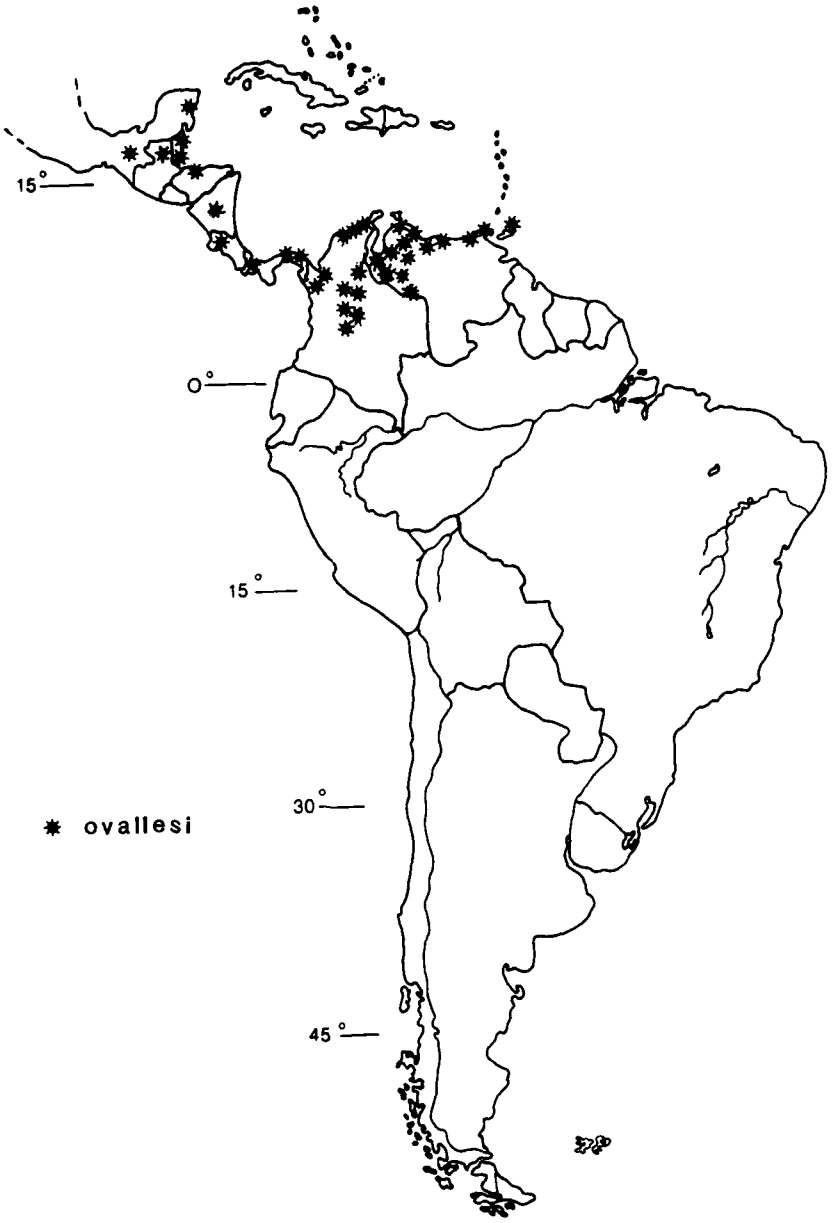
Map 34



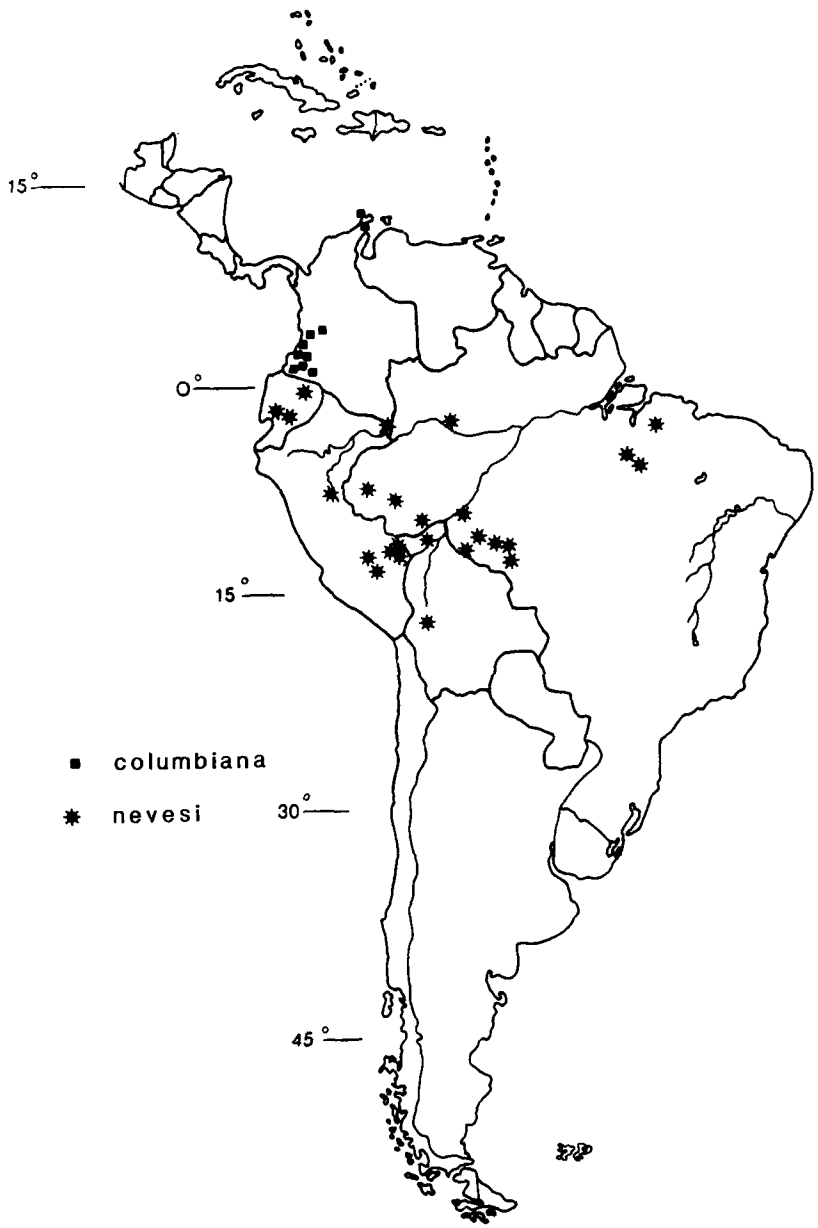
Map 35



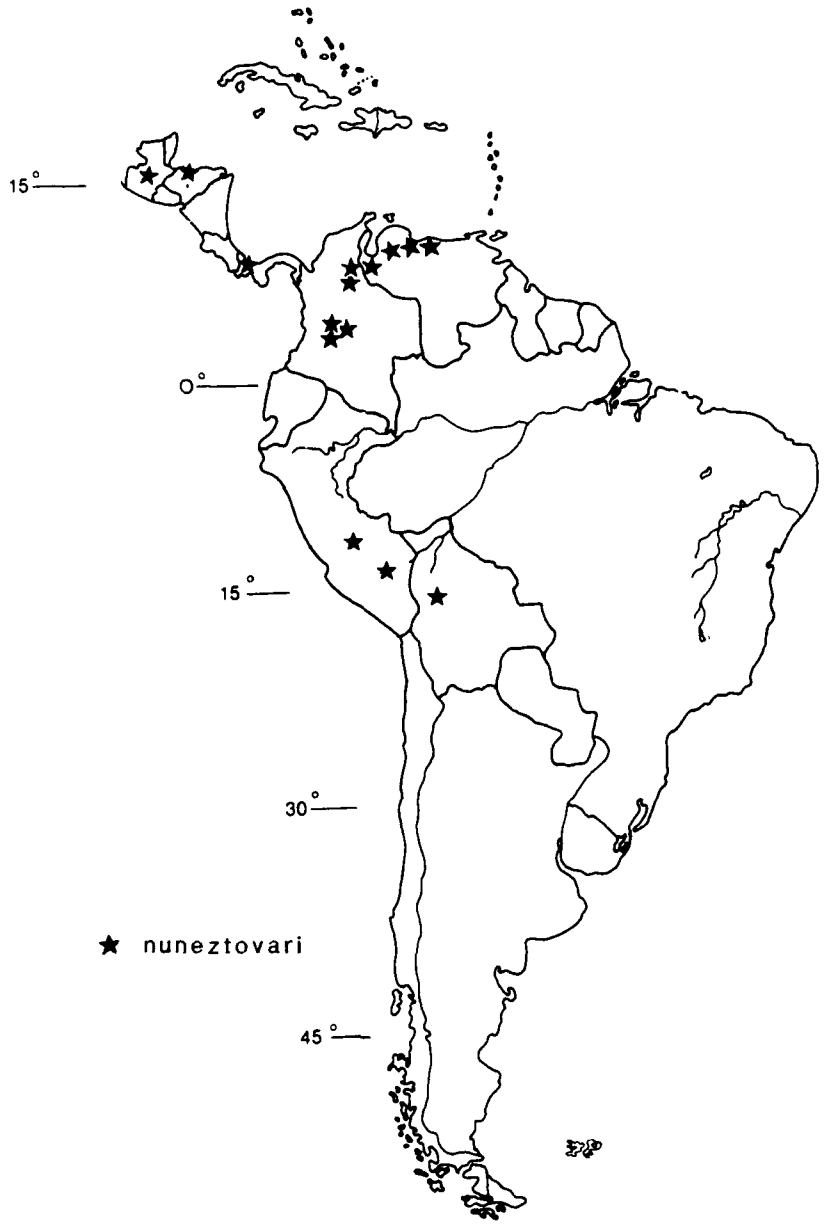
Map 36



Map 37



Map 38



Map 39

SUBGENUS *COROMYIA* BARRETTO

Lutzomyia, subgenus *Coromyia* Barretto 1962: 97 (type species: *Phlebotomus vespertilionis* by orig. designation). Forattini 1971a: 101; 1973: 273 (in part, defined). Martins et al. 1978: 88. Artemiev 1991: 74 (in part).
Lutzomyia, subgenus *Dampfomyia* (in part): Forattini 1971a: 100; 1973: 329.
Lutzomyia species group *vespertilionis* Theodor 1965: 183. Lewis et al. 1977: 325. Young 1979: 88.

Identification. Coloration pale to light brown. Antennal ascoids simple. Palpomere 5 usually longer than palps. 3 + 4. ♀ cibarium with 4 horizontal teeth; variable number of vertical teeth; complete arch. Pharynx unarmed. Spermathecae sac-like (series *vespertilionis*) or highly modified (series *deleoni*). ♂ *genitalia*. Coxite with persistent setae at base. Style with 2-4 spines & small subterminal seta; other small setae may be present. Parameres simple, without lateral, ventral or dorsal arms. Lateral lobes markedly inflated.

Medical Importance. Unknown; females feed on bats and other small mammals. There are few reports of man biting behavior.

Key to the Males of the Subgenus *Coromyia*

1. Style with 3-4 strong spines. Paramere with acute ventral projection (series *deleoni*) 2
   Style with 2 strong spines. Paramere lacking acute ventral projection (series *vespertilionis*) 4

2. Style with 3 strong spines . . . . . *L. vesicifera* (Fig. 98)
   Style with 4 strong spines 3

3. Paramere apically clubbed . . . . . *L. zeledoni* (Fig. 99D,G-H)
   Paramere otherwise, relatively slender . . . . . *L. deleoni* (Fig. 99I-J)

4. Genital filaments 3X length of genital pump or longer. Style lacking subterminal seta but with small basal & median setae . . . . . *L. viriosa* (Fig. 100A)
   Genital filaments shorter than 3X length of pump. Style with subterminal seta & small basal seta 5

5. Style with median spine inserted at middle of structure . . . . . *L. steatopyga* (Fig. 100F)
   Style with corresponding spine inserted well beyond middle of structure 6

6. Paramere with dorsal setae restricted to distal third of structure 7
   Paramere with dorsal setae covering distal half or more of structure . . . . . *L. vespertilionis* (Fig. 101G-H)

7. Style with spines inserted close together; distance between them subequal to 3X diameter of terminal spine . . . . . *L. isovespertilionis* (Fig. 101F)
   Style with spines will separated, distance between them 4 or more times width of terminal spine 8

8. Lateral lobe length less than 4X maximum width . . . *L. disneyi* (Fig. 102C)
   Lateral lobe length greater than 6X maximum width . . . . . *L. beltrani* (Fig. 102A)

Key to the Females of the Subgenus *Coromyia**

1. Spermathecae with large, bladder-like lateral expansion (series *deleoni*) . . . . . *L. vesicifera* (Fig. 98D)
   L. deleoni
   L. zeledoni
   Spermathecae otherwise; wrinkled, weakly annulated, sac-like or barrel-shaped 2

2. Individual & common sperm ducts slender, about subequal in length; individual ducts longer than spermathecae . . . . . *L. virosa* (Fig. 100C)
   Individual sperm ducts shorter than common ducts, or spermathecae 3

3. Common sperm duct broad, not more than 2X as long as wide . . . . . *L. beltrani* (Fig. 102D)
   L. steatopyga (Fig. 100E)
   L. disneyi
   Common sperm duct more slender, at least 3X as long as wide . . . . . *L. vespertilionis* (Fig. 101J)
   L. isovespertilionis

Lutzomyia* (*Coromyia*) *vesicifera (Fairchild & Hertig)
Fig. 98

Phlebotomus vesiciferus Fairchild & Hertig 1947b: 620 (♂, ♀, Cruces Trail, Panama Canal Zone); 1958a: 510 (refs., ♀ fig.).
Lutzomyia vesicifera: Barretto 1962: 97. Theodor 1965: 184. Forattini 1973: 333 (♂, ♀ figs., tax.). Martins et al. 1978: 92 (refs., ♂, ♀ figs.). Zeledón & Murillo 1983: 280 (Nicaragua). Christensen et al. 1983: 466 (Panama). Young

*From Fairchild & Hertig (1958a), in part.

& Murillo 1984: 712 (♂ fig.). Murillo & Zeledón 1985: 84 (♂, ♀ figs., Costa Rica).

Distribution (Map 40). NICARAGUA (Zeledón & Murillo 1983); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978).

Lutzomyia (*Coromyia*) *zeledoni* Young & Murillo
Fig. 99 A-H

Lutzomyia zeledoni Young & Murillo 1984: 711 (♂, Brasilito, Guanacaste, Costa Rica). Murillo & Zeledón 1985: 87 (♂ fig., Costa Rica). Le Pont et al. 1987: 273 (♀ descript., Nicaragua).

Distribution (Map 41). COSTA RICA; HONDURAS (Young & Murillo 1984); NICARAGUA (Le Pont et al. 1987).

Remarks. Females have been captured with males of *L. zeledoni* at the type locality and in Nicaragua. It is not possible structurally to distinguish females of this species from those of *L. deleoni* or *L. vesicifera*.

Lutzomyia (*Coromyia*) *deleoni* (Fairchild & Hertig)
Fig. 99 I-J

Phlebotomus deleoni Fairchild & Hertig 1947b: 622 (♂, ♀, Peten, Guatemala); 1958a: 510 (full refs., keyed).

Lutzomyia deleoni: Barretto 1962: 97 (listed). Theodor 1965: 184 (♀ fig.). Williams 1970b: 333 (coll. data, Belize); 1976b: 603 (in caves, Belize); 1976c: 616 (neg. for flagellates, Belize). Forattini 1973: 329 (figs.). Martins et al. 1978: 92 (refs., dist.). Murillo & Zeledón 1985: 84 (♂, ♀ figs., Costa Rica). Porter et al. 1987: 930 (human bait collection, Guatemala). Rowton et al. 1991: 501 (human bait collection, Guatemala).

Distribution (Map 42). MEXICO; GUATEMALA; BELIZE; HONDURAS; EL SALVADOR (Martins et al. 1978); COSTA RICA (Murillo & Zeledón 1985).

Lutzomyia (*Coromyia*) *viriosa* (Fairchild & Hertig)
Fig. 100 A, C-D

Phlebotomus viriosus Fairchild & Hertig 1958a: 510 (♂, ♀, Almirante, Bocas del Toro, Panama).

Lutzomyia viriosa: Barretto 1962: 97 (listed). Theodor 1965: 184 (listed). Forattini 1973: 291 (♂, ♀ figs., tax.). Martins et al. 1978: 91 (refs., dist.). Christensen et al. 1983: 466 (Panama). Murillo & Zeledón 1985: 82 (♂, ♀ figs., Costa Rica).

Distribution (Map 43). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978).

Lutzomyia (Coromyia) steatopyga (Fairchild & Hertig)
Fig. 100 B, E-F

Phlebotomus steatopygus Fairchild & Hertig 1958a: 512 (♂, ♀, Palenque, Chiapas, Mexico).

Lutzomyia steatopyga: Barretto 1962: 97 (listed). Theodor 1965: 184 (listed). Forattini 1973: 289 (♂ fig., tax.). Williams 1976a: 595 (cf. to *beltrani*, Belize form). Martins et al. 1978: 91 (refs., dist.).

Distribution (Map 40). MEXICO (type locality).

Remarks. This species was reported in Belize by Williams (1970b), who later (1976a) pointed out differences between Belize males and those from Mexico.

Lutzomyia (Coromyia) vespertilionis (Fairchild & Hertig)
Fig. 101 A-E, G-M

Phlebotomus vespertilionis Fairchild & Hertig 1947b: 617 (♂, ♀, Cerro Campana, Panama); 1958a: 514 (redescript. ♂, fig.).

Lutzomyia vespertilionis: Barretto 1962: 97 (listed). Theodor 1965: 184 (♂, ♀ figs.). Martins et al. 1978: 91 (refs., dist., ♂, ♀ figs.). Young 1979: 90 (figs., refs., dist.). Christensen & Herrer 1980b: 523 (feeding habits). Zeledón & Murillo 1983: 280 (Nicaragua). Christensen et al. 1983: 466 (Panama). Young & Rogers 1984: 599 (Ecuador). Murillo & Zeledón 1985: 81 (♂, ♀ figs., Costa Rica). Alexander et al. 1992a: 35; 1992c: 124 (Ecuador).

Distribution (Map 44). COSTA RICA (Murillo & Zeledón 1985); PANAMA; COLOMBIA; ECUADOR (Martins et al. 1978; Young 1979; Alexander et al. 1992a,c).

Remarks. As the specific name indicates, *L. vespertilionis* is associated with bats and probably serves as an important vector of *Trypanosoma* throughout its range (Christensen & Herrer 1975).

Lutzomyia (Coromyia) isovespertilionis (Fairchild & Hertig)
Fig. 101 F

Phlebotomus isovespertilionis Fairchild & Hertig 1958a: 516 (♂, ♀, Panama Canal Zone).

Lutzomyia isovespertilionis: Barretto 1962: 97 (listed). Forattini 1973: 287 (♂ fig., tax.). Christensen et al. 1983: 466 (Panama). Martins et al. 1978: 90 (refs.,

dist.). Young 1979: 88 (♂ fig., refs., dist.). Murillo & Zeledón 1985: 78 (♂ fig., Costa Rica).

Distribution (Map 41). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979).

Remarks. As discussed by Fairchild & Hertig (1958a), the adults of this and *L. vespertilionis* are structurally similar. Hanson (1968) could not detect differences between the immature stages of the species.

Lutzomyia (*Coromyia*) *disneyi* Williams
Fig. 102 C

Lutzomyia disneyi Williams 1987: 525 (♂, ♀, San Antonio, Cayo District, Belize).
Lutzomyia beltrani (Belize form): Williams 1976a: 595 (tax., figs.); 1976b: 601; 1976c: 615 (nat. flagellate infections).

Distribution (Map 40). BELIZE (Williams 1976b); GUATEMALA (2 ♂♂, 3 ♀♀, Coop. Tanhoc, Poptun, Peten, June 1981, C.H. Porter).

Remarks. This species is probably a vector of *Trypanosoma leonidasdeanesi*, a blood parasite of bats, in Belize. Williams (1976b,c) determined that *L. disneyi* was the most common *Lutzomyia* spp. found in selected limestone caves that he sampled in this country.

Lutzomyia (*Coromyia*) *beltrani* (Vargas & Nájera)
Fig. 102 A-B, D

Phlebotomus beltrani Vargas & Nájera 1951b: 101 (♂, San Andres Tuxtla, Veracruz, Mexico). Fairchild & Hertig 1958a: 512 (♂, ♀, redescript., figs.).
Lutzomyia beltrani: Barretto 1962: 97 (listed). Theodor 1965: 184 (listed). Forattini 1973: 283 (♂, ♀ figs., tax.). Williams 1976a: 595 (variant form, Belize). Martins et al. 1978: 90 (dist. refs.).

Distribution (Map 43). MEXICO; HONDURAS (Fairchild & Hertig 1958a).

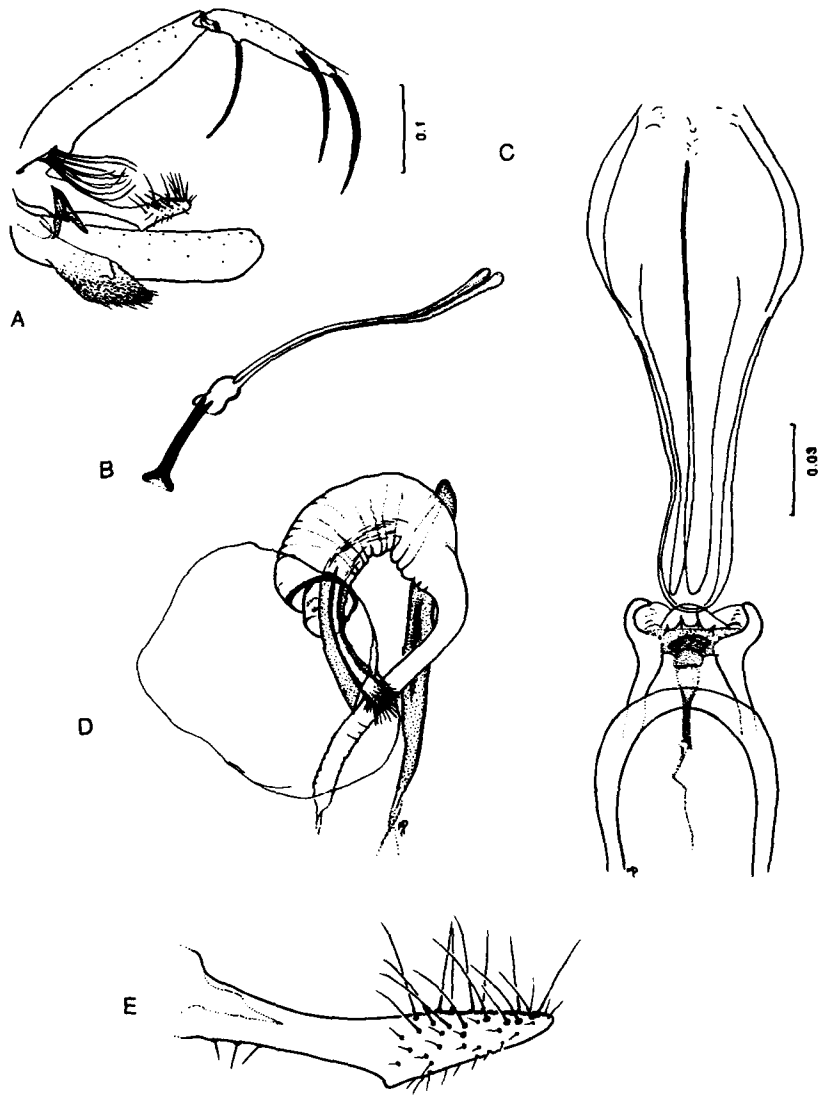


FIG. 98. ***Lutzomyia vesicifera.*** A. Male terminalia; B. Genital pump & filaments; C. Female cibarium & pharynx; D. Spermatheca, other one not shown; E. Paramere (Fig. E from Young & Murillo 1984).

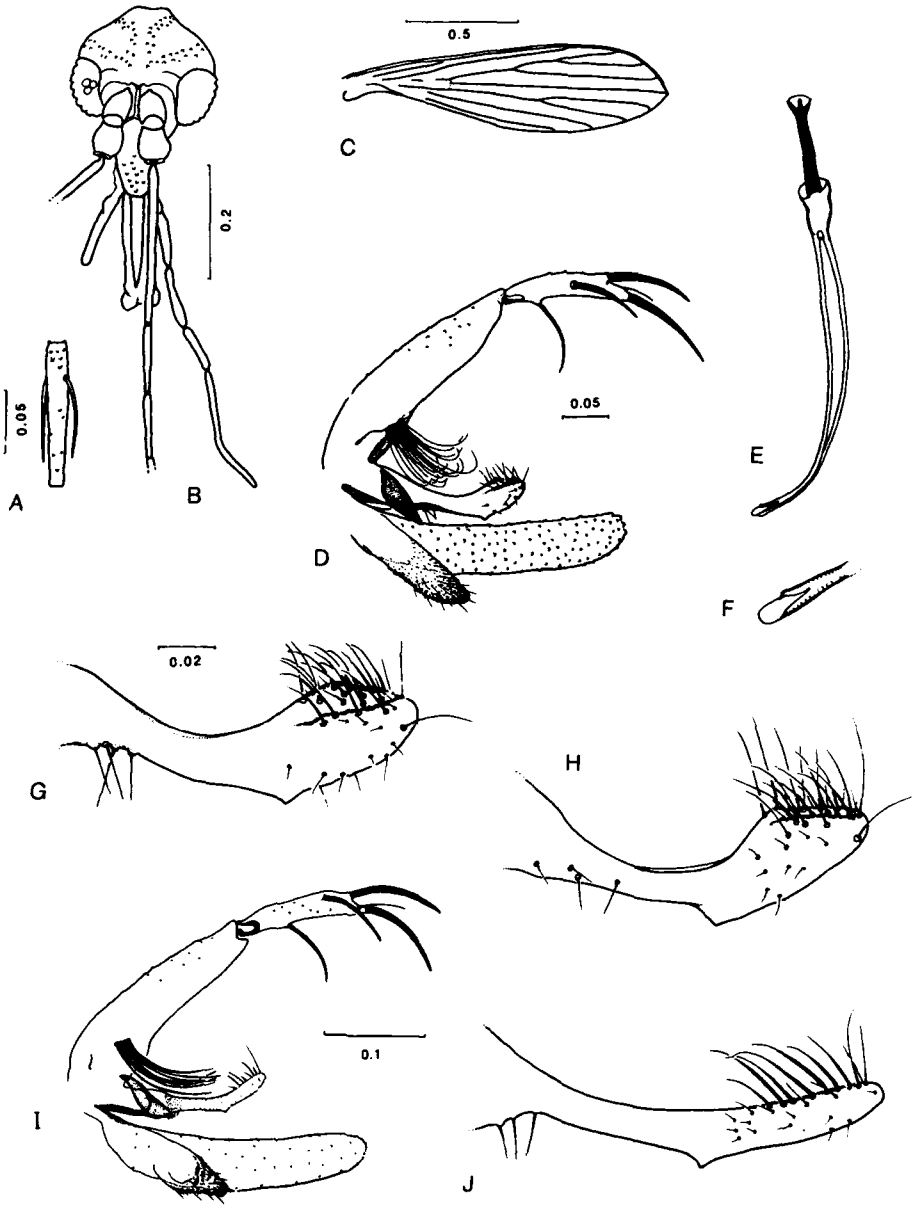


FIG. 99. ***Lutzomyia zeledoni.*** A. Male flagellomere II; B. Male head; C. Male wing; D. Male terminalia; E. Genital pump & filaments; F. Tip of genital filament; G. Paramere; H. Paramere (from Young & Murillo 1984).
Lutzomyia deleoni. I. Male terminalia; J. Paramere (fig. J from Young & Murillo 1984).

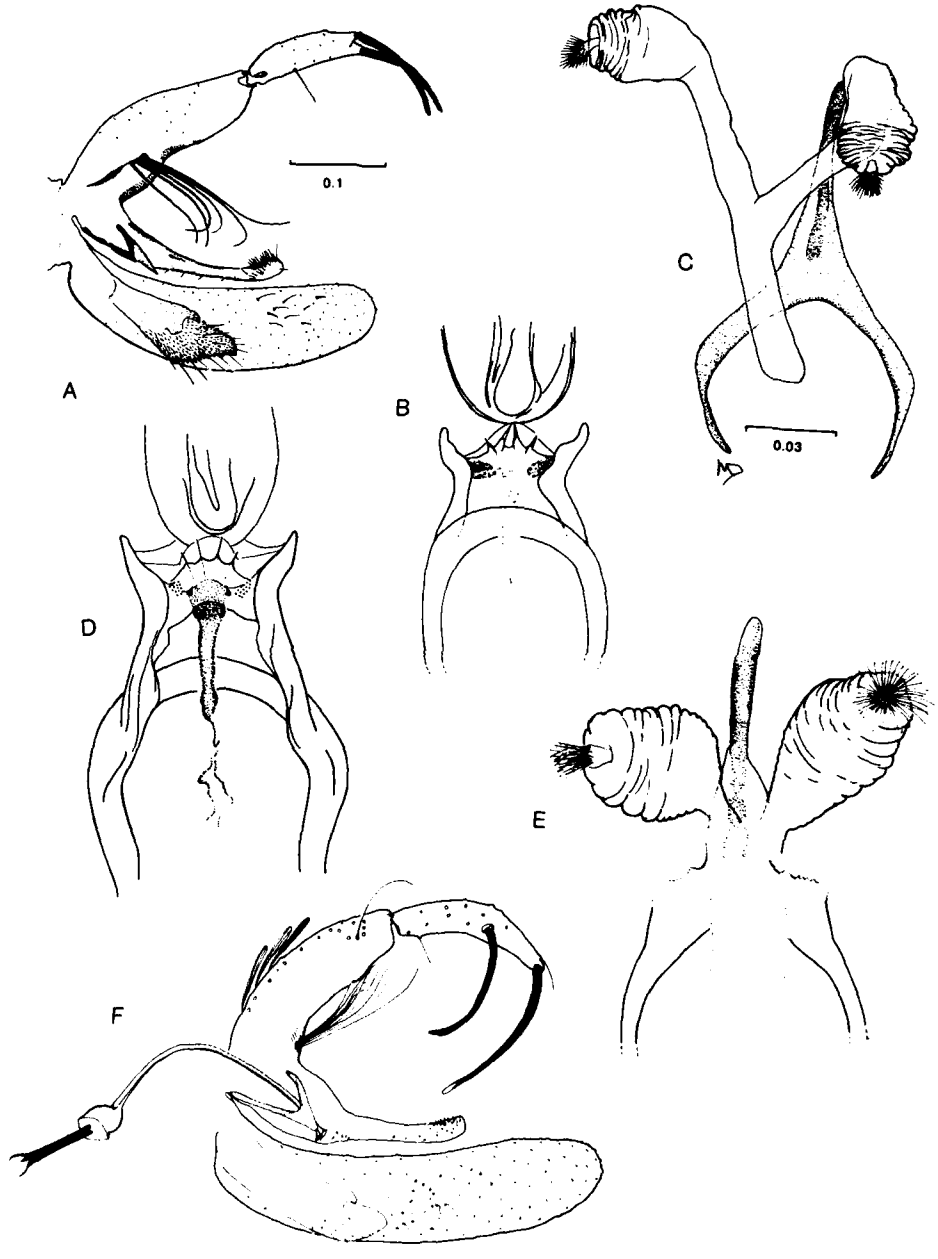


FIG. 100. ***Lutzomyia viriosa***. A. Male terminalia; C. Spermathecae; D. Female cibarium.
utzomyia steatopyga. B. Female cibarium; E. Spermathecae; F. Male terminalia (fig. E after Fairchild & Hertig 1958a).

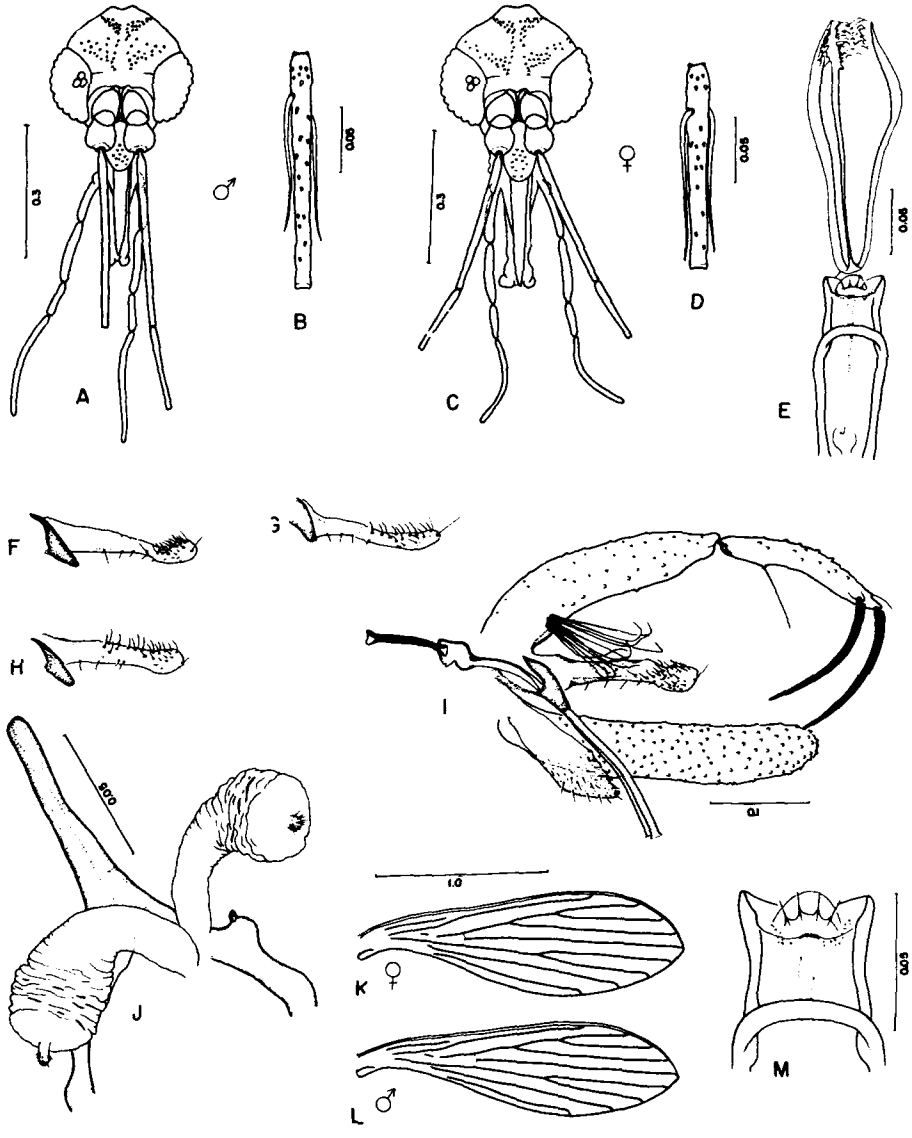


FIG. 101. ***Lutzomyia vespertilionis***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium; G. Paramere; H. Paramere; I. Male terminalia; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium. (from Young 1979).
Lutzomyia isovespertilionis. F. Paramere (from Young 1979).

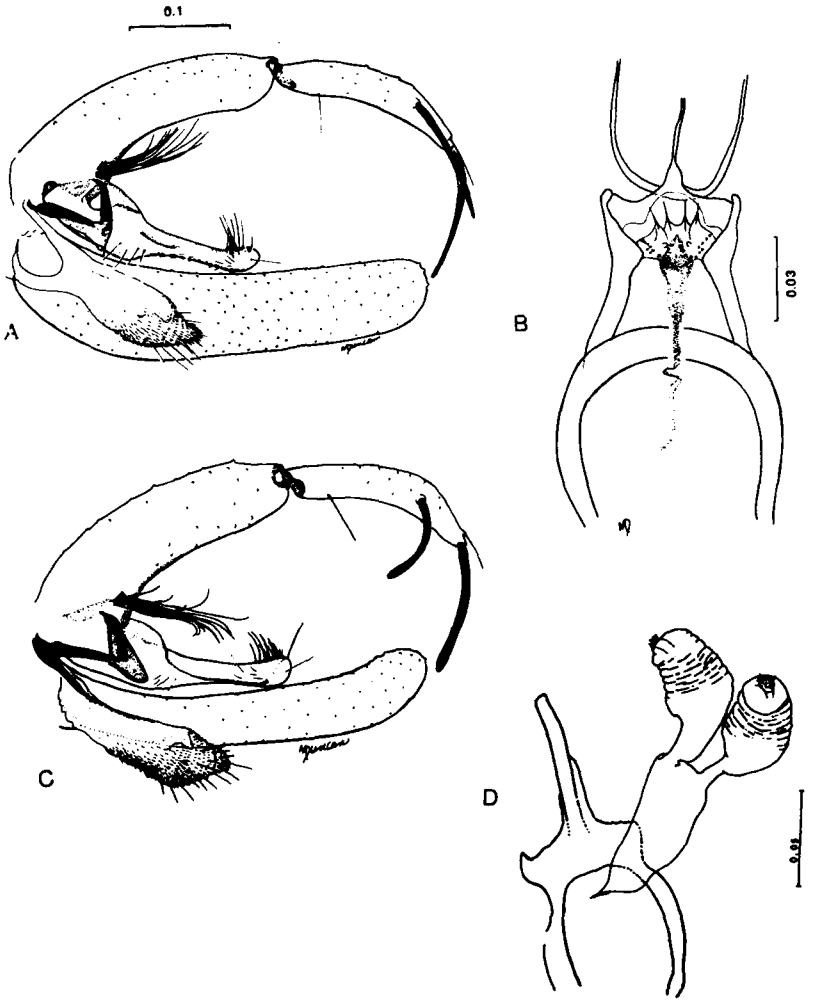
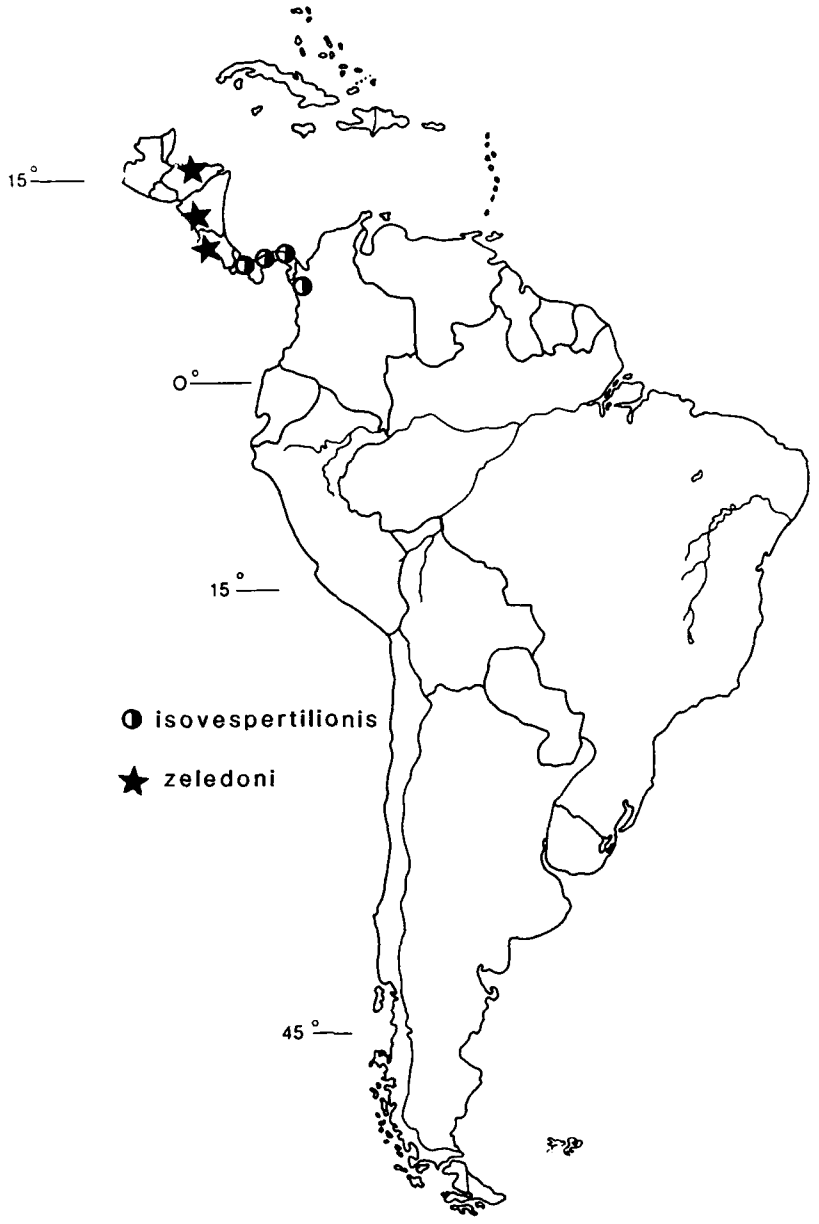


FIG. 102. ***Lutzomyia beltrani.*** A. Male terminalia; B. Female cibarium; D. Spermatheca (from Fairchild & Hertig 1958a).
Lutzomyia disneyi. C. Male terminalia.

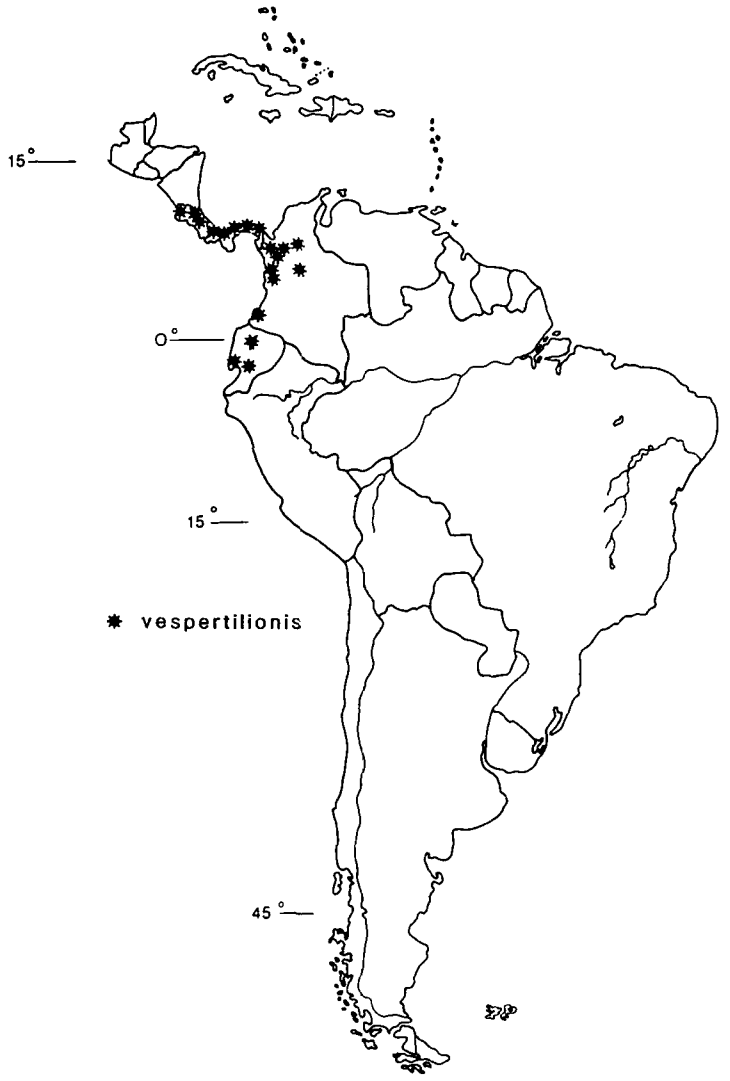
Map 40



Map 41

Map 42

Map 43



Map 44

SPECIES GROUP *DELPOZOI*

Lutzomyia species group *delpozoi* Lewis et al. 1977: 325. Martins et al. 1978: 155.
Micropygomyia, subgenus *Sciopemyia*: Artemiev 1991: 74.

Identification. Coloration dusky. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with two blade-like horizontal teeth & well developed lateral teeth; cibarial arch complete & prominent. ♀ pharynx unarmed. Spermathecae sac-like with relatively long terminal knob. ♂ *genitalia*. Style with 4 strong spines (basal spine isolated) & small subterminal seta. Coxite with basal tuft of long setae; apex somewhat truncate. Parameres variable, with simple setae.

The *delpozi* group species share some apomorphic characters with males in the subgenus *Coromyia* (e.g., inflated lateral lobes of one species). The cibarial armatures resemble those of some *Lutzomyia* (*Dampfomyia*) spp. but the males of the *delpozoi* group have a basal coxite tuft, similar to that of males in the *verrucarum* species group. Forattini (1971a, 1973) places these species in the subgenus *Pressatia* but the spermathecae differ greatly. Artemiev (1991) listed the *delpozoi* group species with 3 other groups (*pilosa*, *microps* and *gasparviannai*) in the subgenus *Sciopemyia*, genus *Micropygomyia*, without explanation.

We list three named species in this review but another species, as yet undescribed, has been discovered in Arizona, U.S.A. (W.J. Hanson, unpub. data). Structurally, the females of the three described species are indistinguishable.

Medical Importance. Unknown; females are not anthropophilic.

Key to the Males of the *delpozoi* Species Group

1. Paramere relatively slender, its apex truncate . . . . . *L. inusitata* (Fig. 104)
   Paramere broader, its apex subacute 2

2. Paramere with a ventral acute projection . . . . . *L. piedraferroi* (Fig. 105)
   Paramere without a ventral acute projection . . . . . *L. delpozoi* (Fig. 103)

Lutzomyia delpozoi (Vargas & Nájera)
Fig. 103

Phlebotomus del-pozoi Vargas & Nájera 1953a: 42 (♂, ♀, Mariscal, Chiapas, Mexico).
Lutzomyia delpozoi: Theodor 1965: 196 (♀ figs.).
Pressatia delpozoi: Forattini, 1971a: 106; 1973: 515 (figs.)

Distribution (Map 45). MEXICO; ? BELIZE (Martins et al. 1978); GUATEMALA (3 ♂♂, Potum, Peten, 1981, C.H. Porter).

Remarks. Williams (1970b) captured a male sand fly (species D) in Belize that belongs in this species group but its specific identity was not determined. Later, Martins et al. (1978) definitely list *L. delpozoi* from this country.

The males from Guatemala agree with the description of *L. delpozoi* except that the lateral lobes are more inflated (Fig. 103).

Lutzomyia inusitata (Fairchild & Hertig)
Fig. 104

Phlebotomus inusitatus Fairchild & Hertig 1961a: 22 (♂, ♀, Ocosocoautla, Chiapas, Mexico).
Lutzomyia inusitata: Theodor 1965: 196. Martins et al. 1978: 156.
Pressatia inusitata: Forattini 1971a: 107; 1973: 517 (figs.).

Distribution (Map 45). MEXICO (Fairchild & Hertig 1961a).

Remarks. This species is known only from two specimens, the holotype and allotype collected together on tree trunks in southern Mexico about 60 km W of Tuxtla.

Lutzomyia piedraferroi (León)
Fig. 105

Phlebotomus piedra-ferroi León 1971: 189 (♂, Piedra de los Fierros, Esquipulas, Chiquimula, Guatemala). Martins et al. 1978: 169 (listed as inadequately described).

Distribution (Map 45). GUATEMALA (León 1971; present paper).

Remarks. The holotype of *L. piedraferroi*, examined by us through the courtesy of C.H. Porter, has four major spines on the style rather than three as illustrated by León (1971, Fig. 5).

In addition, we studied 20 ♂♂ and 15 ♀♀ of *L. piedraferroi* from Finca Santa Isabel, Suchitepequez Dept., Guatemala collected by Dr. Porter in 1980 and 1981. The males closely resemble *L. delpozoi* but their paramere has an acute ventral projection and the basal spine on the style is nearly as large as the subterminal spines, unlike those illustrated for *L. delpozoi* by Vargas & Nájera (1953a).

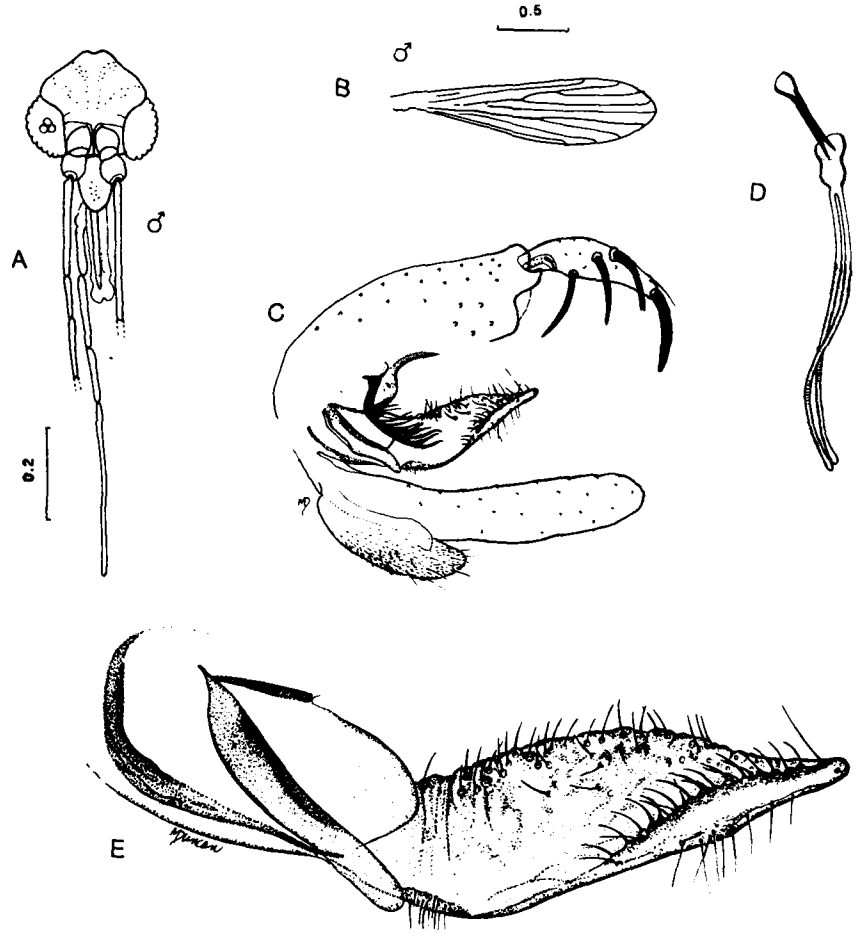


FIG. 103. ***Lutzomyia delpozoi.*** A. Male head; B. Male wing; C. Male terminalia; D. Genital pump & filaments; E. Paramere.

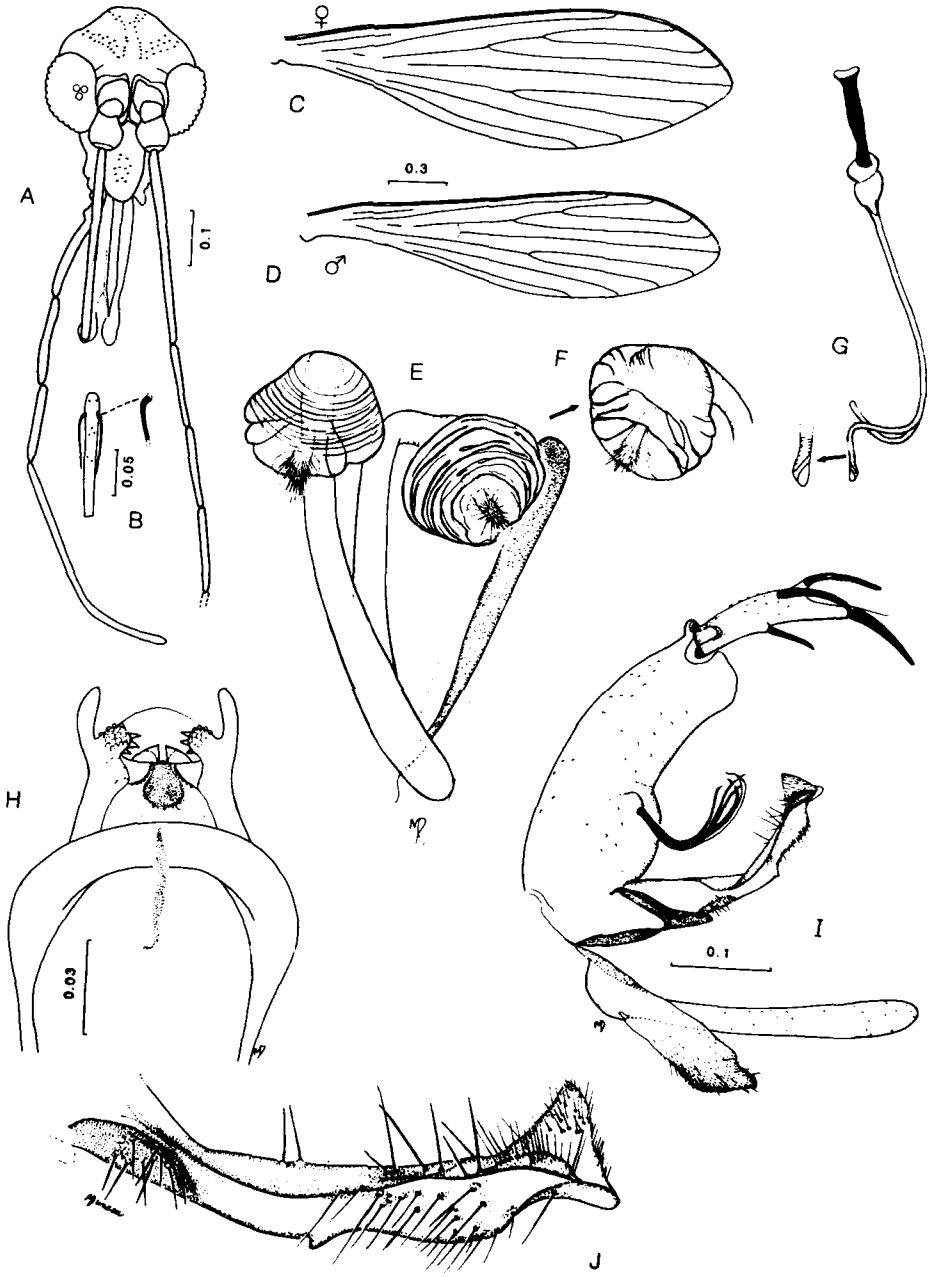


FIG. 104. ***Lutzomyia inusitata.*** A. Male head; B. Male flagellomere II & ascoid; C. Female wing; D. Male with; E. Spermathecae; F. Spermatheca (different aspect); G. Genital pump & filaments; H. Female cibarium; I. Male terminalia; J. Paramere.

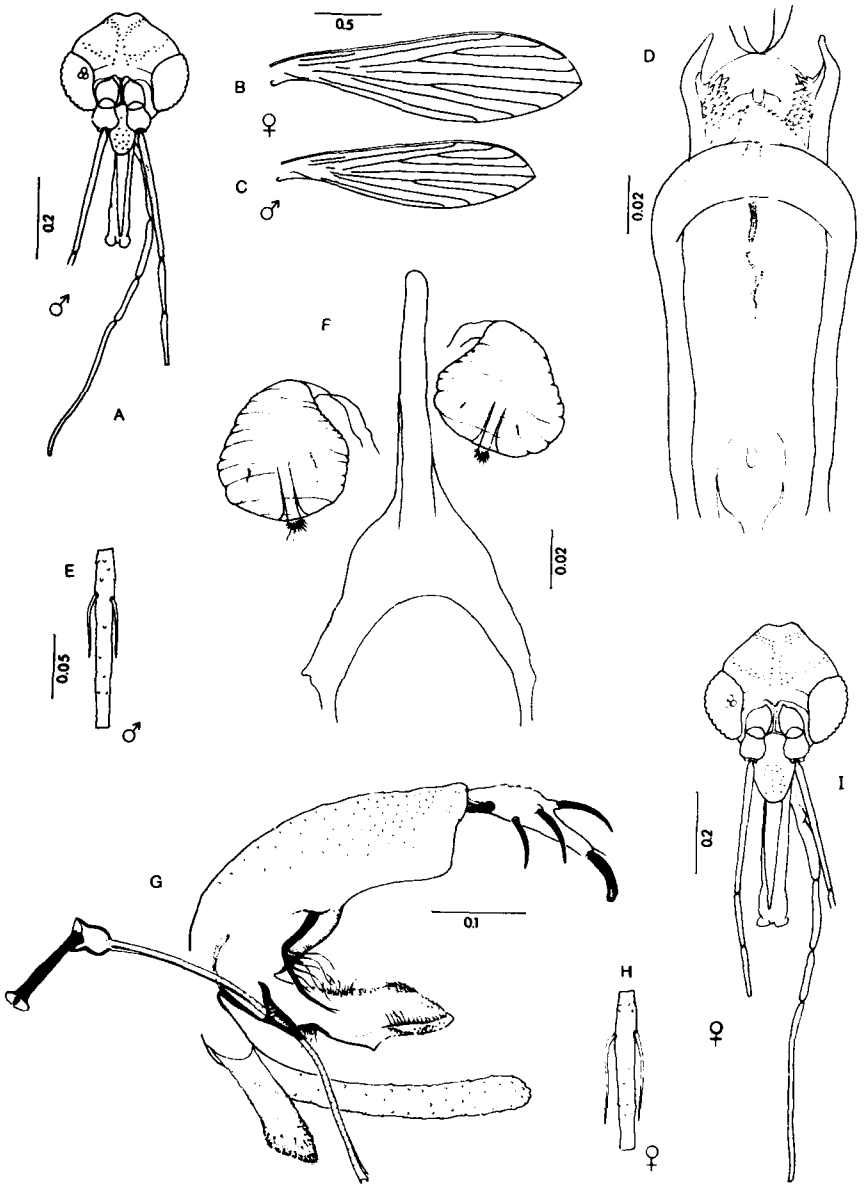
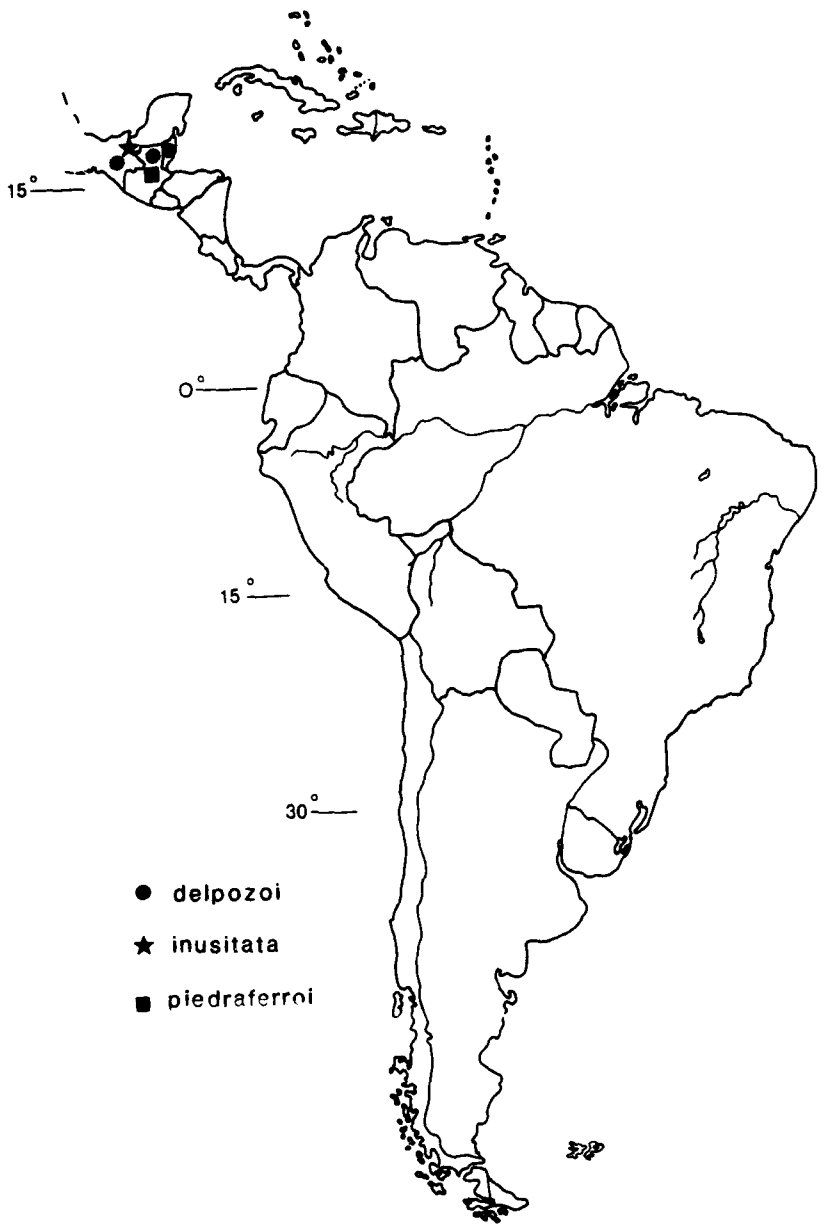


FIG. 105. ***Lutzomyia piedraferroi.*** A. Male head; B. Female wing; C. Male wing; D. Female cibarium; E. Male flagellomere II; F. Spermathecae; G. Male terminalia & genital pump ; H. Female flagellomere II; I. Female head.



Map 45

SUBGENUS *DAMPFOMYIA* ADDIS

Phlebotomus, subgenus *Dampfomyia* Addis 1945a: 120 (type species: *Phlebotomus anthophorus* Addis by orig. designation). Fairchild & Hertig 1956: 307 (review).

Lutzomyia, subgenus *Dampfomyia* Barretto 1962:95 (defined). Theodor 1965: 193 (defined). Martins et al. 1978: 57 (defined). Artemiev 1991: 74 (listed).

Phlebotomus, subgenus *Anthophorus* of León 1971: 187 (*Lapsus*).

Identification. Coloration pale to light brown. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. Eyes small. ♀ cibarium with 4-6 horizontal teeth, pointed or blade-like & complete arch. Pharynx unarmed. Spermathecae modified with bubble-like evaginations. ♂ *genitalia*. Coxite lacking persistent setae. Style with 3-5 spines & a subterminal seta. Paramere with dorsal arm, bearing setae.

The center of distribution of the *Dampfomyia* spp. is in the northern neotropics, in Central America. One species, *L. rosabali*, has been recorded as far south as Colombia (Young 1979). Forattini (1973) enlarges this subgenus by including *L. saulensis*, *L. samueli*, *L. deleoni* and *L. vesicifera*, species that are included in other species groups in the present review. León (1971) incorrectly used the name *Anthophorus*, instead of *Dampfomyia*, for the subgenus containing the species treated here.

Medical Importance. Unknown; females feed on small mammals. *Lutzomyia anthophora* is a probable host of Rio Grande Virus (Young & Perkins 1984), and was recently found naturally-infected with *Leishmania mexicana* in south Texas, USA (McHugh & Grogl 1993).

Key to the Males of the Subgenus *Dampfomyia*

1. Style with 5 strong spines and a small subterminal seta *L. insolita* (Fig. 110)
   Style with 2-3 strong spines and 2 small setae, one subterminal & one basal 2

2. Paramere with short, strongly clubbed dorsal arm *L. anthophora* (Fig. 106)
   Paramere with longer, more slender dorsal arm 3

3. Genital filament tips markedly enlarged & modified. Paramere lacking acute ventral projection . . . . . *L. permira* (Fig. 111)
   Genital filament tips simple. Paramere with acute ventral projection 4

4. Paramere tip acute and pointed downwards; dorsal arm with 7-16 long setae . . . . . *L. rosabali* (Fig. 109)
   Paramere tip broadly rounded; dorsal arm with 20 or more long setae . . . 5

5. Paramere clubbed apically; dorsal arm with long setae inserted on most of structure . . . . . *L. dodgei* (Fig. 107)
   Paramere more slender, not clubbed; dorsal arm with long setae restricted to distal half of structure . . . . . *L. atulapai* (Fig. 108)

Key to the Females of the Subgenus *Dampfomyia*

1. Individual sperm ducts seemingly absent or shorter than spermathecal body 2
   Individual sperm ducts at least as long as spermathecal body 3

2. Spermathecae almost lacking individual ducts; the evaginations rounded & larger at sides than those finger-like projections near terminal knob . . . . . *L. permira* (Fig. 111)
   Spermathecae with short but distinct individual ducts; all bubble-like evaginations subequal in size . . . . . *L. atulapai* (Fig. 108) *L. rosabali* (Fig. 109)

3. Cibarium with 4 spine-tipped horizontal teeth . . . . . *L. insolita* (Fig. 110)
   Cibarium with 2 blade-like horizontal teeth . . . . *L. anthophora* (Fig. 106) *L. dodgei*

Lutzomyia (Dampfomyia) anthophora (Addis)
Fig. 106

Phlebotomus anthophorus Addis 1945a: 119 (♂, ♀, Uvalde, Uvalde Co., Texas, USA).

Lutzomyia anthophora: Theodor 1965: 193 (♂, ♀ figs.). Young & Perkins 1984: 272 (full refs., figs., dist.). Magnarelli et al. 1984: 681 (age grading ♀♀). Endris et al. 1984: 656 (lab. biology); 1987a: 243 (as exp. vector of *Leishmania mexicana*); 1987b: 412 (egg surface morphol.). McHugh 1991: 192 (USA, coll. data). McHugh & Grogl 1993: 631 (nat. infected with *Leishmania mexicana*, Texas).

Distribution (Map 46). MEXICO & USA (Young & Perkins 1984; McHugh 1991).

Remarks. Natural infections of *Leishmania mexicana* have been reported in *L. anthophora* and the wood rat, *Neotoma micropus*, its primary host in south Texas (McHugh et al. 1991; McHugh & Grogl 1993). It remains to be determined, however, whether this sand fly serves as a vector of this parasite to people in the endemic area of Texas and northern Mexico. Calisher et al. (1977) isolated a *Phlebovirus* (Rio Grande Virus) from *Neotoma micropus* near Brownsville, Texas and, again, *L. anthophora* is regarded as the likely vector among these rodents. Endris et al. (1983) demonstrated transovarial

transmission of this virus by experimentally-infected female flies, obtained from a laboratory colony with origins in Brownsville, Texas. Sand flies from this colony also were capable of transmitting *Leishmania mexicana* to rodents (Endris et al. 1987a). Earlier, Addis (1945b) successfully colonized this sand fly in the laboratory and described the immature stages.

Lutzomyia (Dampfomyia) dodgei (Vargas & Nájera)
Fig. 107

Phlebotomus dodgei Vargas & Nájera 1953a: 44 (♂, ♀, Cocula, Guerrero, Mexico); 1953b: 311 (dist., Mexico).
Lutzomyia dodgei: Barretto 1962: 95 (listed). Theodor 1965: 193 (listed). Forattini 1973: 329 (figs., review). Martins et al. 1978: 58 (dist.).

Distribution (Map 47). MEXICO; EL SALVADOR (Martins et al. 1978).

Remarks. Forattini (1973) considers *L. dodgei* and *L. rosabali* to be conspecific but there are significant structural differences between the males. We examined more than 100 *dodgei* males from Morelos State, Mexico kindly provided by M. Camino who captured them in flight traps with males of *L. anthophora*. We are unable to separate the females by structure or color.

Lutzomyia (Dampfomyia) atulapai (León)
Fig. 108

Phlebotomus atulapai León 1971: 187 (♂, ♀, Rio Atulapa, Chiquimuta, Guatemala).
Phlebotomus dodgei (not *dodgei* Vargas & Nájera): Fairchild & Hertig 1956: 308 (in part). Rosabal & Trejos 1964: 168 (El Salvador); 1965: 222 (♂ fig., tax.).

Distribution (Map 46). MEXICO (Fairchild & Hertig 1956, in part); GUATEMALA (León 1971); EL SALVADOR (Rosabal & Trejos 1964; 1965).

Remarks. As with other type specimens of species named by León (1971), the holotype and allotype of *L. atulapai* are not labelled as such, but Figs. 1 & 2 and photographs 1 & 2 in his 1971 paper represent 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 *L. atalupai* male, with the apically enlarged arm of the paramere, differs readily from *L. dodgei* (Vargas & 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 & Hertig (1956) and Rosabal & Trejos (1964) represents *atalupai* (León), instead of *dodgei* (Vargas & Nájera). There are no significant differences between the Mexican

and other available specimens when allowances are made for obvious distortion due to improper slide mounting technique. Fairchild & Hertig (loc. cit.) illustrated the spermathecae of the Mexican female. We examined this specimen and the male that was discussed and illustrated by them.

Lutzomyia (Dampfomyia) rosabali (Fairchild & Hertig)
Fig. 109

Phlebotomus rosabali Fairchild & Hertig 1956: 310 (♂, Puerto Armuelles, Chiriqui, Panama).

Lutzomyia rosabali: Martins et al. 1978: 58. Young 1979: 91 (full references). Murillo & Zeledón 1985: 39 (♂, ♀ figs, Costa Rica).

Distribution (Map 47). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Fairchild & Hertig 1956); COLOMBIA (Young 1979).

Remarks. Murillo & Zeledón (1985) captured 62 ♂♂ and 222 ♀♀ of this species in a squirrel's nest (*Sciurus* sp.) in Costa Rica. This finding and the fact that *L. anthophora*, a closely related species, also is associated with rodents' nests, suggests that other *Lutzomyia* (*Dampfomyia*) species may share similar habits.

Lutzomyia (Dampfomyia) insolita (Fairchild & Hertig)
Fig. 110

Phlebotomus insolitus Fairchild & Hertig 1956: 310 (♂, Almirante, Bocas del Toro, Panama).

Phlebotomus rubidulus Fairchild & Hertig 1956: 312 (♀, Mojinga Swamp, Canal Zone, Panama). Christensen & Rutledge 1973: 314 (as synonym of *insolitus*).

Lutzomyia isolita: Barretto 1962: 95. Theodor 1965: 193. Forattini 1973: 330 (figs., review). Martins et al. 1978: 58 (dist.). Murillo & Zeledón 1985: 39 (♂ figs., dist., Costa Rica).

Distribution (Map 46). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Fairchild & Hertig 1956).

Lutzomyia (Dampfomyia) permira (Fairchild & Hertig)
Fig. 111

Phlebotomus permirus Fairchild & Hertig 1956: 312 (♀, Palenque, Chiapas, Mexico). Lewis & Garnham 1959: 83 (♂ descript., Belize).

Phlebotomus tikalensis León 1971: 190 (♂, Dos Lagunas, Peten, Guatemala) **(NEW SYNONYMY).**

Lutzomyia permira: Barretto 1962: 95 (listed). Theodor 1965: 193 (listed). Williams 1970b: 333 (Belize). Forattini 1973: 332 (♂, ♀ figs.). Williams 1976b: 603 (Belize). Martins et al. 1978: 58 (dist.).

Distribution (Map 48). MEXICO (Fairchild & Hertig 1956); GUATEMALA (León 1971); BELIZE (Martins et al. 1978).

Remarks. The *L. tikalensis* males, described and illustrated by León (1971), and examined by us through the courtesy of C.H. Porter, are morphologically indistinguishable from those of *L. permira*.

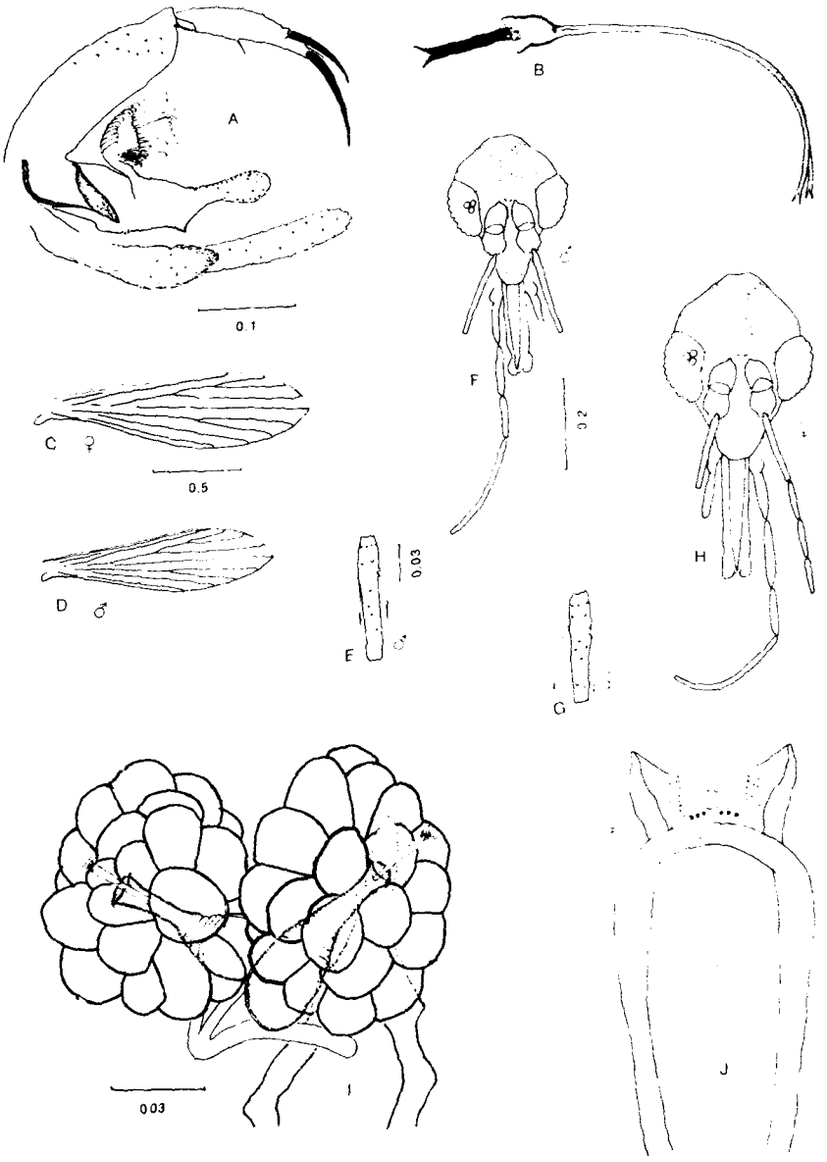


FIG. 106. ***Lutzomyia anthophora***. A. Male terminalia; B. Genital pump & filaments; C. Female wing; D. Male wing; E. Male flagellomere II; F. Male head; G. Female flagellomere II; H. Female head; I. Spermathecae; J. Female cibarium (from Young & Perkins 1984).

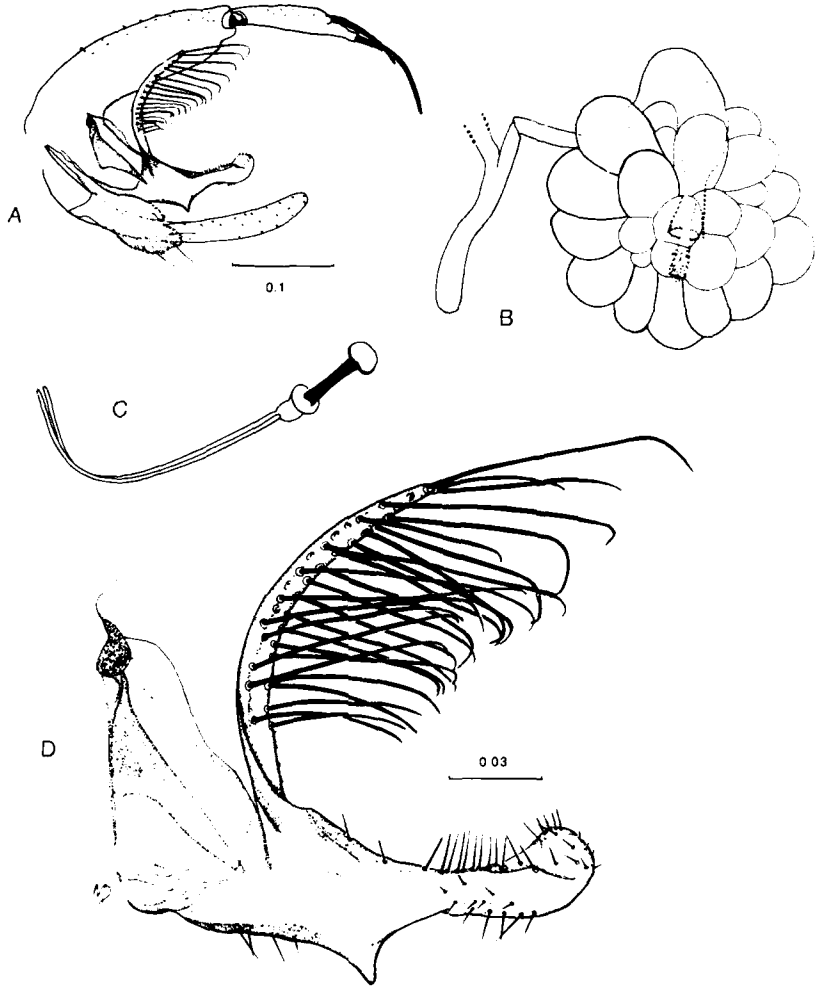


FIG. 107. ***Lutzomyia dodgei***. A. Male terminalia; B. Spermatheca; D. Genital pump & filaments; D. Paramere.

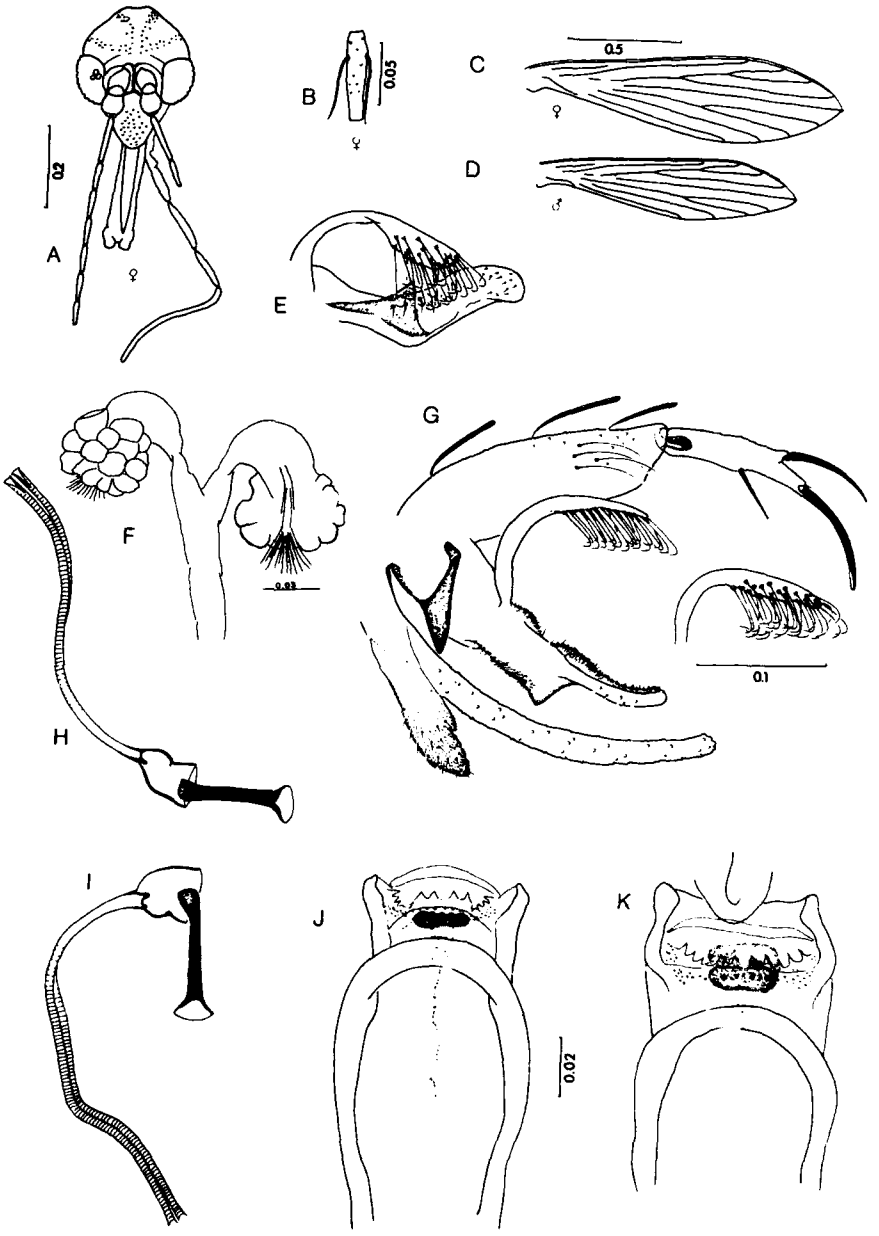


FIG. 108. ***Lutzomyia atulapai.*** A. Female head; B. Female flagellomere II; C. Female wing; D. Male wing; E. Paramere & aedeagus, flattened; F. Spermathecae; G. Male terminalia; H. & I. Genital pump & filaments; J. Female cibarium; K. Female cibarium, flattened (fig. from Fairchild & Hertig 1956).

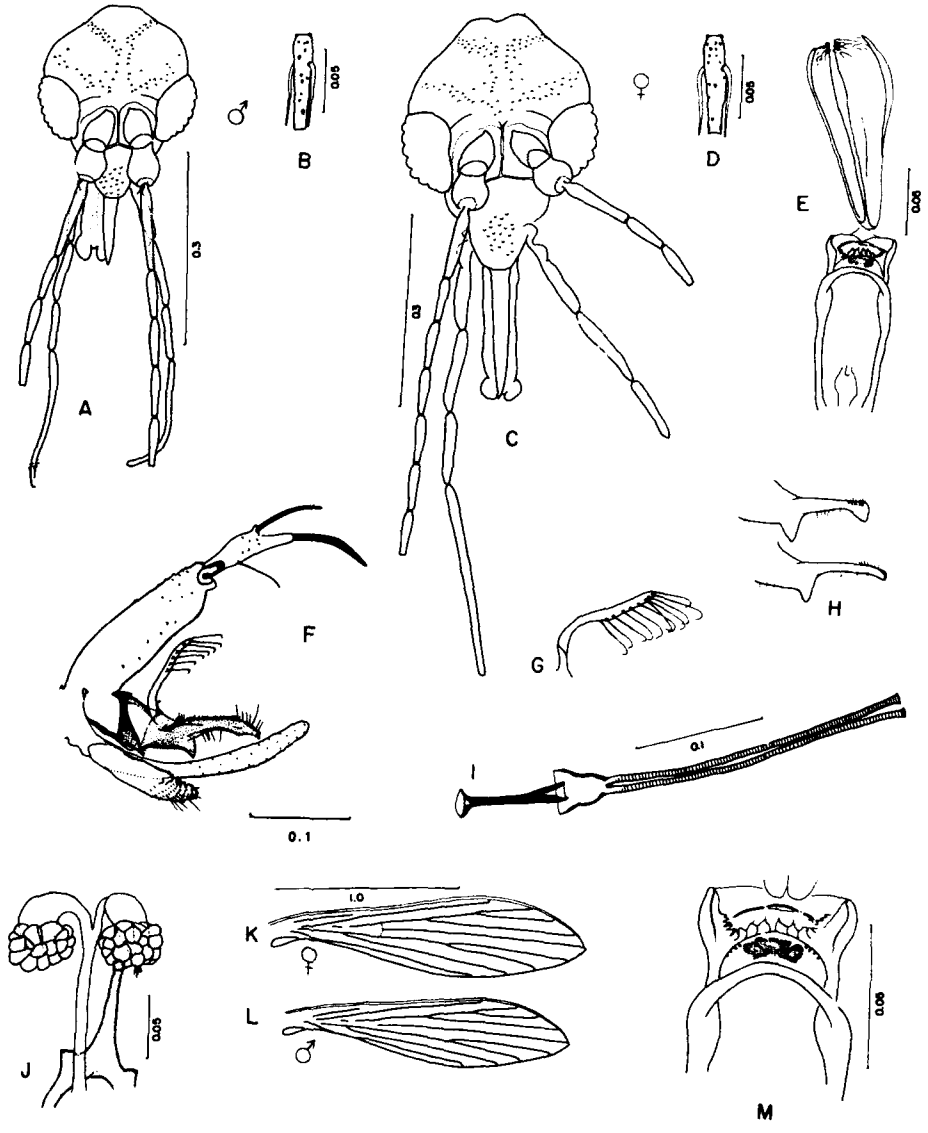


FIG. 109. ***Lutzomyia rosabali***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Dorsal arm of paramere; H. Parameres; I. Genital pump & filaments; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium (from Young 1979).

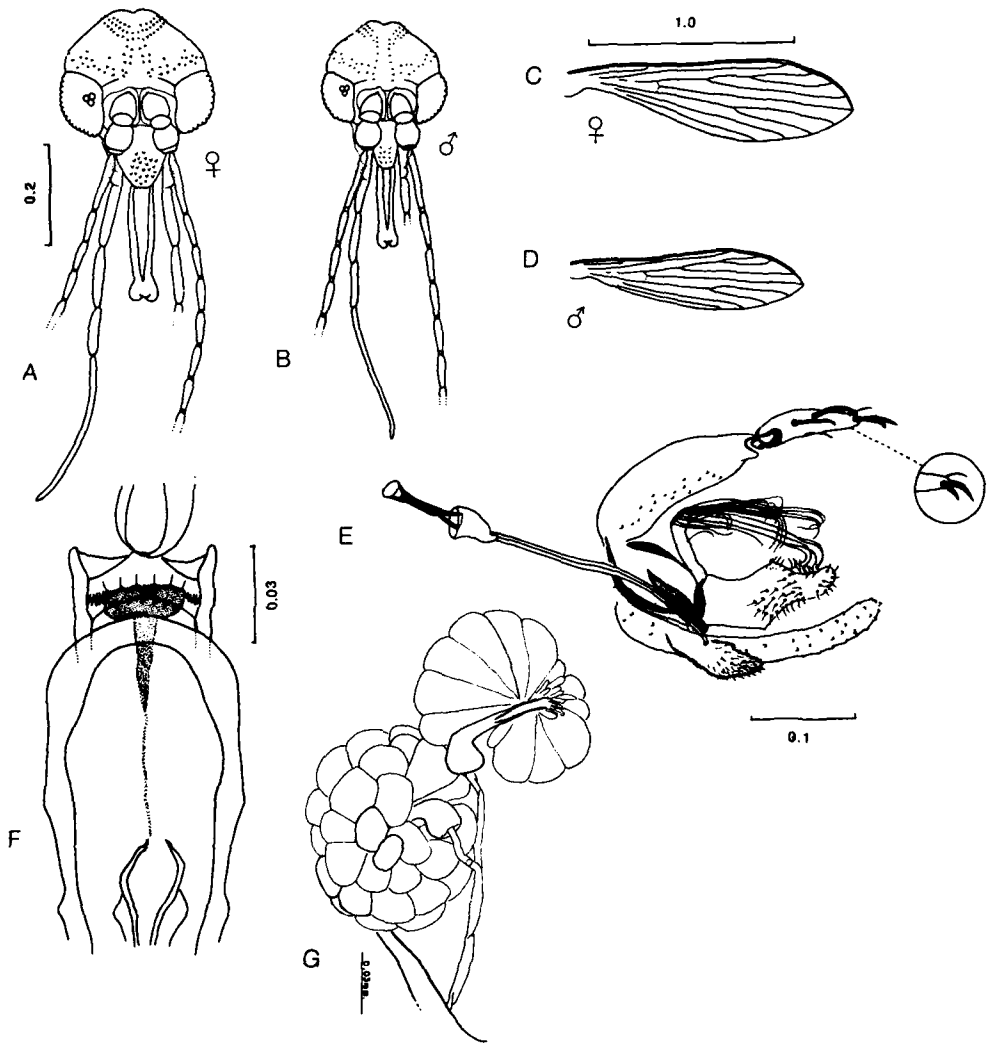


FIG. 110. ***Lutzomyia insolita.*** A. Female head; B. Male head; C. Female wing; D. Male wing; E. Male terminalia; F. Female cibarium; G. Spermathecae (fig. G from Fairchild & Hertig 1956).

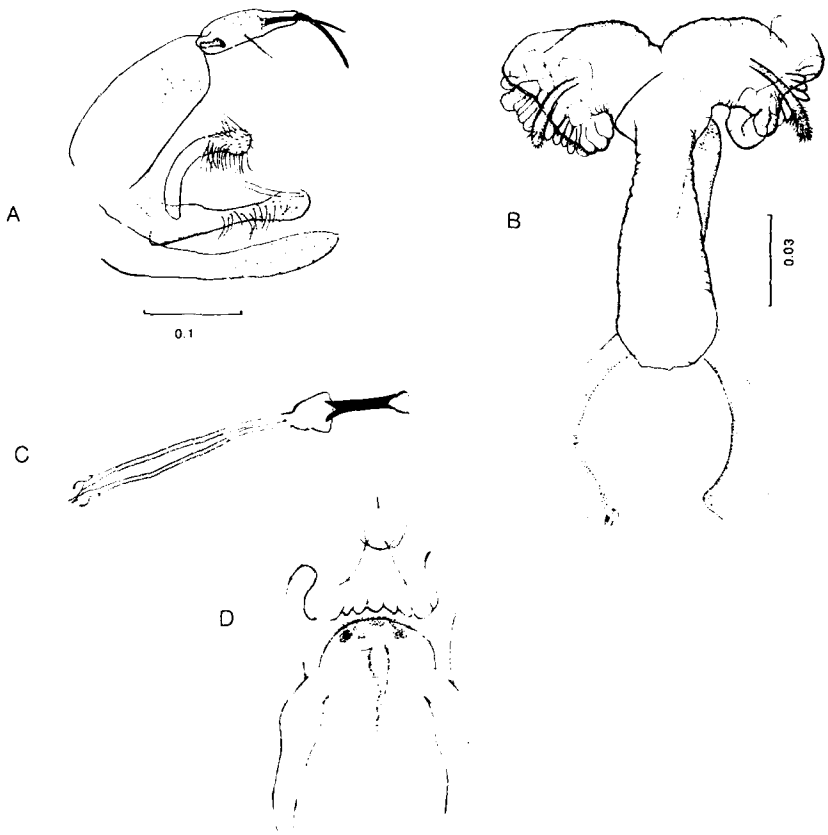
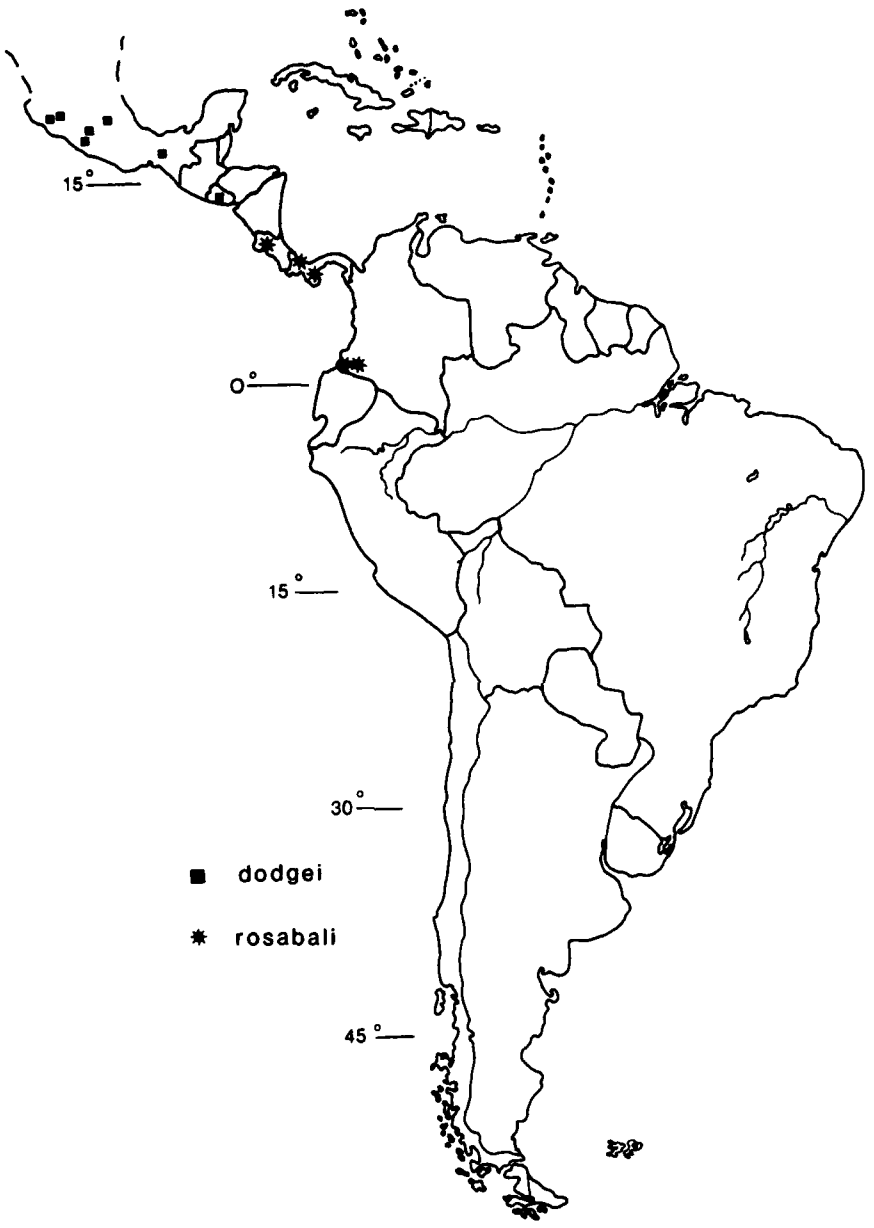


FIG. 111. ***Lutzomyia permira.*** A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Female cibarium.

Map 46



Map 47

Map 48

SPECIES GROUP *SAULENSIS*

Lutzomyia, species group *saulensis*: Lewis et al. 1977: 325. Young 1979: 69.
Lutzomyia, subgenus *Dampfomyia*: Forattini 1973: 327 (in part).
Lutzomyia, subgenus *Coromyia*: Martins et al. 1978: 93 (in part). Artemiev 1991: 74.

Identification. Coloration pale. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with 4 pointed horizontal teeth & complete arch. Pharynx unarmed. Spermathecae with bubble-like evaginations, terminal part smooth-walled & tapered. ♂ *genitalia*. Coxite with 4-8 persistent setae at base. Style with 4 spines & subterminal seta. Paramere with 2 acute, ventral projections.

The two species in this group share character states with members of the *verrucarum* species group (= *Coromyia* Barretto, in part) and with the *Dampfomyia* species. The spermathecae, however, differ from those of the *Dampfomyia* species (Theodor 1965) and the males have persistent setae on their coxites. At present, we provisionally separate *L. saulensis* and *L. wilsoni* from these other groups.

The females of these two species are structurally similar and associated males must be on hand before definitive identifications can be made.

Medical Importance. Unknown; females have been rarely captured on human bait.

Key to the Males of the Species Group *Saulensis*

1. Paramere with large dorsal hump bearing numerous long setae . . . . . *L. wilsoni* (Fig. 112)
   Paramere without dorsal hump . . . . . *L. saulensis* (Fig. 113)

Lutzomyia wilsoni (Damasceno & Causey)
Fig. 112

Flebotomus wilsoni Damasceno & Causey 1945: 639 (♂, Itaúna, Parintins, Amazonas, Brazil).
Lutzomyia wilsoni: Forattini 1973: 357 (♂). Martins et al. 1978: 94 (dist.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Martins et al. 1983a: 67 (♀ descript., dist.). Arias et al. 1985: 1101 (neg. for flagellates, Brazil).

Distribution (Map 49). BRAZIL (Martins et al. 1978; 1983a; Biancardi et al. 1982).

Remarks. From associated females collected at Costa Marquez, Rondônia, Brazil (T. Klein), we observed that the tapered ends of the *L. wilsoni* spermathecae are stouter than those of *L. saulensis* from Panama (compare Figs. 112 & 113). This may or may not be a reliable diagnostic character; more material is needed to confirm this possibility.

Lutzomyia saulensis (Floch & Abonnenc)
Fig. 113

Phlebotomus saulensis Floch & Abonnenc 1944a: 1 (♂, Saül, Haute Mana, French Guiana).

Phlebotomus pinealis Floch & Abonnenc 1944b: 11 (♀, Crique Anguille, French Guiana). Fairchild & Hertig 1958b: 204 (refs., as synonym of *saulensis*).

Lutzomyia saulensis: Theodor 1965: 196 (♂, ♀ figs.). Forattini 1973: 333 (♂, ♀ figs., dist.). Llanos 1973: 34 (figs., Peru). Llanos et al. 1975b: 671 (Peru). Léger et al. 1977: 227 (French Guiana). Martins et al. 1978: 94 (figs., refs., dist.). Young 1979: 69 (refs., figs.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Llanos 1983: 183 (Peru). Martins et al. 1983a: 67 (cf. to ♀ *wilsoni*). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Murillo & Zeledón 1985: 67 (♂, ♀ figs., dist., Costa Rica). Ryan 1986: 87 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Lebbe et al. 1987: 30 (computer aided ident.). Feliciangeli 1988: 107 (dist., Venezuela). Alexander et al. 1992a: 35; 1992c: 124 (Ecuador).

Distribution (Map 50). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979); VENEZUELA (Feliciangeli 1988); PERU (Llanos 1981); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); ECUADOR (Alexander et al. 1992c).

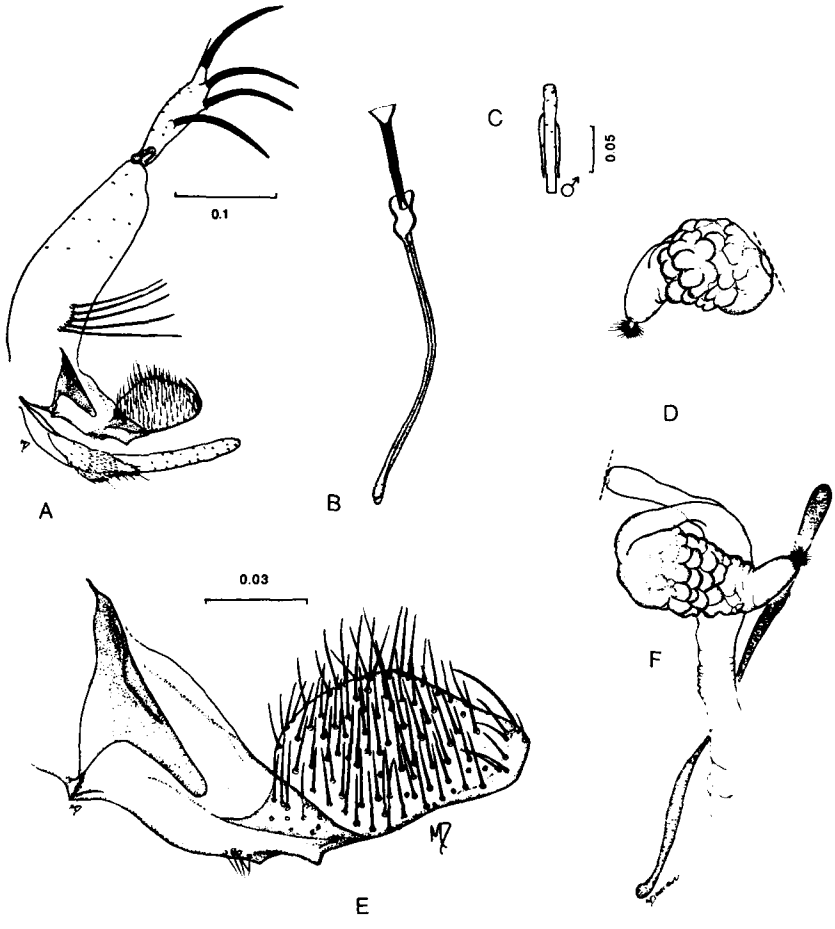


FIG. 112. ***Lutzomyia wilsoni***. A. Male terminalia; B. Genital pump & filaments; C. Male flagellomere II; D. Spermathecae; E. Paramere; F. Spermathecae.

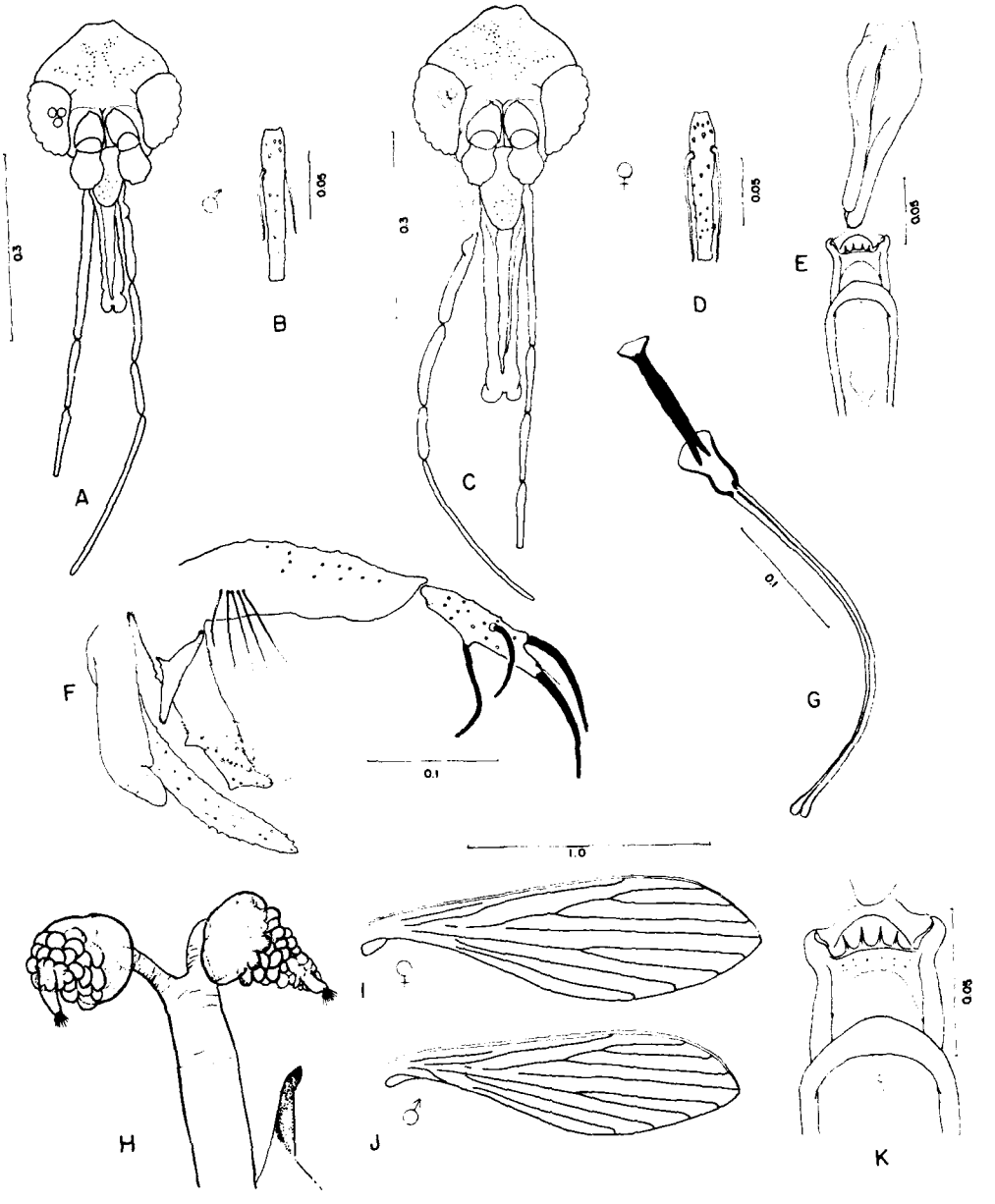
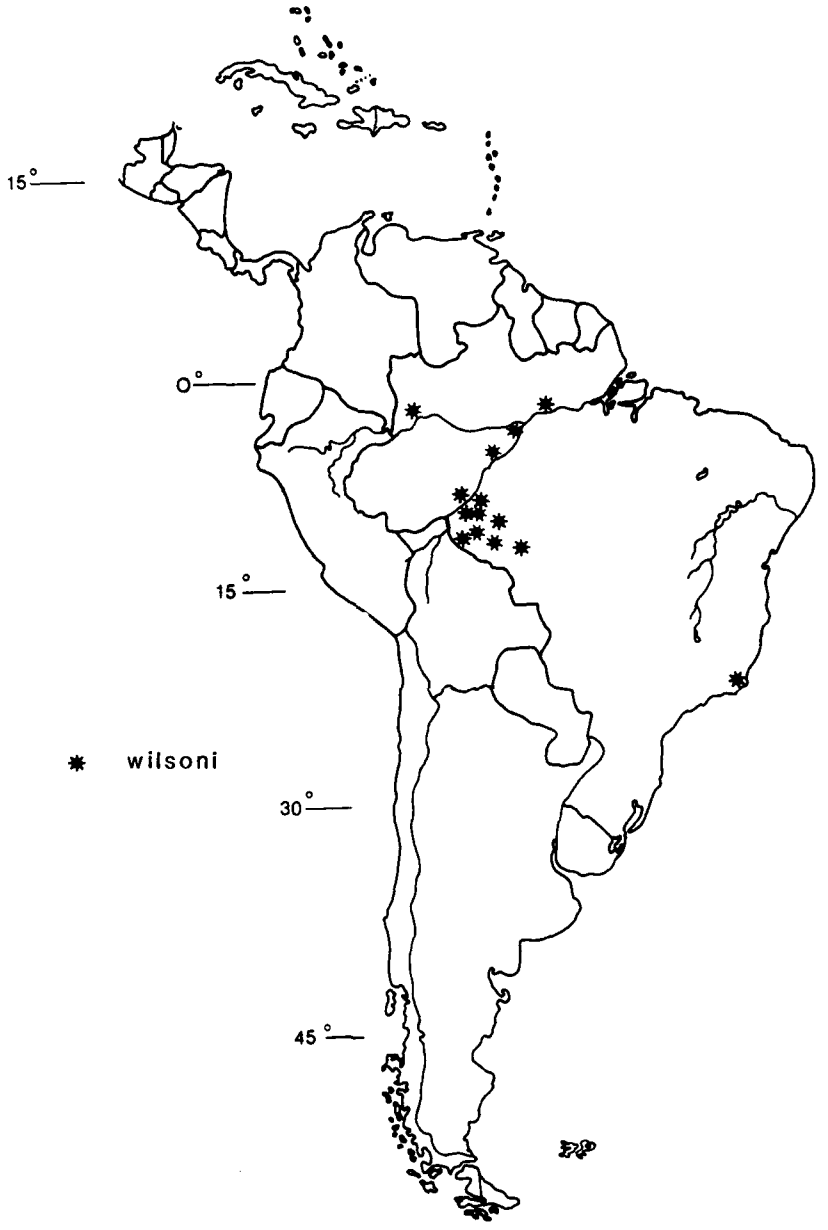


FIG. 113. ***Lutzomyia saulensis.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).



Map 49

Map 50

SUBGENUS *PINTOMYIA* Costa Lima

Phlebotomus, subgenus *Pintomyia* Costa Lima 1932: 44 (type species: *Phlebotomus fischeri* Pinto by orig. designation).
Phlebotomus species group *triacanthus* Fairchild 1955: 194 (series *fischeri*).
Lutzomyia, subgenus *Pintomyia*: Barretto 1962: 9?. Theodor 1965: 192. Lewis et al. 1977: 325. Martins et al. 1978: 25.
Pintomyia, genus: Forattini 1971a: 103; 1973: 497. Artemiev 1991: 73.

Identification. Coloration dark. Head broad. Antennal ascoids with short, barely visible posterior spurs. Palpomere 5 larger than palps. 3 + 4. ♀ cibarium with 4 horizontal teeth, sometimes very short in an irregular row; 2-3 rows of vertical teeth; arch complete; pigment patch conspicuous or not. Pharynx unarmed. Spermathecae suboval without terminal knob, ductules (= "hairs") present; individual sperm ducts well sclerotized, in part; common duct long, nonsclerotized. ♂ *genitalia*. Coxite with basal group of persistent setae. Style with 4 large spines; subterminal seta present or absent. Paramere simple. Hind femur of both sexes with a row of 3-8 spines.

This is a distinctive subgenus of *Lutzomyia* containing 5 named species. Aguiar & Soucasaux (1984) reported, but did not describe, a *Pintomyia* sp. from Serra dos Orgãos, Rio de Janeiro, Brazil. We have not seen material from there.

Medical Importance. Two species are anthropophilic and one of them, *L. pessoai*, has been found naturally infected with promastigotes believed to be *Leishmania*.

Key to the Males of the Subgenus *Pintomyia**

1. Palpomere 5 longer than flagellomere I 2
   Palpomere 5 shorter than flagellomere I 3

2. Style with proximal spines inserted almost on same level. Coxite with basal tuft of 10 or more setae. Paramere with 1-2 isolated dorsal setae near middle of structure . . . . . *L. pessoai* (Fig. 114)
   Style with proximal spines well separated as shown. Coxite with basal tuft of 2-5 setae. Paramere without isolated dorsal setae . . . . . *L. fischeri* (Fig. 115)

3. Paramere relatively slender with dorsal setae implanted over distal half of structure . . . . . *L. christenseni* (Fig. 116)
   Paramere broader with dorsal setae restricted to distal third of structure . . . . . *L. damascenoi* (Fig. 117)

*The male of *L. gibsoni* is unknown.

Key to the Females of the Subgenus *Pintomyia*

1. Labrum > 0.30 mm. Palpomere 5 as long as, or longer than, flagellomere I. Cibarium with 4 prominent horizontal teeth differing markedly from vertical teeth; pigment patch conspicuous, with dark transverse band near horizontal teeth 2

   Labrum < 0.30 mm. Palpomere 5 shorter than flagellomere I. Cibarium with 4 inconspicuous horizontal teeth but slightly larger than largest vertical teeth; pigment patch poorly defined, without dark transverse band at posterior end, i.e., near horizontal teeth . . . *L. damascenoi* (Fig. 117)
   L. christenseni (Fig. 116)

2. Spermathecae subcylindrical . . . . . *L. fischeri* (Fig. 115)
   ? *L. gibsoni*

   Spermathecae subspherical . . . . . *L. pessoai* (Fig. 114)

Lutzomyia (Pintomyia) pessoai (Coutinho & Barretto)
Fig. 114

Phlebotomus pessoai Coutinho & Barretto 1940a: 98 (♂, ♀, Pompéia, São Paulo, Brazil).

Flebotomus pessoai: Barretto 1947a: 218 (full refs.).

Lutzomyia pessoai: Barretto 1962: 93 (listed). Theodor 1965: 192 (listed). Martins et al. 1978: 28 (refs., dist.) Aguiar & Soucasaux 1984: 199 (seasonal biting habits, Brazil). Aguiar et al. 1985a: 188 (vertical dist.); 1985b: 340 (coll. data); 1985c: 467 (coll. data). Vexenat et al. 1986b: 296 (Bahia, Brazil). Aguiar & Vilela 1987: 585 (resting sites, Brazil). Gomes et al. 1989a: 32 (biting activity, Brazil). Hashiguchi et al. 1992: 139 (coll. data, Paraguay).

Pintomyia pessoai: Forattini 1971a: 104 (listed); 1973: 498 (figs., tax.).

Distribution (Map 51). BRAZIL; ARGENTINA; PARAGUAY (Martins et al. 1978; Hashiguchi et al. 1992). Also, 7 ♂♂, Sommerfeld, Yhú, Paraguay, 24 March 1950, M. Hertig).

Remarks. Promastigotes, believed to be *Leishmania braziliensis*, were observed in 8 out of 2,711 *L. pessoai* females individually dissected in the early 1940s by Pessôa and colleagues in southern Brazil (see Johnson et al. 1963). Later, in São Paulo State, Brazil, Forattini et al. (1972) observed *Leishmania* in the nose of a hamster that had been inoculated with a triturated group of 179 *L. pessoai* females. In view of these results and of the man-biting behavior of *L. pessoai*, this sand fly is regarded as a suspected vector of *Leishmania braziliensis* in southern Brazil. Further efforts are needed to identify the parasites using modern methods.

Forattini (1973) reviewed the habits of *L. pessoai* in southern Brazil.

Lutzomyia (Pintomyia) fischeri (Pinto)
Fig. 115

Phlebotomus fischeri Pinto 1926: 373 (♂, Butantan, São Paulo, Brazil). Theodor 1932: 22 (♀).

Flebotomus fischeri: Barretto 1947a: 199 (full refs.).

Lutzomyia fisheri: Barretto 1962: 93 (listed). Theodor 1965: 192 (♂, ♀, figs.). Llanos 1973: 33 (♀, Peru). Martins et al. 1978: 27 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Llanos 1983: 183 (Peru). Aguair & Soucasaux 1984: 199 (seasonal biting habits, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Barros et al. 1985: 150 (Espirito Santo, Brazil). Aguair et al. 1985a: 188 (vertical dist.); 1985b: 340; 1985c: 467; 1986: 478 (coll. data, habits, Brazil). Vexant et al. 1986b: 293 (Bahia, Brazil). Aguiar & Vilela 1987: 585 (tree trunk resting sites). Feliciangeli 1988: 105 (Venezuela). Gomes et al. 1989a: 32 (biting activity, Brazil). Brazil et al. 1991: 113 (resting site, chicken coop, Brazil). Queiroz et al. 1991: 159 (coll. data, Brazil). Hashiguchi et al. 1992: 139 (coll. data, Paraguay).

Pintomyia fischeri: Forattini 1971a: 104 (listed); 1973: 500 (figs., tax.). Gomes et al. 1986: 282 (ecology, São Paulo, Brazil).

Distribution (Map 52). VENEZUELA (Feliciangeli 1988); BRAZIL; PERU (Martins et al. 1978); PARAGUAY (Hashiguchi et al. 1992; 1 ♂, 4 ♀♀, Acá-Pai, San Pedro, May 1950, M. Hertig; 2 ♂♂, 1 ♀, Sommerfeld, Yhú, March 1950, M. Hertig).

Remarks. *Lutzomyia fischeri* is an anthropophilic species. Favored resting sites appear to be tree trunks; females are frequently found inside and near houses where they attack man. Trypanosomes have been isolated from wild-caught females in Bahia, Brazil (Ryan et al. 1987c).

The immature stages were described by Barretto (1941).

Lutzomyia (Pintomyia) gibsoni (Pifano & Ortiz)

Phlebotomus gibsoni Pifano & Ortiz 1972: 29 (♀, Sierra Parima, Amazonas, Venezuela).

Lutzomyia gibsoni: Martins et al. 1978: 27 (as junior synonym of *fischeri*). Young 1979: 95 (mention).

Distribution (Map 52). VENEZUELA (type locality).

Remarks. The status of *L. gibsoni* remains undetermined. It was described from a single female, incorrectly designated the allotype, and is now apparently lost (D. Feliciangeli, pers. comm.). Martins et al. (1978) treat *L. gibsoni* as a

junior synonym of *L. fischeri*, but it will be necessary to collect and study males from the type locality before this species can be recognized with certainty.

Lutzomyia (Pintomyia) christenseni Young & Duncan, n.sp.
Fig. 116

Phlebotomus spinosus (not *spinosus* Floch & Abonnenc): Hertig & Fairchild 1950: 92 (abdominal sternites, figs.). Johnson & Hertig 1961: 765 (rearing data).
Lutzomyia spinosa (not *spinosus* Floch & Abonnenc): Christensen & Fairchild 1971: 302 (Panama). Christensen 1972a: 88 (listed). Osorno-Mesa et al. 1972c: 60 (in part, Colombia). Christensen & Herrer 1973: 579 (coll. data, Panama). Martins et al. 1978: 29 (in part, dist.). Young 1979: 93 (in part, ♂, ♀ figs., refs.). Christensen et al. 1983: 466 (Panama). Ryan 1986: 81 (♂, ♀ figs., dist. Pará, Brazil).
Pintomyia spinosa (in part): Forattini 1973: 505 (tax.).

Holotype ♂ (measurements in mm). Wing length 1.69, width 0.51. Whole insect moderately to strongly infuscated. Head height from vertex to tip of clypeus 0.31, head width 0.34. Eyes large, separated by 0.11 or by distance equal to 7.5 facet diameters. Flagellomere I 0.27 long; II+III + 0.25; ascoids on II ending slightly beyond middle of flagellomere, visible on all flagellomeres except terminal 3 (XII-XIV); very short posterior spurs present on ascoids. Labrum 0.18 long. Length of palpomeres: 1, 0.035; 2, 101; 3, 0.121; 4, 0.083; 5, 0.24; palpal sensilla (ca. 8) visible only at middle third of palp. 3. Cibarium with remnants of horizontal teeth; pigment patch absent; arch conspicuous at sides. Pharynx 0.11 long, with posterior ridges. Pleura with 15 upper & 2-3 lower episternal setae. Length of wing vein sections: α, 0.34; ß, 0.27; δ, 0.10; γ, 0.20. Length of femora, tibiae & basitarsi: foreleg, 0.64, 0.71, 0.39; midleg, 0.68, 0.96, 0.47; hindleg, 0.74, 1.15, 0.54; femur of hindleg with 3 short spines in a single row. *Genitalia*. Style 0.10 long, with 4 strong spines inserted at different levels; subterminal seta, if present, not visible. coxite 0.21 long, with 5-6 upwardly-curved, simple setae at inner base. Paramere simple, slightly tapering towards tip, dorsal setae simple, straight or gently curved. Aedeagus well-infuscated, subtriangular. Genital pump 0.137 long, each filament 0.31 long or 2.26X length of pump; striations visible at distal third of filaments. Lateral lobe 0.22 long.

Allotype ♀. Wing length 1.76, width 0.51. Coloration as in ♂. Head height 0.33, width 0.33. Eyes separated by 0.12 or by distance equal to 7.5 facet diameters. flagellomere I 0.25; II+III = 0.24; ascoids reaching to end of flagellomere II, present on flagellomers I-VI (rest missing). Labrum 0.17 long. Length of palpomeres: 1, 0.04; 2, 0.10; 3, 0.13; 4, 0.08; 5 (missing); palpal sensilla (ca. 16) on inner surface of palp. 3. Cibarium with 4-5 small, spine-like horizontal teeth in an irregular row; vertical teeth (ca. 12) also spine-like but shorter; no pigment patch; arch complete, with bulging sides. Pharynx 0.14 long, with

numerous posterior ridges. Pleura with 15-17 upper & 2-3 lower episternal setae. Length of wing vein sections: α, 0.40; ß, 0.27; δ, 0.15; γ, 0.18. Length of femora, tibiae & basitarsi: foreleg, 0.64, 0.68, 0.37; midleg, 0.66, 0.74, 0.42; hindleg, 0.74, 1.15, 0.49; hindfemur with row of 4 short spines. Spermathecae cylindrical, sac-like; hair-like ductules arise from broad terminal knob; distal half of individual sperm ducts with heavily-sclerotized, well-pigmented walls; remainder thin-walled, similar to common duct that is subequal in length to that of individual duct.

Type Material (Map 53). *Holotype* ♂ (slide 3399). **Panama**. Canal Zone, Las Cruces Trail, tree buttress, 4 Aug. 1951, M. Hertig. *Allotype* ♀ (slide 1801). Colon Prov., Rio del Medio, tree buttress, 15 Oct. 1949, R. Hartmann. *Paratypes*. 1 ♂, 1 ♀, Panama Prov., Cerro Azul, Prov., Cerro Campana, various dates & collectors. 1 ♂, Colon Prov., Palenque, 5 Sept. 1949, hollow tree, R. Hartmann. 1 ♂, Colon Prov., Rio del Medio, tree trunk, 15 Oct. 1949, R. Hartmann. 1 ♂, Canal Zone, Cerro Galera, dead leaves, 3 April 1959, W. Hanson. 2 ♀♀, **Colombia**. Choco, Curiche, 1967, D. Young. 12 ♂♂, 8 ♀♀, Antioquia, 24 km SW of Zaragoza, 1971-1972, C. Porter & D. Young. 4 ♂♂, 8 ♀♀, Amazonas, Leticia, tree trunks, July 1973, D. Young. 1 ♂, 1 ♀, **Trinidad**. Turure & Arena forests, T.H.G. Aitken & E. Tikasingh. 1 ♂, **Brazil**. Veracruz, Maranhão, 2 Feb. 1962, J.E. Silva. 2 ♂♂, Pará, 47 km W of Altamira, tree trunks, Oct. 1972, D. Young. 11 ♂♂, 1 ♀, Amazonas, Labrea, tree trunks, Oct. 1972, D. Young.

Remarks. We examined and compared the male holotype of *L. spinosa* (Floch & Abonnenc) with 12 other males in the subgenus from French Guiana, and with 2 topotypic males of *L. damascenoi* (Mangabeira) from Belém, Brazil. The materials from French Guiana was kindly loaned to us by Drs. F. Rodhain and J.-P. Dedet. We also studied females from the same localities where the males were captured.

The shape and setation of the parameres are identical among these males, with the dorsal setae restricted to the distal third of the structure. The number of setae of the coxite tuft ranged from 8 to 10 for males from French Guiana and from 12-14 for the two males from Belém. We did not detect any other structural differences among these males or females and, therefore, believe that *L. spinosa* and *L. damascenoi* are conspecific **(NEW SYNONYMY).**

Specimens in this subgenus, reported as *L. spinosa* (Floch & Abonnenc) by Christensen & Fairchild (1971) in Panama, Young (1979) in Colombia and Brazil (in part), and Ryan (1986) in Brazil differ from *L. damascenoi* (= *L. spinosa*) as was first suggested to us by Dr. H.A. Christensen, formerly of Gorgas Memorial Laboratory, Panama.

The parameres of this species, *L. christenseni*, are more slender than those of *L. damascenoi* and the dorsal setae are implanted over the distal half of the structure. The females of *L. christenseni* and *L. damascenoi* are not easily separated and males should be available before confirmed identifications can be made. Distributional records of *L. spinosa* may or may not represent *L. christenseni* (e.g., those of Martins et al. 1978; Biancardi et al. 1982; Arias et al. 1985; Feliciangeli 1988). Thus, the geographic ranges of *L. christenseni* and *L. damascenoi*, as given here should be considered provisional, and subject to change as new material becomes available and after existing specimens are reexamined.

The present (or absence) of the small subapical seta on each style of the *L. christenseni* males is variable among the type specimens and, represents the only variation observed other than size differences.

The holotype, allotype, and some paratypes will be deposited in the Florida State Collection of Arthropods, Gainesville, Florida. Other paratypes will be sent to the National Institute of Health, Bogota, Colombia and INPA, Manaus, Brazil.

Lutzomyia (*Pintomyia*) *damascenoi* (Mangabeira)
Fig. 117

Flebotomus damascenoi Mangabeira 1941e: 369 (♂, ♀, Aurá, Belém, Pará, Brazil). Barretto 1947a: 196 (refs.). Damasceno et al. 1949: 823 (dist., Pará, Brazil). Barretto 1950c: 224 (dist.).

Phlebotomus damascenoi: Floch & Abonnenc 1952: 31,42 (keyed).

Phlebotomus spinosus Floch & Abonnenc 1942b: 1 (♂, Gallion, French Guiana); 1945c: 2 (♀ keyed); 1952: 80 (♂, ♀ figs., redescript., French Guiana).

Lutzomyia damascenoi: Barretto 1962: 93 (listed). Theodor 1965: 183 (listed). Ward et al. 1973b: 178. Lewis 1975a: 501 (mouthpart morphol.). Martins et al. 1978: 27 (refs., dist.). Lainson et al. 1979: 240 (biting man, Pará, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil).

Lutzomyia spinosa: Barretto 1962: 93 (listed). Theodor 1965: 183 (listed). Léger et al. 1977: 227 (French Guiana). Martins et al. 1978: 29 (in part, dist.). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 35 (as potential vector of *Leishmania*).

Distribution (Map 54). COLOMBIA (Martins et al. 1978; ♂, La Macarena, 1987, C. Ferro); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978; Geoffroy et al. 1986); BRAZIL (Martins et al. 1978; Ryan 1986).

Remarks. See *L. christenseni*.

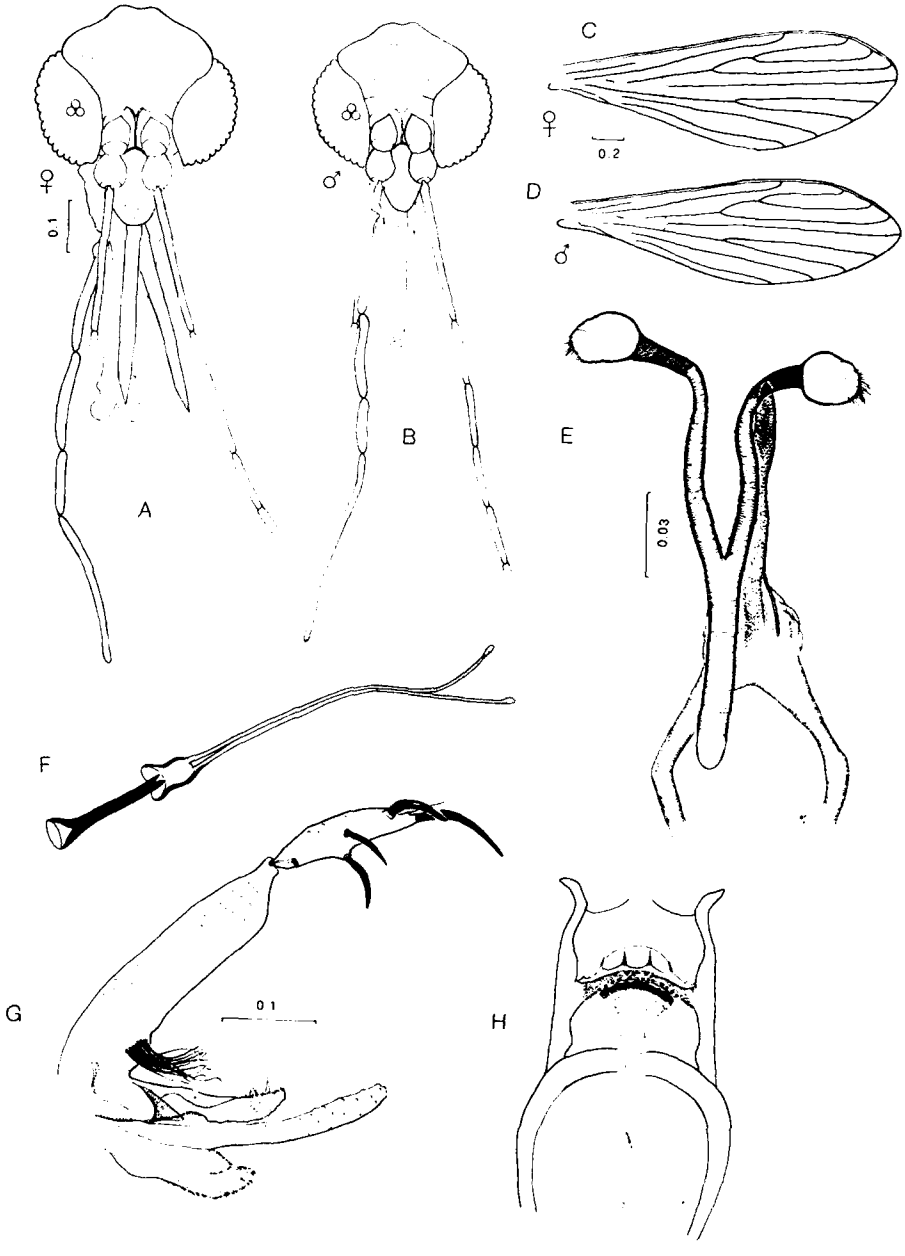


FIG. 114. ***Lutzomyia pessoai***. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Spermathecae; F. Genital pump & filaments; G. Male terminalia; H. Female cibarium.

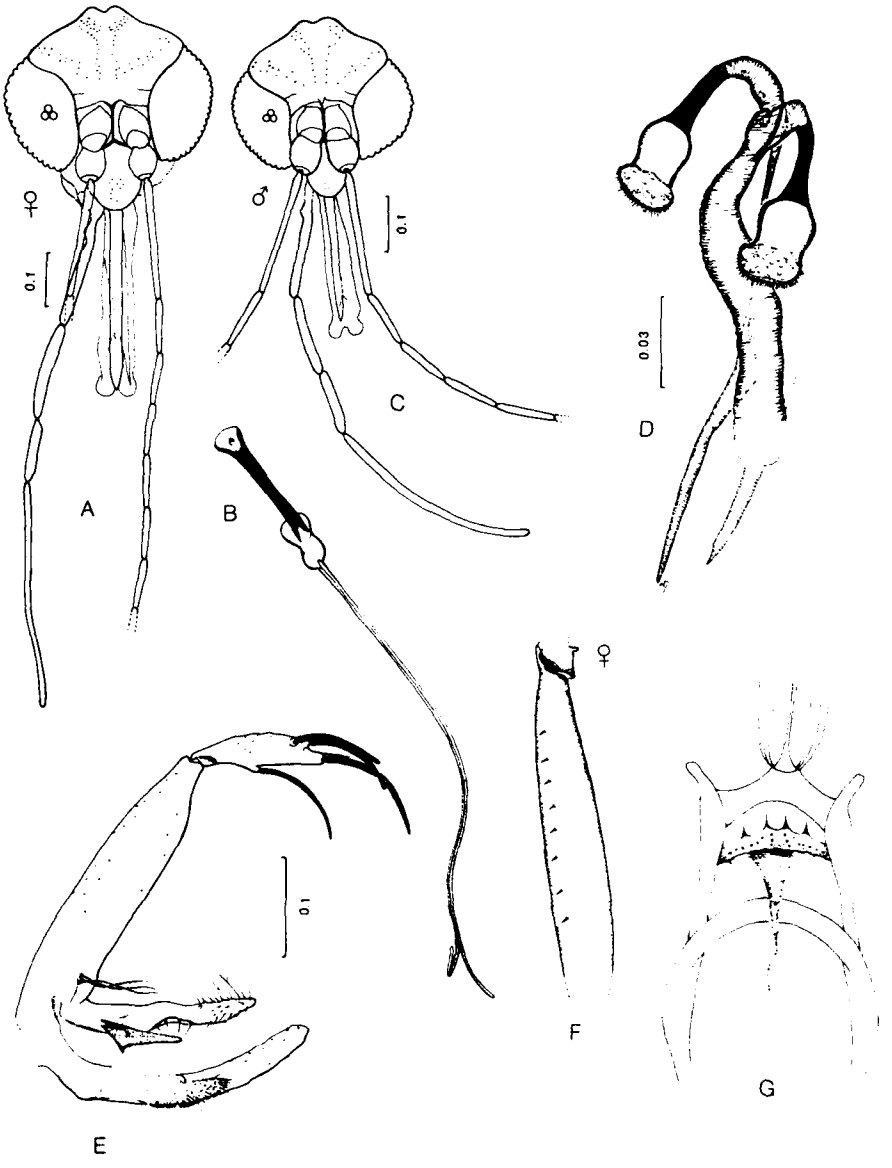


FIG. 115. ***Lutzomyia fischeri.*** A. Female head; B. Genital pump & filaments; C. Male head; D. Spermathecae; E. Male terminalia; F. Female femur of hingleg showing row of spines; G. Female cibarium.

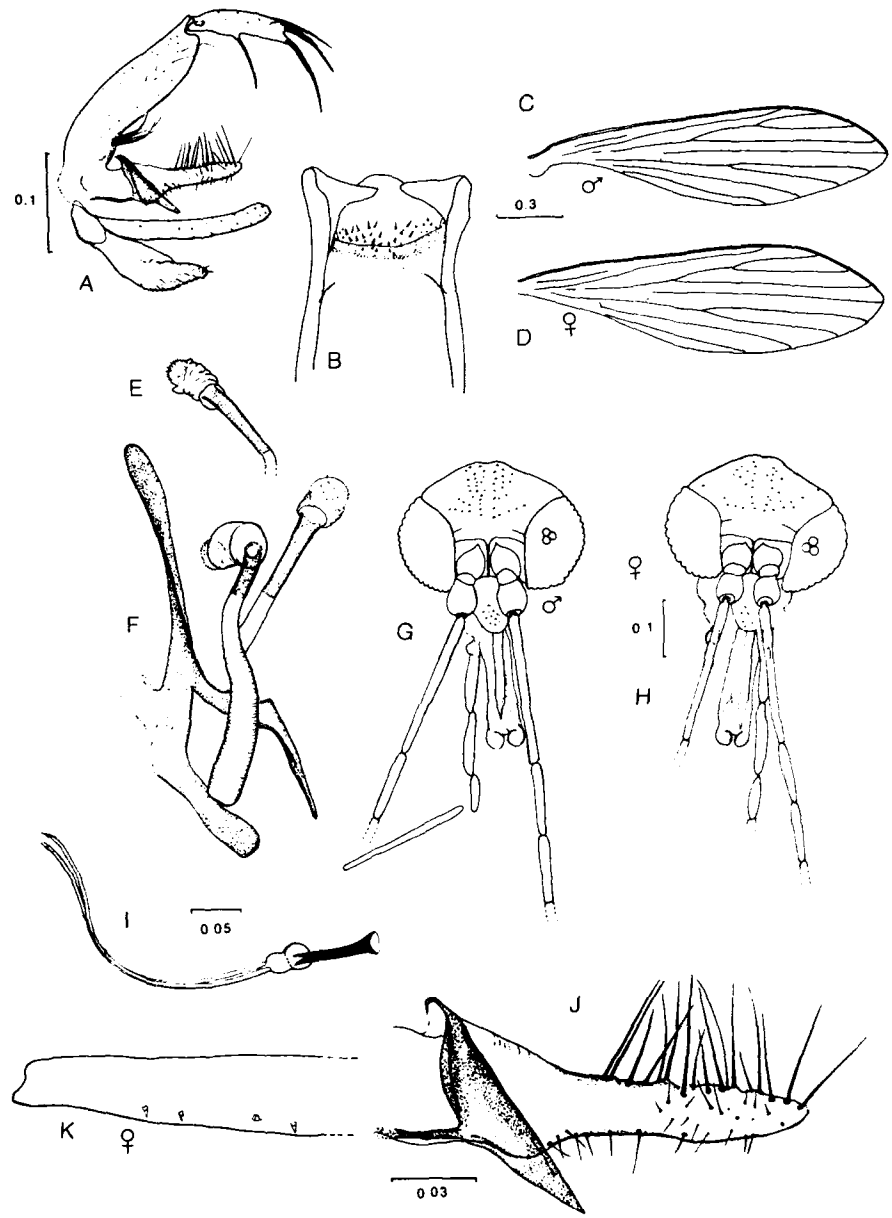


FIG. 116. ***Lutzomyia christenseni.*** A. Male terminalia; B. Female cibarium; C. Male wing; D. Female wing; E. Lateral view of spermathecae; F. Spermatheacae; G. Male head; H. Female head; I. Genital pump & filaments; J. Paramere; K. Female femur showing spines.

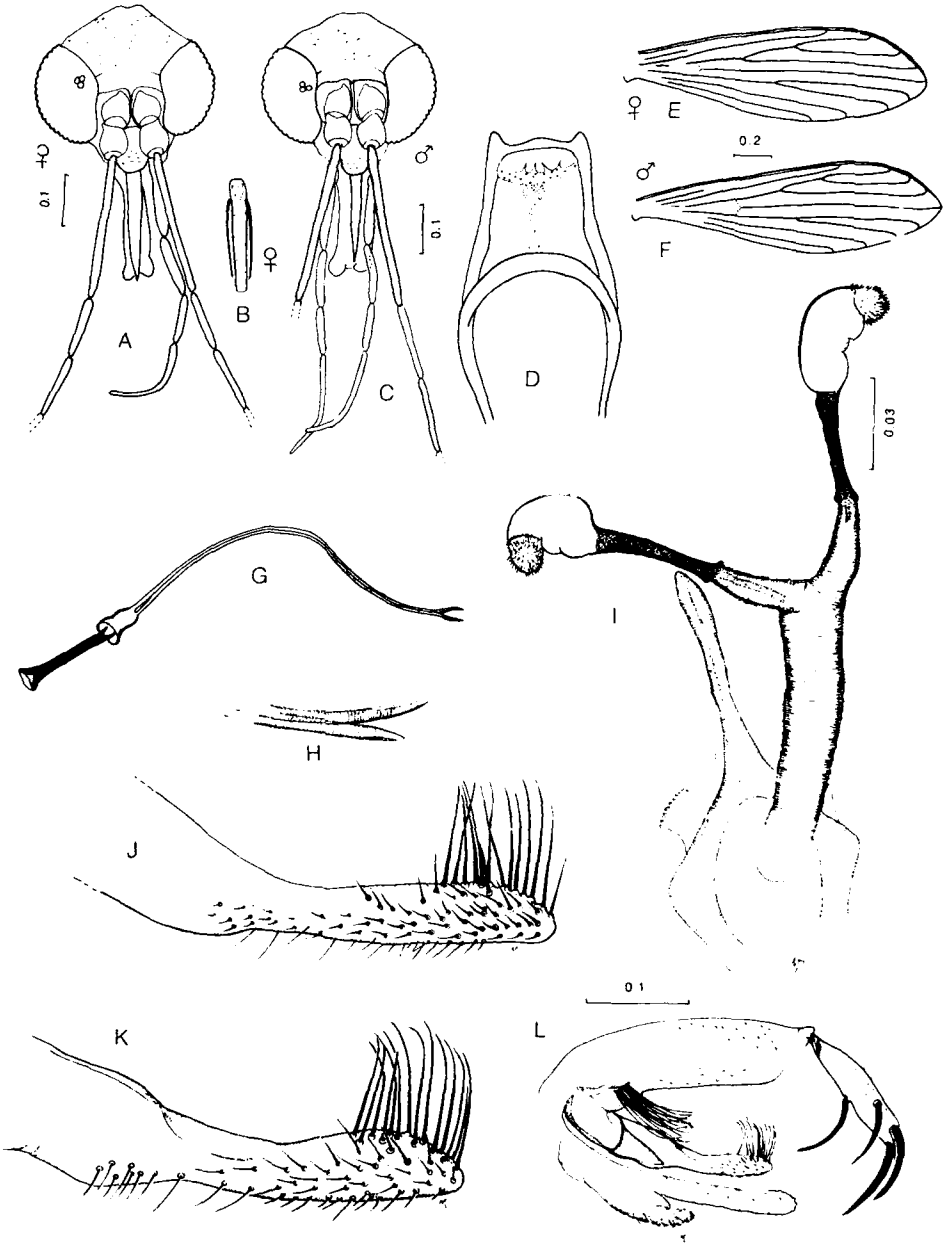
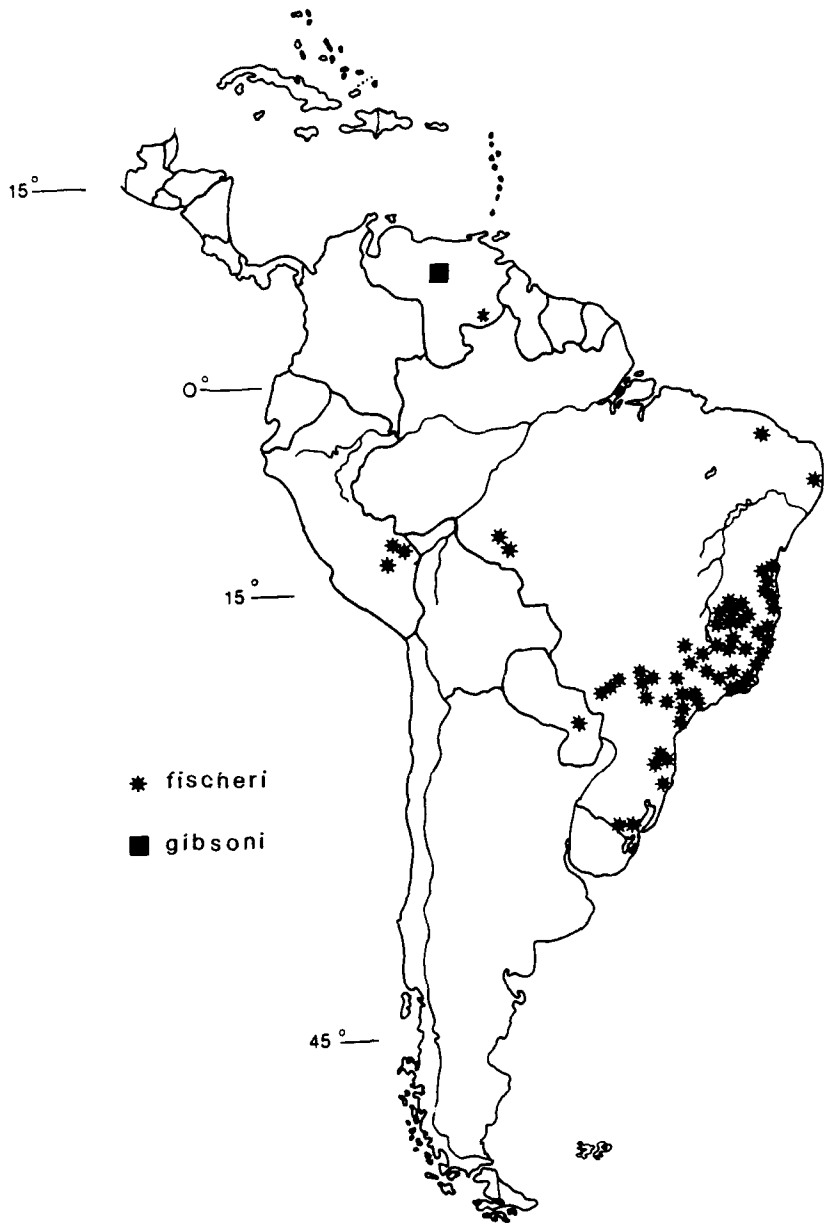


FIG. 117. ***Lutzomyia damascenoi.*** A. Female head; B. Female flagellomere II; C. Male head; D. Female cibarium; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Tips of genital filaments; I. Spermathecae; J.,K. Paramere; L. Male terminalia.

Map 51



Map 52

Map 53

Map 54

SUBGENUS *PRESSATIA* MANGABEIRA

Flebotomus subgenus *Pressatia* Mangabeira 1942a: 131 (type species: *Flebotomus triacanthus* Mangabeira by orig. designation).
Lutzomyia, genus: Barretto 1962: 94. Theodor 1965: 112. Lewis et al. 1977:325. Martins et al. 1978: 52 (defined). Artemiev 1991:74.
Pressatia, genus: Forattini 1971a: 106; 1973: 511.

Identification. Coloration dusky to dark. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with 4 horizontal teeth & distinct group of vertical teeth on each side of cibarium; arch complete & pigment patch distinct. Pharynx unarmed. Spermathecae, smooth-walled capsules, with protruding terminal knob; individual ducts sclerotized, much shorter and thinner than common duct. ♂ *genitalia.* Coxite with 1-3 groups of persistent setae. Style with 2-3 large spines inserted at different levels plus a subterminal seta & small median-distal seta. Paramere usually ending in a short finger-like lobe, acute ventral projection present. Lateral lobe arched upwards, relatively long without modified dorsal setae. Genital filaments with transverse striations distally.

The females in this subgenus are structurally similar and with few exceptions (*L. camposi* and *dysponeta*), are difficult to identify without associated males.

Medical Importance. Unknown; females are not commonly attracted to human bait.

Key to the Males of the Subgenus *Pressatia**

1. Paramere as shown, with about 10 blade-like setae arising from & near ventral margin . . . . . *L. camposi* (Fig. 118)
   Paramere otherwise, without such blade-like setae 2

2. Coxite with median & distal group of persistent setae beyond basal group . . . . . *L. equatorialis* (Fig. 119A)
   Coxite without median group of persistent setae; basal group present 3

3. Paramere slender, its width at level of ventral acute projection less than or subequal to width of lateral lobe. Coxite without fine hairs or tubercle above the base of modified setae . . . . . *L. dysponeta* (Fig. 120)
   Paramere otherwise, broader. Coxite with fine hairs inserted on tubercle next to base of modified setae 4

*It is impossible to construct a useful key to the *Pressatia* females because there are no structural differences between most of the species.

4. Coxite with only 3-4 slender straight setae inserted on small tubercle above base of modified setae . . . . . *L. triacantha* (Fig. 119B)
   Coxite with 10 or more such setae inserted on larger tubercle than above 5

5. Paramere as shown, with apical digitiform process directed upwards . . . . . *L. calcarata* (Fig. 119C)
   Paramere otherwise, apical digitiform process pointing posteriorly 6

6. Paramere with long dorsal setae inserted over distal half of structure, including apical digitiform process . . . . *Lutzomyia* (*Pressatia*) sp. #1 (Fig. 119D)
   Paramere without long dorsal setae as above 7

7. Coxite with 8-9 modified setae at base . . . . . *L. trispinosa* (Fig. 119E)
   Coxite with 6 or fewer modified setae at base . . . . . *L. choti* (Fig. 119F)

Lutzomyia (*Pressatia*) *camposi* (Rodríguez)
Fig. 118

Phlebotomus camposi Rodríguez 1952: 7 (♂, Quevedo, Los Rios, Ecuador).
Phlebotomus acanthobasis Fairchild & Hertig 1952: 508 (♂, ♀, Panama); 1958b: 205 (as synonym of *camposi*).
Lutzomyia camposi: Barretto 1962: 95. Martins et al. 1978: 55 (refs., dist.). Young 1979: 97 (♂, ♀ figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits). Christensen et al. 1983: 466 (Panama). Young & Rogers 1984: 599 (Ecuador). Murillo & Zeledón 1985: 43 (♂, ♀ figs., Costa Rica). Alexander et al. 1992a: 35; 1992c: 124 (Ecuador).
Pressatia camposi: Forattini 1971a: 106 (listed); 1973: 512 (♂, ♀ figs., tax.)

Distribution (Map 55). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979); ECUADOR (Martins et al. 1978; Young 1979; Young & Rogers 1984; Alexander et al. 1992a,c).

Remarks. This species and *L. dysponeta* occur together in many localities; the females are distinguished by the longer individual sperm ducts of *L. camposi* (see Fairchild & Hertig 1952).

Lutzomyia (*Pressatia*) *equatorialis* (Mangabeira)
Fig. 119 A

Flebotomus equatorialis Mangabeira 1942a: 127 (♂, Aurá, Belém, Pará, Brazil).
Lutzomyia equatorialis (or *aequatorialis*): Barretto 1962: 95. Theodor 1965: 192. Léger et al. 1977: 227 (♂ fig., French Guiana). Martins et al. 1978: 56 (Brazil records). Ryan 1986: 84 (♂ fig.). Lebbe et al. 1987: 29 (computer aided ident.).

Pressatia equatorialis: Forattini 1971a: 106 (listed); 1973: 517 (♂ fig., tax.).

Distribution (Map 56). FRENCH GUIANA (Léger et al. 1977); BRAZIL (Martins et al. 1978; Ryan 1986).

Remarks. The male of *L. equatorialis* differs from other *Pressatia* males by the presence of a median group of setae on each coxite. The female remains undescribed.

Lutzomyia (Pressatia) dysponeta (Fairchild & Hertig)
Fig. 120

Phlebotomus dysponetus Fairchild & Hertig 1952: 505 (♂, ♀, Juan Mina, Canal Zone, Panama).

Phlebotomus triacanthus (not *triacanthus* Mangabeira): Rodríguez 1952: 6 (Ecuador).

Lutzomyia dysponeta: Barretto 1962: 95. Martins et al. 1978: 55 (refs., dist.). Young 1979: 98 (♂, ♀ figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits, Panama). Christensen et al. 1983: 466 (Panama). Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 43 (♂, ♀ figs., Costa Rica). Alexander et al. 1992a: 35; 1992c: 124 (Ecuador). Eshita et al. 1992: 22 (Ecuador).

Pressatia dysponeta: Forattini 1971a: 106; 1973: 515 (♂, ♀ figs., tax.).

Distribution (Map 56). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979); ECUADOR (Rodríguez 1950; Young & Rogers 1984; Alexander et al. 1992a,c); VENEZUELA (Marmol Leon 1968; Martins et al. 1978).

Remarks. Thatcher (1968b) collected larvae in Panama, 6 m above ground level in dead leaves in a tree and Rutledge & Ellenwood (1975a) captured an adult in a soil emergence trap, placed on the forest floor, also in Panama.

Lutzomyia (Pressatia) triacantha (Mangabeira)
Fig. 119 B

Flebotomus triacanthus Mangabeira 1942a: 119 (♂, Aurá, Belém, Pará, Brazil); 1942c: 242 (♀, immatures).

Lutzomyia triacantha: Barretto 1962: 95 (listed). Theodor 1965: 192 (♂, ♀ figs.). Léger et al. 1977: 226 (French Guiana). Martins et al. 1978: 56 (refs., dist.). Feliciangeli 1980: 246 (Venezuela). Llanos 1983: 183 (Peru). Biancardi et al. 1982: 173 (Rondônia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 85 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Pressatia triacantha: Forattini 1971a: 107; 1973: 520 (♂, ♀ figs., tax.).

Distribution (Map 57). VENEZUELA (Pifano et al. 1962c, no locality given; Feliciangeli 1980); COLOMBIA (Osorno-Mesa et al. 1972b); BRAZIL; PERU (Martins et al. 1978; Pérez et al. 1991).

Remarks. Records of *L. triacantha* in Colombia and Venezuela, cited above, are questionable and must be confirmed when males are obtained. The male illustrated by Young (1979) from Ecuador (also Young & Rogers 1984) is conspecific with *L. choti*, not *L. triacantha*. Eshita et al. (1992) listed this species from Esmeraldas Prov., Ecuador but only females were recorded so the specimens may have represented *L. triramula*, not *L. triacantha*.

We have examined 2 *triacantha* males identified by O. Mangabeira and collected by him from the type locality.

Lutzomyia (Pressatia) calcarata Martins & Silva
Fig. 119 C

Lutzomyia calcarata Martins & Silva 1964: 131 (♂, Seringal, Carioca, Acre, Brazil). Llanos et al. 1975b: 669 (Peru); 1976: 483 (♀). Martins et al 1978: 53 (dist., refs.). Biancardi 1982: 173 (Rôndonia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil). Llanos 1983: 183 (Peru). Feliciangeli 1988: 105 (Apure & Barinas, Venezuela).
Pressatia calcarata: Forattini 1971a: 106 (listed); 1973: 512 (fig., tax.).

Distribution (Map 56). VENEZUELA (Feliciangeli 1988); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982); PERU (Llanos 1981); BOLIVIA (J. Velasco, unpublished data).

Lutzomyia (Pressatia) sp. #1
Fig. 119 D

Distribution (Map 58). BOLIVIA (J. Velasco, unpublished data); ? COLOMBIA (Young & Morales 1987).

Remarks. This species, known from a single male, is easily distinguished from other *Pressatia* males by the presence of long setae on the dorsum of the paramere. It has not been assigned a formal name owing to the lack of material.

A *Pressatia* male, illustrated in Fig. 119D by Young & Morales (1987), from Colombia closely resembles the Bolivian species but it has lost some structures and therefore it is not possible to specifically identify this specimen.

Lutzomyia* (*Pressatia*) *trispinosa (Mangabeira)
Fig. 119 E

Flebotomus trispinosus Mangabeira 1942a: 127 (♂, Aurá, Belém, Pará, Brazil).
Lutzomyia trispinosa: Barretto 1962: 95. Theodor 1965: 192. Léger et al. 1977: 227 (♂ figs., French Guiana). Martins et al. 1978: 56 (dist.). Ryan 1986: 86 (♂ fig., Brazil records).
Pressatia trispinosa: Forattini 1971a: 107; 1973: 514 (in part, as junior synonym of *choti*).

Distribution (Map 58). FRENCH GUIANA (Léger et al. 1977); BRAZIL (Martins et al. 1978; Ryan 1986); PERU (Llanos 1983).

Remarks. Forattini (1973) treats *L. trispinosa* as a synonym of *L. choti* but this proposal has not been accepted because of salient differences in the shape of the parameres and number of persistent setae of the coxite tuft (Léger et al. 1977).

We studied one topotype male of *L. trispinosa* identified by O. Mangabeira.

Lutzomyia* (*Pressatia*) *choti (Floch & Abonnenc)
Fig. 119 F

Phlebotomus choti Floch & Abonnenc 1941a: 7 (♂, ♀, Montjoly, French Guiana); 1952: 64 (figs.).
Lutzomyia choti: Barretto 1962: 95 (listed). Theodor 1965: 192 (listed). Llanos 1973: 34 (♂, Peru). Léger et al. 1977: 226 (♂ fig., French Guiana). Martins et al. 1978: 53 (refs., dist., figs.). Arias & Freitas 1982: 403 (Acre, Brazil). Llanos 1983: 183 (Peru). Ready et al. 1983a: 780 (♀, Pará, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 83 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Young & Morales 1987: 662 (Colombia).
Pressatia choti: Forattini 1971a: 106 (listed); 1973: 514 (in part).
Pressatia triacantha (not *triacanthus* Mangabeira): Young 1979: 100 (♂ fig., Ecuador). Young & Rogers 1984: 599 (listed Ecuador).

Distribution (Map 55). FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); BRAZIL (Martins et al. 1978; Arias & Freitas 1982; Ryan 1986); COLOMBIA (Young & Morales 1987); ECUADOR (Young 1979); PERU (Llanos 1981); SURINAME (♂♂, Aseli Kamp & Putamakko 1979, 1983, A.M. Burgos).

Remarks. We compared a *L. choti* male from French Guiana, identified by H. Floch, with males from Ecuador (Young 1979) and Colombia (Young & Morales 1987) and concluded that they were conspecific.

Lutzomyia choti has been commonly found resting in armadillo burrows in Pará State, Brazil (Ready et al. 1983a).

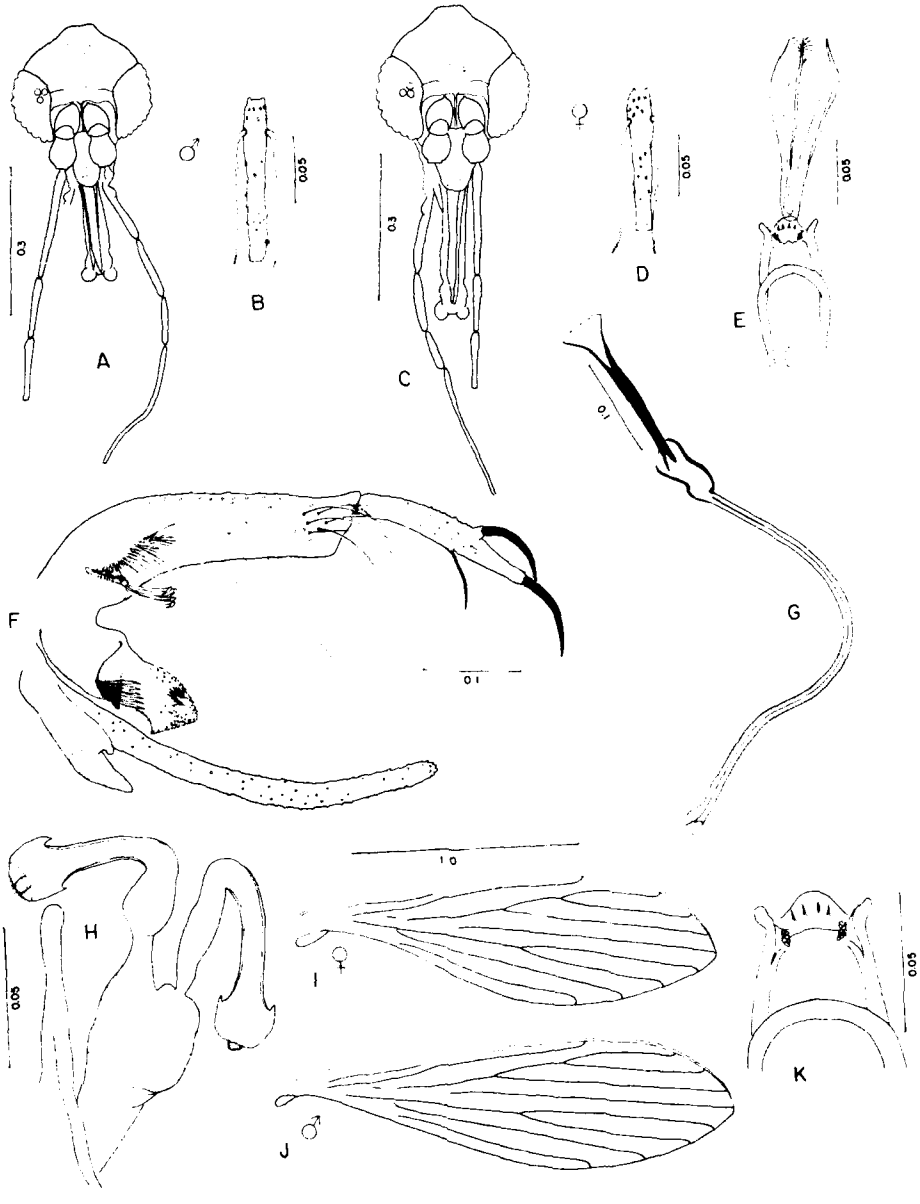


FIG. 118. ***Lutzomyia camposi***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

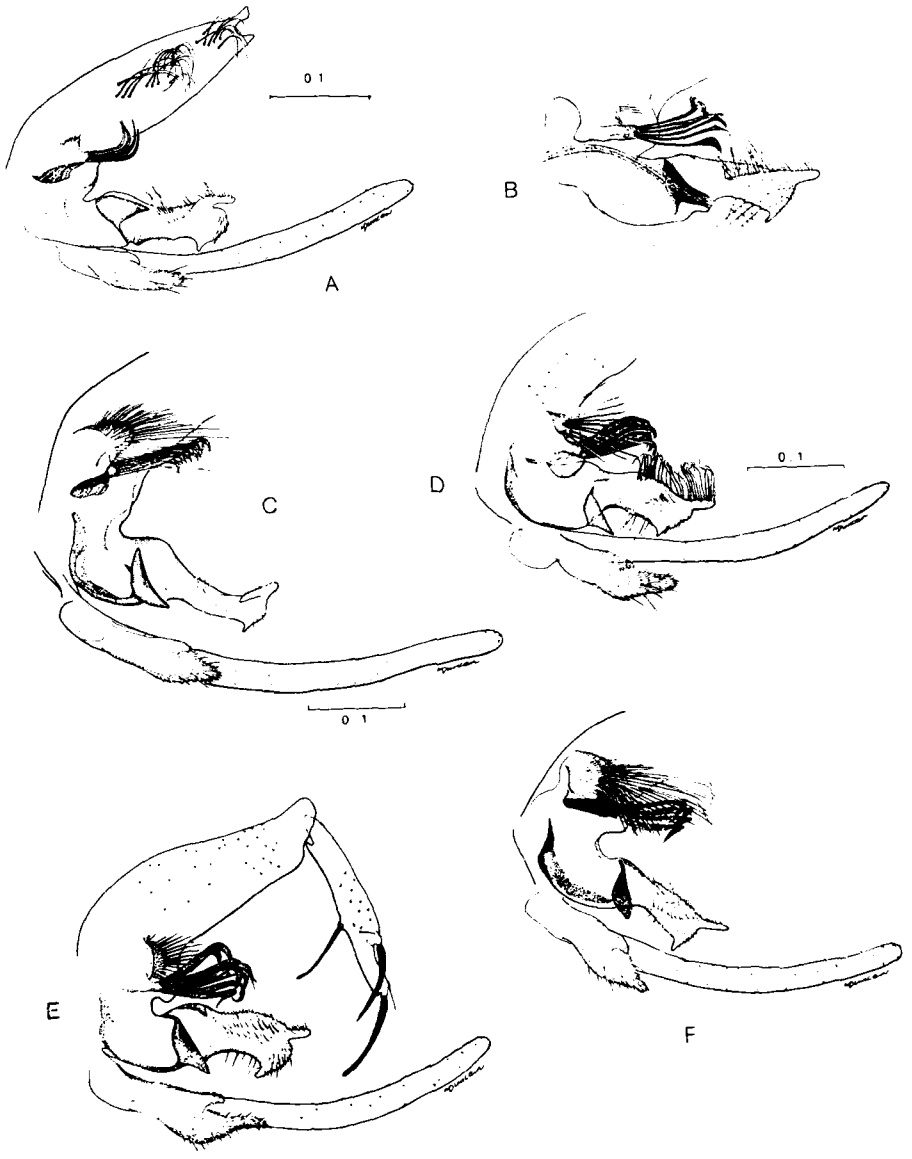


FIG. 119. ***Lutzomyia equatorialis***. A. Male terminalia, in part.
Lutzomyia triacantha. B. Paramere & coxite base (from Mangabeira 1942a).
Lutzomyia calcarata. C. Male terminalia, in part.
***Lutzomyia* (*Pressatia*) sp. #1**. D. Male terminalia, in part.
Lutzomyia trispinosa. E. Male terminalia.
Lutzomyia choti. F. Male terminalia, in part.

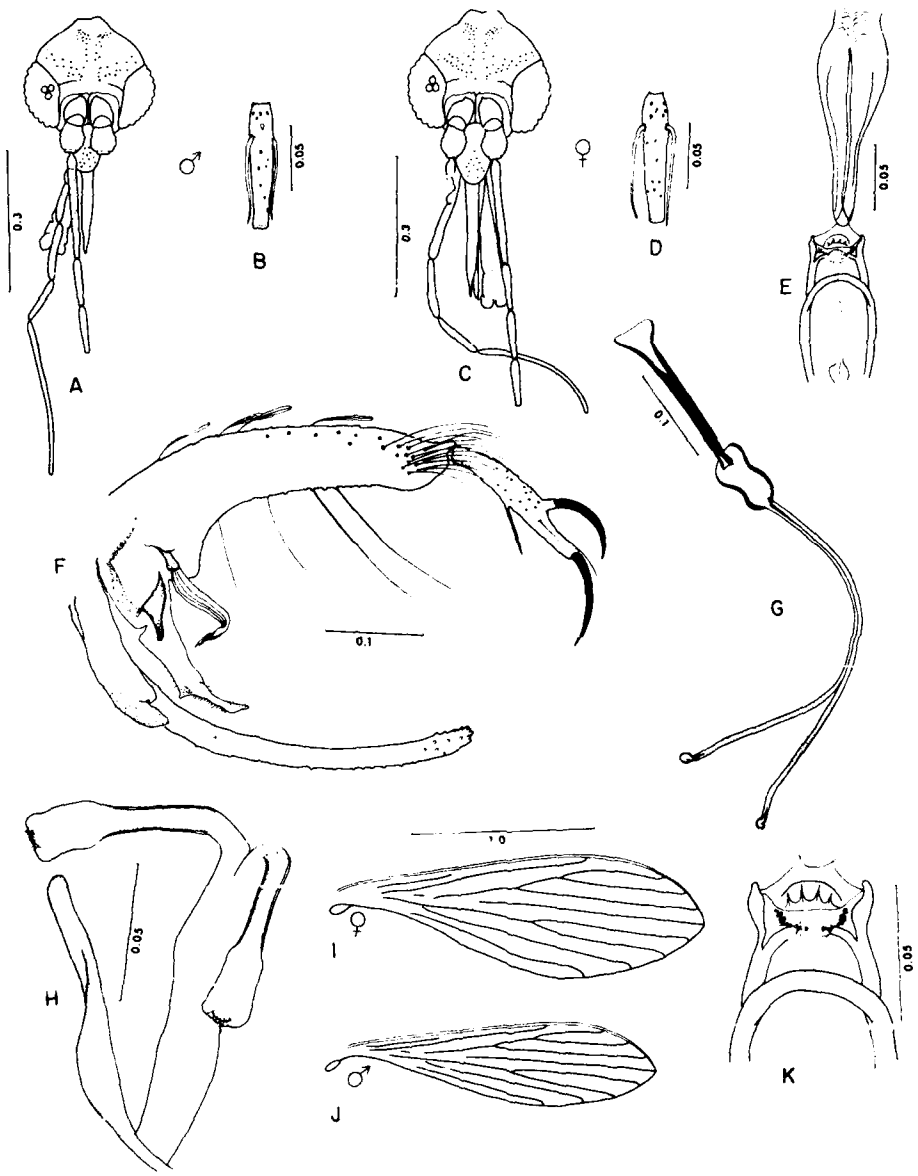
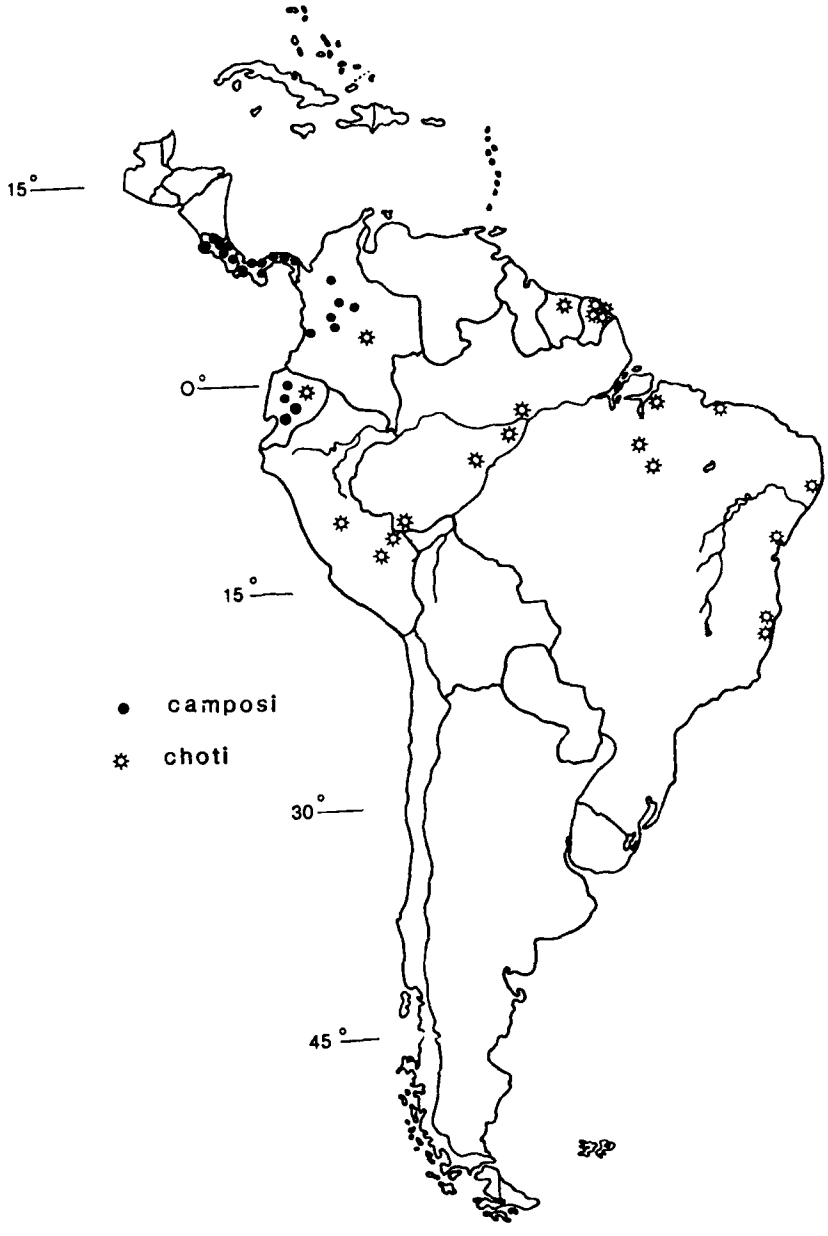
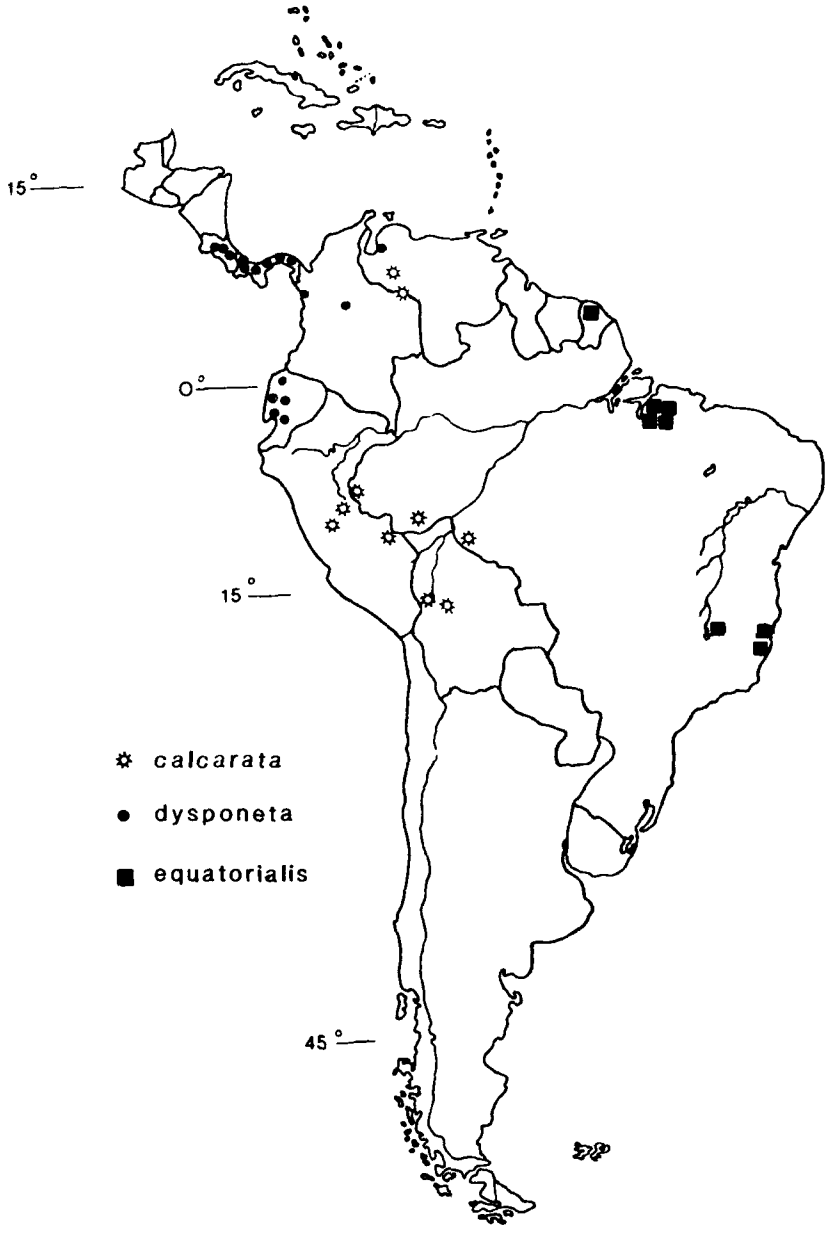


FIG. 120. ***Lutzomyia dysponeta.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

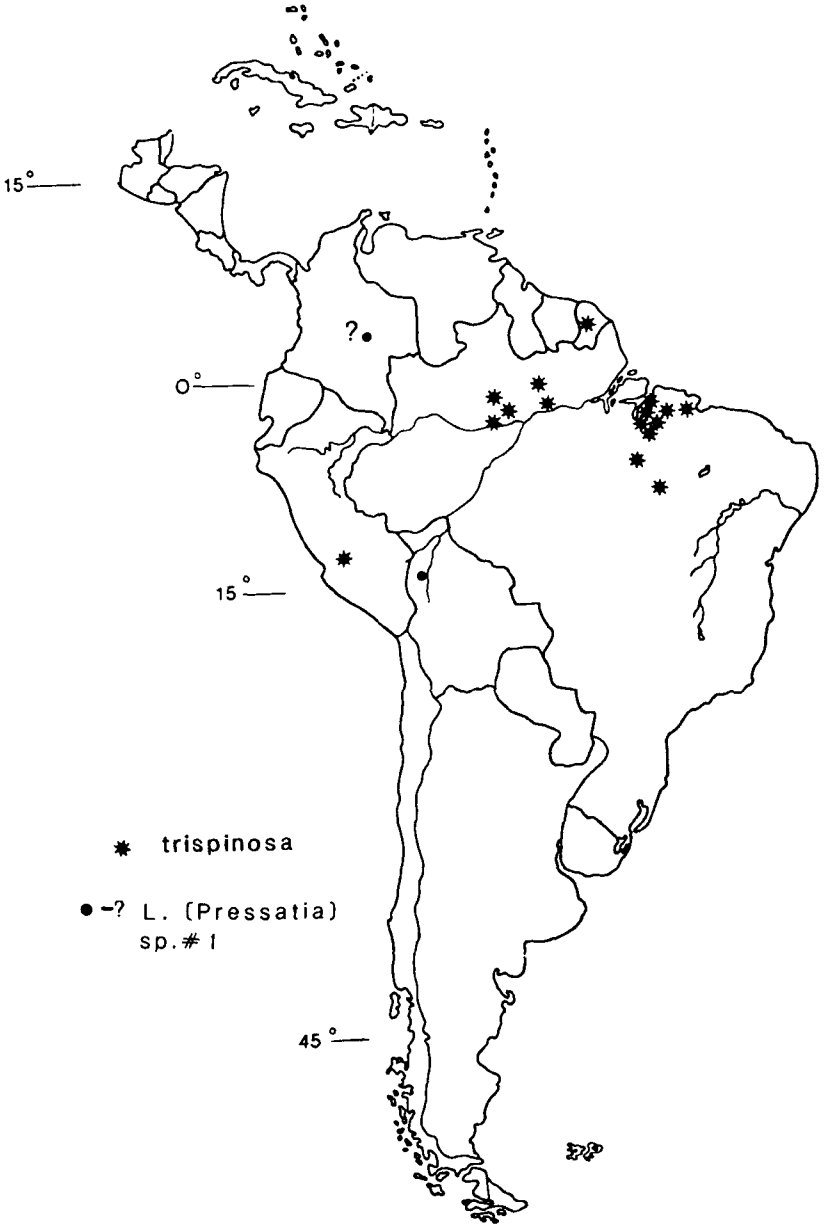


Map 55



Map 56

Map 57



Map 58

SPECIES GROUP *BAITYI*

Lutzomyia species group *baityi* Theodor 1965: 194. Lewis et al. 1977: 325.
Lutzomyia, subgenus *Coromyia* (in part): Forattini 1971a. 101.
Lutzomyia species group *gorbitzi*: Martins et al. 1978: 156.
Lutzomyia, subgenus *Barrettomyia* (in part): Artemiev 1991: 73.

Identification. Coloration dusky, scutum lightly to moderately pigmented. Flagellomere I shorter than proboscis; ascoids simple. Palpomere 5 long, subequal to combined length of palpomeres 2 + 3 + 4. ♀ cibarium with 4 pointed horizontal teeth; complete arch & well-defined pigment patch. Pharynx unarmed. Spermathecae tubular, with short to long individual ducts; common duct short or absent. ♂ *genitalia*: Coxite with distal row or group of 4-8 long setae; basal tuft present or absent. Style with 4 short, thick spines & subterminal seta. Genital filaments shorter than 3X pump length. Lateral lobes shorter than coxite length & with tapered ends.

The *baityi* group males, like those in the *dreisbachi* group, have long persistent setae at the distal end of each coxite but the antennal ascoids are simple and a small subterminal seta is present on the style.

Medical Importance. Unknown. Females have not been reported attacking man.

Key to the Males of the Species Group *baityi*

1. Style with 4 spines at distal third of segment. Coxite with patch of very short setae at base . . . . . *L. gorbitzi* (Fig. 122)
   Style with proximal isolated spine near middle of segment. Coxite with or without persistent basal setae; if present they are longer than width of coxite 2

2. Coxite with basal group of 4-6 long setae. Genital filaments about 2X length of pump & with modified tips . . . . . *L. baityi* (Fig. 121)
   Coxite without basal group of setae. Genital filaments longer (ca. 2.6X length of pump) & having simple tips . . . . . *L. moucheti* (Fig. 123)

Key to the Females of Species Group *baityi*

1. Spermathecae with terminal knob multilobed; individual ducts long, exceeding length of genital fork stem . . . . . *L. moucheti* (Fig. 123)
   Spermathecae with terminal knob unilobed; individual ducts shorter than genital fork stem . . . . . *L. gorbitzi* (Fig. 122)

Lutzomyia baityi (Damasceno, Causey & Arouck)
Fig. 121

Flebotomus baityi Damasceno, Causey & Arouck 1945: 22 (♂, Cuiteua, Irituia, Pará, Brazil).
Lutzomyia baityi: Theodor 1965: 194. Forattini 1973: 281. Martins et al. 1978: 158 (? ♀ figs., refs.). Young 1979: 102 (♂ fig., refs.). Feliciangeli 1980: 246; 1988: 101 (Venezuela). Young & Rogers 1984: 599 (listed, Ecuador). Ryan 1986: 25 (♂ fig.). Añez et al. 1988: 457 (Mérida, Venezuela).

Distribution (Map 59). BRAZIL (Martins et al. 1978; Ryan 1986); COLOMBIA and ECUADOR (Young 1979); VENEZUELA (Martins et al. 1978; Añez et al. 1988; Feliciangeli 1988).

Remarks. The female of *L. baityi* is not known with certainty but may be conspecific with that illustrated by Martins et al. (1978).

Lutzomyia gorbitzi (Blancas)
Fig. 122

Phlebotomus gorbitzi Blancas 1959/1960: 125 (♂, ♀, Canon del Pato, Ancash, Peru).
Phlebotomus hansoni Fairchild & Hertig 1961b: 244 (♂, ♀, Panama).
Lutzomyia hansoni: Theodor 1965: 194 (♂, ♀, figs.). Christensen & Rutledge 1973: 314 (junior synonym of *gorbitizi*).
Lutzomyia gorbitzi: Theodor 1965: 194. Forattini 1971a: 101; 1973: 286. Martins et al. 1978: 158. Christensen et al. 1983: 466 (rel. abundance in Panama). Murillo & Zeledón 1985: 121 (♂, ♀ figs., Costa Rica). Barreto et al. 1989: 53 (Nariño, Colombia). Alexander et al. 1992a: 36 (Ecuador record); 1992c: 124 (Ecuador).

Distribution (Map 59): COSTA RICA (Murillo & Zeledón 1985); PANAMA, PERU (Martins et al. 1978); COLOMBIA (Barreto et al. 1989); ECUADOR (Alexander et al. 1992a,c).

Remarks: Most specimens of *L. gorbitzi* in Panama have been aspirated from tree trunks or hollows that are sometimes occupied with bats (Christensen et al. 1983). The feeding habits of this species have not been studied.

Hanson (unpublished data) collected, reared and described larvae of *L. gorbitzi* that he recovered from soil between buttressed roots in Panama.

Lutzomyia moucheti Pajot & Le Pont
Fig. 123

Lutzomyia moucheti Pajot & Le Pont 1978: 295 (♂, French Guiana). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 59). FRENCH GUIANA (Pajot & Le Pont 1978); PERU (♂, ♀, Madre de Dios, Tambopata Reserve, canopy fogging collections, T. Erwin); BRAZIL (♂, Amazonas, Balbina Hydroelectric Dam, NE of Manaus, canopy light trap, J. Arias).

Remarks. The description of the previously unknown female from Tambopata Reserve, Peru, is given below (measurements in mm).

♀ (n = 1). Wing length 1.32; width 0.36. Whole insect moderately pigmented but scutum darker than pleura. Head height 0.35; width 0.27. Eyes small, separated by 0.13 or by distance = to 9 facet diameters. Flagellomere I, 0.11 long; II & III = 0.14 long; ascoids simple, those on II extending to end of segment; on all flags, except last flag. (XIV). Labrum 0.21 long. Length of palpomeres: 1, 0.03; 2, 0.09; 3, 0.12; 4, 0.09; 5, 0.22; palpal sensillae (ca. 8) visible on middle 1/2 of palp. 3, scattered. Cibarium with 4 sharp equidistant horizontal teeth & transverse row of 7 small vertical teeth; pigment patch as shown, moderately infuscated; arch complete. Pharynx unarmed, 0.14 long. Pleura with 5-7 upper & 3 lower episternal setae. Length of wing vein sections: α, 0.23; β, 0.24; δ, 0.02-0.03; γ, 0.18-0.20. Length of femora, tibiae & basitarsi: foreleg, 0.50, 0.45, 0.25; midleg, 0.52, 0.52, 0.31; hindleg, 0.56, 0.68. 0.35. Spermathecae slightly wider than individual ducts, with incipient annuli, terminal knob not distinct, apparently embedded into spermathecae & divided. Common sperm duct very short.

Remarks. The female of *L. moucheti* was associated with the male on the basis of its very small eyes, short flagellomeres, length of palpomeres, coloration and wing venation. Both specimens from Peru, as well as the males from Brazil and French Guiana, were taken in the forest canopy, suggesting that *L. moucheti* is a true canopy dwelling species.

The distinctive spermathecae and, particularly, the multilobed terminal knob, serve to distinguish the *L. moucheti* females from others in the genus.

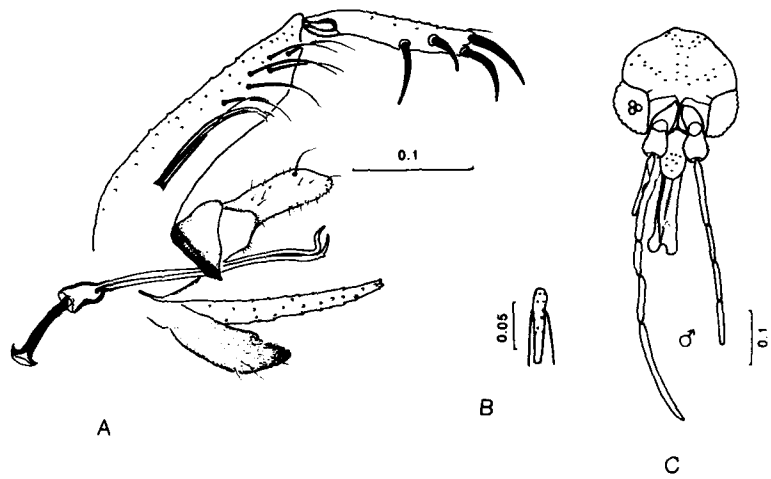


FIG. 121. ***Lutzomyia baityi.*** A. Male terminalia; B. Male flagellomere II; C. Male head (fig. A from Young 1979).

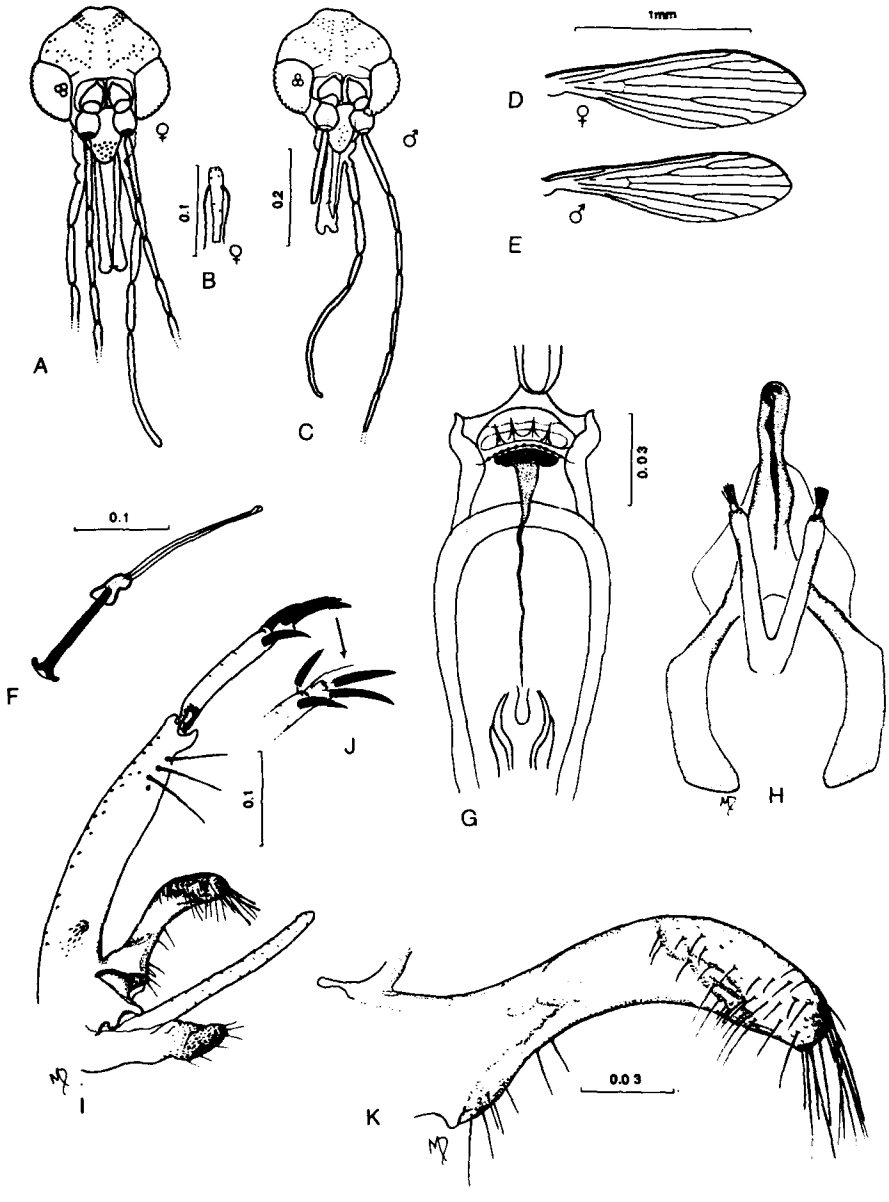


FIG. 122. ***Lutzomyia gorbitzi.*** A. Female head; B. Female flagellomere II; C. Male head; D. Female wing; E. Male wing; F. Genital pump & filaments; G. Female cibarium; H. Spermathecae; I. Male terminalia; J. Apex of style, different angle of view; K. Paramere.

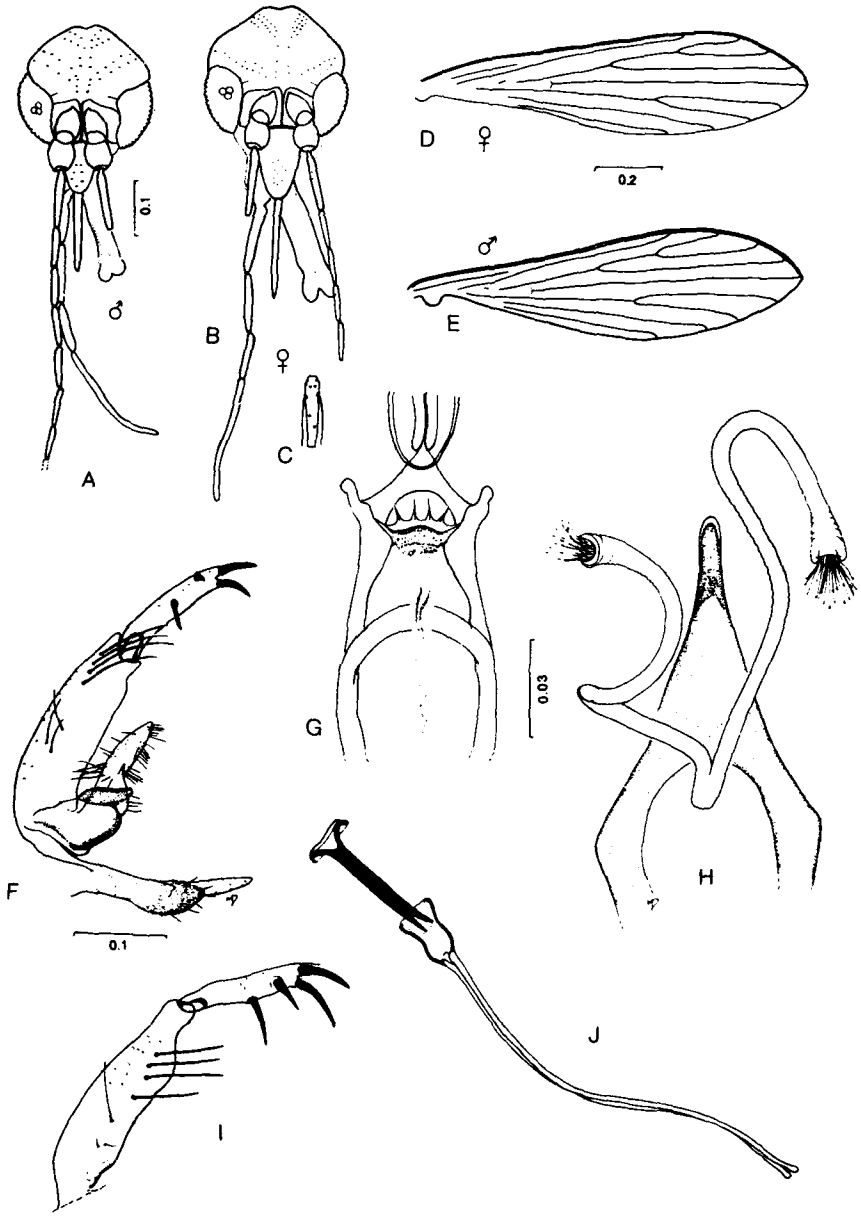
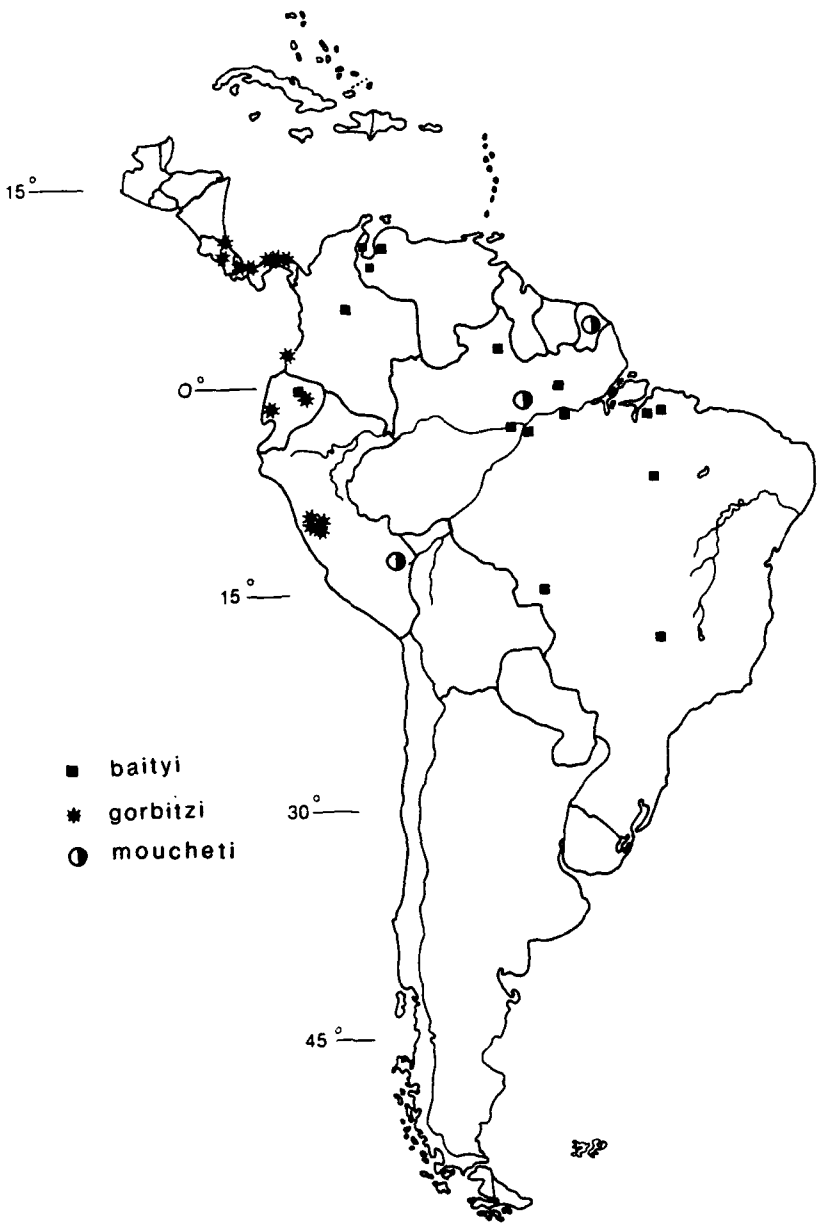


FIG. 123. ***Lutzomyia moucheti***. A. Male head; B. Female head; C. Female flagellomere II; D. Female wing; E. Male wing; F. Male terminalia; G. Female cibarium; H. Spermathecae; I. Male coxite & style; J. Genital pump & filaments.



Map 59

SUBGENUS *EVANDROMYIA* MANGABEIRA

Flebotomus subgenus *Evandromyia* Mangabeira 1941b: 216 (type species: *Flebotomus infraspinosus* Mangabeira by orig. designation).

Lutzomyia, subgenus *Evandromyia*: Barretto 1962: 93 (defined). Theodor 1965: 190 (defined). Young & Arias 1977: 59 (review). Martins et al. 1978: 29 (defined). Artemiev 1991: 74.

Identification. Coloration pale to dark brown. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. Eyes relatively small. ♀ cibarium with 4 equidistant horizontal teeth & complete arch. Pharynx unarmed. Spermathecae sac-like or tubular. ♂ *genitalia*; Coxite with persistent setae at base. Style with 4 spines & subterminal seta. Paramere simple, bifurcate (series *infraspinosa*) or trifurcate (series *monstruosa*). Aedeagus with ventral extension or process (series *monstruosa*) or simple (series *infraspinosa*). Lateral lobe with 2-4 long spatulate setae at tip (series *infraspinosa*) or lacking such setae (series *monstruosa*).

Medical Importance. Unknown; females are not readily attracted to human bait.

Key to the males of the subgenus *Evandromyia*

1. Paramere undivided or bifurcate. Lateral lobe with dorsal spatulate setae at tip. Aedeagus simple (series *infraspinosa*) 2
   Paramere trifurcate. Lateral lobe without dorsal spatulate setae. Aedeagus with long ventral extension (series *monstruosa*) 8

2. Paramere undivided 3
   Paramere bifurcate 4

3. Lateral lobe with 4 spatulate setae. Paramere relatively broad & slightly upturned . . . . . *L. pinottii* (Fig. 127)
   Lateral lobe with 3 spatulate setae. Paramere more slender, not upturned . . . . . *L. bourrouli* (Fig. 126)

4. Style with short spines, all inserted at distal third of segment. Coxite with 7-8 short setae grouped on an inconspicuous tubercle at inner base . . . . . *L. cerqueirai* (Fig. 130)
   Style with longer spines, one or more inserted at proximal third of segment. Coxite with persistent setae longer than width of style 5

5. Lateral lobe with 2 spatulate setae. Coxite tuft of 4-6 setae . . . . . *L. brachyphalla* (Fig. 129)
   Lateral lobe with 3 spatulate setae. Coxite tuft of 10+ setae 6

6. Genital filaments very thick, especially near end. Paramere as shown . . . . . *L. inpai* (Fig. 128)
   Genital filaments much thinner. Paramere otherwise 7

7. Paramere with long ventral projection on lower arm, its length greater than width of dorsal arm . . . . . *L. begonae* (Fig. 125)
   Paramere with or without ventral projection on lower ventral arm, if present, then shorter than width of dorsal arm . . . . . *L. infraspinosa* (Fig. 124)

8. Aedeagus with ventral extension longer than dorsal part, more or less sinuous. Coxite setal tuft of 6-7 setae. Paramere as shown . . . . . *L. monstruosa* (Fig. 131)
   Aedeagus with much shorter ventral extension, ending well before apex of dorsal part. Coxite setal tuft of ca. 12 setae. Paramere otherwise . . . . . *L. teratodes* (Fig. 132)

Key to the Females of the Subgenus *Evandromyia*

1. Spermatheca short & stout, its width nearly equal to its length 2
   Spermatheca 2 or more times longer than wide 3

2. Individual sperm ducts long, about 3x length of spermatheca . . . . . *L. cerqueirai* (Fig. 130)
   Individual sperm ducts apparently absent; spermathecae appear to attach directly to common duct . . . . . *L. inpai* (Fig. 128)

3. Pleura & scutum heavily pigmented . . . . . *L. pinottii* (Fig. 127)
   L. bourrouli
   Pleura & scutum pale or only lightly pigmented 4

4. Spermathecae and common ducts subequal in width . . . . . *L. brachyphalla* (Fig. 129)
   Spermathecae considerably more slender than common ducts, visible or not 5

5. Spermatheca curved apically like an inverted "J"; individual ducts with a median or distal transverse constriction 6
   Spermathecae not as above; individual ducts without such a constriction . . . . . *L. infraspinosa* (Fig. 124)
   L. begonae (Fig. 125)

6. Individual sperm ducts and spermathecae subequal in width . . . . . *L. teratodes* (Fig. 132)
   Individual sperm ducts obviously much thinner than width of spermathecae . . . . . *L. monstruosa* (Fig. 131)

Lutzomyia (Evandromyia) infraspinosa (Mangabeira)
Fig. 124

Flebotomus infraspinosus Mangabeira 1941b: 216 (♂, Aurá, Belém, Pará, Brazil). Barretto 1947a: 204 (full refs.).

Lutzomyia infraspinosa: Young & Arias 1977: 61 (full refs.). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 33 (refs, dist.). Lainson et al. 1979: 241 (neg. for flagellates, Brazil). Léger et al. 1980: 116 (French Guiana). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Hudson & Young 1985: 418 (Suriname). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ready et al. 1986: 29 (Pará, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan 1986: 33 (figs., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Lutzomyia begonae (not *begonae* Ortiz & Torres): Young & Arias 1977: 63 ♂, ♀, tax., Amazonas, Brazil). Arias & Freitas 1977b: 511 (coll. data, Brazil); 1978: 391 (neg. for flagellates). Biancardi et al. 1982: 168 (? Rondônia, Brazil). Arias et al. 1985: 1102 (neg. for flagellates). Young & Arias 1977:63 (♂, ♀, Manaus, Amazonas, Brazil). Arias & Freitas 1977b: 511 (coll. data, Amazonas, Brazil); 1978: 391 (neg. for flagellates, Brazil). Biancardi et al. 1982: 168 (? Rondônia, Brazil). Young & Morales 1987: 664 (? Amazonas, Colombia).

Distribution (Map 60). FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); SURINAME (Martins et al. 1978; Hudson & Young 1985); BRAZIL (see refs. in species bibliography); ? PERU (Young et al. 1985); COLOMBIA (♂♂, Leticia, Amazonás, 1987, A. Morales).

Remarks. Females from SE Peru & Ecuador resemble *L. infraspinosa*, but males are needed to confirm the identifications (Young et al. 1985; Young & Rogers 1984).

The shape of the parameres varies among males of *L. infraspinosa* from different localities in South America. Those from Leticia, Colombia (Fig. 124G,H) and Manaus, Brazil (Young & Arias 1977) have a short acute process on the ventral margin of the lower arm of each paramere. This projection is absent from males from other parts of Brazil and the Guyanas, but is strongly developed in males of *L. begonae* as described by Ortiz & Torres (1975) from Venezuela.

Recently, M.D. Feliciangeli (pers. comm. 1992) kindly informed us that males of *L. begonae* and the form described by Young & Arias (1977, as *L. begonae*) were taken together at the same locality in southern Venezuela, thus indicating that they are not conspecific.

The status of this latter form in relation to *L. infraspinosa*, described by Mangabeira, remains unsettled. Rather than formally assigning a new name to this form, we prefer to treat it as a geographic variant of *L. infraspinosa* pending more information.

Lutzomyia (Evandromyia) begonae (Ortiz & Torres)
Fig. 125

Phlebotomus begonae Ortiz & Torres 1975: 101 (♂, El Gavilan, Amazonas, Venezuela).

Lutzomyia begonae: Feliciangeli 1980: 246 (listed); 1988: 102. Feliciangeli et al. 1988a: 60 (♀, tax., dist.).

Distribution (Map 61). VENEZUELA (Ortiz & Torres 1975); BRAZIL (Young & Arias 1977; Biancardi et al. 1982).

Remarks. See *L. infraspinosa*.

Lutzomyia (Evandromyia) bourrouli (Barretto & Coutinho)
Fig. 126

Phlebotomus bourrouli Barretto & Coutinho 1941d: 227 (♂, ♀, Palmeiras, São Paulo, Brazil).

Lutzomyia bourrouli: Forattini 1973: 208 (as senior synonym of *L. pinottii*). Young & Arias 1977: 60 (full refs.). Martins et al. 1978: 31 (in part, refs., figs.). Arias & Freitas 1982: 404 (Acre, Brazil). Ryan 1986: 36 (as distinct species).

Distribution (Map 62). BRAZIL (Martins et al. 1978, in part).

Remarks. Ryan (1986) compared the holotype and allotype ♀ of *L. bourrouli* with specimens of *L. pinottii* and noted that the *bourrouli* male has 3 spatulate setae on each lateral lobe. There are 4 such setae on the lateral lobe of *L. pinottii*. The females, although similar in coloration and structure, were distinguished by Ryan (1986) by the relative lengths of the common ducts; that of *L. pinottii* is longer than the duct of *L. bourrouli*. We have not examined females referable to *L. bourrouli* from the type locality or nearly localities.

Lutzomyia (Evandromyia) pinottii (Damasceno & Arouck)
Fig. 127

Flebotomus pinottii: Damasceno & Arouck 1956a: 2 (♂, Rio Capim, Pará, Brazil).

Lutzomyia aroucki: Barretto 1962: 93 (unnecessary new name for *pinottii*).

Lutzomyia pinottii: Young & Arias 1977: 65 (refs.). Martins et al. 1978: 31 (as junior synonym of *bourrouli*). Ryan 1986: 36 (♂, ♀, Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.). Feliciangeli 1988: 102 (Venezuela).

Lutzomyia bourrouli (not *bourrouli* Barretto & Coutinho): Léger et al. 1980: 116 (French Guiana).

Distribution (Map 62). BRAZIL (Martins et al. 1978, in part; Ryan 1986); FRENCH GUIANA (Léger et al. 1980); VENEZUELA (Feliciangeli 1988).

Remarks. Lucena (1960) assigned the name *pinottii* to another sandfly species, not *pinottii* Damasceno & Arouck, and therefore it was a junior homonym. Forattini (1971a) renamed it *L. lentiodes* but later (1973) considered the species to be a junior synonym of *L. lenti*.

Lutzomyia pinottii (Damasceno & Arouck) is treated as a junior synonym of *L. bourrouli* by Forattini (1973) and Martins et al. (1978) but following Ryan (1986), we continue to treat the species as distinct. Ryan et al. (1987c) reported a natural trypanosome infection in one of six females of *L. pinottii* dissected in Pará, Brazil.

Lutzomyia inpai Young & Arias
Fig. 128

Lutzomyia inpai Young & Arias 1977: 61 (♂, ♀, Amazonas, Brazil). Arias & Freitas 1978; 391 (neg. for flagellates, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ready et al. 1986a: 29 (Pará, Brazil). Ryan 1986: 34 (♂, ♀ figs., Pará, Brazil). Feliciangeli 1988: 102 (Venezuela).

Distribution (Map 63). BRAZIL (Young & Arias 1977; Ready et al. 1986); VENEZUELA (Feliciangeli 1988).

Lutzomyia (*Evandromyia*) *brachyphalla* (Mangabeira)
Fig. 129

Flebotomus brachyphallus Mangabeira 1941b: 219 (♂, Piratuba, Pará, Brazil). Barretto 1947a: 189 (refs.)

Lutzomyia brachyphalla: Young & Arias 1977: 60 (full refs.). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 31 (refs., dist.). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan 1986: 32 (♀ descript., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 61). FRENCH GUIANA (Martins et al. 1978); BRAZIL (Martins et al. 1978; Ryan 1986).

Lutzomyia (*Evandromyia*) *cerqueirai* (Causey & Damasceno)
Fig. 130

Flebotomus cerqueirai Causey & Damasceno 1945b: 645 (♂, Utinga, Belém, Pará, Brazil).

Lutzomyia cerquerai: Young & Arias 1977: 60 (refs.). Martins et al. 1978: 32 (dist., refs.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ryan 1986: 32 (♂ fig., Pará, Brazil). Young & Morales 1987: 658 (♀ descript., ♂ figs., Colombia).

Distribution (Map 64). BRAZIL (Forattini 1973; Martins et al. 1978; Biancardi et al. 1982); COLOMBIA (Young & Morales 1987).

Remarks. Observations of this species near Mariquita, Tolima Dept., Colombia showed that females of *L. cerqueirai* readily feed on hamsters kept in cages within an open shed in secondary forest (C. Ferro de Carrasquilla, pers. comm.).

Lutzomyia (*Evandromyia*) *monstruosa* (Floch & Abonnenc)
Fig. 131

Phlebotomus monstruosus Floch & Abonnenc 1944a: 1 (♂ , Baduel, French Guiana).

Phlebotomus falciformis Floch & Abonnenc 1944c: 8 (♀, Crique Anguille, French Guiana. Fraiha et al. 1970b: 215 (as ♀ of *monstruosa*).

Lutzomyia monstruosa: Martins et al. 1964b: 324. Young & Arias 1977: 66 (full refs.). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 33 (dist., refs.). Arias & Freitas 1978: 391 (neg. for flagellates, Brazil). Morales & Minter 1981: 96 (Colombia), Biancardi et al. 1982· 168 (Rondônia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil). Ready et al. 1983a: 780 (Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 35 (♂, ♀ figs., Pará, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan et al. 1987a: 356 (nat. flagellate infection, Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.). Feliciangeli 1988: 102 (Venezuela).

Pressatia monstruosa: Forattini 1971a: 103; 1973: 518 (rev., figs.).

Distribution (Map 65). COLOMBIA (Morales & Minter 1981); FRENCH GUIANA (Martins et al. 1978; Léger et al. 1977); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); VENEZUELA (Feliciangeli 1988).

Remarks. This pale, relatively small, sand fly is probably more widespread than present records indicate.

Lutzomyia (Evandromyia) teratodes Martins, Falcão & Silva
Fig. 132

Lutzomyia teratodes. Martins, Falcão & Silva 1964b: 321 (♂, Itapaci, Goiás, Brazil). Forattini 1971a: 103. Martins et al., 1975d: 515 (♀ descript.). Young & Arias 1977: 66 (♂ figs., Paraguay). Martins et al. 1978: 33 (♀ figs., dist.).
Pressatia teratodes: Forattini 1973: 518.

Distribution (Map 61). BRAZIL (Martins et al. 1978); PARAGUAY (Young & Arias 1977).

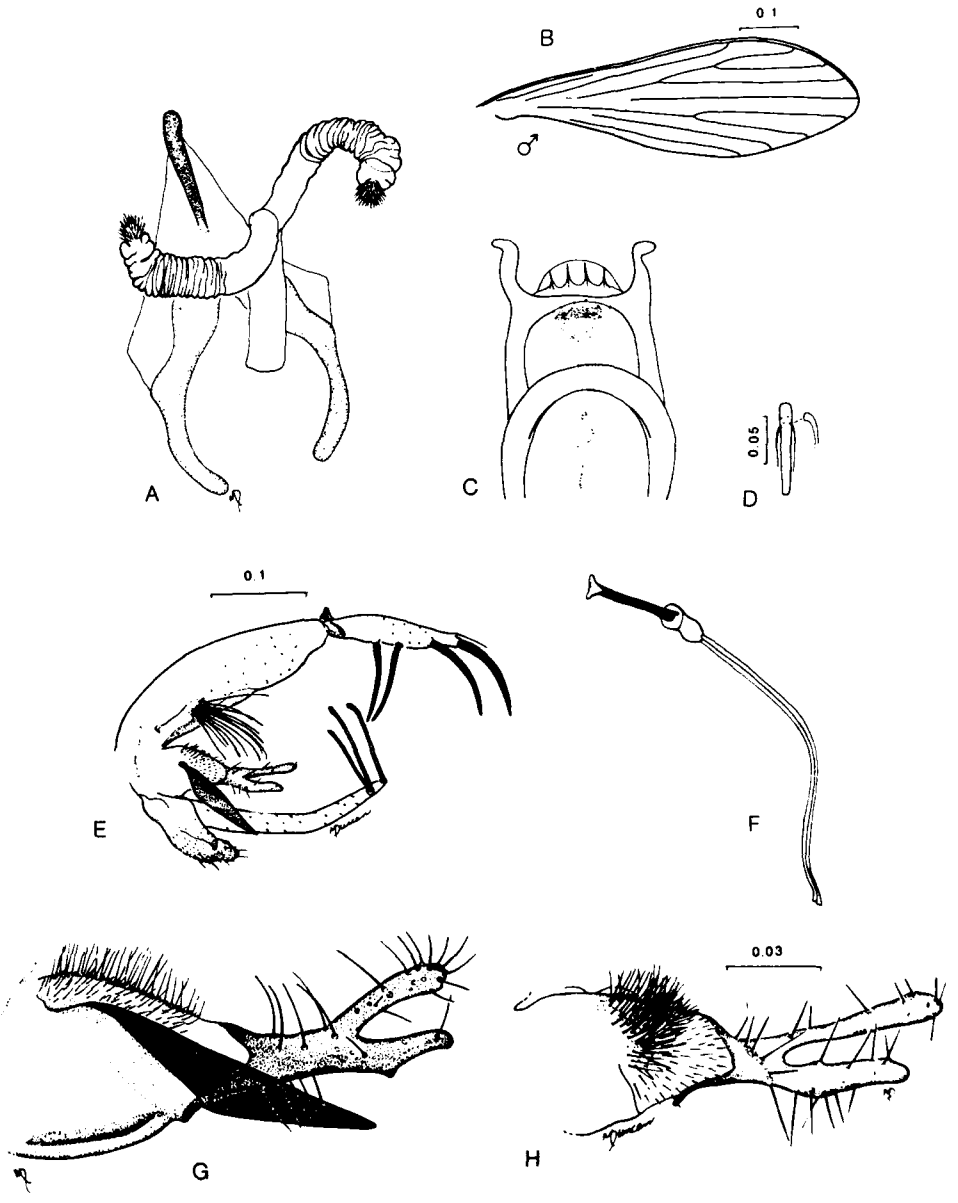


FIG. 124. ***Lutzomyia infraspinosa.*** A. Spermathecae; B. Male wing; C. Female cibarium; D. Female flagellomere; E. Male terminalia; F. Genital pump & filaments; G. Paramere (Leticia, Colombia); H. Paramere (Belém, Brazil).

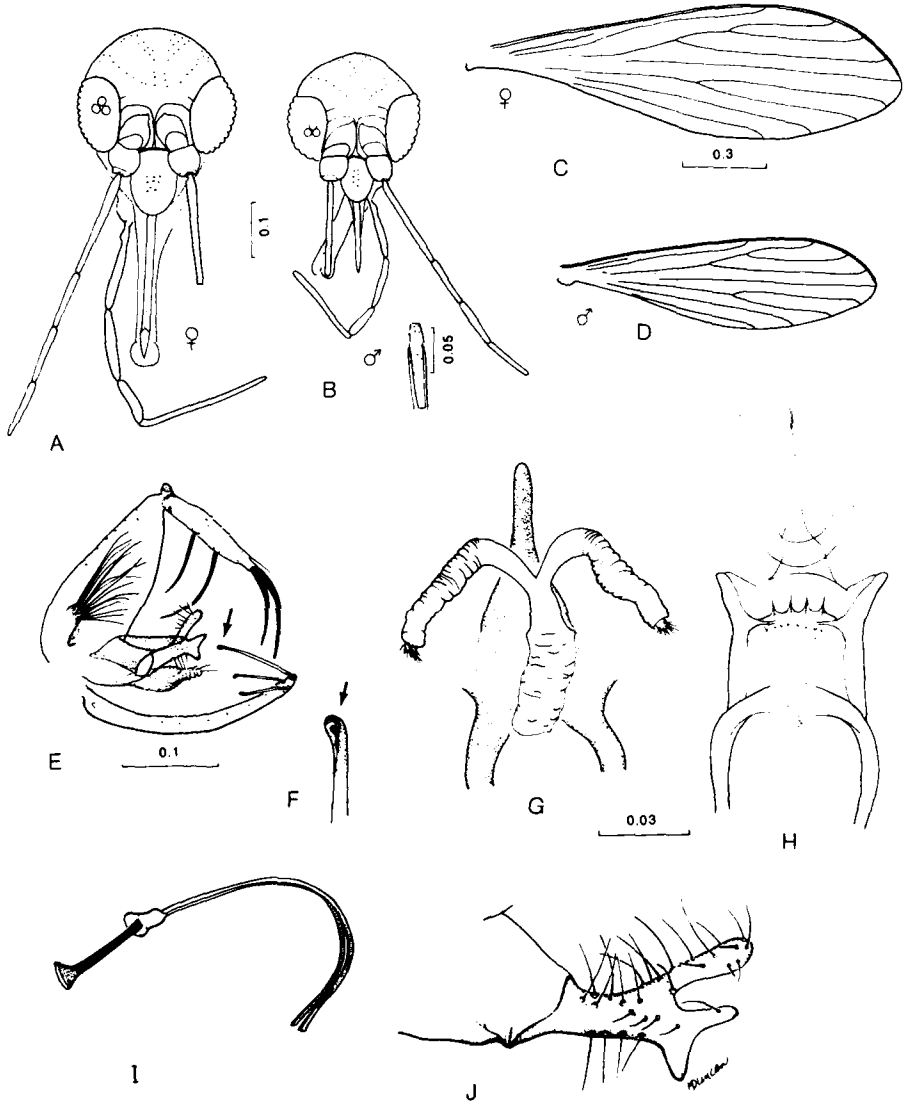


FIG. 125. ***Lutzomyia begonae***. A. Female head; B. Male head & flagellomere II; C. Female wing; D. Male wing; E. Male terminalia; F. Tip of genital fork; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Paramere. (figs. from Feliciangeli et al. 1988a).

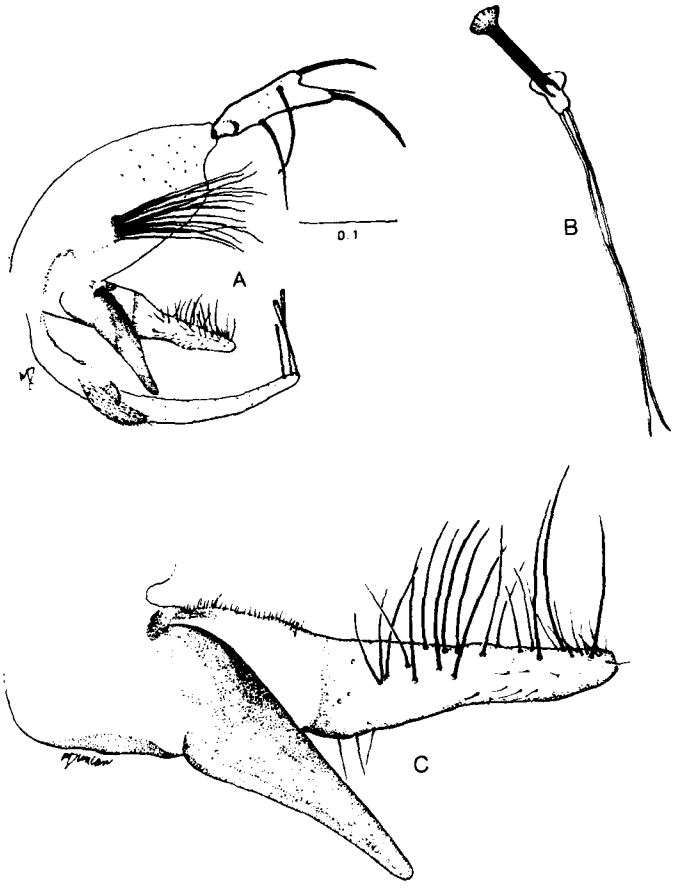


FIG. 126. ***Lutzomyia bourrouli.*** A. Male terminalia; B. Genital pump & filaments; C. Paramere.

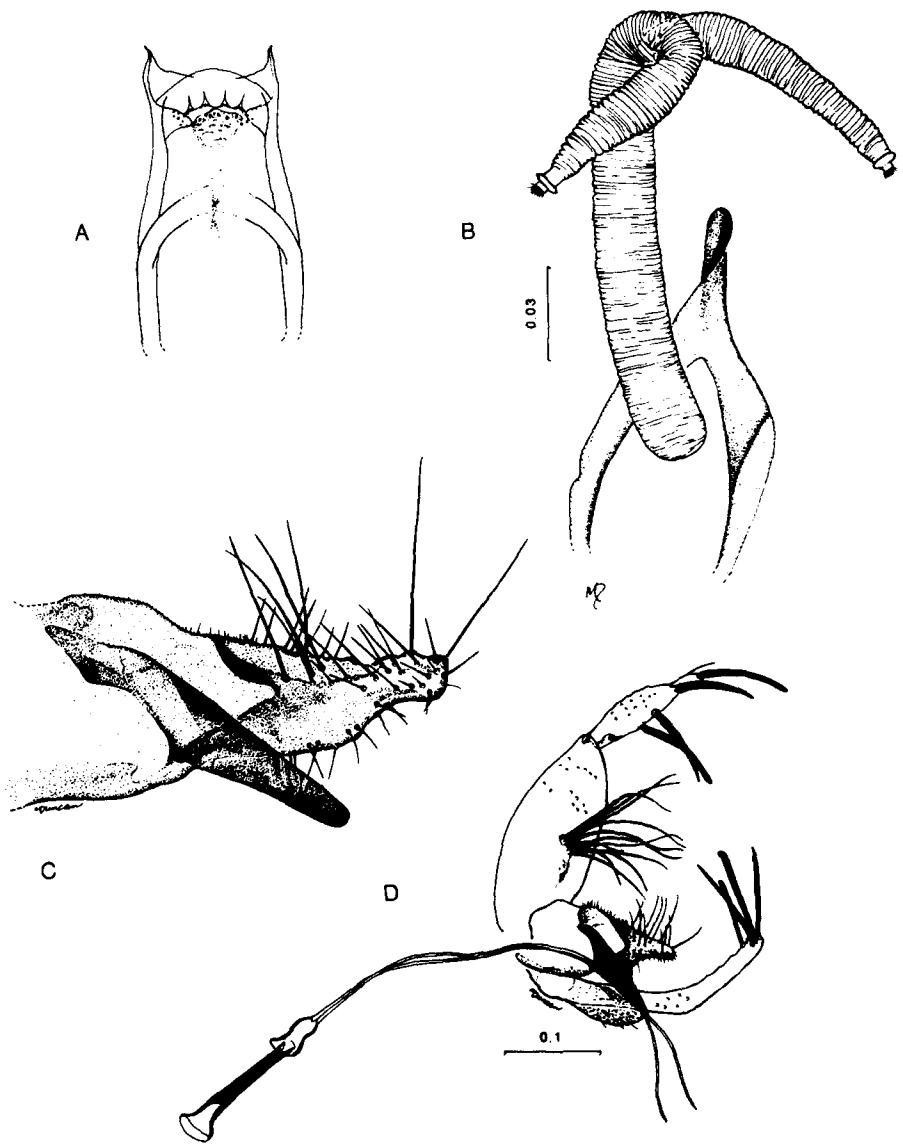


FIG. 127. ***Lutzomyia pinottii.*** A. Female cibarium; B. Spermathecae; C. Paramere; D. Male terminalia.

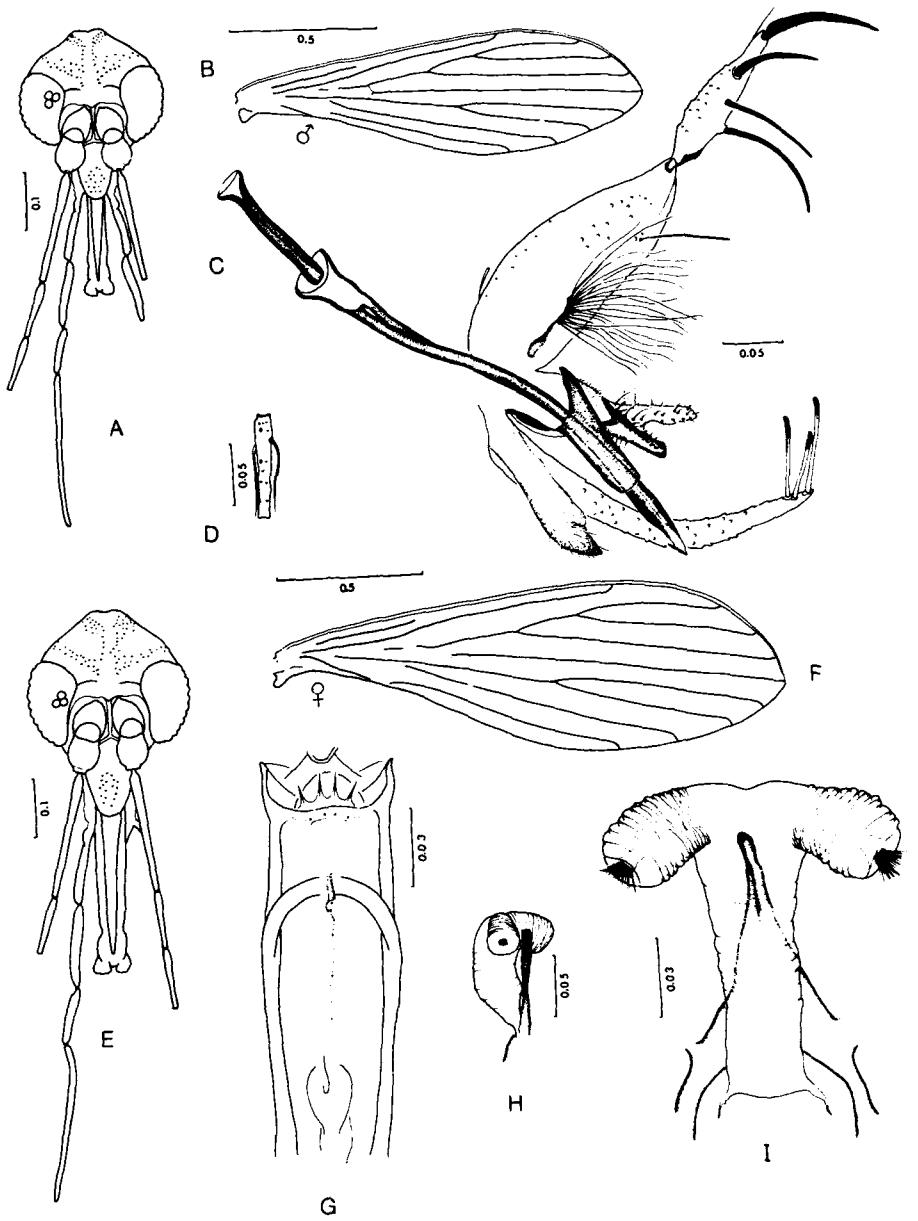


FIG. 128. ***Lutzomyia inpai***. A. Male head; B. Male wing; C. Male terminalia & genital filaments; D. Male flagellomere II; E. Female head; F. Female wing; G. Female cibarium; H. Spermathecae; I. Spermathecae (from Young & Arias 1977).

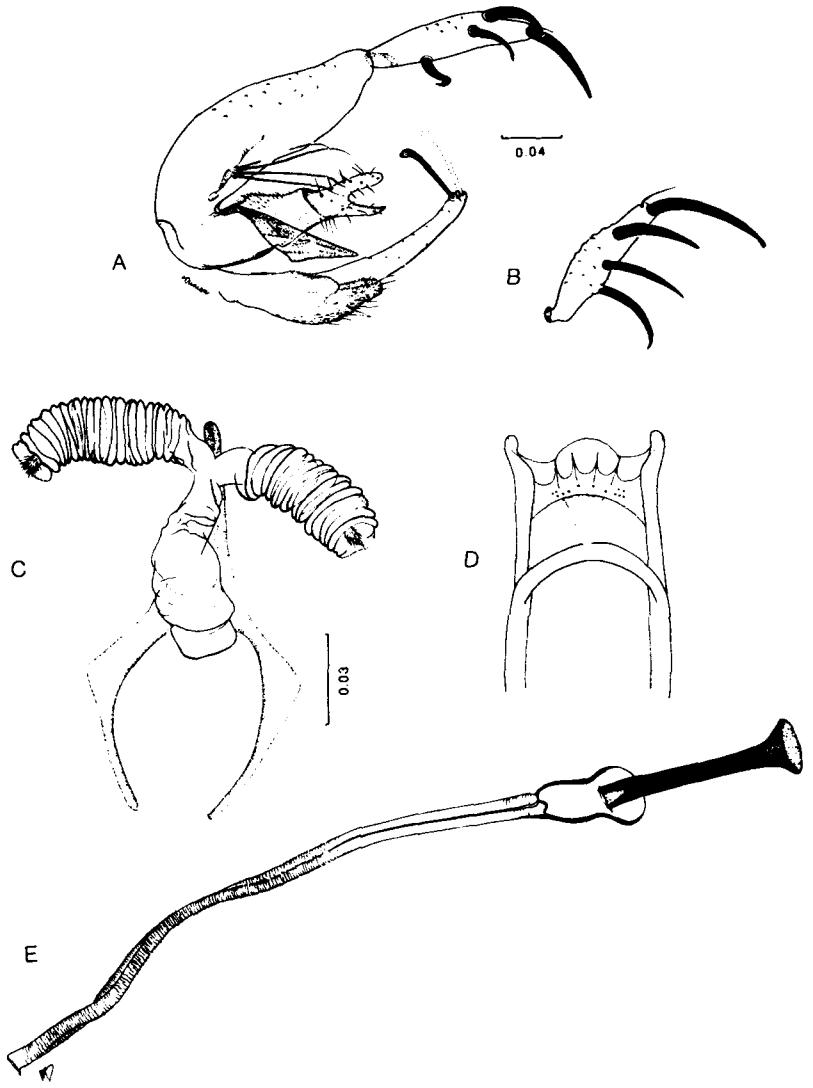


FIG. 129. ***Lutzomyia brachyphalla***. A. Male terminalia; B. Style; C. Spermathecae; D. Female cibarium; E. Genital pump & filaments.

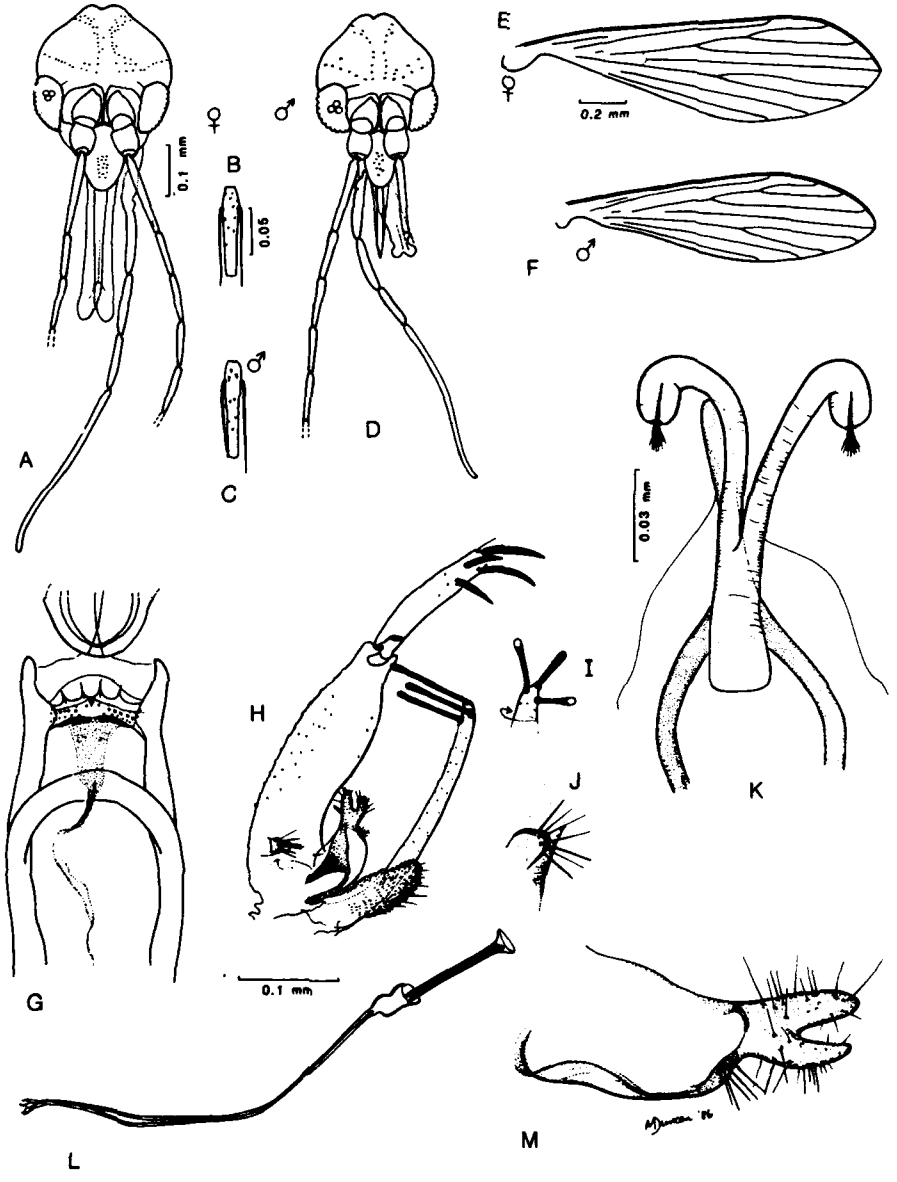


FIG. 130. ***Lutzomyia cerqueirai.*** A. Female head; B. Female flagellomere II; C. Male flagellomere II; D. Male head; E. Female wing; F. Male wing; G. Female cibarium; H. male terminalia; I. Tip of lateral lobe; J. Tubercle on coxite; K. Spermathecae; L. Genital pump & filaments; M. Paramere (from Young & Morales 1987).

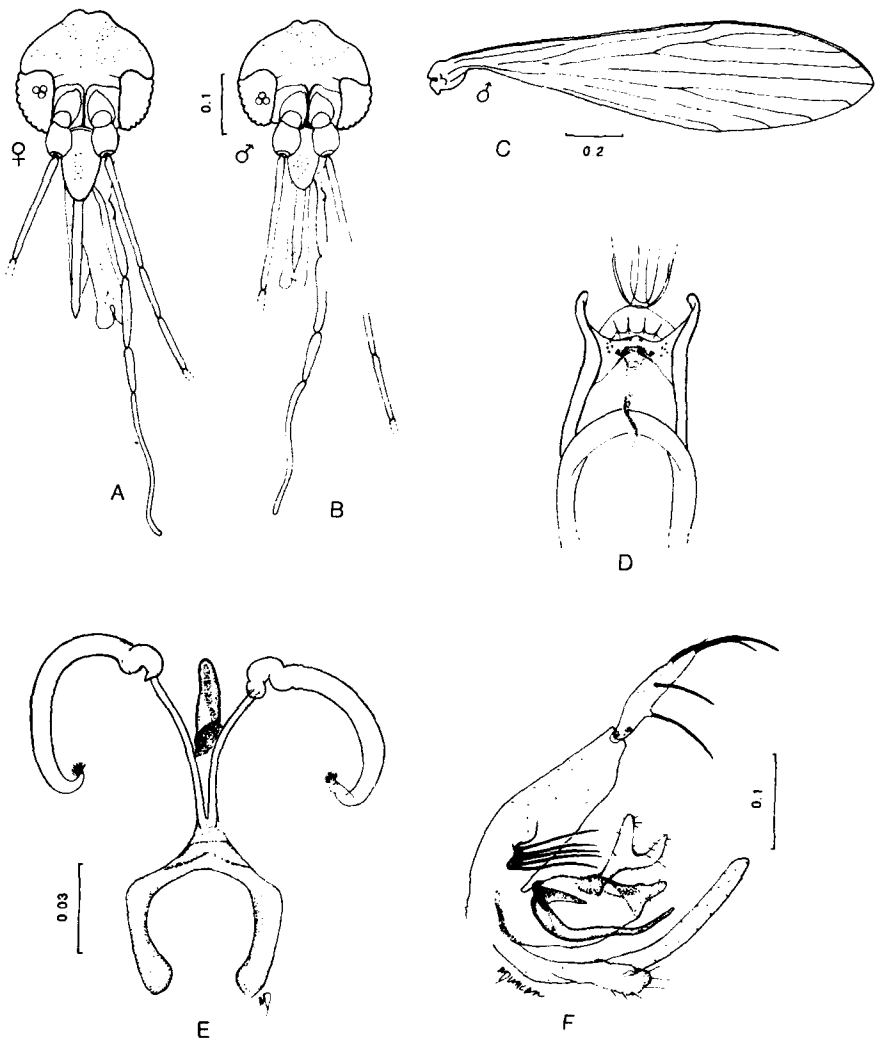


FIG. 131. ***Lutzomyia monstruosa.*** A. Female head; B. Male head; C. Male wing; D. Female cibarium; E. Spermathecae; F. Male terminalia.

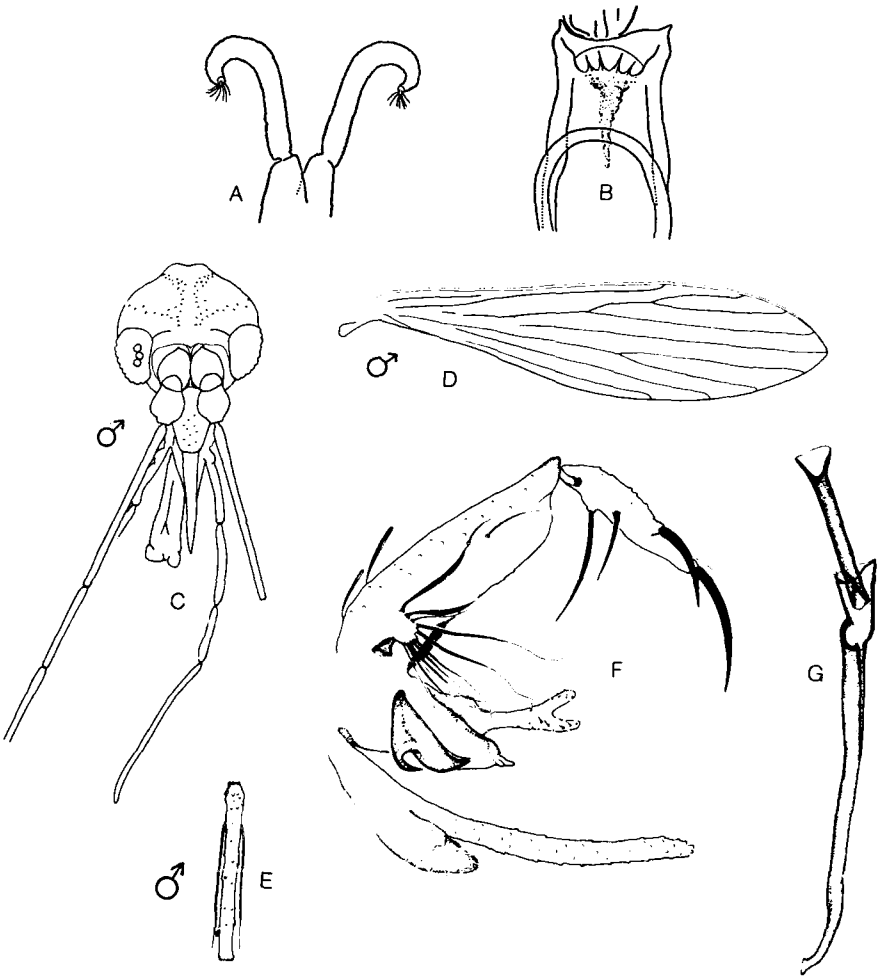
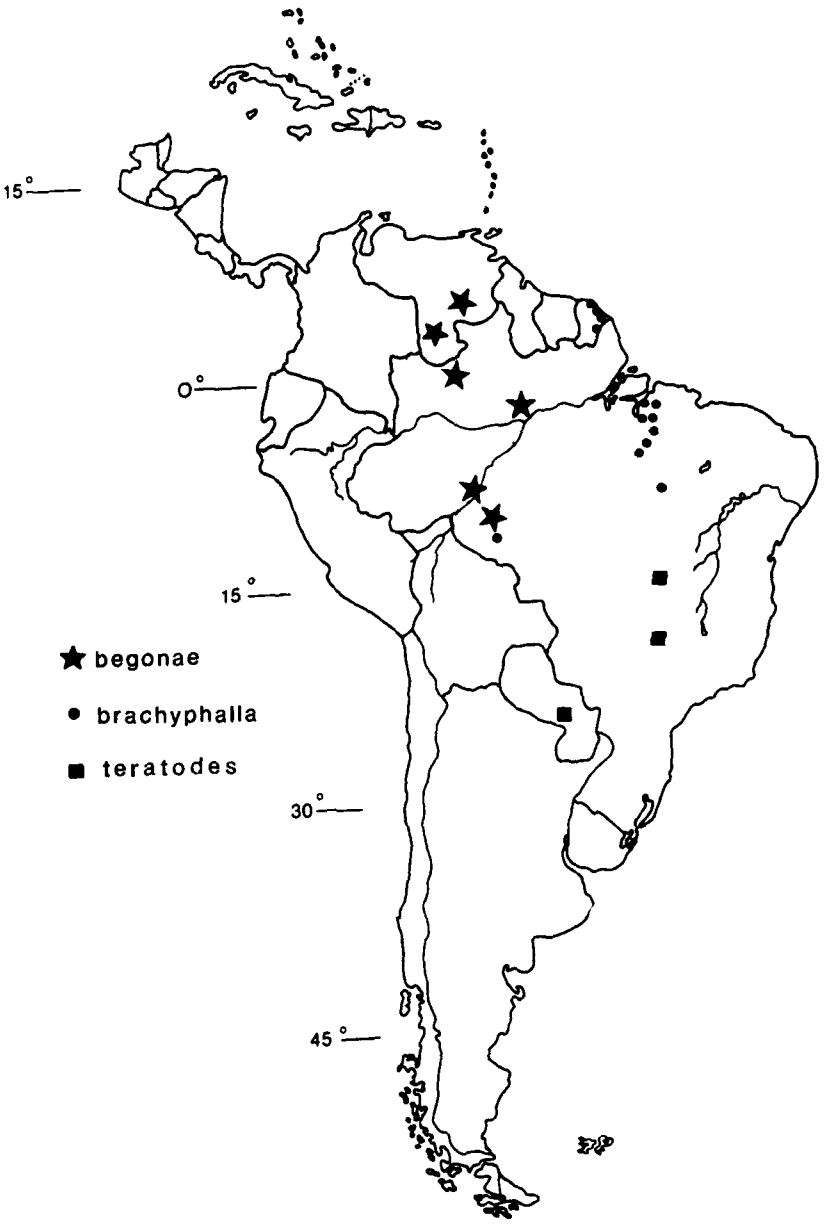
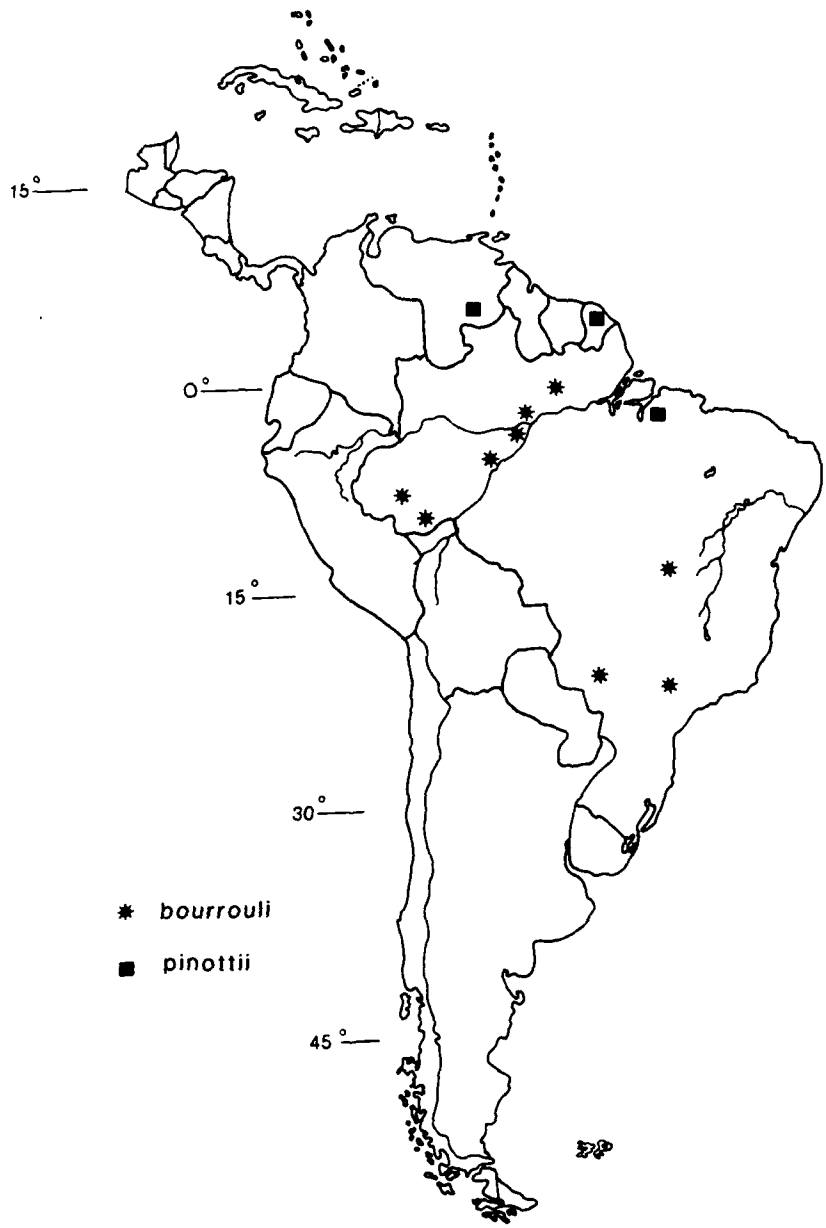


FIG. 132. ***Lutzomyia teratodes.*** A. Spermathecae; B. Female cibarium; C. Male head; D. Male wing; E. Male flagellomere II; F. Male terminalia; G. Genital pump & filaments (figs. A & B from Martins et al. 1975d; figs. C-G from Young & Arias 1977).

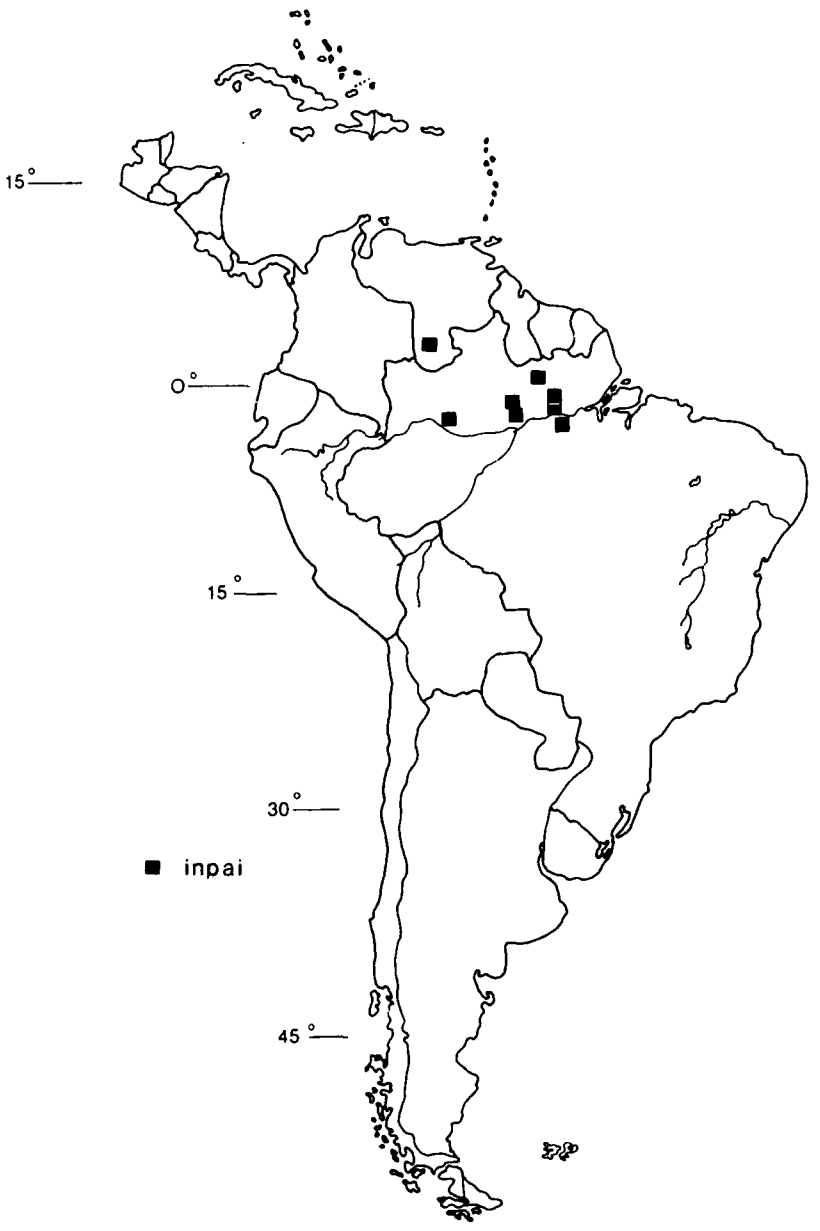
Map 60



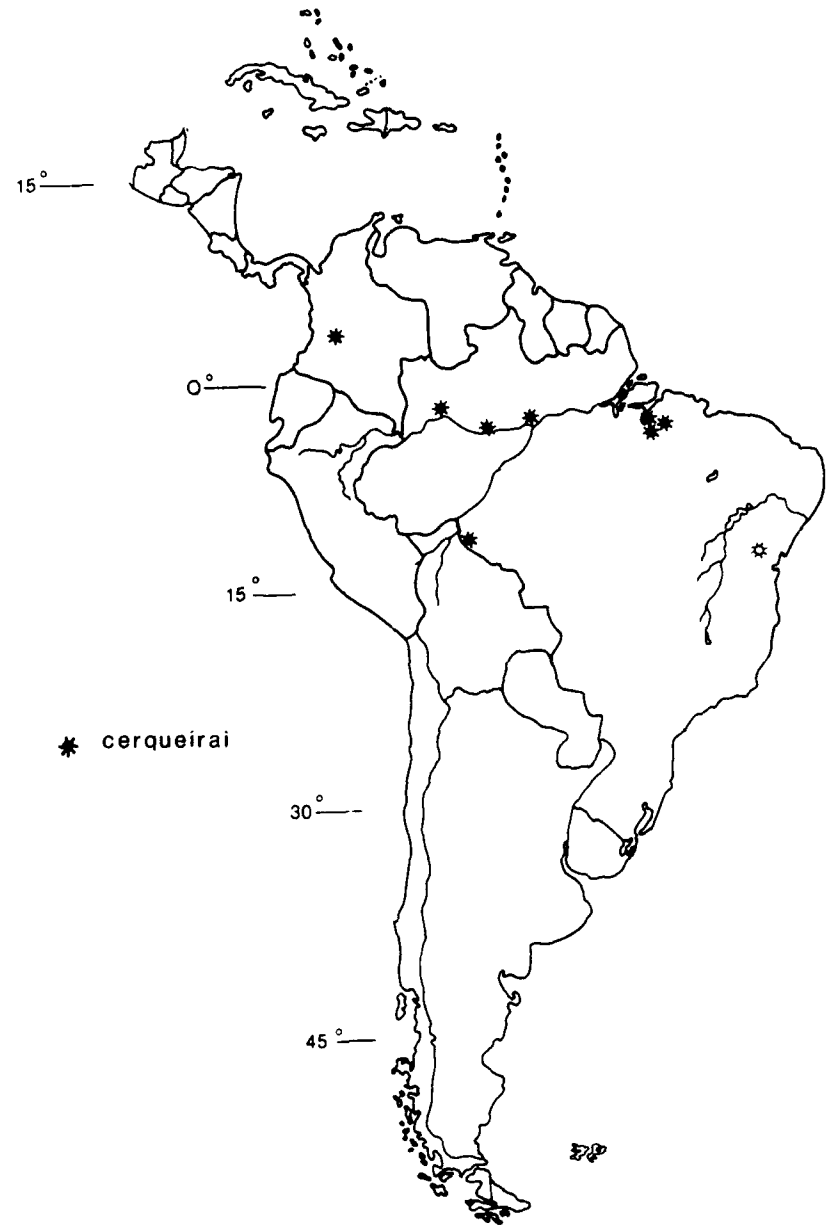
Map 61



Map 62



Map 63



Map 64

Map 65

SUBGENUS *VIANNAMYIA* MANGABEIRA

Flebotomus subgenus, *Viannamyia* Mangabeira 1941d: 251 (type species: *Flebotomus tuberculatus* Mang. by orig. designation).

Lutzomyia subgenus, *Viannamyia*: Barretto 1962: 94 (defined). Theodor 1965: 190 (defined).

Viannamyia, genus: Forattini 1971a: 106; 1973: 506 (as a genus of Phlebotominae). Artemiev 1991: 73.

Identification. Coloration dark. Antennal ascoids simple. Palpomere 5 relatively short, not larger than palps. 3 + 4. ♀ cibarium with 4 pointed horizontal teeth & complete arch. ♀ pharynx unarmed. Spermathecae associated with paired sclerotized processes. ♂ *genitalia*. Coxite lacking persistent setae at base but apical group present. Style deeply forked or else with median spine(s) inserted on distinct extension. Paramere with specialized setae, some having brush-like tips.

Medical Importance. Unknown. Females are not readily attracted to human bait. *Leishmania braziliensis* has been isolated from *L. tuberculata* in Brazil (see Ryan et al. 1987c).

Key to the Males of the Subgenus *Viannamyia*

1. Style with two proximal spines implanted on separate arms or processes. Paramere as shown . . . . . *L. tuberculata* (Fig. 135)
   Style with proximal spines implanted on a common arm. Paramere otherwise 2

2. Genital filament tips markedly enlarged . . . . . *L. fariasi* (Fig. 134)
   Genital filament tips slender & pointed 3

3. Paramere slender & downwardly curved distally . . . *L. furcata* (Fig. 133G)
   Paramere slightly enlarged and stout distally, shaped like a goat's head . . . . . *L. caprina* (Fig. 133H)

Key to the Females of the Subgenus *Viannamyia*

1. Spermathecae tubular, associated with larger funnel-shaped sclerotized processes . . . . . *L. tuberculata* (Fig. 135)
   Spermathecae oval, sclerotized processes rod-like . . *L. caprina* (Fig. 133J)
   L. furcata

Lutzomyia* (*Viannamyia*) *caprina Osorno-Mesa, Morales & Osorno
Fig. 133 A-F, H-M

Lutzomyia caprina Osorno-Mesa, Morales & Osorno 1972a: 437 (♂, Vereda El Llano, Caldas, Colombia). Young 1979: 103 (full refs.). Morales & Minter 1981: 96 (questionable record, Colombia). Llanos 1983: 183 (listed, Peru). Murillo & Zeledón 1985: 47 (♂, ♀ figs., dist. Costa Rica).

Distribution (Map 66). HONDURAS (Young 1979); COSTA RICA (Murillo & Zeledón 1985); PANAMA & COLOMBIA (Young 1979); PERU (Llanos 1983).

Remarks. We have not detected structural differences between females of *L. caprina* and *L. furcata*; accordingly, the confirmation of either species in a given locality should be based on the presence of the male. From various sites in the Panama Canal Zone and Panama Prov., Panama, all males examined are assigned to *L. caprina*. One male from Honduras more closely resembles *L. furcata* and there is variation in paramere shape and setation among males from different populations (Young 1979).

Lutzomyia* (*Viannamyia*) *furcata (Mangabeira)
Fig. 133 G

Flebotomus furcatus Mangabeira 1941d: 256 (♂, Aurá, Belém, Pará, Brazil).
Phlebotomus arborealis Floch & Abonnenc 1944d: 8 (♀, Baduel, French Guiana). Young 1979: 104 (full refs.).
Lutzomyia arborealis: Barretto 1962: 94 (as synonym of *furcata*).
Lutzomyia furcata: Barretto 1962: 94. Theodor 1965: 190. Lainson et al. 1976a: 57 (Brazil). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 50 (refs., dist.). Arias & Freitas 1978: 391 (neg. for flagellate infections, Brazil). Young 1979: 104 (figs., refs.). Fraiha et al. 1980a: 21 (Peru). Morales & Minter 1981: 96 (questionable record, Colombia). Llanos 1981: 183 (Peru). Shaw 1981: 232 (exp. infections with *Endotrypanum*). Lewis & Mcfarlane 1981: 181 (mite parasite, Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Ready et al. 1984c: 641 (age grading ♀♀). Murillo & Zeledón 1985: 47 (dist. Costa Rica, fig.). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (neg. for flagellate infections Brazil). Ready et al. 1986b: 34 (Pará, Brazil). Ryan et al. 1986b: 164 (exp. vector of *Le. amazonensis*); Ryan 1986: 119 (figs., dist., Brazil). Ryan et al. 1987a: 356 (neg. for flagellate infections, Brazil). Lebbe et al. 1987: 30 (computer aided ident.). Feliciangeli et al. 1988: 48 (Amazonas, Venezuela). Alexander 1992a: 35 (Ecuador); 1992c: 124 (Ecuador).
Viannamyia furcata: Forattini 1971a: 106; 1973: 507 (figs.).

Distribution (Map 67). COSTA RICA (Murillo & Zeledón 1985); COLOMBIA; VENEZUELA; FRENCH GUIANA; BRAZIL and PERU (see refs. listed above); ECUADOR (Alexander 1992c).

Remarks. The record of *L. furcata* from Iquitos District, Peru (Fraiha et al. 1980a) was based on a female but the male is needed to confirm its presence there.

Hanson (unpublished data) described the first and fourth larval stages and pupa from immatures reared in Panama. The possibility exists that they represented *L. caprina*, not *L. furcata*.

Ryan et al. (1986b) demonstrated that laboratory-bred *L. furcata* can transmit *Le. amazonensis* following experimental infections.

Lutzomyia* (*Viannamyia*) *fariasi (Damasceno, Causey & Arouck)
Fig. 134

Flebotomus fariasi Damasceno, Causey & Arouck 1945: 19 (♂, Santarem, Pará, Brazil).
Phlebotomus fariasi: Fauran 1960: 8 (♂, French Guiana).
Lutzomyia fariasi: Barretto 1962: 94 (listed). Theodor 1965: 190 (listed). Léger et al. 1977: 226 (French Guiana). Martins et al. 1978: 50 (dist., refs.). Ryan 1986: 115 (fig.). Lebbe et al. 1987: 30 (computer aided ident.).
Viannamyia fariasi: Forattini 1971a: 106; 1973: 507 (figs.).

Distribution (Map 66). BRAZIL; FRENCH GUIANA (Martins et al. 1978).

Remarks. This species remains known only from the male and is rarely collected. The holotype (Fig. 134) has slightly modified setae of the parameres, similar to, but less developed, than the dorsal setae observed in other *Lutzomyia* (*Viannamyia*) spp. males.

Lutzomyia* (*Viannamyia*) *tuberculata (Mangabeira)
Fig. 135

Flebotomus tuberculatus Mangabeira 1941d: 251 (♂, Aurá, Belém, Pará, Brazil).
Phlebotomus sp. x Floch & Abonnenc 1944a: 10 (♀, French Guiana. Barretto 1962: 94 (as ♀ of *tuberculata*).
Lutzomyia munangai Wijers & Huisenga 1967: 395 (♂, Suriname). Lewis 1975a: 511(as synonym of *tuberculata*).
Lutzomyia tuberculata: Lainson et al. 1976a: 57. Léger et al. 1977: 218 (French Guiana. Martins et al. 1978: 52 (figs., refs., dist.). Arias & Frietas 1978: 391 (neg. for flagellates, Brazil). Young 1979: 106 (figs., refs., dist.). Morales & Minter 1981: 96 (Colombia). Arias & Freitas 1982: 405 (Acre, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias et al 1985: 1101 (neg. for

flagellates, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 29 (N. Brazil). Ryan 1986: 117 (figs., dist.). Ryan et al. 1987a: 356 (neg. for flagellates). Lebbe et al. 1987: 30 (computer aided ident.). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela).

Viannamyia tuberculata: Forattini 1971a: 106; 1973: 510 (figs.).

Distribution (Map 68). PANAMA (Young 1979); COLOMBIA (Martins et al 1978; Young 1979; Morales & Minter 1981); FRENCH GUIANA; SURINAME (Martins et al. 1978); BRAZIL (Martins et al. 1978; Arias & Freitas 1982; Biancardi et al. 1982; Ryan 1986); VENEZUELA (Feliciangeli et al. 1988).

Remarks. *Lutzomyia tuberculata* likely occurs in other parts of Amazónia that have not been adequately sampled (e.g., Ecuador and Bolivia).

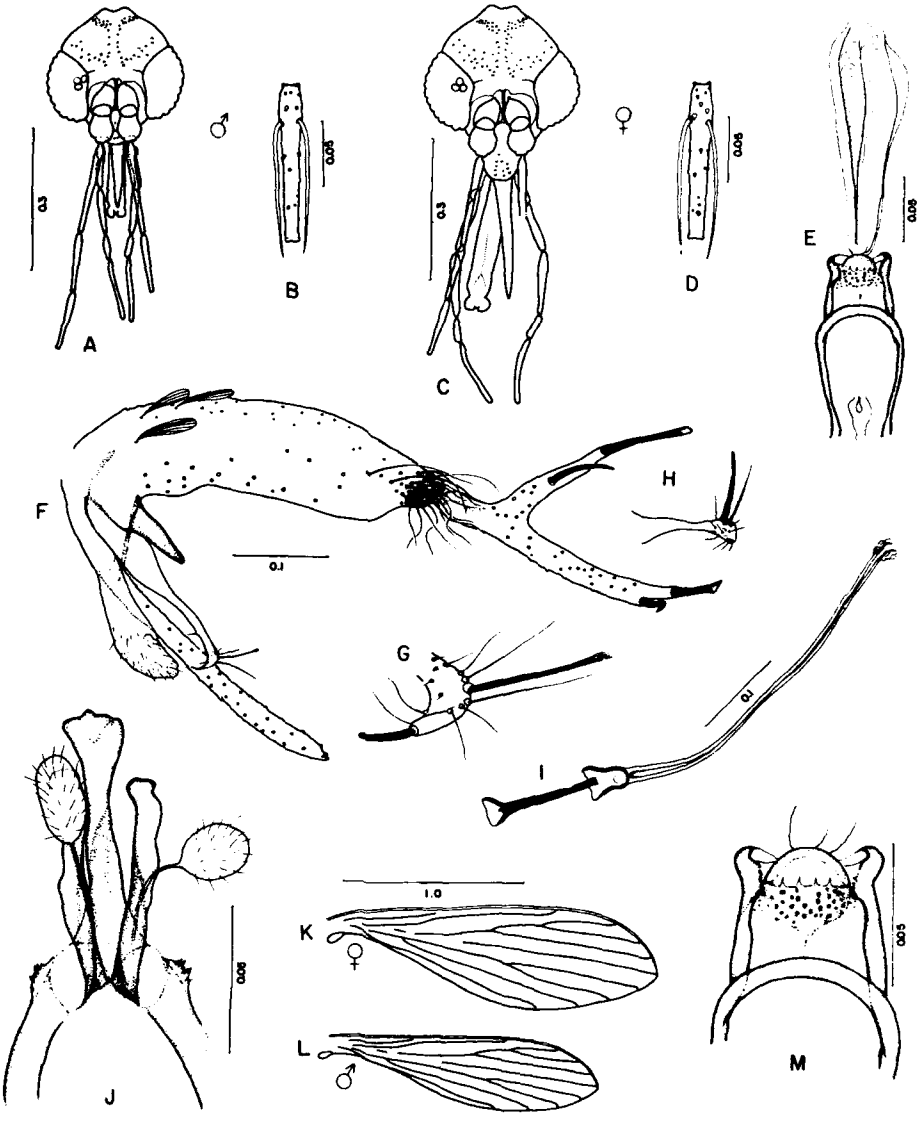


FIG. 133. ***Lutzomyia caprina.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; H. Tip of paramere of male from Rio Anori, Antioquia Dept., Colombia; I. Genital pump & filaments; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium. ***Lutzomyia furcata.*** G. Tip of paramere of male (Figs. from Young 1979).

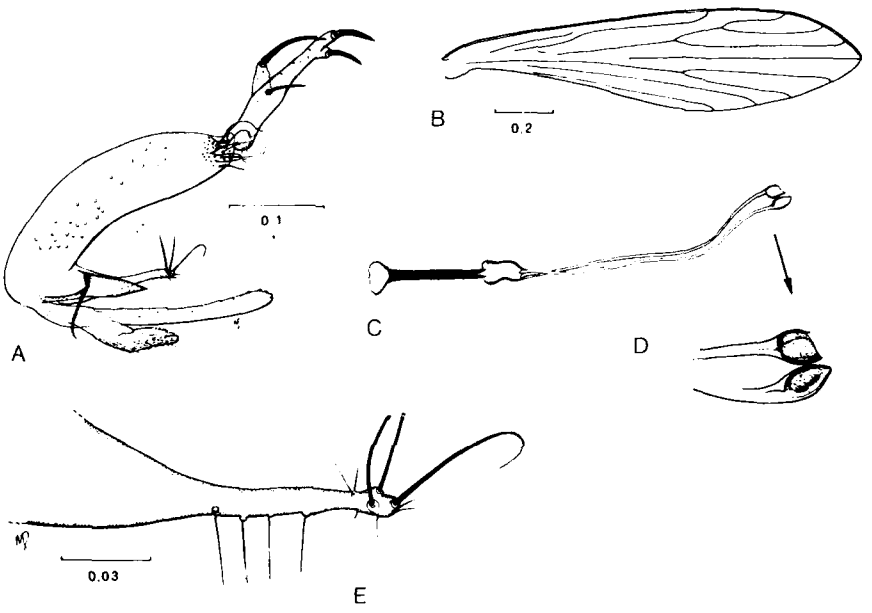


FIG. 134. ***Lutzomyia fariasi.*** A. Male terminalia; B. Male wing; C. Genital pump & filaments; D. Tips of genital filaments; E. Paramere.

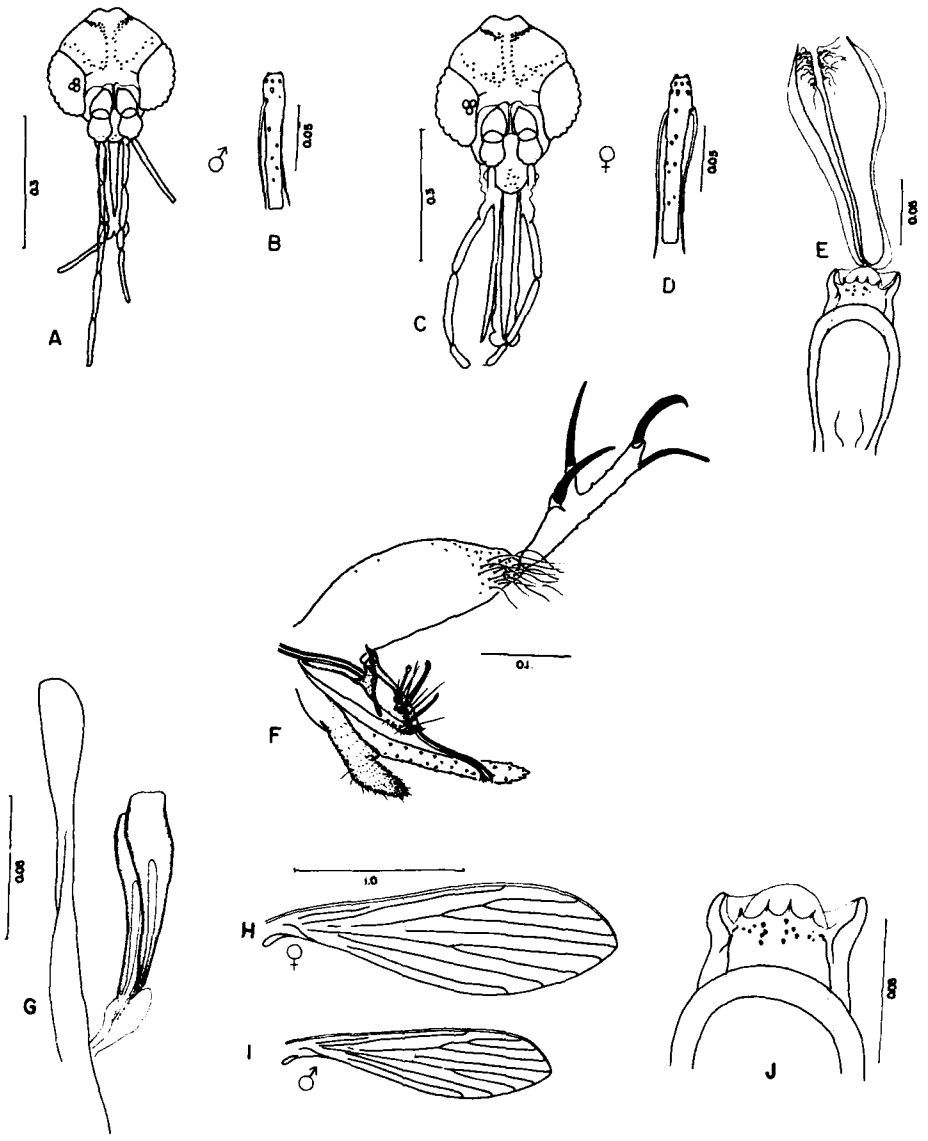
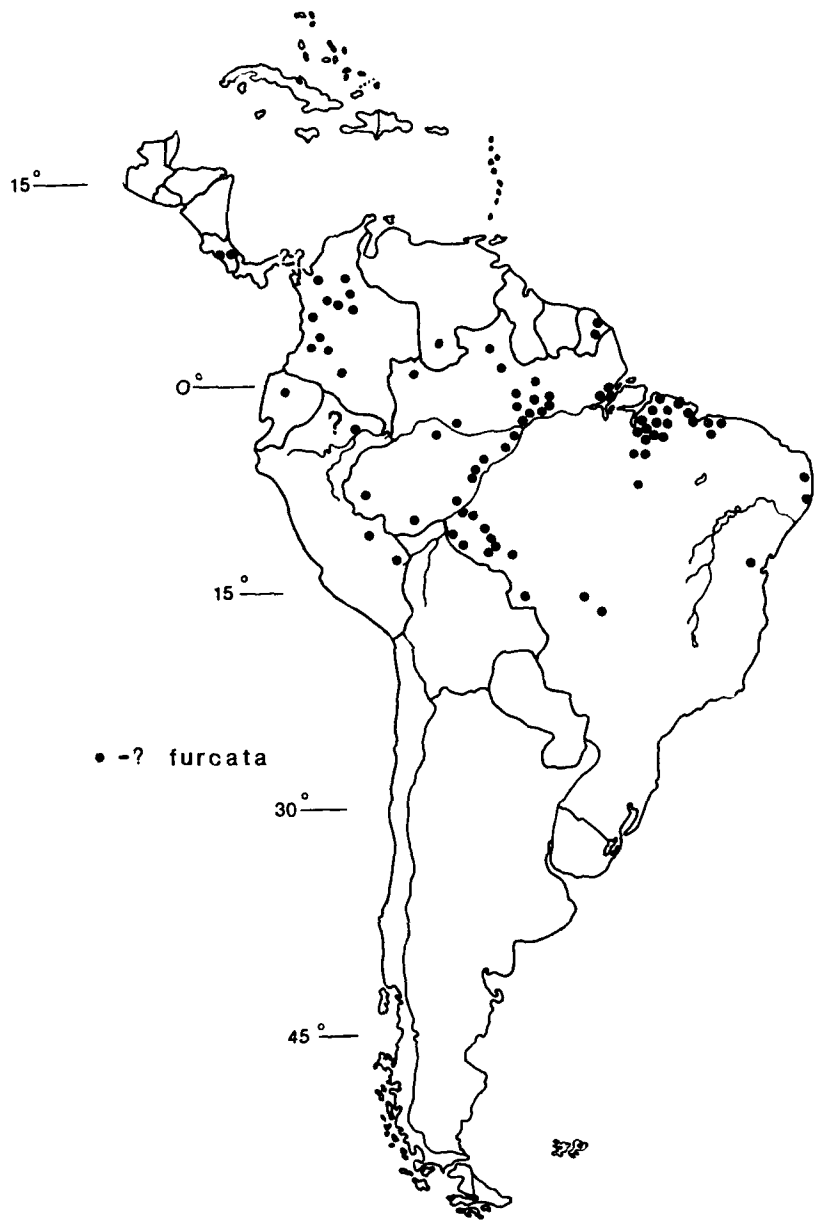
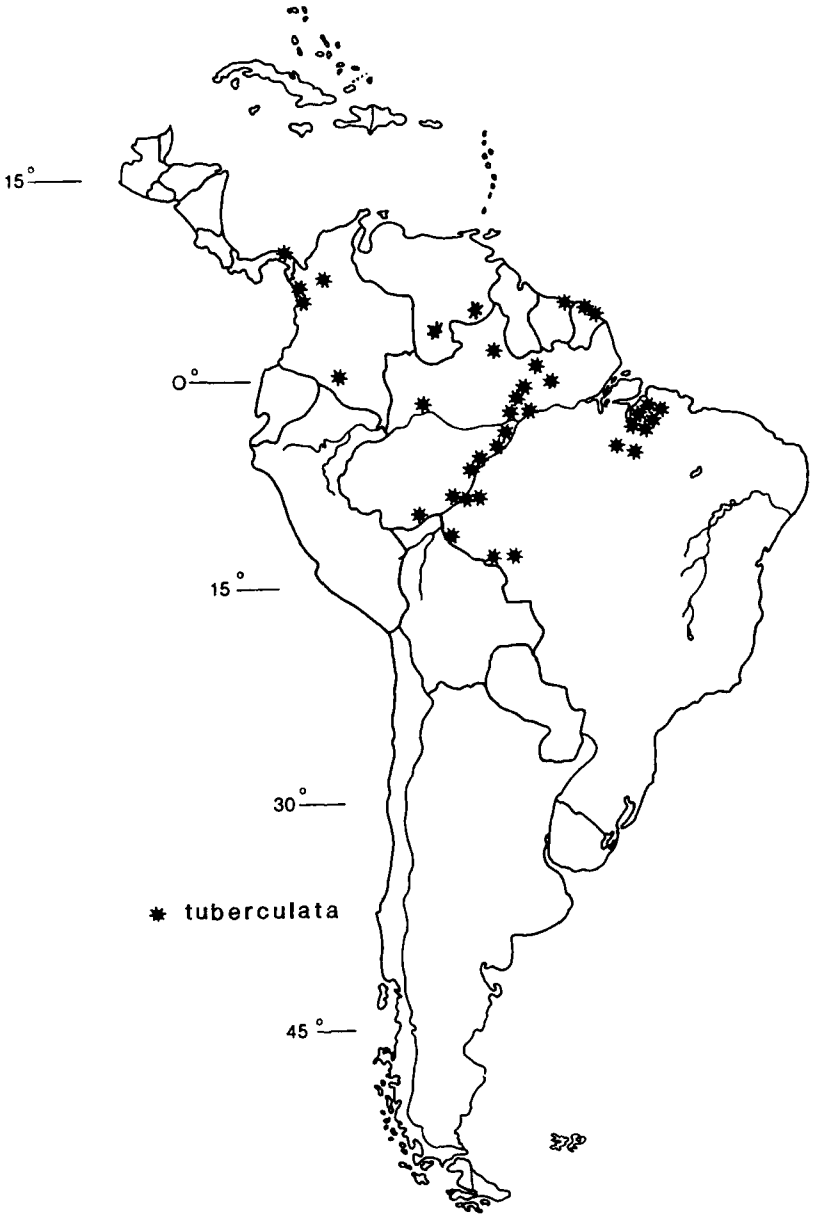


FIG. 135. ***Lutzomyia tuberculata.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Spermathecae; H. Female wing; I. Male wing; J. Female cibarium (from Young 1979).

Map 66



Map 67



Map 68

SPECIES GROUP *RUPICOLA*

Lutzomyia species group *rupicola* Lewis et al. 1977: 325.

Identification. Coloration light brown. Antennal ascoids simple. Palpomere 5 longer than palp. 3 + 4. ♀ cibarium with 4 small horizontal teeth; arch nearly complete. ♀ pharynx unarmed. Spermathecae globose; common duct much longer than individual ducts. ♂ *genitalia*. Coxite with 3 long modified setae inserted on common tubercle. Style with 4 spines, median pair inserted on long process, basal spine isolated & much smaller than others; subterminal seta absent. Paramere backwardly turned at apex.

Of the two species included in this group, only the female of *L. correalimai* is known with certainty. It resembles some of the *migonei* group females in the structure of the spermathecae and cibarial armature but the male lacks a subterminal seta on the style and the median spines are borne on a long process, unlike those in the *migonei* group. Martins et al. (1978) include these two species with aberrant and ungrouped species.

Key to the Males of the Species Group *Rupicola*

1. Style with basal spine reduced to a fine, thin seta. Antennal ascoids reaching ends of their respective flagellomeres . . . . . *L. rupicola* (Fig. 136E)
   Style with larger basal spine. Antennal ascoids not reaching to end of their respective flagellomeres . . . . . *L. correalimai* (Fig. 136B)

Lutzomyia rupicola Martins, Godoy & Silva
Fig. 136 E, G-H

Lutzomyia rupicola Martins, Godoy & Silva 1962a: 57 (♂, Petrópolis, Rio de Janeiro, Brazil.) Martins et al. 1970a: 189 (cf. to *correalimai*). Forattini 1973: 288 (♂ fig.). Martins et al. 1978: 167 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Aguiar et al. 1985c: 467 (coll. data, Brazil).

Distribution (Map 69). BRAZIL (Martins et al. 1978; Mayrink et al. 1979; Aguiar et al. 1985c).

Remarks. Martins et al. (1978) suggested that *L. rupicola* may be a geographic variant of *L. correalimai* but that its status can be determined only when the female becomes known. Mayrink et al. (1979) provisionally identified female sand flies from Minas Gerais State, Brazil as *L. rupicola* but we have not examined specimens, or seen descriptions, from these collections.

Lutzomyia correalimai Martins, Coutinho & Luz
Fig. 136 A-D, F

Lutzomyia correalimai Martins, Coutinho & Luz 1970a: 189 (♂, ♀, Curitiba, Paraná, Brazil). Forattini 1973: 283 (♂, ♀ figs., tax.). Martins et al. 1978: 163 (refs., dist.).

Distribution (Map 69). BRAZIL (Martins et al. 1978).

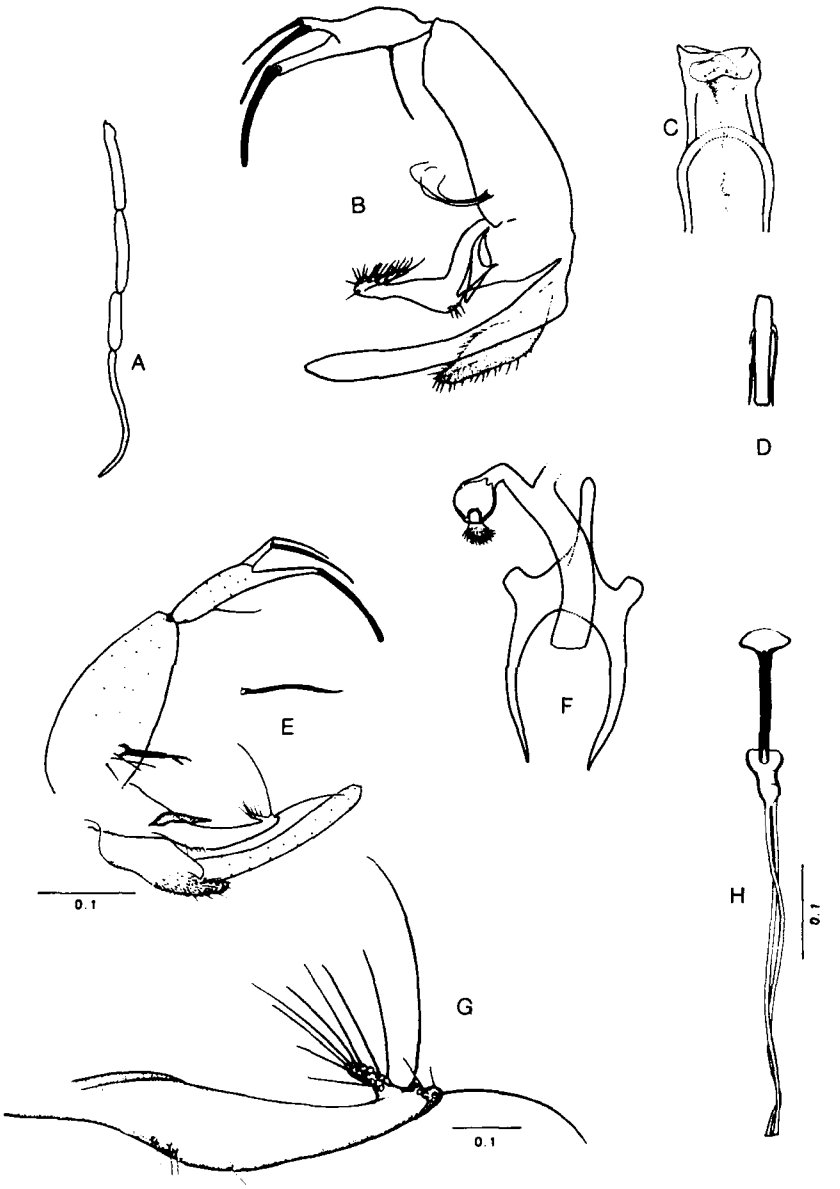
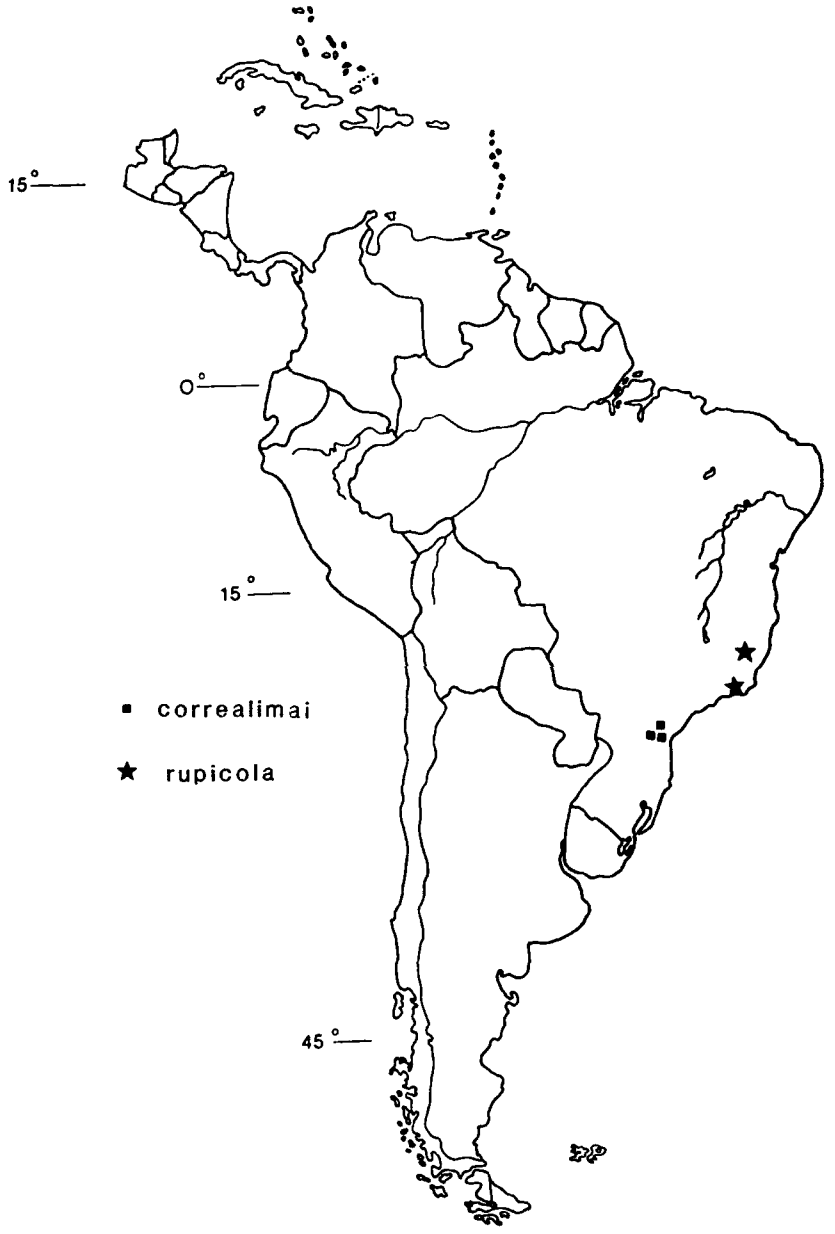


FIG. 136. ***Lutzomyia correalimai***. A. Male palpus; B. Male terminalia; C. Female cibarium; D. Female flagellomere II; F. Spermathecae other not shown (all figs. from Martins et al. 1970a). ***Lutzomyia rupicola***. E. Male terminalia; G. Paramere; H. Genital pump & filaments.



Map 69

SUBGENUS *PSATHYROMYIA* BARRETTO

Lutzomyia, subgenus *Psathyromyia* Barretto 1962: 98 (type species: *Phlebotomus shannoni* by orig. designation). Martins et al. 1978: 104 (in part, defined).
Lutzomyia species group *shannoni*: Theodor 1965: 189. Lewis et al. 1977: 328.
Lutzomyia, subgenus *Trichopygomyia* (in part): Forattini 1971a: 102; 1973: 294.
Lutzomyia species group *brasiliensis* (in part) Martins et al. 1978.
Lutzomyia, subgenus *Forattiniella* (in part) Vargas 1978:89 (type species: *Phlebotomus lutziana* Costa Lima by orig. designation).
Psathyromyia, genus: Artemiev 1991: 73 (in part).

Identification. Coloration variable, no completely pale species known. Antennal ascoids with short to long proximal spurs. Palpomere 5 variable, usually shorter than palps 2 + 3 + 4. ♀ cibarium with 4-8 horizontal teeth; a complete arch & prominent pigment patch; vertical teeth present. Pharynx unarmed. Spermathecae smooth-walled capsules or spherical structures or cylindrical with annulations. ♂ *genitalia*. Coxite lacking persistent setae. Style with 4 spines & no subterminal seta. Paramere simple or with dorsal setiferous arm. Lateral lobe without specialized setae.

The species in this subgenus appear to be closely related to those in the *aragaoi* species group and Barretto (1962) includes both groups in the subgenus *Psathyromyia*. Martins et al. (1978) separate *L. campbelli* and *L. dasymera* from the others included here, placing them in the *dreisbachi* species group. Forattini (1971a: 1973) includes most of these species in the *Lutzomyia* subgenus *Trichopygomyia*. Artemiev (1991) raises the rank of the subgenus and includes in it members of the *dreisbachi* group, the *lanei* group, the *argaoi* group and others.

Medical Importance. Poorly studied; *L. abonnenci* has served as a laboratory host for *Leishmania mexicana*; there are numerous man-biting records for *L. shannoni*, a species considered by Zeledón & Alfaro (1973) to be a probable vector of *Leishmania* in Costa Rica. In the U.S.A., *L. shannoni* is a suspected vector of VSV-New Jersey. *Lutzomyia dendrophyla* has been found naturally infected with flagellates in Brazil and females have been taken on human bait (Lainson & Shaw 1979; Ryan et al. 1987a). Other information is given in the individual species accounts.

Key to the Males of the Subgenus *Psathyromyia*

1. Paramere with a dorsal setiferous arm 2
   Paramere simple, without a dorsal arm 3

2. Genital filament tips with several small teeth . . . . *L. campbelli* (Fig. 138)
   Genital filament tips without teeth . . . . . *L. dasymera* (Fig. 137)

3. Genital filaments about 1.5X length of pump, their tips inflated. Aedeagus wider apically than at middle . . . . . *L. lutziana* (Fig. 139)
   Genital filaments at least 2X length of pump, their tips inflated or not. Aedeagus wider at middle than at end 4

4. Antennal ascoids with short proximal spurs 5
   Antennal ascoids with long proximal spurs 6

5. Style with isolated basal spine. Paramere as shown. Antennal ascoids with proximal spurs having pointed tips . . . . . *L. guatemalensis* (Fig.140)
   Style with basal spines paired, inserted at same level. Paramere otherwise. Antennal ascoids with proximal spurs having blunt rounded tips . . . . . *L. punctigeniculata* (Fig. 141)

6. Paramere with a ventral row of enlarged setae extending to end of paramere . . . . . *L. cratifer* (Fig. 142F)
   Paramere otherwise, without such setae 7

7. Paramere with sinuous dorsal setae 8
   Paramere without such setae 9

8. Paramere with a subterminal ventral heel . . . . . *L. soccula* (Fig. 143)
   Paramere without such a process . . . . . *L. undulata* (Fig. 142E)

9. Paramere with dorsal setae restricted to apical third of structure . . . . . *L. abonnenci* (Fig. 144)
   Paramere with dorsal setae covering distal half or more of structure . . . 10

10. Paramere as shown, distal slender part abruptly joining the wider basal section. Genital filament tips modified . . . . . *L. souzacastroi* (Fig. 146)
    Paramere otherwise, more slender throughout. Genital filament tips simple 11

11. Pleuron and scutum dark. Paramere as shown . . . . . *L. scaffi* (Fig. 147)
    Pleuron much paler than scutum 12

12. Paramere with terminal dorsal setae almost foliaceous, i.e., with thickened, slightly bent ends 13
    Paramere with simple dorsal setae 14

13. Paramere with median group of 30+ short setae . *L. dendrophyla* (Fig. 148)
    Paramere without well defined group of short setae . *L. pestanai* (Fig. 149)

14. Paramere width subequal to, or greater than, width of middle part of lateral lobe, ventral apical setae long & directed backwards . . . . . *L. volcanensis* (Fig. 150)
Paramere more slender, without long ventral setae at apex 15

15. Genital filaments about 2X length of pump. Paramere as shown . . . . . *L. cuzquena* (Fig. 145)
Genital filaments longer than 2X length of pump. Paramere otherwise . . . . . *L. shannoni* (Fig. 151)

Key to the Females of the Subgenus *Psathyromyia**

1. Spermathecae cylindrical, longer than wide, annulated or not 2
Spermathecae spherical, about as long as wide . . . . . *L. lutziana* (Fig. 139)

2. Cibarium with 6 or more horizontal teeth 3
Cibarium with 4 horizontal teeth 5

3. Spermathecae with complete or nearly complete annulations . . . . . *L. undulata* (Fig. 142D)
L. cratifer
Spermathecae without annulations 4

4. Antennal ascoids with short blunt proximal spurs. Individual sperm ducts shorter than 2X length of spermatheca . . *L. punctigeniculata* (Fig. 141)
Antennal ascoids with long pointed proximal spurs. Individual sperm ducts longer that 2.5X length of spermatheca . . . . . *L. dasymera* (Fig. 137)
L. campbelli (Fig. 138)

5. Spermathecae with complete or nearly complete annulations 6
Spermathecae without annulations, smooth-walled 7

6. Antennal ascoids with long proximal spurs extending to end, or nearly to end of preceding flagellomere . . . . . *L. volcanensis* (Fig. 150)
Antennal ascoids with very short, barely discernible proximal spurs . . . . . *L. guatemalensis* (Fig. 140)

7. Pleuron with dark areas 8
Pleuron pale, contrasting to dark scutum . . . . . *L. shannoni* (Fig. 151)
L. abonnenci (Fig. 144)
L. pestanai (Fig. 149)

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*The females of *L. cuzquena*, *L. soccula* and *L. souzacastroi* are unknown. It is likely, however, that they resemble *L. shannoni* in details of the cibarial armature and spermathecae.

8. Pleuron darkly pigmented throughout . . . . . *L. scaffi* (Fig. 147)
Pleuron darkly pigmented except for metathoracic area . . . . . *L. dendrophyla* (Fig. 148)

Lutzomyia* (*Psathyromyia*) *dasymera (Fairchild & Hertig)
Fig. 137

Phlebotomus dasymerus Fairchild & Hertig 1961b: 242 (♂, ♀, Panama Canal Zone).
Lutzomyia dasymera: Barretto 1962: 99. Theodor 1965: 193 (listed). Martins et al. 1978: 154 (refs., dist.). Young 1979: 111 (♂, ♀ figs., full refs.). Feliciangeli 1980: 246 (Venezuela). Biancardi et al. 1982: 168 (Rondônia, Brazil). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 87 (figs., Costa Rica). Feliciangeli 1988: 107 (Venezuela). Alexander et al. 1992a: 36 (Ecuador record); 1992c: 124 (Ecuador).

Distribution (Map 70). MEXICO; BELIZE; NICARAGUA; COSTA RICA (Murillo & Zeledón 1985); PANAMA; COLOMBIA; VENEZUELA (Martins et al. 1978; Young 1979; Feliciangeli 1988); BRAZIL (Biancardi et al. 1982); ECUADOR (Alexander et al. 1992a,c).

Remarks. See *L. campbelli*.

Lutzomyia* (*Psathyromyia*) *campbelli (Damasceno, Causey & Arouck)
Fig. 138

Flebotomus campbelli Damasceno, Causey & Arouck 1945: 26 (♂, Machira, Pará, Brazil). Barretto 1947a: 191 (listed).
Phlebotomus campbelli: Fauran 1960: 5 (♂, French Guiana).
Lutzomyia campbelli: Theodor 1965: 194 (listed). Llanos 1973: 33 (figs., Peru). Forattini 1973: 303 (figs., tax.);. Llanos et al. 1975a: 655 (♀, Peru); 1975b: 669 (Peru). Léger et al. 1977: 227 (French Guiana). Martins et al. 1978: 153 (refs., dist.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Llanos 1983: 183 (dist.). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Young et al. 1985: 143 (Peru). Ryan 1986: 90 (♂, ♀ figs., Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli 1988: 107 (Venezuela).

Distribution (Map 71). VENEZUELA (Feliciangeli 1988); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); BRAZIL (Martins et al. 1978); Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); PERU (Llanos et al. 1975a; Martins et al. 1978); BOLIVIA (Martins et al. 1978; Le Pont & Desjeux 1986).

Remarks. The male of *L. campbelli* has a row of short teeth on the tip of each genital filament (absent in *L. dasymera*). There are no other structural

differences between the males. The females are morphologically indistinguishable.

Lutzomyia* (*Psathyromyia*) *lutziana (Costa Lima)
Fig. 139

Phlebotomus lutzianus Costa Lima 1932: 48 (♂, Lassance, Minas Gerais, Brazil).
Phlebotomus sp. of Cayenne: Floch & Abonnenc 1945b: 3 (♀, French Guiana). Léger et al. 1977: 229 (French Guiana).
Flebotomus lutzianus: Barretto 1947a: 209 (full refs.).
Lutzomyia lutziana: Theodor 1965: 189 (listed). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 145 (refs., dist., in species group *braziliensis*). Feliciangeli 1980: 240 (Venezuela). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young et al. 1985: 143 (Peru). Ryan 1986: 92 (♂, ♀ figs., Brazil). Young & Morales 1987: 662 (Amazonas, Colombia). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela).

Distribution (Map 70). VENEZUELA (Martins et al. 1978; Feliciangeli et al. 1988); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); COLOMBIA (Young & Morales 1987); PERU (Young et al. 1985); BRAZIL (Lainson et al. 1976b; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); PARAGUAY (1 ♂, Acá-Poi, San Pedro, Shannon trap, May 1950, M. Hertig). SURINAME (2 ♀♀, Patamakka, 1983-84, A.M. Burgos).

Remarks. This rather pale species was provisionally identified from collections made near Caratinga, Minas Gerais, Brazil by Mayrink et al. (1979).

The placement of *L. lutziana* in the subgenus *Psathyromyia*, as defined in the present review, is also considered provisional. The spherical spermathecae are unlike those of other species in this subgenus but on the basis of other character states (e.g., long proximal spurs of the antennal ascoids), both sexes appear to be more closely related to the *Psathyromyia* spp. than to other species.

Lutzomyia lutziana has not been previously reported in Paraguay or in Suriname.

Lutzomyia* (*Psathyromyia*) *guatemalensis Porter & Young
Fig. 140

Lutzomyia guatemalensis Porter & Young 1986: 236 (♂, ♀, Montana Plan de Pinto, Chiquimula, Guatemala).

Distribution (Map 72). GUATEMALA (Porter & Young 1986).

Lutzomyia (Psathyromyia) punctigeniculata (Floch & Abonnenc)
Fig. 141

Phlebotomus punctigeniculatus Floch & Abonnenc 1944b: 5 (♂, ♀, French Guiana).
Phlebotomus christophersoni Damasceno & Causey 1944: 347 (♂, Santarem, Pará, Brazil). Fairchild & Hertig 1950: 526 (as synonym of *punctigeniculata*).
Lutzomyia punctigeniculata: Barretto 1962: 99 (listed). Llanos 1973: 33 (figs., Peru). Llanos et al. 1975b: 671 (Peru). Arias & Freitas 1977b: 511 (Amazonas, Brazil); 1978: 391 (neg. for flagellates, Brazil). Martins et al. 1978: 108 (refs, dist.). Ramirez Pérez et al. 1978: 52 (♂, ♀ figs., Venezuela). Young 1979: 115 (♂, ♀ figs., refs.). Fraiha et al. 1980a: 21 (Peru). Ramirez Pérez et al. 1981: 124; 1982a: 14; 1982b: 58 (Venezuela). Arias & Freitas 1982: 404 (Acre, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Porter & Young 1986: 239 (cf. to *guatemalensis*). Ready et al. 1986: 35 (as potential vector of leishmaniasis). Ryan 1986: 93 (♂, ♀ figs., Pará, Brazil). Morales et al. 1987: 93 (Colombia record). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli 1987a: 122; 1987b: 127; 1988: 107 (coll. data, Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Bonfante-Garrido et al. 1991: 99 (neg. for flagellates, Lara, Venezuela).

Distribution (Map 73). PANAMA; FRENCH GUIANA; PERU; COLOMBIA (Martins et al. 1978; Young 1979; Morales et al. 1987; Pérez et al. 1991); BRAZIL (Martins et al. 1978; Arias & Freitas 1982; Ryan 1986); BOLIVIA (Martins et al. 1978); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1978; 1981; 1982a; 1982b; Feliciangeli 1987a; 1987b); SURINAME (2 ♂♂, Patamakka, 19 May 1985, A.M. Burgos).

Remarks. Ready et al. (1986) collected *L. punctigeniculata* in the forest canopy in Pará State, Brazil and speculated that females could be involved in transmitting *Leishmania guyanensis* among arboreal mammal hosts.

Lutzomyia (Psathyromyia) cratifer (Fairchild & Hertig)
Fig. 142 F

Phlebotomus cratifer Fairchild & Hertig 1961b: 242 (♂, ♀, Palenque, Chiapas, Mexico).
Lutzomyia cratifer (or *cratifera*): Theodor 1965: 194 (listed). Forattini 1973: 303 (♂ fig., tax.). Martins et al. 1978: 107 (refs., dist.). Young 1979: 119 (mention). Murillo & Zeledón 1985: 87 (figs., Costa Rica). Porter & Young 1986: 239 (cf. to *guatemalensis*).

Distribution (Map 71). MEXICO; BELIZE; HONDURAS; PANAMA (Fairchild & Hertig 1961b); COSTA RICA (Murillo & Zeledón 1985).

Remarks. The published records of *L. cratifer* in Colombia (Osorno et al. 1972c; Martins et al. 1978) refer instead to *L. undulata*, a species having a wider geographic distribution.

Lutzomyia (Psathyromyia) soccula (Fairchild & Hertig)
Fig. 143

Phlebotomus socculus Fairchild & Hertig 1961b: 240 (♂, Almirante, Bocas del Toro, Panama).

Lutzomyia soccula: Theodor 1965: 189 (listed). Forattini 1973: 329 (♂ fig., tax.). Martins et al. 1978: 111 (listed as *socculus*). Christensen et al. 1983: 466 (Panama). Murillo & Zeledón 1985: 94 (♂ fig., Costa Rica).

Distribution (Map 74). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Fairchild & Hertig 1961b).

Lutzomyia (Psathyromyia) undulata (Fairchild & Hertig)
Fig. 142 A-E

Phlebotomus undulatus Fairchild & Hertig 1950: 524 (♂, Guatemala); 1961b: 244 (cf. to *cratifer*). Rosabal & Trejos 1964: 169 (♂ figs., El Salvador); 1965: 222 (El Salvador).

Phlebotomus humboldti Vargas & Najera 1959: 143 (♂, ♀, Oaxaca, Mexico). Rosabal & Trejos 1964: 169 (as synonym of *undulatus*).

Lutzomyia undulata: Barretto 1962: 99 (listed). Forattini 1973: 323 (♂, ♀, tax.). Martins et al. 1978: 111 (refs., dist.). Young 1979: 119 (♂, ♀ figs., refs.). Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 94 (♂, ♀ figs., Costa Rica). Porter & Young 1986: 239 (Guatemala). Rowton et al. 1991: 501 (Guatemala). Alexander et al. 1992a: 36 (Ecuador records); 1992c: 124 (Ecuador).

Distribution (Map 75). MEXICO; GUATEMALA (Porter & Young 1986); BELIZE; HONDURAS; EL SALVADOR; COSTA RICA; PANAMA; COLOMBIA; ECUADOR (Martins et al. 1978; Young 1979; Murillo & Zeledón 1985; Alexander et al. 1992a,c).

Remarks. The females of *L. undulata* and *L. cratifer* are structurally indistinguishable; therefore, males must be available to confirm the presence of the species in given localities. One female, out of 106 dissected and examined from human bait collections in Guatemala, was infected with unidentified flagellates, but these were not established in culture.

Lutzomyia (*Psathyromyia*) *abonnenci* (Floch & Chassignet)
Fig. 144

Phlebotomus abonnenci Floch & Chassignet 1947c: 1 (♂, Baduel, French Guiana).
Lutzomyia abonnenci: Barretto 1962: 99 (listed). Léger et al. 1977: 223 (French Guiana). Martins et al. 1978: 106 (refs., dist.). Young 1979: 109 (♂ figs., refs.). Morales & Minter 1981: 96 (Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Morales et al. 1982: 19 (tax., figs.). Christensen et al. 1983: 467 (coll. data, Panama). Young et al. 1985: 143 (Peru). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 36 (Pará, Brazil). Ryan 1986: 89 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Walters et al 1987: 294 (as exp. host of *Leishmania mexicana*). Feliciangeli 1988: 107 (Venezuela). Alexander et al. 1992a: 36 (Ecuador record); 1992c: 124 (Ecuador).

Distribution (Map 72). PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales & Minter 1981); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978; Geoffroy et al. 1986); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); PERU (Martins et al. 1978; Llanos 1983; Young et al. 1985); ECUADOR (Alexander et al. 1992a,c); VENEZUELA (Feliciangeli 1988).

Remarks. The female of *L. abonnenci*, illustrated in this review from a laboratory reared specimen, is structurally similar to *L. shannoni* and *L. dendrophyla*. Morales et al. (1982) provided a key to these and other closely related species but some of the character states (e.g., length of common sperm ducts) appear to be variable.

Lutzomyia (*Psathyromyia*) *cuzquena* Martins, Llanos and Silva
Fig. 145

Lutzomyia cuzquena Martins, Llanos & Silva 1975e: 650 (♂, Pilcopata, Cuzco, Peru). Llanos et al. 1975b: 670 (Peru). Llanos 1983: 183 (Peru) Young & Morales 1987: 662 (♂, Amazonas, Brazil). Feliciangeli 1988: 107 (Venezuela).

Distribution (Map 72). COLOMBIA (Young & Morales 1987); PERU (Llanos et al. 1975b).

Remarks. The male *L. cuzquena* can be confused with that of *L. souzacastroi* but the filament tips are simple; the subterminal spine on the style is relatively close to the subterminal spine; and the paramere is different in shape.

Lutzomyia (Psathyromyia) souzacastroi (Damasceno & Causey)
Fig. 146

Flebotomus souzacastroi Damasceno & Causey 1944: 344 (♂, Fonte Boa, Amazonás, Brazil). Barretto 1947a: 224 (listed).
Lutzomyia souzacastroi: Theodor 1965: 189 (listed). Forattini 1973: 320 (♂ fig., tax.). Martins et al. 1975e: 651 (♂ fig., cf. to *cuzquena*)

Distribution (Map 74). BRAZIL (Martins et al. 1978).

Remarks. Figure 146 is based on the holotype male of *L. souzacastroi* stored in the USNM and examined by us in 1986.

Lutzomyia (Psathyromyia) scaffi (Damasceno & Arouck)
Fig. 147

Phlebotomus scaffi Damasceno & Arouck 1956a: 6 (♂, Rio Capim, Pará, Brazil).
Lutzomyia scaffi: Theodor 1965: 185 (listed). Forattini 1973: 318 (♂ fig., tax.). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Martins et al. 1976b: 498 (♂, Peru); 1978: 108 (refs., dist.). Young 1979: 115. Morales & Minter 1981: 96 (Colombia). Morales et al. 1982: 17 (♀ descript.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 40 (Acre, Brazil). Young et al. 1985: 143 (Peru). Ready et al. 1986: 33 (Pará, Brazil). Ryan 1986: 94 (♂, ♀ figs., Brazil). Lebbe et al. 1987: 29 (computer aided ident.).
Lutzomyia volcanensis (not *volcanensis* Fairchild & Hertig): Léger et al. 1977: 226 (French Guiana).

Distribution (Map 76). COLOMBIA (Morales & Minter 1981); PERU (Martins et al. 1978); FRENCH GUIANA (Léger et al. 1977); BRAZIL (Lainson et al. 1976; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); SURINAME (1 ♂, Brownsweg, A.M. Burgos).

Remarks. The dark pleura of *L. scaffi* serves to separate females from those of closely related species (Morales et al. 1982; Ryan 1986).

Lutzomyia (Psathyromyia) dendrophyla (Mangabeira)
Fig. 148

Flebotomus dendrophylus Mangabeira 1942a: 139 (♂, Aurá, Belém, Pará, Brazil). Barretto 1947a: 197 (listed).
Lutzomyia dendrophyla (or *dendrophila*): Barretto 1962: 99 (listed). Lainson et al. 1976a: 57. Arias & Freitas 1977b: 523 (Amazonas, Brazil). Léger et al. 1977: 223 (French Guiana). Martins et al. 1978: 144 (refs., dist.). Young 1979: 113 (♂, ♀ figs., refs.). Lainson et al. 1979: 240 (nat. *Trypansoma* infection, Pará, Brazil). Fraiha et al. 1980a: 21 (Peru). Lewis & Macfarlane 1981: 179 (mite

parasite, Colombia). Morales & Minter 1981: 96 (Caqueta, Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Morales et al. 1982· 19 (♀ tax., figs.). Young & Rogers 1984: 599 (listed, Ecuador). Young et al. 1985: 143 (Peru). Hudson & Young 1985: 418 (Suriname). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 33 (Pará, Brazil). Ryan 1986: 91 (♂, ♀ figs., Brazil). Ryan et al. 1987: 356 (nat. flagellate infections, Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli 1988: 107 (Venezuela). Alexander et al. 1992c: 124 (Ecuador).

Distribution (Map 75). COLOMBIA (Young 1979; Morales & Minter 1981); PERU (Martins et al. 1978; Llanos 1983; Pérez et al. 1991; Young et al. 1985); ECUADOR (Young 1979; Alexander et al. 1992c); SURINAME (Hudson & Young 1985); VENEZUELA (Feliciangeli 1988); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978; Geoffroy et al. 1986); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); BOLIVIA (Young 1979); VENEZUELA (Pifano et al. 1962c).

Remarks. *Lutzomyia dendrophyla*, not *dendrophila* (see Lewis 1975a), is widespread in Amazonian forests where both sexes are often captured on tree trunks. Females are suitable laboratory hosts for *Le. amazonensis* (Ryan et al. 1986b).

Lutzomyia (*Psathyromyia*) *pestanai* (Barretto & Coutinho)
Fig. 149

Phlebotomus pestanai Barretto & Coutinho 1941b: 144 (♂, São Paulo, Brazil). Coutinho & Barretto 1941b: 74 (♀).

Lutzomyia pestanai: Barretto 1962: 99 (listed). Theodor 1965: 189 (listed). Forattini 1973: 314 (in part, ♂, ♀ figs., tax.). Martins et al. 1978: 107 (refs., dist.). Mayrink et al. 1979: 131 (provisional ident., Minas Gerais, Brazil).

Distribution (Map 73). BRAZIL (Martins et al. 1978; Mayrink et al. 1979).

Remarks. Forattini (1973) mistakenly regards *L. pestanai* and *L. nevesi* as conspecific but the female of the latter species has completely different spermathecae and the antennal ascoids of both sexes lack proximal spurs.

The dorsal setae on the distal half of the paramere of *L. pestanai* are modified like those of *L. dendrophyla* but the former species lacks a well defined group of short setae on the paramere.

Barretto (1941) described the immature stages of *L. pestanai*.

Lutzomyia (Psathyromyia) volcanensis (Fairchild & Hertig)
Fig. 150

Phlebotomus volcanensis Fairchild & Hertig 1950: 528 (♂, Cerro Punta, Chiriquí, Panama); 1961b: 246 (♀).
Lutzomyia volcanensis: Theodor 1965: 189 (listed). Forattini 1973: 325 (♂, ♀ figs., tax.). Martins et al. 1978: 112 (refs., dist.). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 97 (♂, ♀ figs., dist., Costa Rica).

Distribution (Map 76). PANAMA (Fairchild & Hertig 1950); COSTA RICA (Murillo & Zeledón 1985).

Remarks. The record of *L. volcanensis* in French Guiana (Léger et al. 1977) was a misidentification of *L. scaffi*. We examined slide-mounted males, labelled "*L. volcanensis*," from there that were kindly sent by J.P. Dedet in 1987.

Lutzomyia (Psathyromyia) shannoni (Dyar)
Fig. 151

Phlebotomus shannoni Dyar 1929: 121 (♂, Panama Canal Zone). Fairchild & Hertig 1950: 524 (♂, ♀ figs., refs., tax.).
Phlebotomus limai Fonseca 1935: 61 (♀, São Paulo, Brazil).
Phlebotomus bigeniculatus Floch & Abonnenc 1941b: 3 (♂, ♀, Cayenne, French Guiana).
Flebotomus shannoni: Barretto 1947a: 222 (full refs.).
Phlebotomus microcephalus Barretto & Duret 1953: 341 (Presidencia Roca, Chaco, Argentina).
Phlebotomus pifanoi Ortiz 1972a: 21 (♂, Sierra Parima, Amazonas, Venezuela).
Lutzomyia shannoni: Lainson et al. 1976a: 57. Léger et al. 1977: 218 (French Guiana). Mogollon et al. 1977: 209 (Venezuela). Arias & Freitas 1977b: 523 (Amazonas, Brazil). Ramirez Pérez et al. 1978: 52 (Venezuela). Martins et al. 1978: 109 (refs., figs., dist.). Young 1979: 117 (refs., figs., dist.). Le Pont et al. 1980: 133 (nat. infection, flagellates, French Guiana). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 96 (Colombia). Lewis & Macfarlane 1981: 177 (mite parasite, Belize). Ramirez Pérez et al. 1981: 124 (Venezuela). Morales et al. 1982: 19 (figs., tax.). Zeledón et al. 1982: 276 (Honduras). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ramirez Pérez et al. 1982b: 58 (♂, ♀ figs., Venezuela). Zeledón & Murillo 1983: 280 (Nicaragua). Young & Perkins 1984: 273 (♂, ♀ figs., refs.). Aguiar & Soucasaux 1984: 199 (seasonal biting habits, Brazil). Young & Rogers 1984: 599 (listed, Ecuador). Hashiguchi et al. 1985a: 442 (biting man, Ecuador). Hudson & Young 1985: 418 (Suriname), Young et al. 1985: 143 (Peru). Aguiar et al. 1985a: 186; 1985b: 339 (vertical dist., Brazil); 1985c: 467 (coll. data, Brazil). Murillo & Zeledón 1985: 91 (♂, ♀ figs., Costa Rica). Geoffroy et al. 1986: 486 (French Guiana). Le Pont &

Desjeux 1986: 314 (Bolivia). Ready et al. 1986: 36 (Pará, Brazil). Ryan 1986: 95 (♂, ♀ figs., Pará, Brazil). Vexenat et al. 1986b: 296 (common man-biter, Bahia, Brazil). Killick-Kendrick 1986: 135 (listed). Alexander 1987: 554 (flight range, Colombia). Morales et al. 1987: 93 (Colombia record). Porter et al. 1987: 929 (Guatemala). Young et al. 1987: 588 (nat. flagellate infections, Colombia). Feliciangeli 1987a: 122; 1987b: 127; 1988: 107 (coll. data, Venezuela). Endris 1987b: 413 (egg structure). Lebbe et al. 1987: 29 (computer aided ident.). Ryan et al. 1987a: 356 (nat. flagellate infections, Brazil). Añez et al. 1988: 457 (Mérida, Venezuela). Rogers et al. 1988: 436 (nat. infection with *Endotrypanum*, Brazil). Feliciangeli et al. 1988a: 48 (Amazonás, Venezuela). Gomes et al. 1989a: 32 (biting man, Brazil). Corn et al. 1990: 476 (as vector of VSV-New Jersey serotype, USA). Comer et al. 1990: 483 (as vector of VSV-New Jersey serotype, USA). Warburg 1991: 189 (nat. infection, tylenchid nematode). Queiroz et al. 1991: 159 (coll. data, Ceará, Brazil, biting man). McHugh 1991: 191 (coll. data, USA). Warburg et al. 1991b: 12 (coll. data, Colombia). Rowton et al. 1991: 501 (nat. flagellate infections, Guatemala). Pérez et al. 1991: 133. Eshita et al. 1992: 22 (Ecuador). Hashiguchi et al. 1992: 139 (Paraguay). Alexander et al. 1992a: 36 (Ecuador); 1992c: 124 (Ecuador). Comer et al. 1992: 368 (VSV-New Jersey, titers). Weaver et al. 1992: 201 (VSV-New Jersey, ultrastructure).

Distribution (Map 77). U.S.A. to ARGENTINA (Martins et al. 1978 & subsequent references, listed above).

Remarks. Wild caught females of *L. shannoni* have been found naturally infected with flagellates in several countries, including U.S.A. (Young & Perkins 1984), Guatemala (Rowton et al. 1991), Costa Rica (Zeledón & Alfaro 1973), Panama (Johnson et al. 1963), Colombia (Young et al. 1987), Brazil (Arias et al. 1985; Ryan et al. 1987a) and French Guiana (Le Pont et al. 1980). Flagellates isolated from *L. shannoni* in Guatemala, although unidentified, correlated well with isozyme patterns observed in a human isolate (Rowton et al. 1991). This species and its close relatives are probable vectors of *Endotrypanum schaudinni* of sloths (Arias et al. 1985; Rogers et al. 1988). In addition, there is strong evidence that *L. shannoni* is a vector of VSV-New Jersey in Georgia, U.S.A. (see Comer et al. 1992).

Vexenat et al. (1986b) consider females of *L. shannoni* to be highly anthropophilic in Bahia State, Brazil; elsewhere throughout its wide range, there are scattered reports of man-biting behavior.

We provisionally follow Martins et al. (1978) who believe that *L. pifanoi* (Ortiz) is a junior synonym of *L. shannoni*. Ortiz (1972a) described *L. pifanoi* from a single male that has since become lost (D. Feliciangeli, pers. comm.). *Lutzomyia microcephala* (Barretto & Duret), believed to be conspecific with *L. shannoni* by Forattini (1973) is listed as a distinct species by Martins et al.

(1978). We tentatively agree with Forattini's conclusions because of the apparent difficulty in separating the taxa but we have not observed material referable to *L. microcephala* from Argentina.

The immature stages of *L. shannoni* were described by Barretto (1941, as *limai*). Endris et al. (1987b) described the egg.

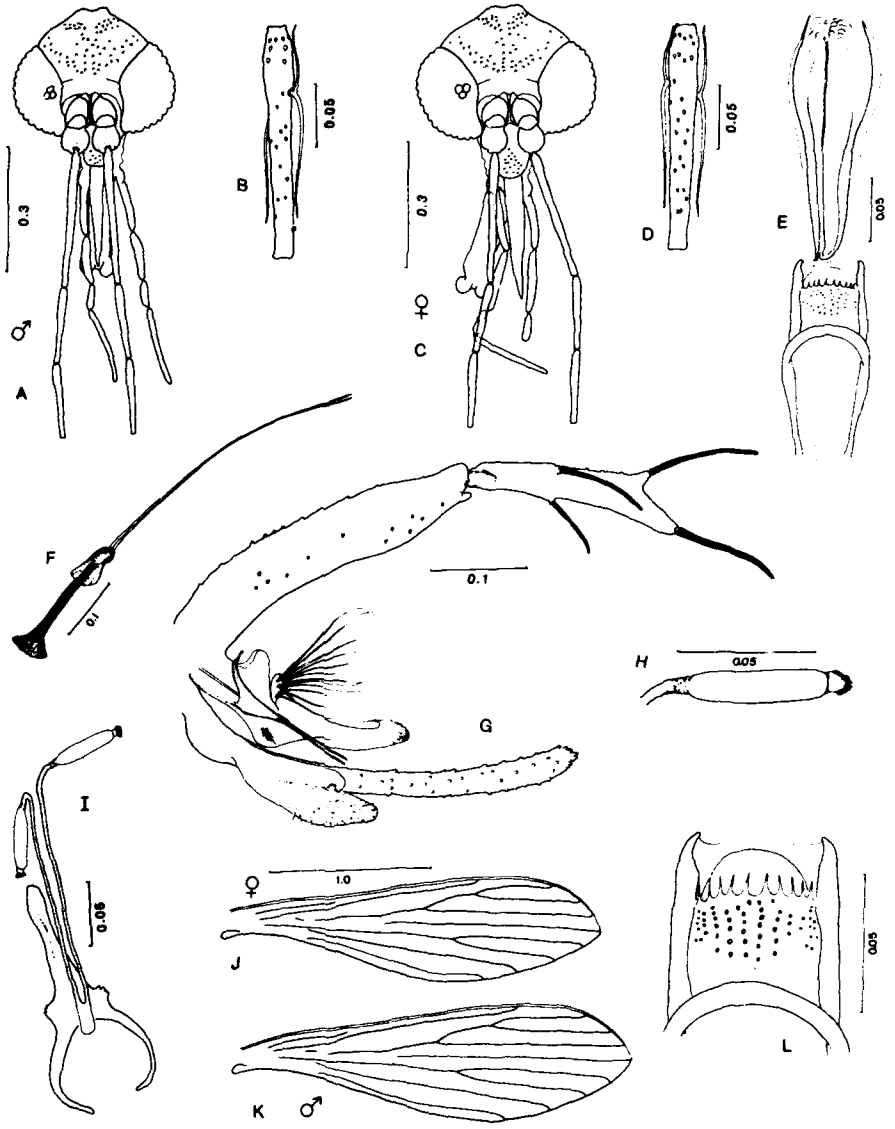


FIG. 137. ***Lutzomyia dasymera.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Body of spermathecae; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

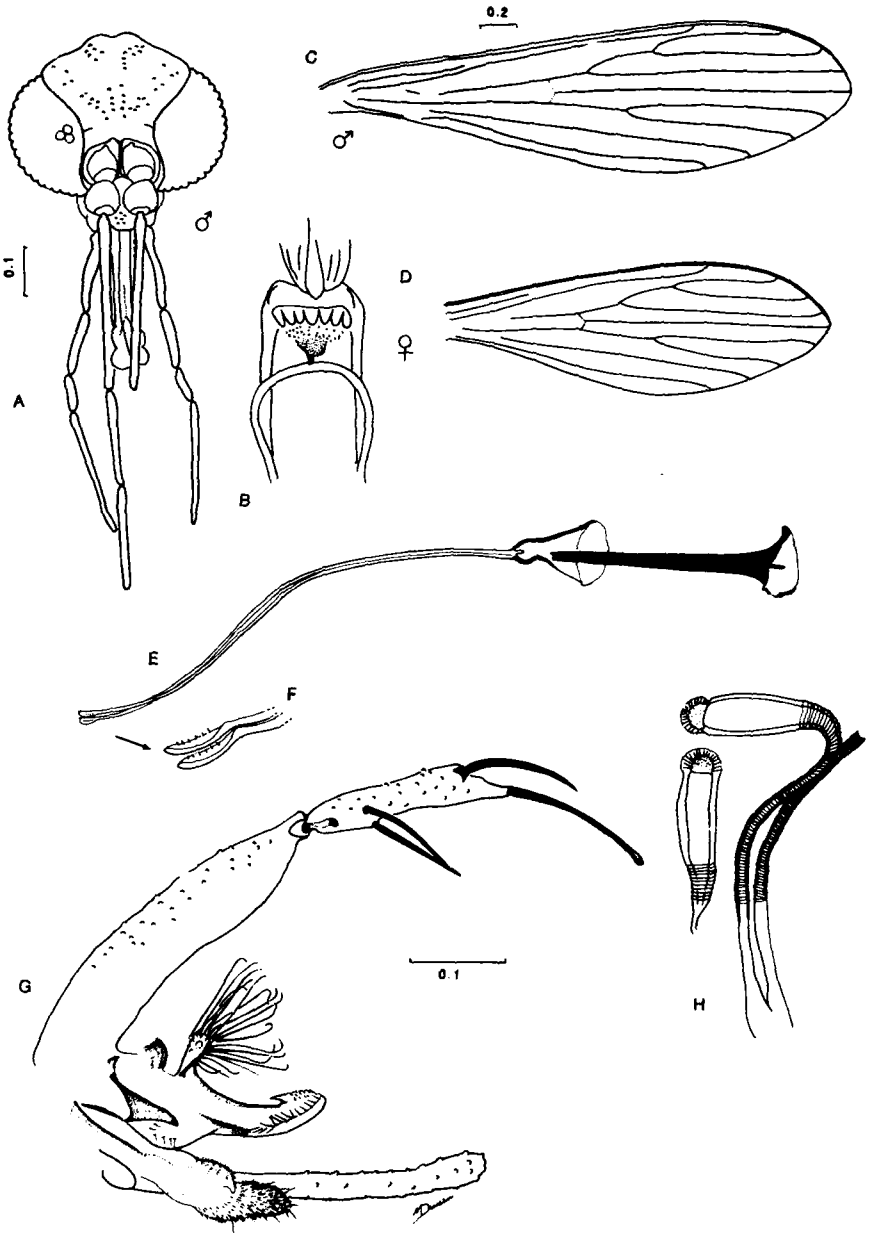


FIG. 138. ***Lutzomyia campbelli.*** A. Male head; B. Female cibarium; C. Male wing; D. Female wing; E. Genital pump & terminalia; F. Tips of genital filaments; G. Male terminalia; H. Spermathecae (figs. B, D, & H from Llanos et al. 1975a).

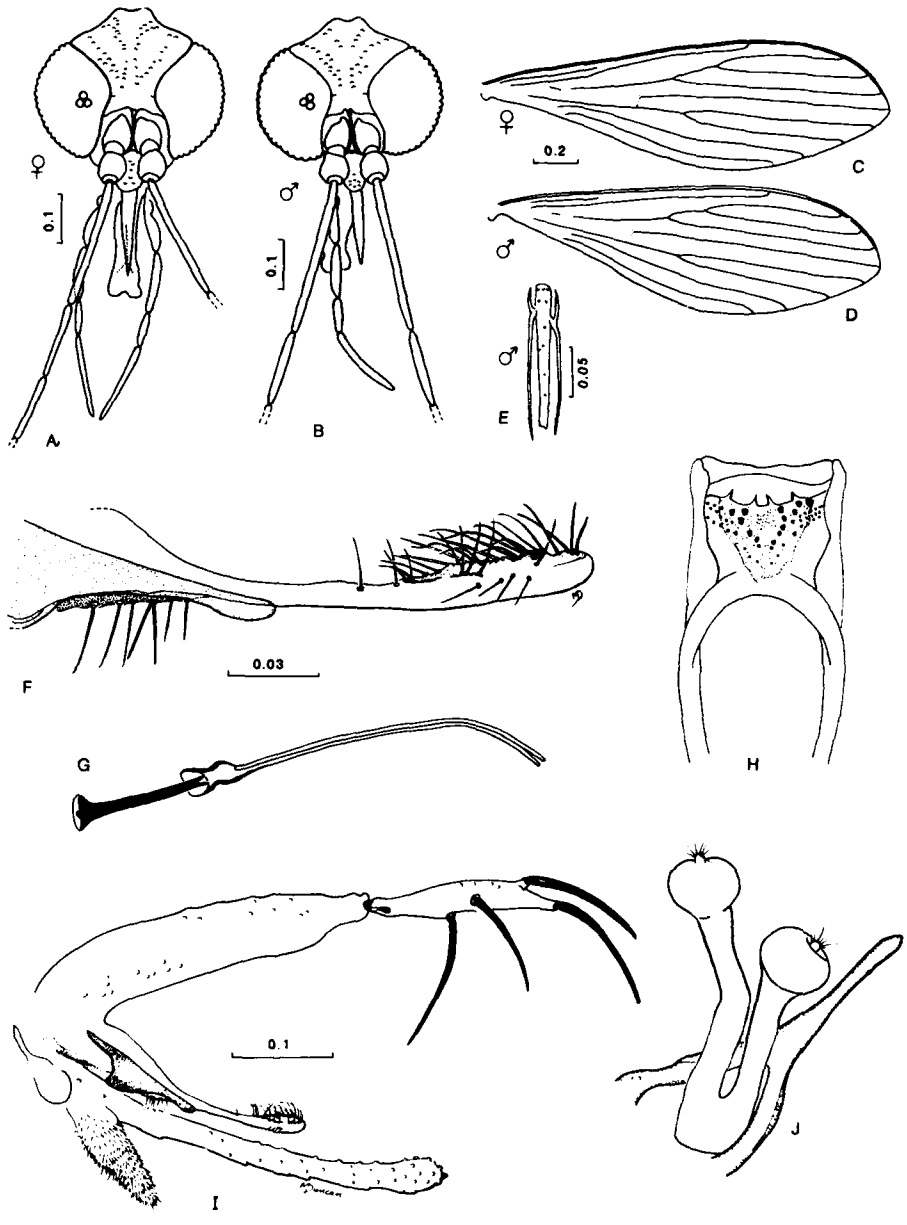


FIG. 139. ***Lutzomyia lutziana.*** A. Female head; B. Male head; C. Female wing; D. Male wing; E. Male flagellomere II; F. Male aedeagus & paramere; G. Genital pump & filaments; H. Female cibarium; I. Male terminalia; J. Spermathecae.

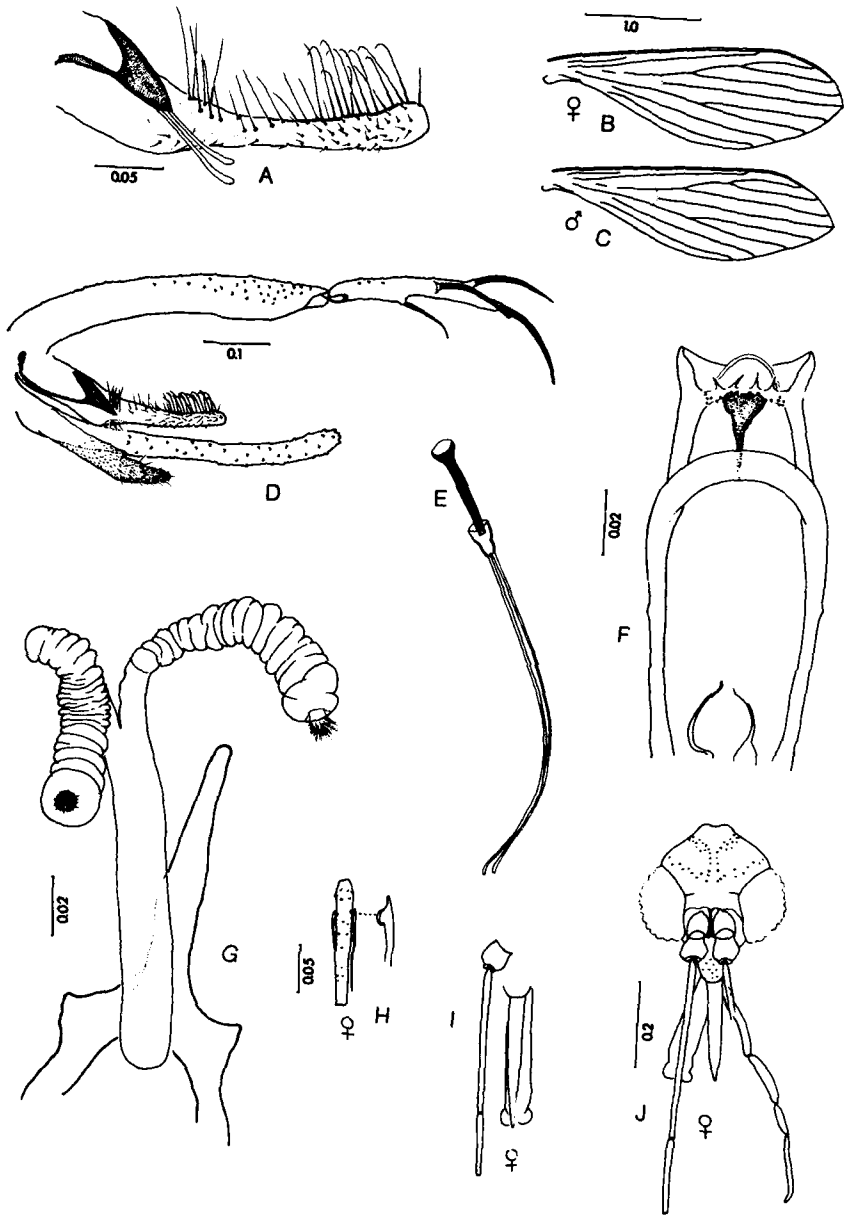


FIG. 140. ***Lutzomyia guatemalensis***. A. Paramere; B. Female wing; C. Male wing; D. Male terminalia; E. Genital pump & filaments; F. Female cibarium; G. Spermathecae; H. Female flagellomere II; I. Female proboscis & basal flagellomeres; J. Female head.

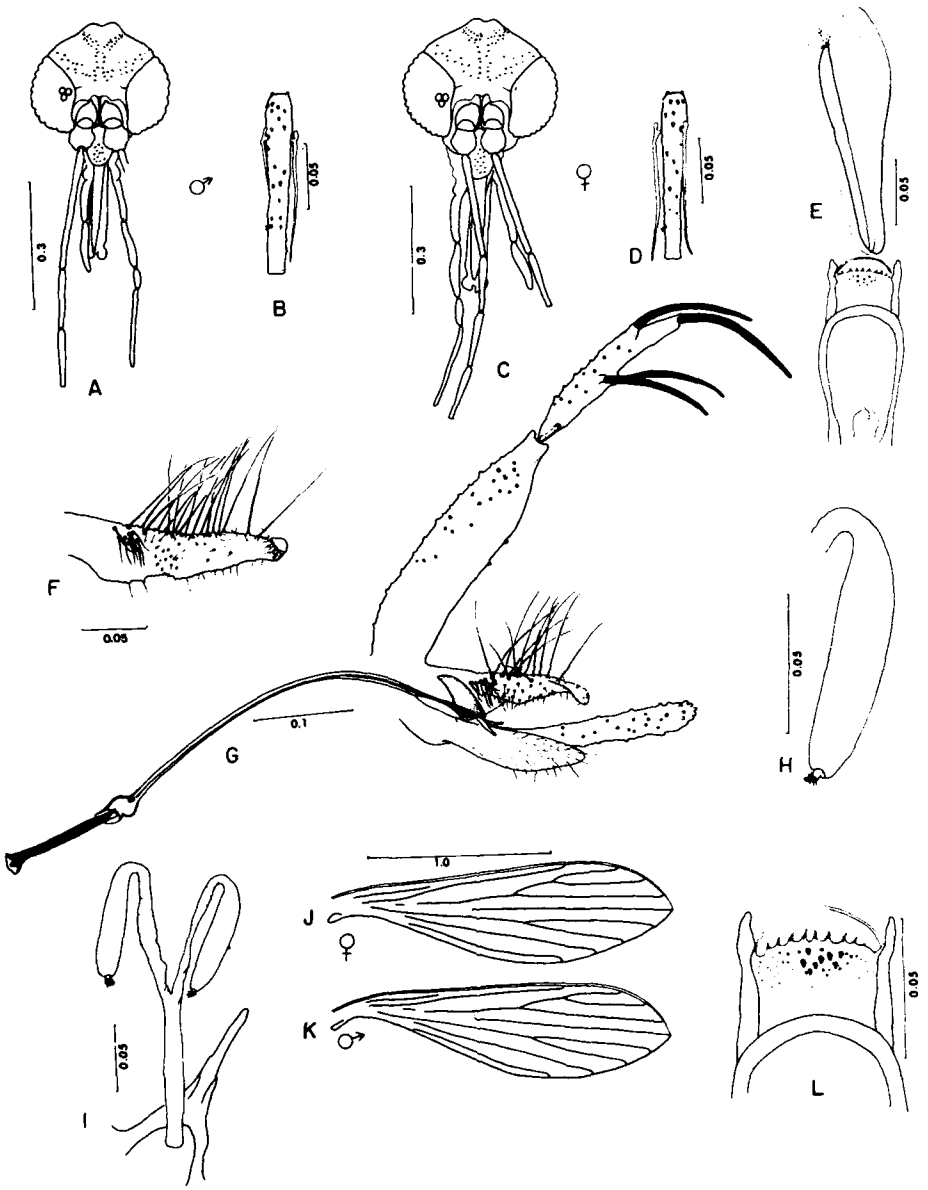


FIG. 141. ***Lutzomyia punctigeniculata.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Paramere; G. Male terminalia; H. Body of spermathecae; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (figs. from Young 1979).

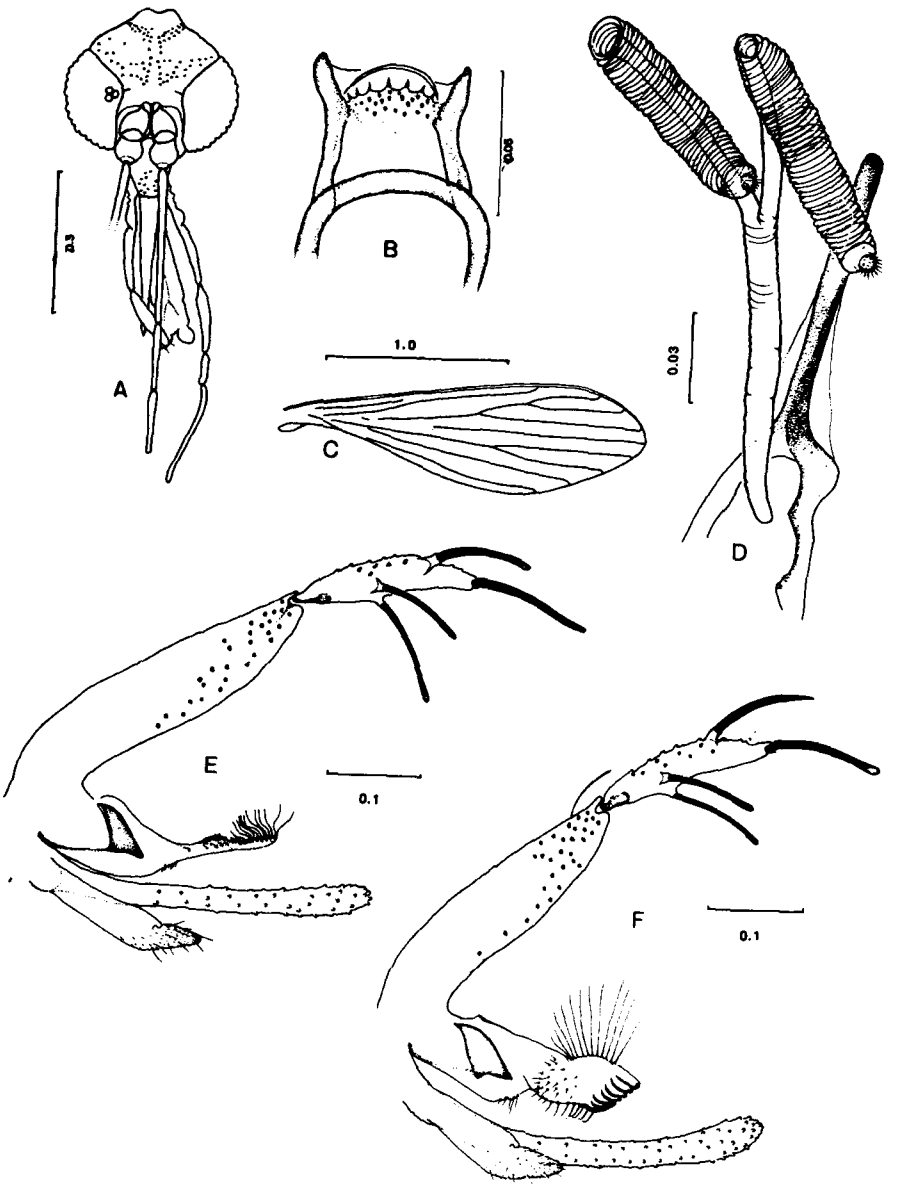


FIG. 142. ***Lutzomyia undulata***. A. Female head; B. Female cibarium; C. Female wing; D. Spermathecae; E. Male terminalia (all figs. except D from Young 1979).
Lutzomyia cratifer. F. Male terminalia.

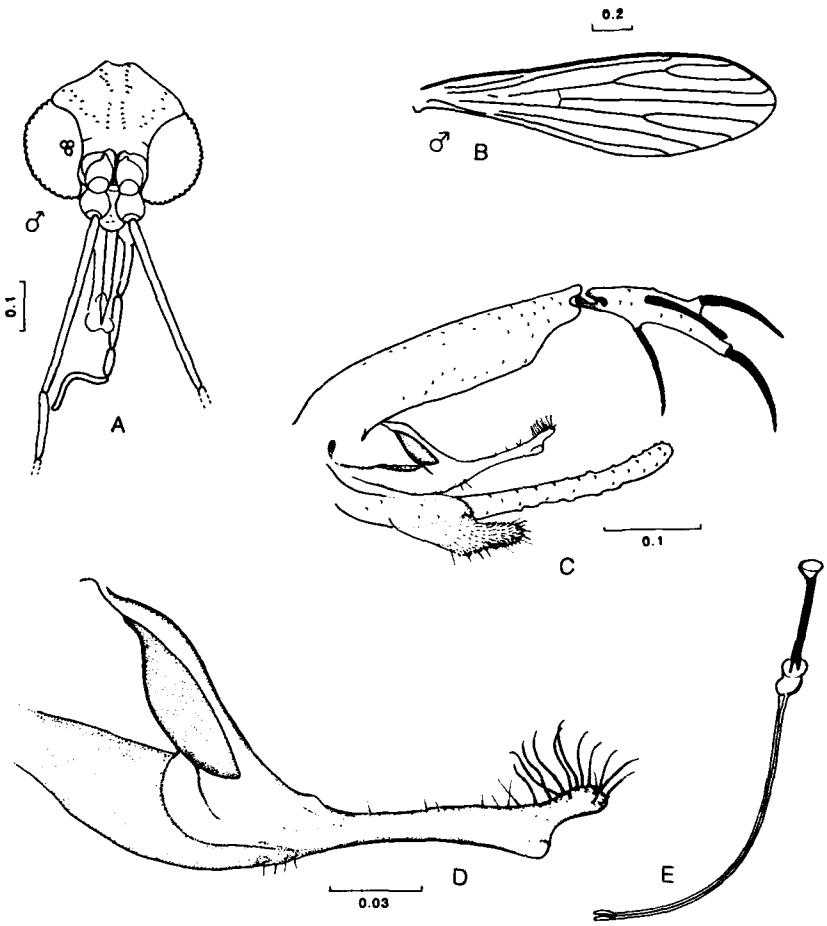


FIG. 143. ***Lutzomyia soccula.*** A. Male head; B. Male wing; C. Male terminalia; D. Paramere; E. Genital pump & filaments.

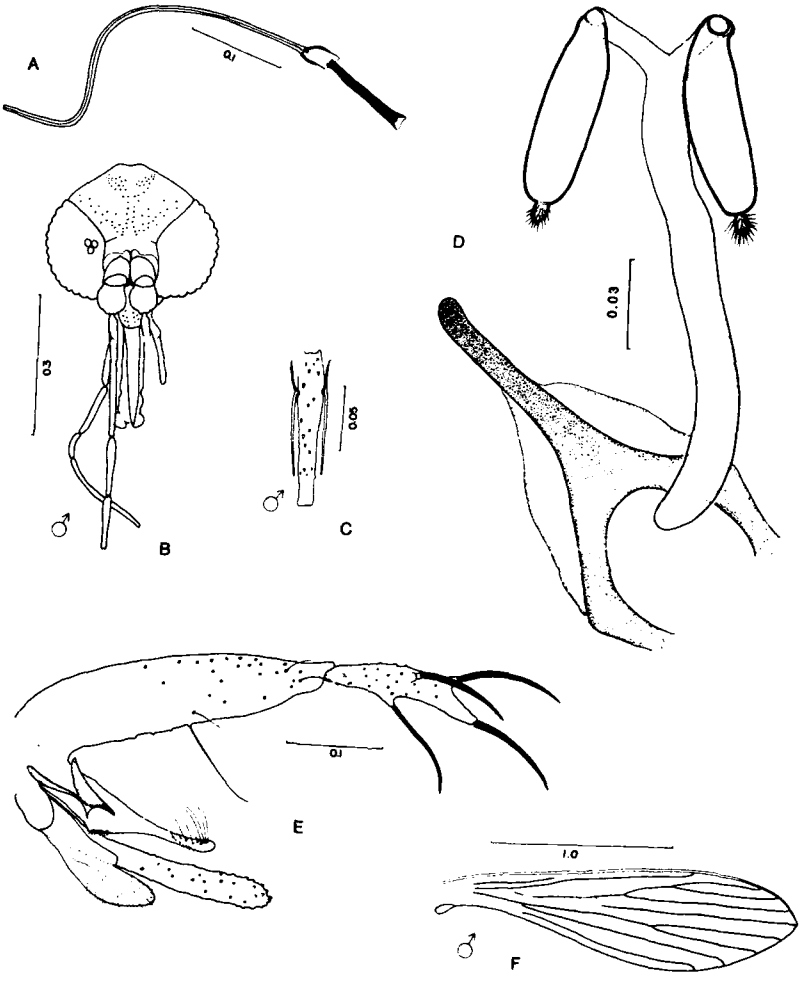


FIG. 144. ***Lutzomyia abonnenci***. A. Genital pump & filaments; B. Male head; C. Male flagellomere II; D. Spermathecae; E. Male terminalia; F. Male wing (all figs. from Young 1979 except fig. D.).

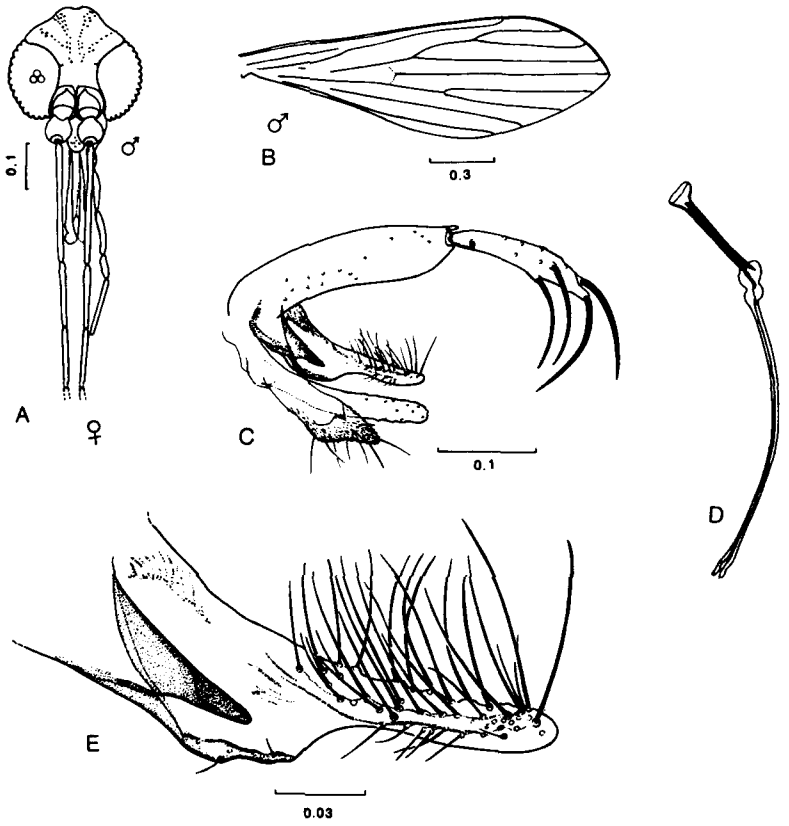


FIG. 145. ***Lutzomyia cuzquena.*** A. Male head;; B. Male wing; C. Male terminalia; D. Genital pump & filaments; E. Paramere.

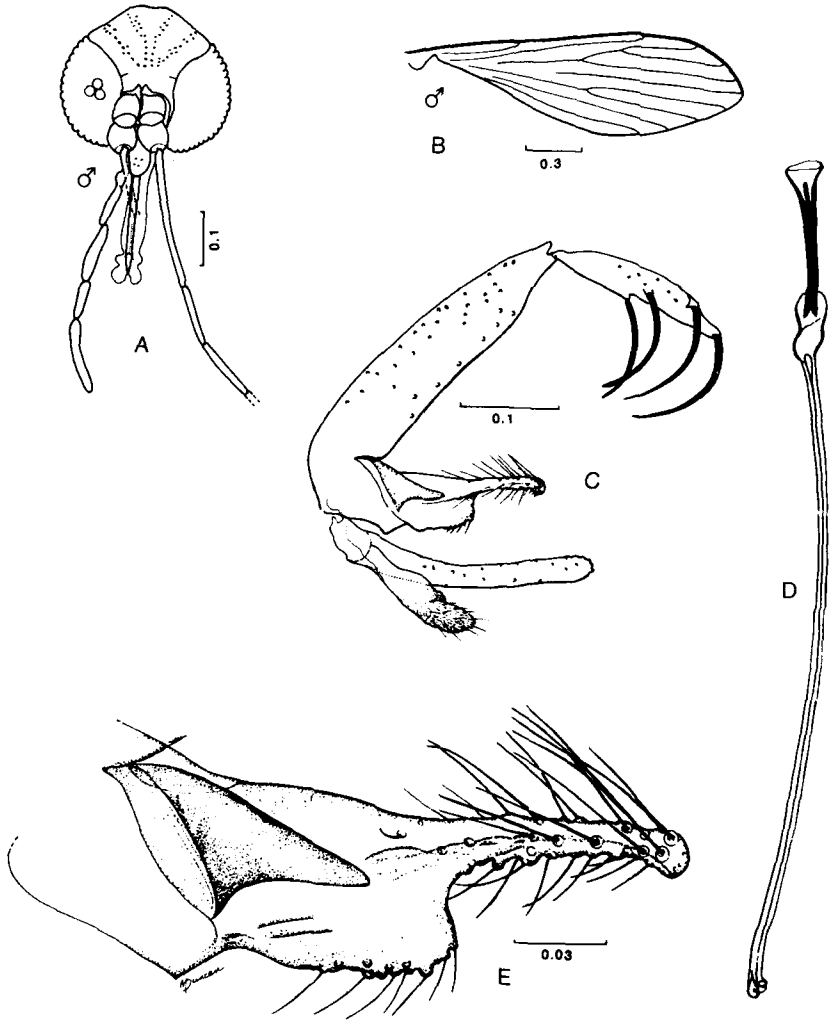


FIG. 146. ***Lutzomyia souzacastroi.*** A. Male head; B. Male wing; C. Male terminalia; D. Genital pump & filaments; E. Paramere.

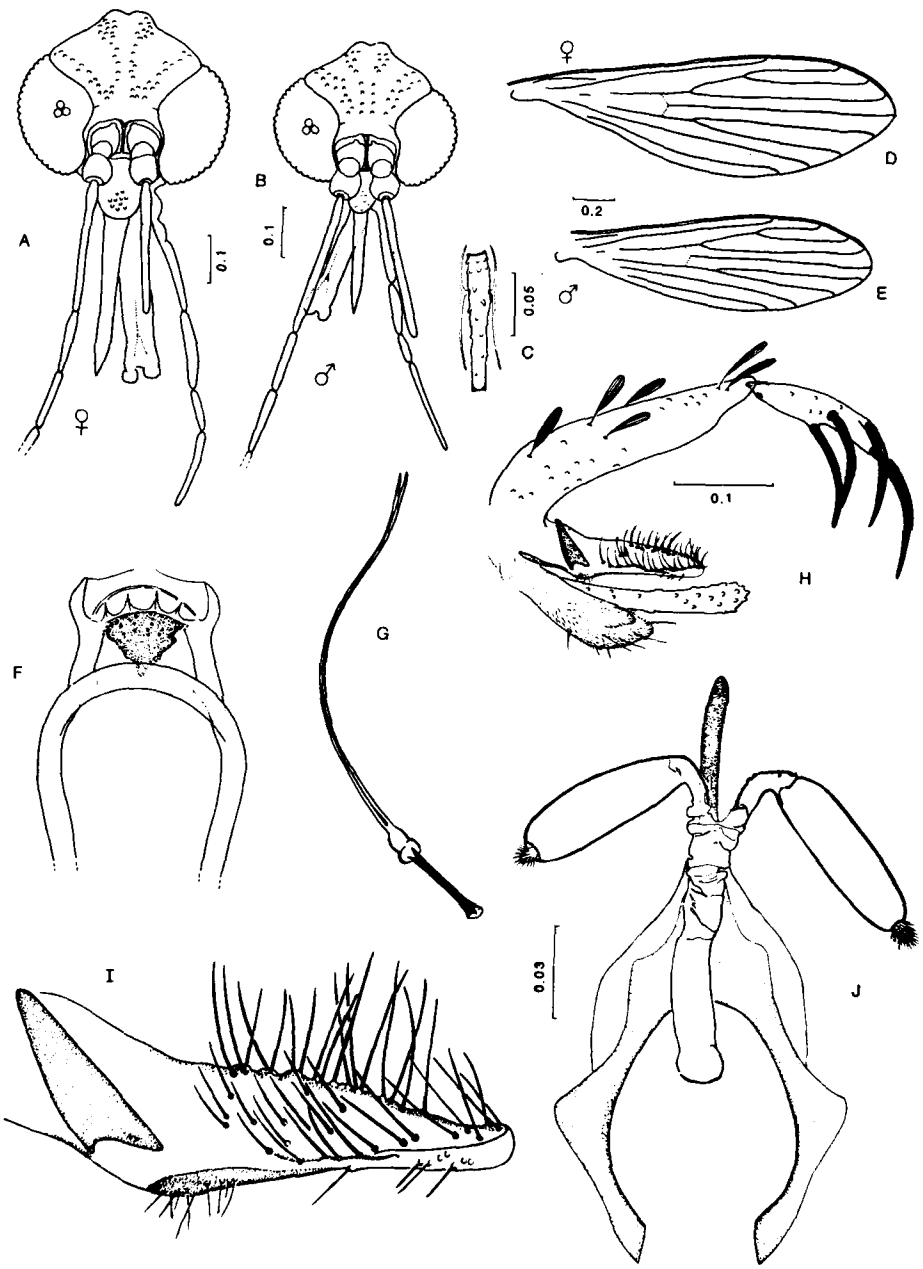


FIG. 147. ***Lutzomyia scaffi.*** A. Female head; B. Male head; C. Male flagellomere II; D. Female wing; E. Male wing; F. Female cibarium; G. Genital pump & filaments; H. Male terminalia; I. Paramere; J. Spermathecae.

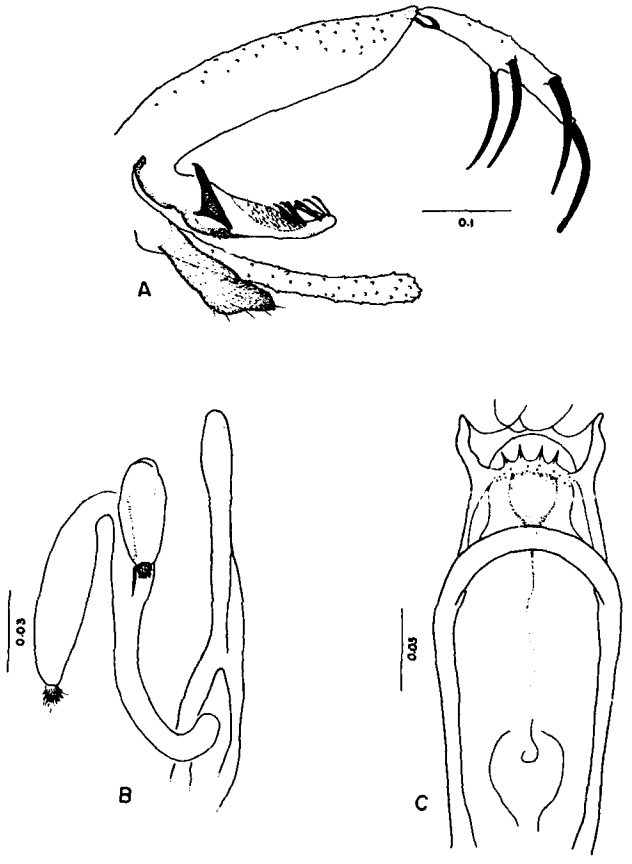


FIG. 148. ***Lutzomyia dendrophyla***. A. Male terminalia; B. Spermathecae; C. Female cibarium (from Young 1979).

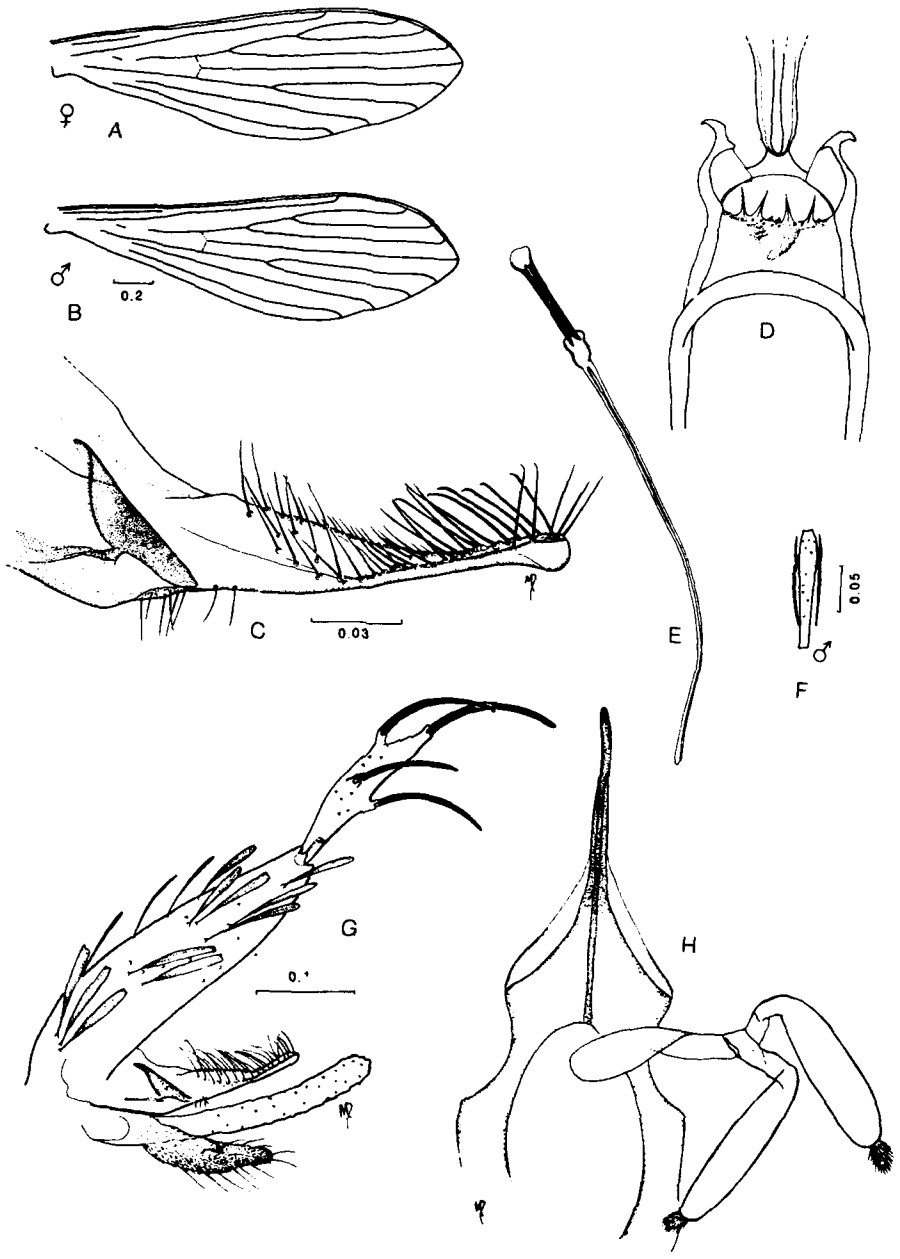


FIG. 149. ***Lutzomyia pestanai.*** A. Female wing; B. Male wing; C. Paramere; D. Female cibarium; E. Genital pump & filaments; F. Male flagellomere II; G. Male terminalia; H. Spermathecae.

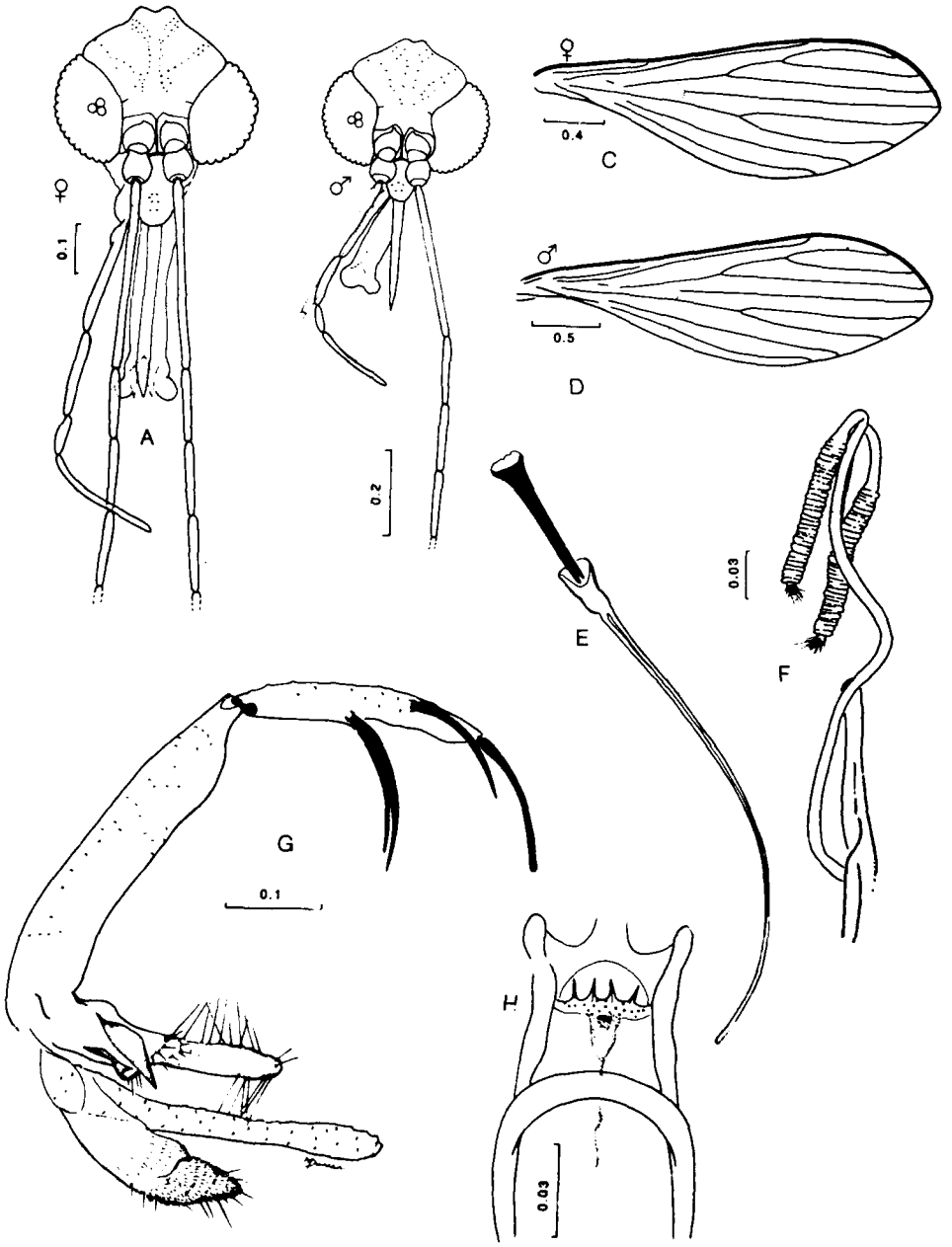


FIG. 150. ***Lutzomyia volcanensis***. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Genital pump & filaments; F. Spermathecae; G. Male terminalia; H. Female cibarium (fig. F from Fairchild & Hertig 1961b).

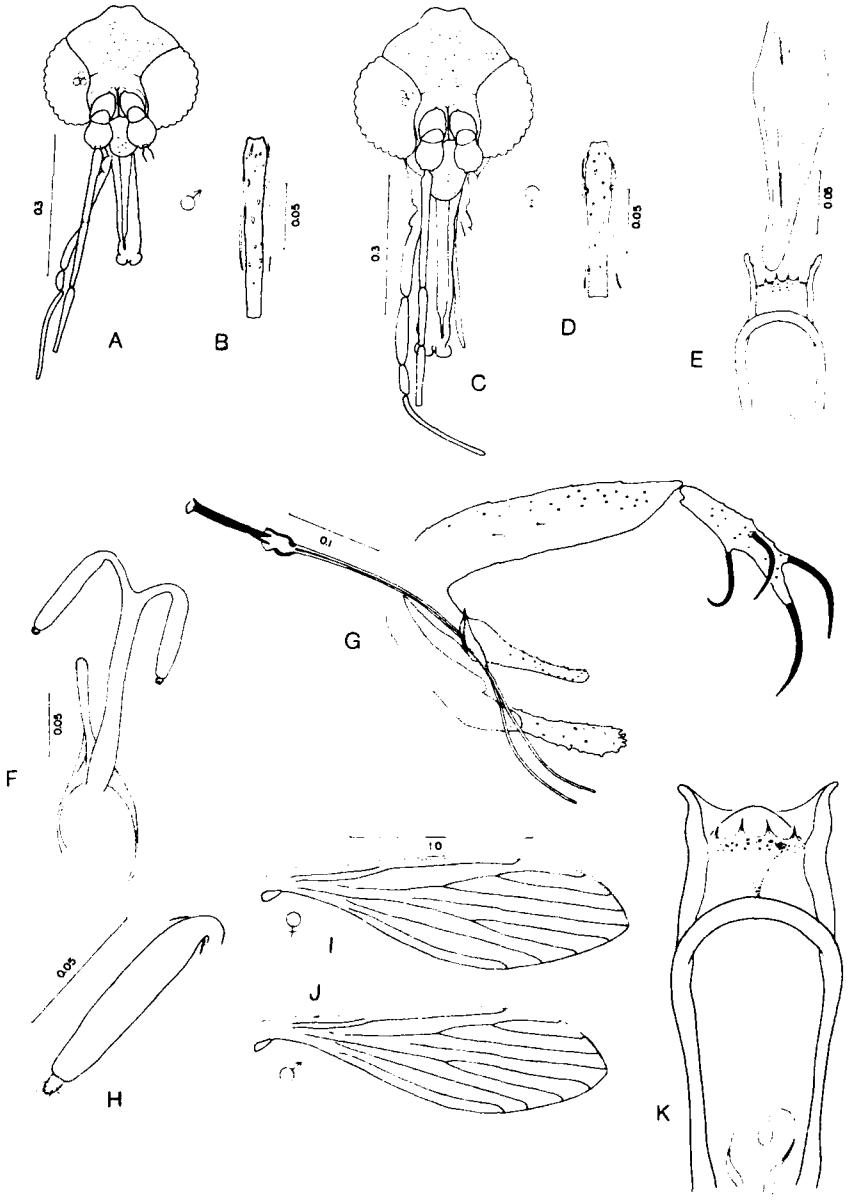
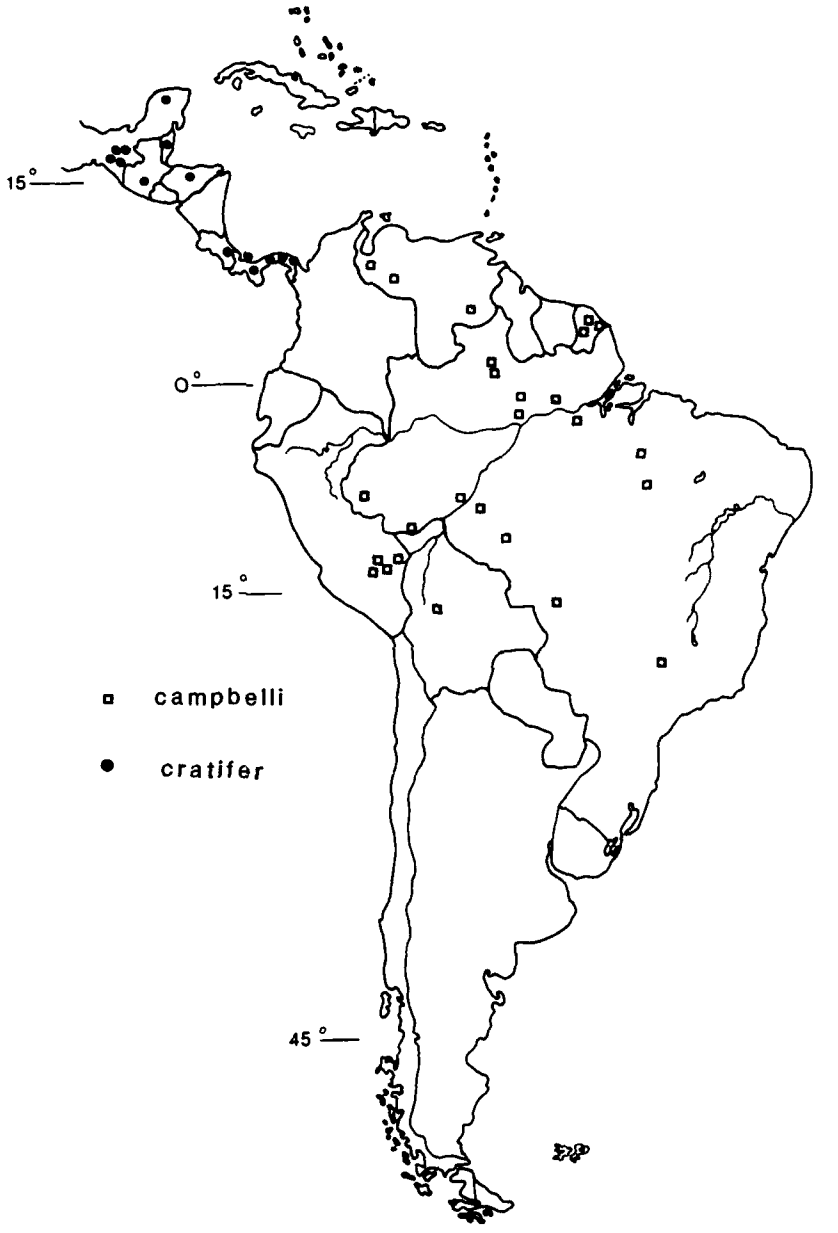


FIG. 151. ***Lutzomyia shannoni.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Spermathecae; G. Male terminalia; H. Spermatheca showing outer envelope; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

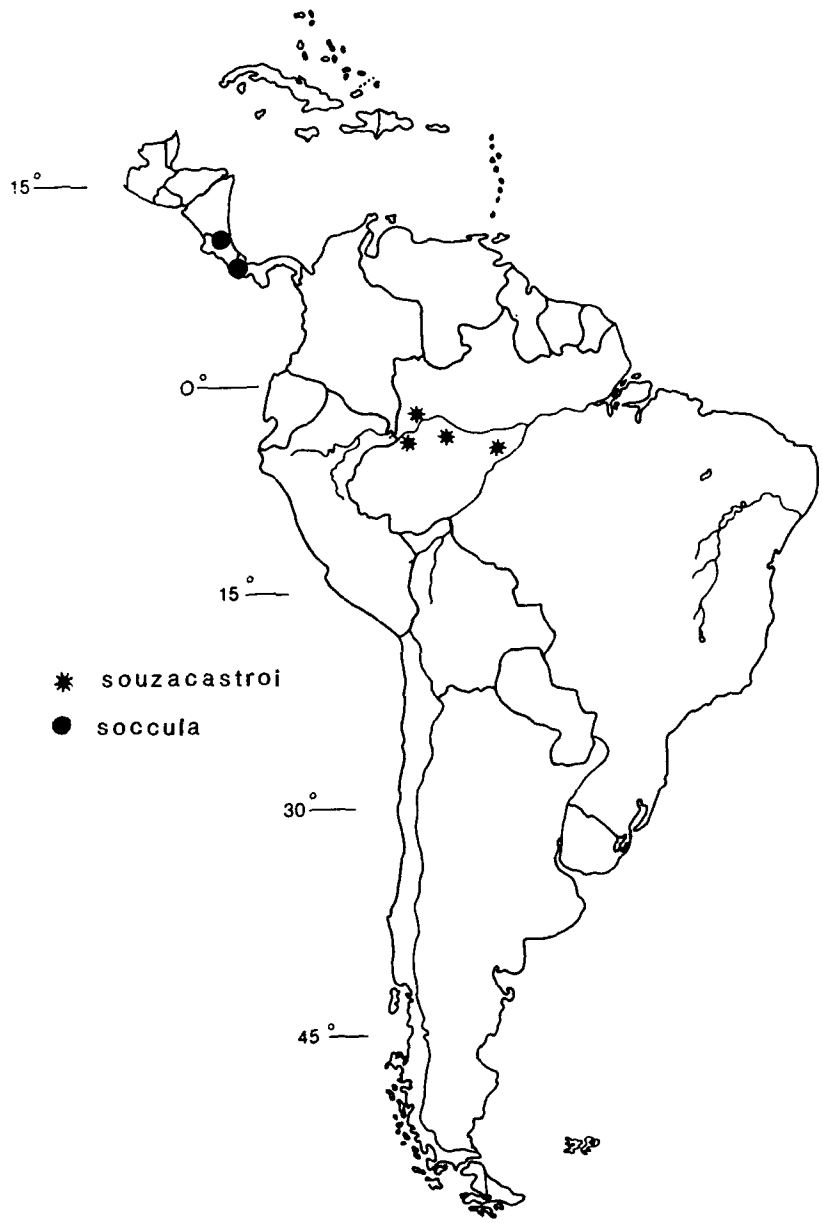
Map 70



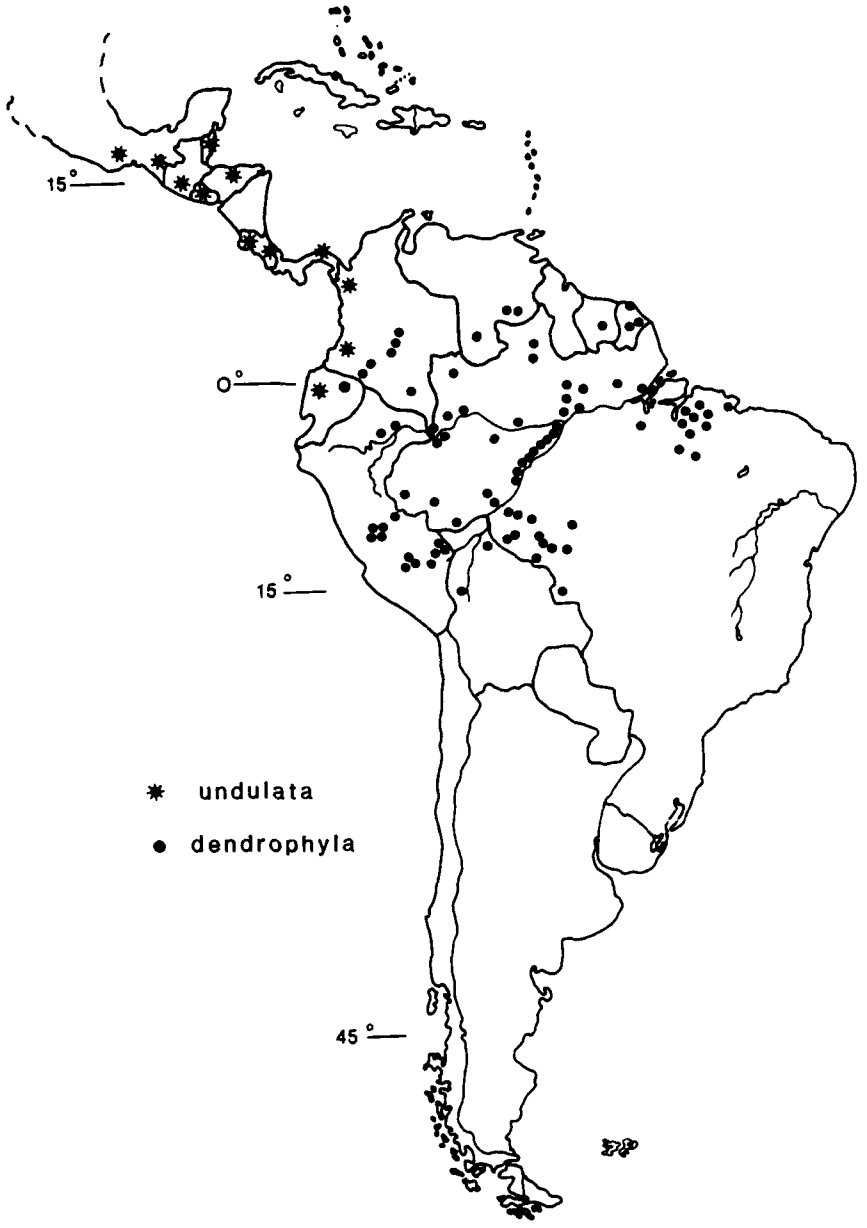
Map 71

Map 72

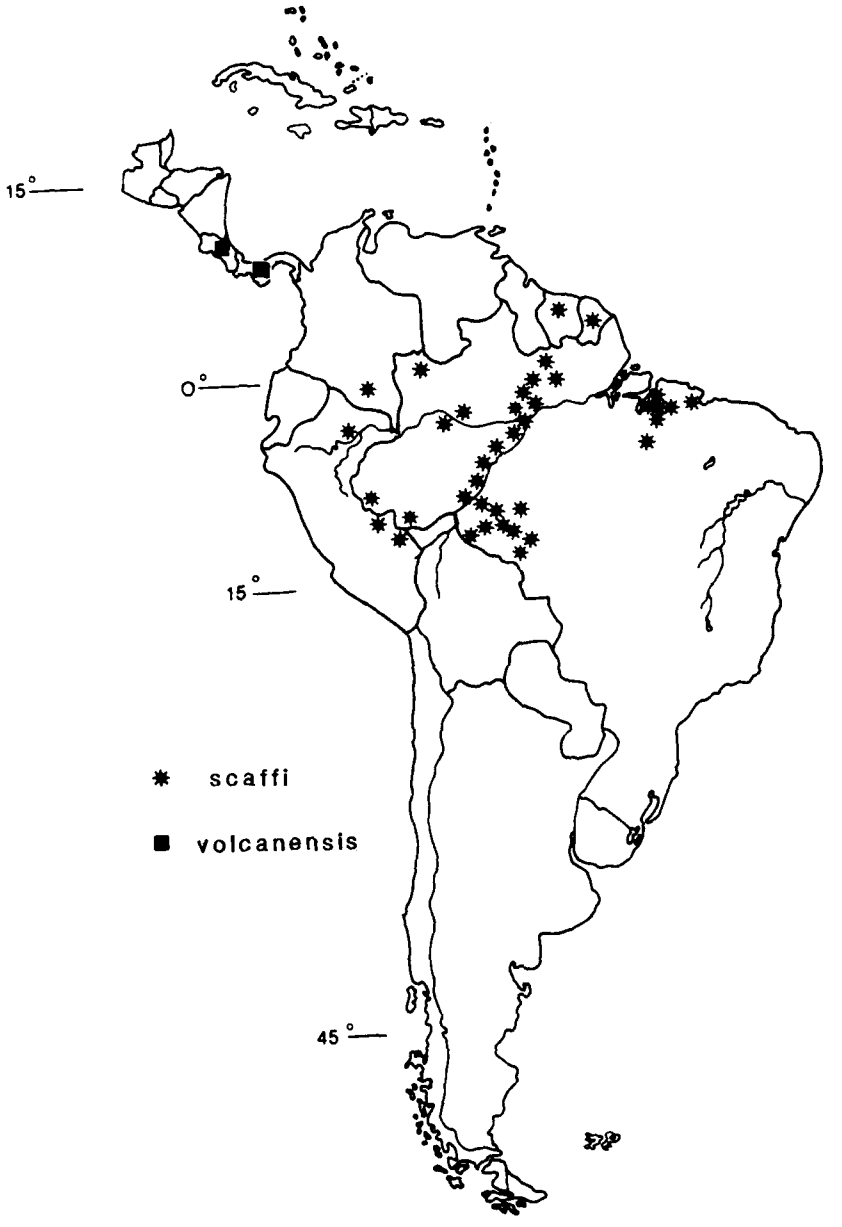
Map 73



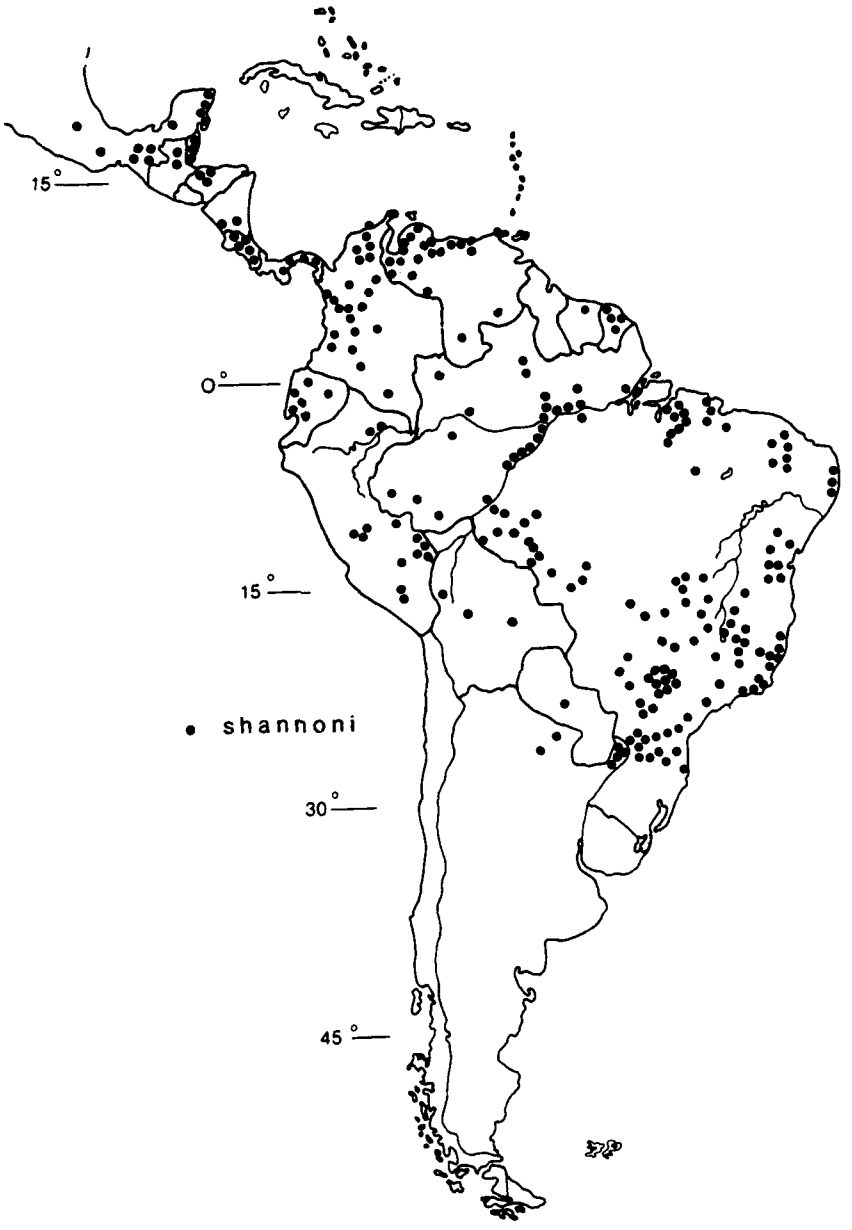
Map 74



Map 75



Map 76



Map 77

SPECIES GROUP *ARAGAOI*

Lutzomyia, subgenus *Psathyromyia* Barretto 1962: 99 (in part).
Lutzomyia species group *aragaoi* Theodor 1965: 185. Lewis et al. 1977: 325.
Psychodopygus, subgenus *Trichophoromyia*: Forattini 1971a: 105; 1973: 415.
Lutzomyia species group *brasiliensis* Martins et al. 1978: 140 (in part).
Psathyromyia, subgenus *Oophoromyia* Artemiev 1991: 73 (type species: *Psathyromyia aragaoi* by orig. designation).

Identification. Coloration dusky to dark. Antennal ascoids with short but distinct proximal spurs. Palpomere 5 short, subequal to palps. 3 + 4. ♀ cibarium with 4-12+ horizontal teeth; conspicuous vertical teeth in rows; dark pigment patch & usually a complete arch. Pharynx unarmed. Spermathecae subspherical or oval without incipient annulations, or cylindrical with annulations; individual sperm ducts longer than common duct. ♂ *genitalia*. Coxite with diffuse, short persistent setae or no persistent setae. Style with 4 spines & no subterminal seta. Genital filaments variable in length, tips modified or not. Paramere usually with dorsal basal hump, without other modifications. Lateral lobe long, extending to or beyond base of style.

The *aragaoi* group species are divided often into 2 series or complexes, the series *brasiliensis* and the series *aragaoi*, based mainly on the structure of the spermathecae (Theodor 1965).

Medical Importance. Unknown; females are not anthropophilic. Both sexes of most species are commonly found resting in armadillo (*Dasypus*) burrows.

Key to the Males of the Species Group *Aragaoi*

1. Genital filament tips hooked or twisted 2
   Genital filament tips inflated, spear-shaped or simple 5

2. Paramere with ventral tuft of 20-25 strong setae . . . *L. antezanai* (Fig. 163)
   Paramere without a distinct tuft of setae 3

3. Style with isolated proximal spine. Genital filament tips shaped like a button-hook . . . . . *L. carpenteri* (Fig. 156)
   Style with paired proximal spines, i.e., inserted more or less on same level. Genital filament tips twisted 4

4. Aedeagus gradually narrowing to apex. Genital filament tip as shown. Paramere relatively slender . . . . . *L. coutinhoi* (Fig. 157)
   Aedeagus with dorsal side abruptly turned downwards near apex. Genital filament tip otherwise. Paramere usually broader . . . . . *L. aragaoi* (Figs. 161 & 162)

5. Genital filaments markedly inflated at or near their tips 6
Genital filaments inflated slightly or not at all at or near their tips 7

6. Genital filaments inflated subterminally, followed by slender extension of filaments . . . . . *L. inflata* (Fig. 155)
Genital filaments inflated at end of filaments . . . . . *L. runoides* (Fig. 159)

7. Genital filaments shorter than 7X length of genital pump 8
Genital filaments longer than 7X length of genital pump . . . . . *L. brasiliensis* (Fig. 164)

8. Aedeagus nearly reaching end of paramere, with a distinct ventral heel at apex . . . . . *L. pascalei* (Fig. 158)
Aedeagus shorter in relation to paramere, lacking ventral heel at apex . . . 9

9. Genital filaments longer than 4X length of genital pump, tips slightly inflated . . . . . *L. abunaensis* (Fig. 154)
Genital filaments shorter than 4X length of genital pump, tips not inflated 10

10. Lateral lobe shorter than 0.50 mm 11
Lateral lobe longer than 0.55 mm . . . . . *L. barrettoi majuscula* (Fig. 153)

11. Genital filaments 3X or greater pump length . . . . . *L. barrettoi barrettoi*
Genital filaments shorter than 3X pump length . . . . . *L. texana* (Fig. 160)

Key to the females of the Species Group *Aragaoi**

1. Spermathecae cylindrical with convoluted individual ducts, in part (series *brasiliensis*) 2
Spermathecae subspherical, oval or pear-shaped, without convoluted individual ducts (series *aragaoi*) 4

2. Cibarium with 4 horizontal teeth. Spermathecae with extremely long individual ducts, each about 20X length of spermathecae . *L. brasiliensis* (Fig. 164)
Cibarium with 8 or more horizontal teeth. Spermathecae with shorter sperm ducts 3

3. Individual sperm ducts much more slender near spermathecae than near common duct. Cibarium with vertical teeth in 3-4 irregular transverse rows . . . . . *L. abunaensis* (Fig. 154)

*The female of *L. coutinhoi* remains undescribed.

Individual sperm ducts more or less subequal in width throughout & shorter. Cibarium with 1-2 rows of vertical teeth . . . . . *L. runoides* (Fig. 159)
L. inflata (Fig. 155)

4. Spermathecae pear-shaped, i.e., with large expanded neck; individual ducts with fine transverse striations . . . . . *L. carpenteri* (Fig. 156)
Spermathecae otherwise, subspherical or oval; individual ducts without striations 5

5. Spermathecae subspherical 6
Spermathecae oval 7

6. Common sperm duct longer than diameter of spermatheca; terminal knob protruding from body of spermatheca . . . . . *L. pascalei* (Fig. 158)
Common sperm duct invisible or barely visible, clearly much shorter than diameter of spermatheca; terminal knob presented as a flat subspherical patch from which tubules ("hairs") arise . . . . . *L. aragaoi* (Fig. 161)
L. texana (Fig. 160)
L. antezanai

7. Spermathecae larger, individual sperm ducts subequal throughout . . . . . *L. barrettoi barrettoi* (Fig. 152B)
Spermathecae smaller, individual sperm ducts noticeably expanded where they enter spermathecae . . . . *L. barrettoi majuscula* (Figs. 152A & 153H)

Lutzomyia barrettoi barrettoi (Mangabeira)
Fig. 152 B-H

Flebotomus barrettoi Mangabeira 1942a: 148 (♂, Aurá, Belém, Pará, Brazil).
Phlebotomus sp. of Maripa Floch & Abonnenc 1946a: 3 (♂, French Guiana); 1952: 46 (♀). Léger et al. 1977: 229 (French Guiana).
Lutzomyia barrettoi: Barretto 1962: 99 (listed). Martins et al. 1976a: 488 (Peru). Léger et al. 1977: 219 (French Guiana). Martins et al. 1978: 143 (in part, dist.). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Aguiar et al. 1985c: 467 (coll. data, Brazil). Lebbe et al. 1987: 28 (computer aided ident.). Aguiar & Vilela 1987: 586 (armadillo burrow as adult resting and breeding site, Brazil).
Lutzomyia barrettoi barrettoi: Young 1979: 128 (figs. refs.). Hudson & Young 1985: 418 (Suriname). Ryan 1986: 21 (figs., Pará, Brazil). Alexander et al. 1992c: 124 (Ecuador record).
Psychodopygus barrettoi: Forattini 1971a: 105 (listed); 1973: 457 (figs.,tax., in part).

Distribution (Map 78). COLOMBIA (Young 1979); FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); TRINIDAD (Young 1979); SURINAME

(Hudson & Young 1985); BRAZIL & PERU (Martins et al. 1978); ECUADOR (Alexander et al. 1992c).

Remarks. The spermathecae are very large, oval sacs, much larger than those of *L. barrettoi majuscula* or *L. texana*. Aguiar & Vilela (1987) reared a single male of *L. b. barrettoi*, the immature stage of which was included in a soil sample from an armadillo burrow.

Lutzomyia barrettoi majuscula Young
Figs. 152 A & 153

Lutzomyia barrettoi majuscula Young 1979: 129 (♂, ♀, Canal Zone, Panama). Young & Rogers 1984: 599 (listed, Ecuador). Navin et al. 1985: 1074 (Honduras). Murillo & Zeledón 1985: 105 (♂, ♀ figs., Costa Rica). Alexander et al. 1992a: 36 (Ecuador); 1992c: '24.
Psychodopygus barrettoi: Forattini 1971a: 105 (listed); 1973: 457 (in part.).

Distribution (Map 79). HONDURAS (Navin et al. 1985); NICARAGUA (Young 1979); COSTA RICA (Young 1979; Murillo & Zeledón 1985); PANAMA (Fairchild & Hertig 1953a; Young 1979); COLOMBIA & ECUADOR (Young 1979; Alexander et al. 1992a,c).

Lutzomyia abunaensis Martins, Falcão & Silva
Fig. 154

Lutzomyia abunaensis Martins, Falcão & Silva 1965: 17 (♂, Abuna, Rondônia, Brazil). Martins et al. 1978: 143 (as synonym of *brasiliensis* Mangabeira). Young 1979: 125 (Ecuador). Young & Rogers 1984: 600 (♀ descript., Ecuador). Alexander 1992c: 124 (listed).
Psychodopygus abunaensis: Forattini 1971a: 105 (listed); 1973: 452 (fig., tax.).

Distribution (Map 78). BRAZIL (type locality); ECUADOR (Young & Rogers 1984; Alexander et al. 1992c); PERU (Pérez et al. 1991).

Remarks. In view of salient differences between females of *L. brasiliensis* and *L. abunaensis* (Young & Rogers 1984), we regard the species as distinct.

Lutzomyia inflata (Floch & Abonnenc)
Fig. 155

Phlebotomus inflatus Floch & Abonnenc 1944a: 9 (♂, Montabo, Cayenne, French Guiana). Fairchild & Hertig 1953a: 34 (cf. to *runoides*).
Phlebotomus aragaoi (not *aragaoi* Costa Lima): Floch & Abonnenc 1945c: 6 (♀).
Lutzomyia inflata: Barretto 1962: 99. Léger et al. 1977: 220. Martins et al. 1978: 145 (refs., dist.). Young 1979: 135. Ready et al. 1983a: 780 (Pará, Brazil);

1986: 33 (armadillo burrow, Brazil). Ryan 1986: 24 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Psychodopygus inflatus: Forattini 1971a: 105 (listed); 1973: 469 (in part, as senior synonym of *runoides*).

Distribution (Map 80). FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); BRAZIL (Ready et al. 1983a; 1 ♂, Jurua River (3°50' S, 66°10' W), Amazonas; 2 ♂♂, Madeira River near Porto Velho, Rondônia, J. Arias).

Remarks. The major difference between the males of *L. inflata* and *L. runoides* is the shape of the terminal portion of the genital filaments. Forattini (1973) regards these taxa as conspecific and he may be correct; this difference could reflect intraspecific variation at the subspecies level. For the present, however, we treat them as full species pending examination of more material from different localities. We examined the holotypes of both species.

Lutzomyia carpenteri (Fairchild & Hertig)
Fig. 156

Phlebotomus carpenteri Fairchild & Hertig 1953a: 28 (♂, Chiva Chiva, Canal Zone, Panama).

Lutzomyia carpenteri: Barretto 1962: 99 (listed). Martins et al. 1978: 144 (refs., dist.). Young 1979: 133 (figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits, Panama). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 105 (♂, ♀ figs., Costa Rica).

Psychodopygus carpenteri: Forattini 1971a: 105.

Distribution (Map 81): MEXICO; BELIZE (Martins et al. 1978); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979).

Lutzomyia coutinhoi (Mangabeira)
Fig. 157

Flebotomus coutinhoi Mangabeira 1942a: 152 (♂, Aurá, Belém, Pará, Brazil).

Lutzomyia coutinhoi: Barretto 1962: 99 (listed). Martins et al. 1965: 2; 1976a: 488 (Peru); 1978: 144 (refs., dist.). Biancardi et al. 1982: 174 (Rondônia, Brazil). Llanos 1983: 183 (listed). Ryan 1986: 23 (♂ fig., dist., Pará, Brazil).

Psychodopygus coutinhoi: Forattini 1971a: 105 (listed); 1973: 463 (♂ fig., tax.).

Distribution (Map 82). BRAZIL (Martins et al. 1978; Biancardi et al. 1982); PERU (Llanos 1981).

Lutzomyia pascalei (Coutinho & Barretto)
Fig. 158

Phlebotomus pascalei Coutinho & Barretto 1940b: 197 (♂, São Paulo, São Paulo, Brazil). Sherlock & Carneiro 1962: 432 (♀ descript.). Carneiro & Sherlock 1964: 314 (pupa).
Lutzomyia pascalei: Barretto 1962: 99 (listed). Martins et al. 1978: 145 (refs., dist.). Vexenat et al. 1986b: 296 (Bahia, Brazil).
Psychodopygus pascalei: Forattini 1971a: 105 (listed); 1973: 477 (figs., tax.). Gomes et al. 1986: 282 (São Paulo, Brazil).

Distribution (Map 82). BRAZIL & ARGENTINA (Martins et al. 1978).

Remarks. The female of *L. pascalei*, described by Sherlock & Carnheiro (1962), differs from the one illustrated here by the longer common sperm duct and larger spermathecae. Our specimen was taken at Três Braços, Bahia, Brazil, where only males of *L. pascalei* and *L. aragaoi* have been captured.

Lutzomyia runoides (Fairchild & Hertig)
Fig. 159

Phlebotomus runoides Fairchild & Hertig 1953a: 30 (♂, ♀, Panama); Fairchild & Hertig 1959: 122 (dist., Central America).
Lutzomyia runoides: Barretto 1962: 99 (listed). Martins et al. 1978: (refs., dist.). Young 1979: 135 (♂, ♀ figs., refs.). Morales & Minter 1981: 96 (Caqueta, Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young et al. 1985: 143 (Peru). Murillo & Zeledón 1985: 109 (♂, ♀ figs., Costa Rica).
Psychodopygus inflatus: Forattini 1971a: 105 (listed); 1973: 469 (in part, as = synonym of *inflata*).

Distribution (Map 83). COSTA RICA (Murillo & Zeledón 1985); PANAMA. (Martins et al. 1978); COLOMBIA (Young 1979; Morales & Minter 1981); PERU (Young et al. 1985; Pérez et al. 1991); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982).

Lutzomyia texana (Dampf)
Fig. 160

Phlebotomus texanus Dampf 1938: 119 (♂, ♀, San Antonio, Texas, U.S.A.).
Lutzomyia texana: Barretto 1962: 99 (listed). Martins et al. 1978: 146. Young 1979: 131 (♀ fig.). Young & Perkins 1984: 276 (full refs., figs.). McHugh 1991: 192 (coll. data, Texas, USA).
Psychodopygus texanus: Forattini 1971a: 105; 1973: 480 (figs., tax.).

Distribution (Map 78). USA (Young & Perkins 1984); MEXICO (Vargas & Nájera 1953b).

Remarks. This species is closely associated with armadillos in southern Texas, USA, and is readily attracted to light (Young & Perkins 1984).

Lutzomyia aragaoi (Costa Lima)
Figs. 161 & 162

Flebotomus aragaoi Costa Lima 1932: 48 (♂, Lassance, Minas Gerais, Brazil). Barretto 1947a: 185 (refs.).
Phlebotomus aragaoi: Fairchild & Hertig 1953a: 21 (♂, ♀ figs., tax.).
Phlebotomus heckenrothi Floch & Abonnenc 1942b: 8 (♀, French Guiana). Forattini 1973: 456 (as synonym of *aragaoi*).
Lutzomyia aragaoi: Barretto 1962: 99 (listed). Léger et al. 1977: 219 (French Guiana). Martins et al. 1978: 142 (dist., figs.). Young 1979: 126 (figs., refs.). Fraiha et al. 1980a: 21 (Peru). Morales & Minter 1981:96 (Caqueta, Colombia). Biancardi et al. 1982: 174 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Young et al. 1985: 143 (Peru). Murillo & Zeledón 1985: 102 (♂, ♀ figs., Costa Rica). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 33 (Pará, Brazil). Ryan 1986: 20 (figs., Pará, Brazil). Aguiar & Vilela 1987: 585 (resting in animal burrows, Brazil). Lebbe et al. 1987: 28 (computer aided ident.). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Alexander et al. 1992a: 36 (Ecuador record); 1992c: 124 (Ecuador).

Distribution (Map 84). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales & Minter 1981); PERU (Fraiha et al. 1980b; Llanos 1983; Young et al. 1985; Pérez et al. 1991); BOLIVIA (♂♂, La Paz Dept., 1985, F. Le Pont); PARAGUAY (Martins et al. 1978); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); TRINIDAD (Young 1979); ECUADOR (Alexander et al. 1992a,c); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. Males of *L. aragaoi* from different localities show considerable variation in the shape of their parameres (Fig. 162). The significance of these observations is not yet known.

Lutzomyia antezanai Le Pont, Dujardin, Mouchet & Desjeux
Fig. 163

Lutzomyia antezanai Le Pont, Dujardin, Mouchet & Desjeux 1990: 139 (♂, Serrania de Marimonos, Dept. of La Paz, Bolivia). Le Pont & Desjeux 1992b: 268 (♀).

Distribution (Map 84). BOLIVIA (Le Pont et al. 1990).

Remarks. The type series, consisting of a holotype and 10 paratypes, was collected at 900 m a.s.l. The conspicuous tuft of long setae on the ventral surface of the paramere readily distinguishes this species from *L. aragaoi*. Le Pont & Desjeux (1992b) distinguish the females of *L. antezanai* and *L. aragaoi* by metrical differences and by the shape of the furca apex but we have not examined specimens of the former species.

Lutzomyia brasiliensis (Costa Lima)
Fig. 164

Flebotomus brasiliensis Costa Lima 1932: 48 (♂, Lassance, Minas Gerais, Brazil). Barretto 1947a: 190 (refs.).
Phlebotomus oliverioi Barretto & Coutinho 1941d: 223 (♂, Osasco, São Paulo, Brazil). Forattini 1973: 452 (as synonym of *brasiliensis*).
Lutzomyia brasiliensis: Barretto 1962: 99 (listed). Theodor 1965: 186 (♀ fig.). Léger et al. 1977: 219 (French Guiana). Martins et al. 1978: 143 (refs.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ryan et al. 1984: 547 (Pará, Brazil). Porter & Young 1986: 242 (cf. to *guatemalensis*). Ryan 1986: 22 (figs., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).
Lutzomyia oliverioi: Theodor 1965: 184. Ready & Fraiha 1981: 710 (in subgenus *Nyssomyia*).
Phlebotomus brasiliensis: Mangabeira & Sherlock 1962: 312 (♂, ♀ descript., immatures).
Psychodopygus brasiliensis: Forattini 1971a: 105 (listed); 1973: 460 (figs., tax.).

Distribution (Map 81). FRENCH GUIANA (Léger et al. 1977); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); PERU (Young et al. 1985).

Remarks. *Lutzomyia oliverioi* has been placed in the subgenus *Nyssomyia* by Theodor (1965) with a query, and by Martins et al. (1978) and Ready & Fraiha (1981) with certainty. Forattini (1973), however, studied the holotype and concluded that it was conspecific with *L. brasiliensis*.

Based solely on the original description and illustrations of *L. oliverioi*, there are character states that suggest it belongs in the *aragaoi* group. These include the broad wing, paramere with proximal hump and subterminal spine of the style inserted on a well marked tubercle. On the other hand, palpomere 5

of *L. oliverioi* is shorter than palp. 3 and, according to Ready & Fraiha (1981), the antennal ascoids lack proximal spurs and the scutum is darker than the pleura. Evidently, they did not examine the holotype of *L. oliverioi* to examine the latter two character states. The presence of ascoid spurs was not mentioned in the original description; but if they are present, then *L. oliverioi* is probably conspecific with *L. brasiliensis* or another *aragaoi* group species.

Young et al. (1985) reported *L. brasiliensis* (1 ♂) from Tambopata Reserve, Madre de Dios, Peru, but this is a probable misidentification. The Peruvian male has relatively short genital filaments (4X pump length). More specimens are needed to draw firm conclusions regarding its identity.

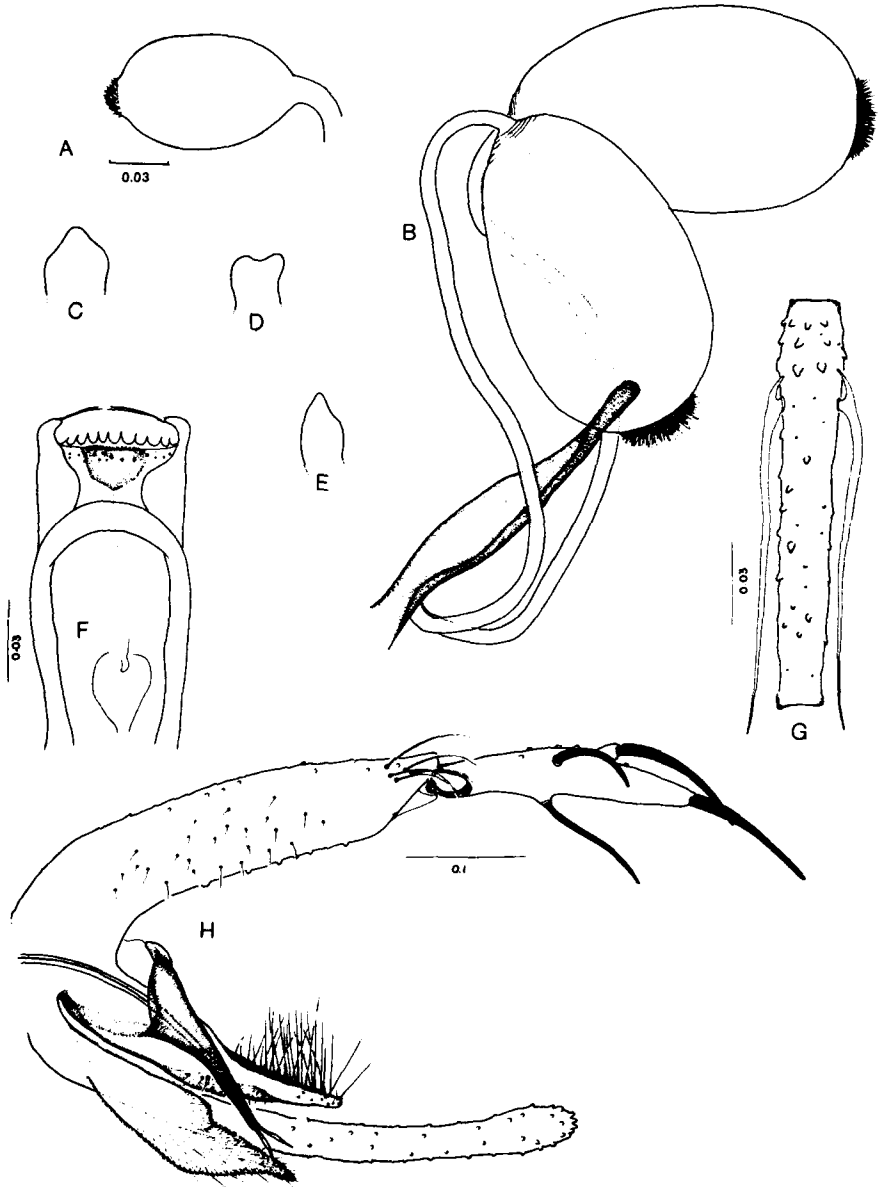


FIG. 152. ***Lutzomyia barrettoi majuscula.*** A. Spermatheca. ***Lutzomyia barrettoi barrettoi.*** B. Spermathecae; C., D., E. Tips of genital fork stems; F. Female cibarium; G. Female flagellomere II; H. Male terminalia (from Young 1979).

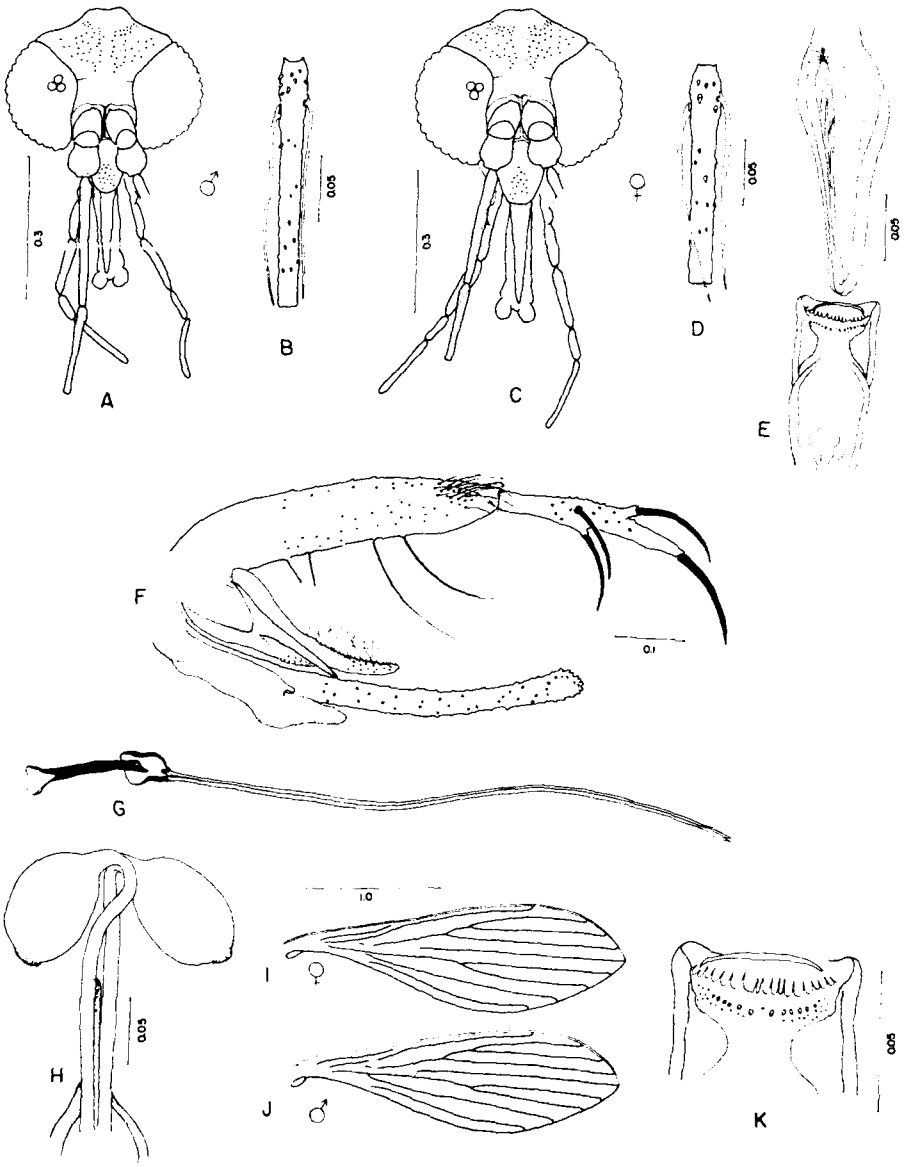


FIG. 153. ***Lutzomyia barrettoi majuscula***. A. Male head; B. Male flagellomere I. C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

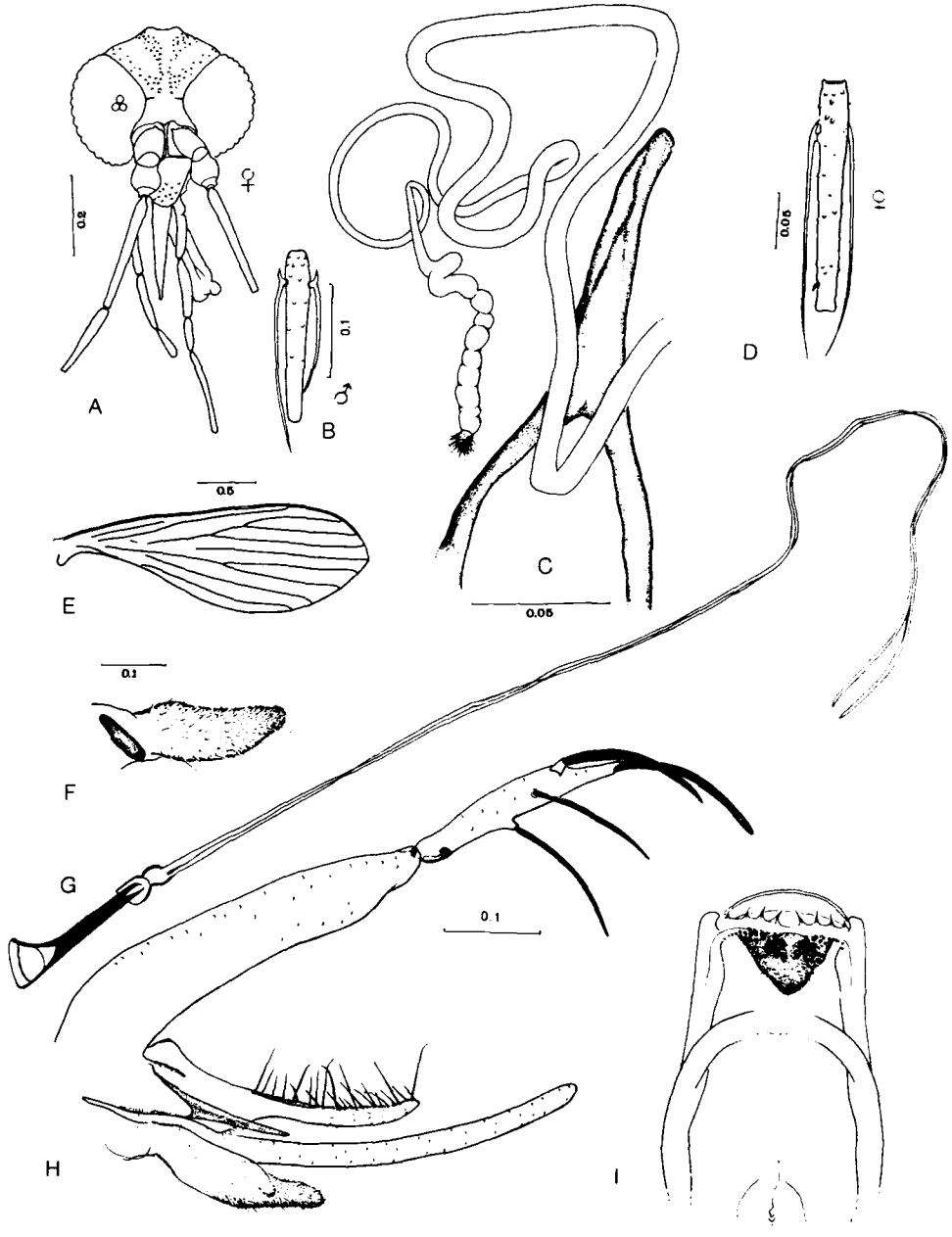


FIG. 154. ***Lutzomyia abunaensis***. A. Female head; B. Male flagellomere II; C. Spermathecae; D. Female flagellomere II; E. Female wing; F. Female cercus; G. Genital pump & filaments; H. Male terminalia; I. Female cibarium (Figs. A, C-F & I from Young & Rogers 1984).

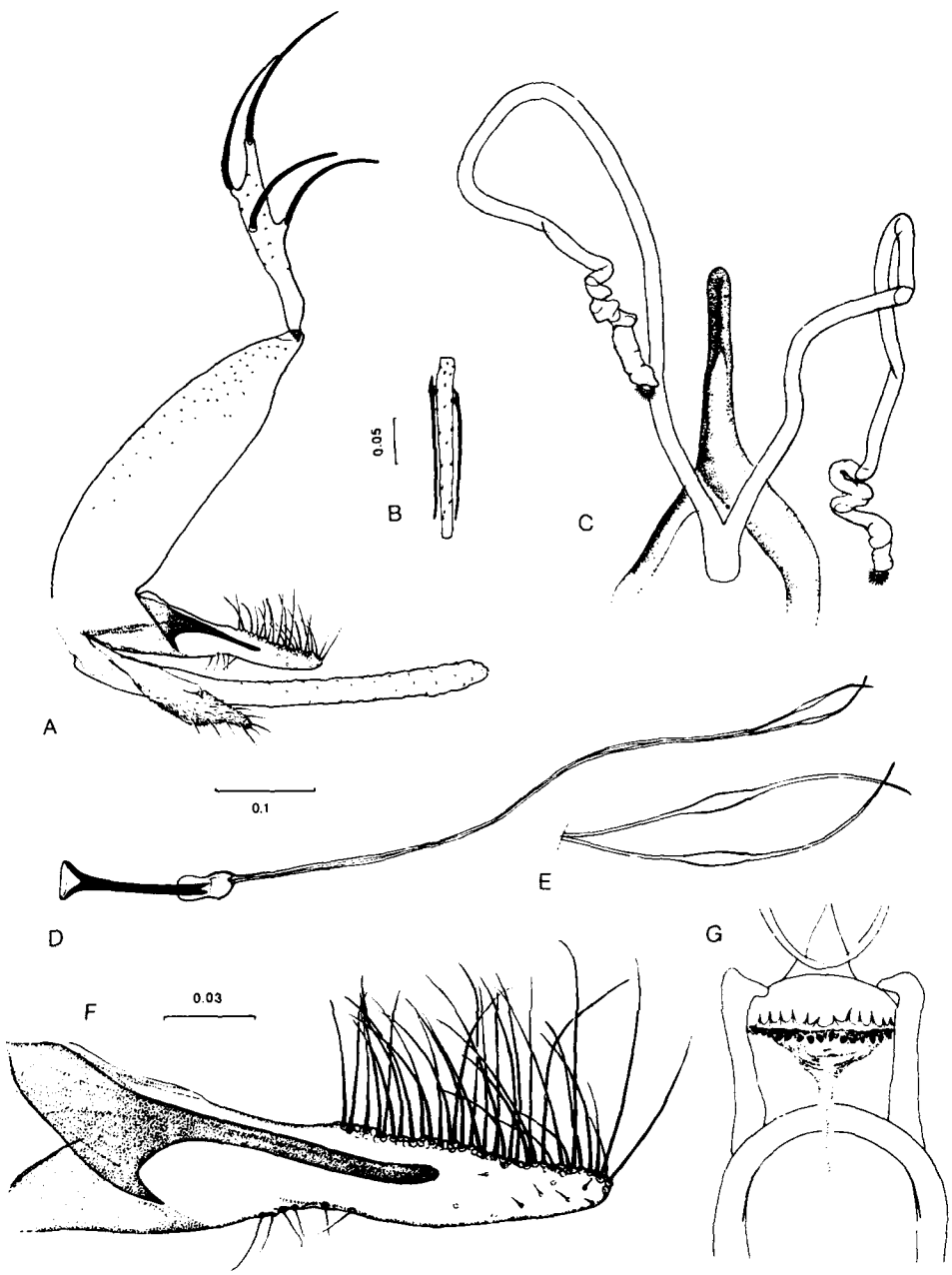


FIG. 155. ***Lutzomyia inflata.*** A. Male terminalia; B. Male flagellomere II; C. Spermathecae; D. Genital pump & filaments; E. Tips of genital filaments; F. Paramere; G. Female cibarium.

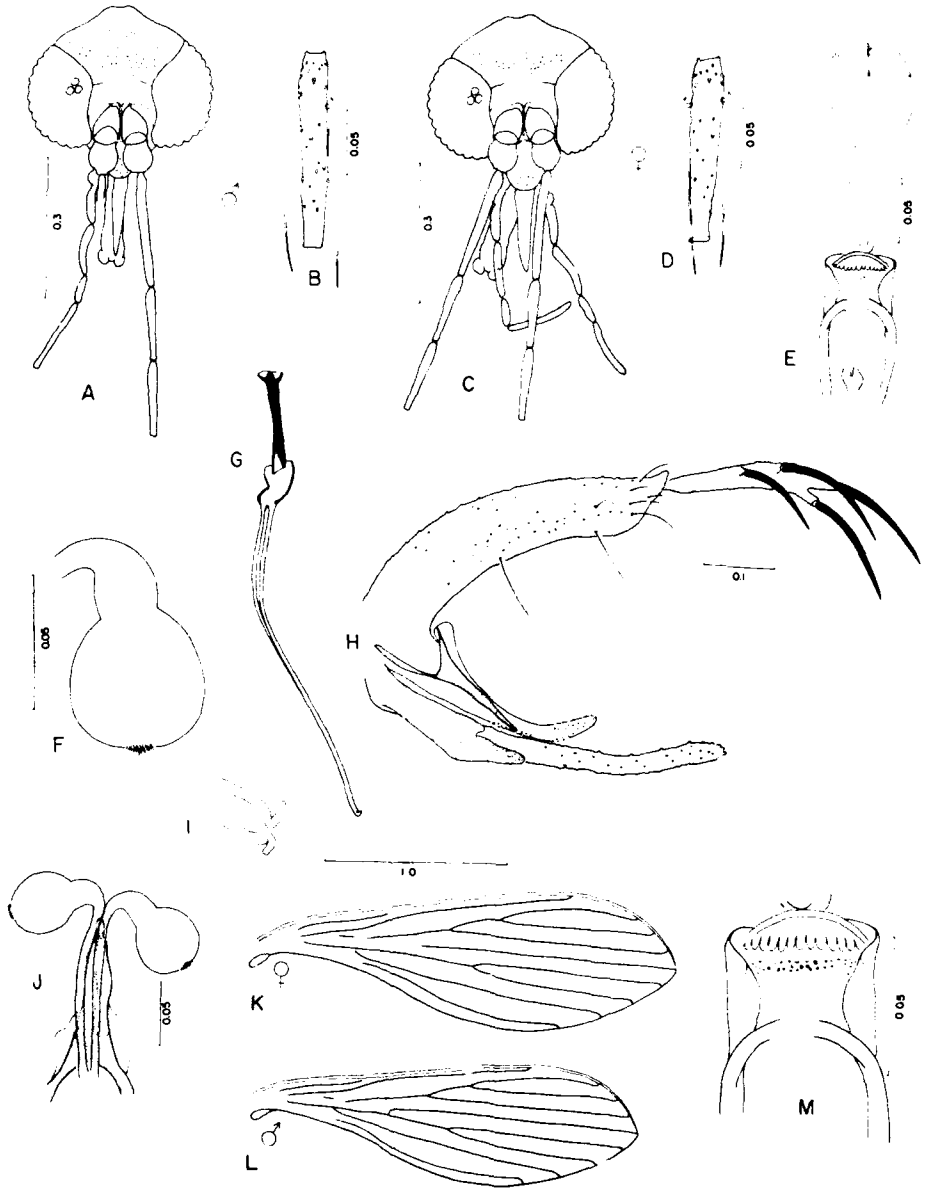


FIG. 156. ***Lutzomyia carpenteri.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Body of spermathecae; G. Genital pump & filaments; H. Male terminalia; I. Tips of genital filaments; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium (from Young 1979).

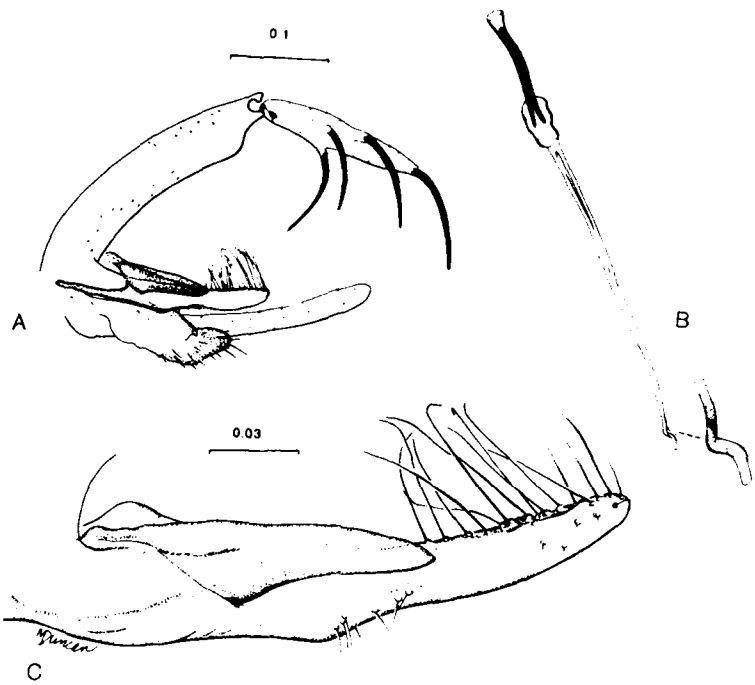


FIG. 157. ***Lutzomyia coutinhoi***. A. Male terminalia; B. Genital pump & filaments; C. Paramere & aedeagus, enlarged.

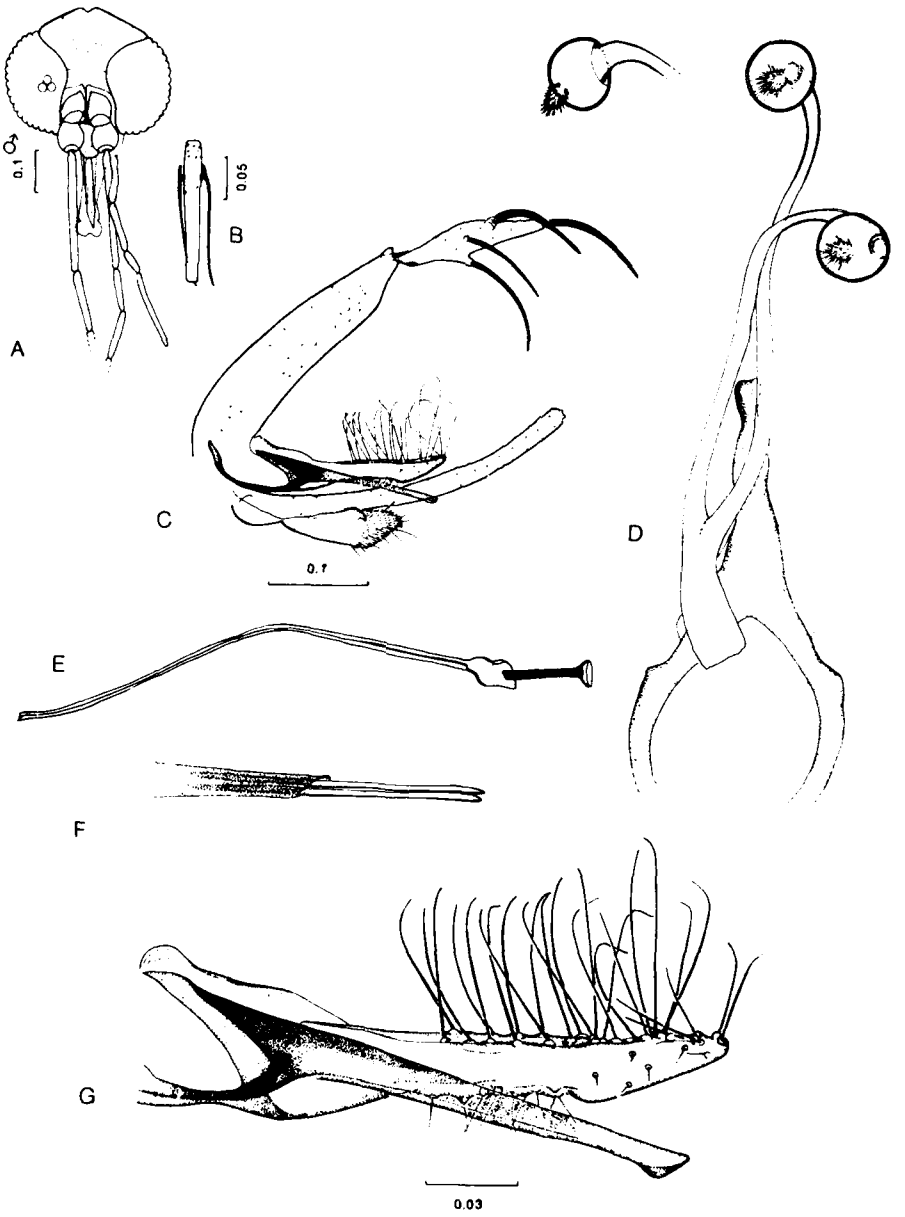


FIG. 158. ***Lutzomyia pascalei***. A. Male head; B. Male flagellomere II; C. Male terminalia; D. Spermathecae; E. Genital pump & filaments; F. Tips of genital filaments; G. Paramere.

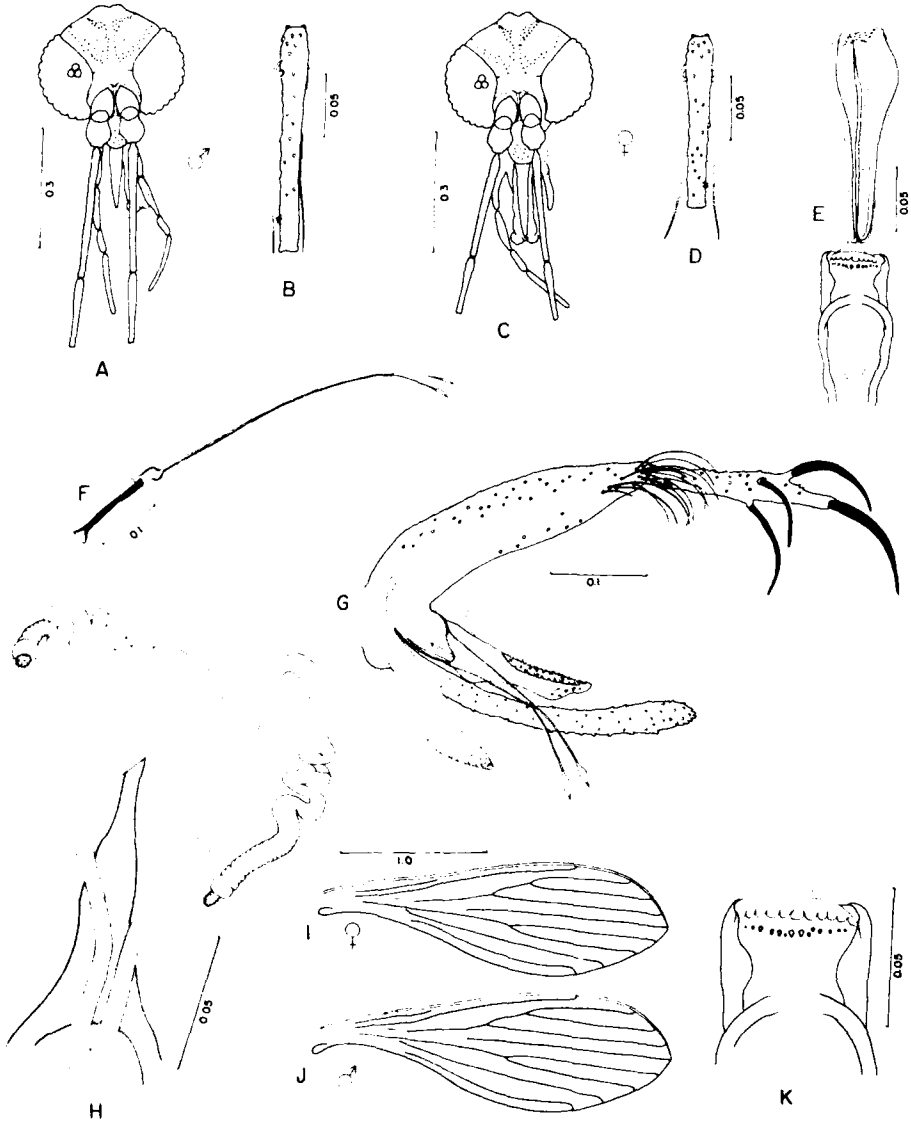


FIG. 159. ***Lutzomyia runoides.*** A. Male head; B. Male flagellomere II; Female head; D. Female flagellomere; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

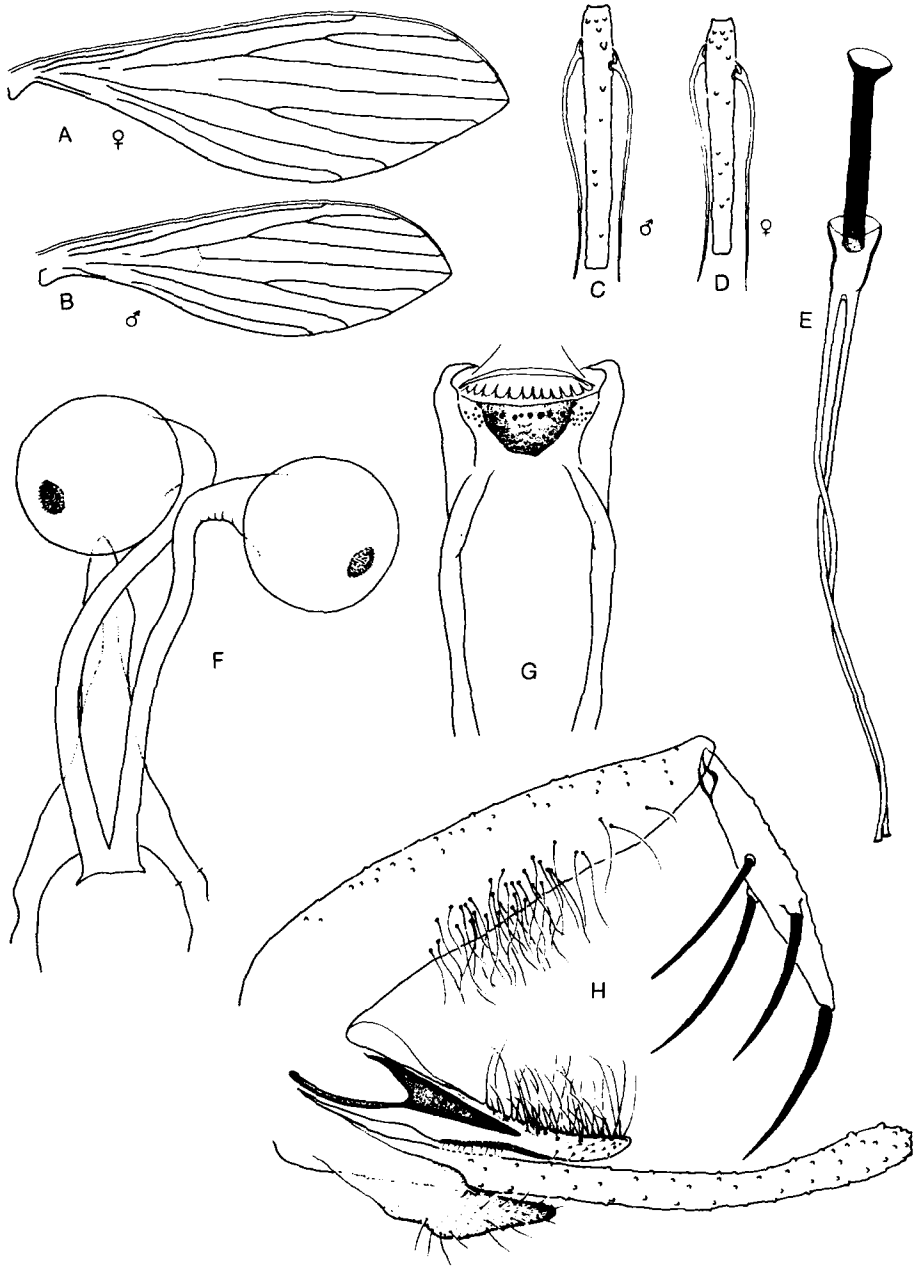


FIG. 160. ***Lutzomyia texana.*** A. Female wing; B. Male wing; C. Male flagellomere II; D. Female flagellomere II; E. Genital pump & filaments; F. Spermathecae; G. Female cibarium; H. Male terminalia (from Young & Perkins 1984).

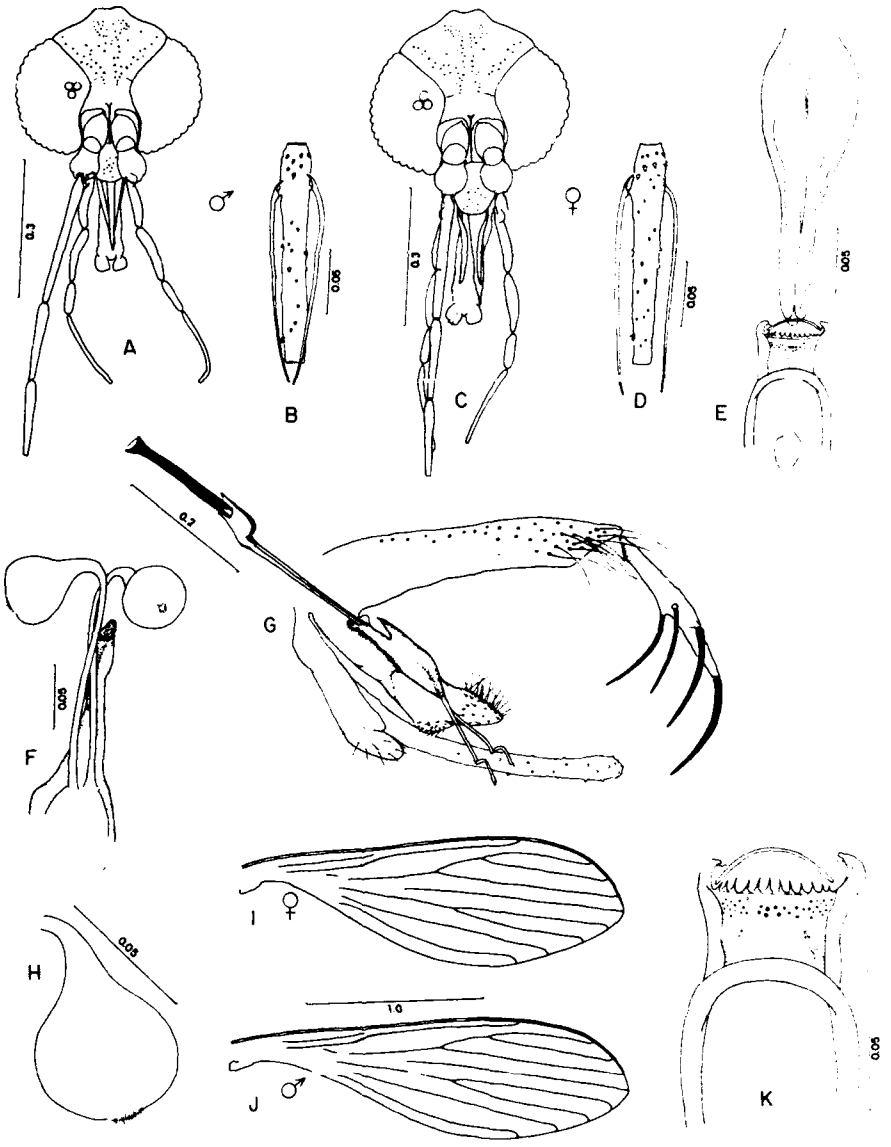


FIG. 161. ***Lutzomyia aragaoi.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Spermathecae; G. Male terminalia; H. Spermatheca; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

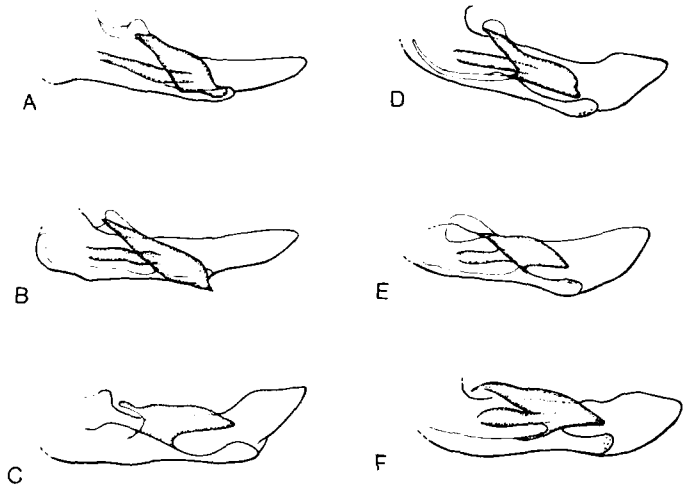


FIG. 162. ***Lutzomyia aragaoi.*** Male parameres. A. Acá Poi, San Pedro, Paraguay; B. Cruces Trail, Canal Zone, Panama; C. Rio Curiche, Choco, Colombia; D. Trinidad; E. Manaus, Amazonas, Brazil; F. Tres Esquinas, Caqueta, Colombia.

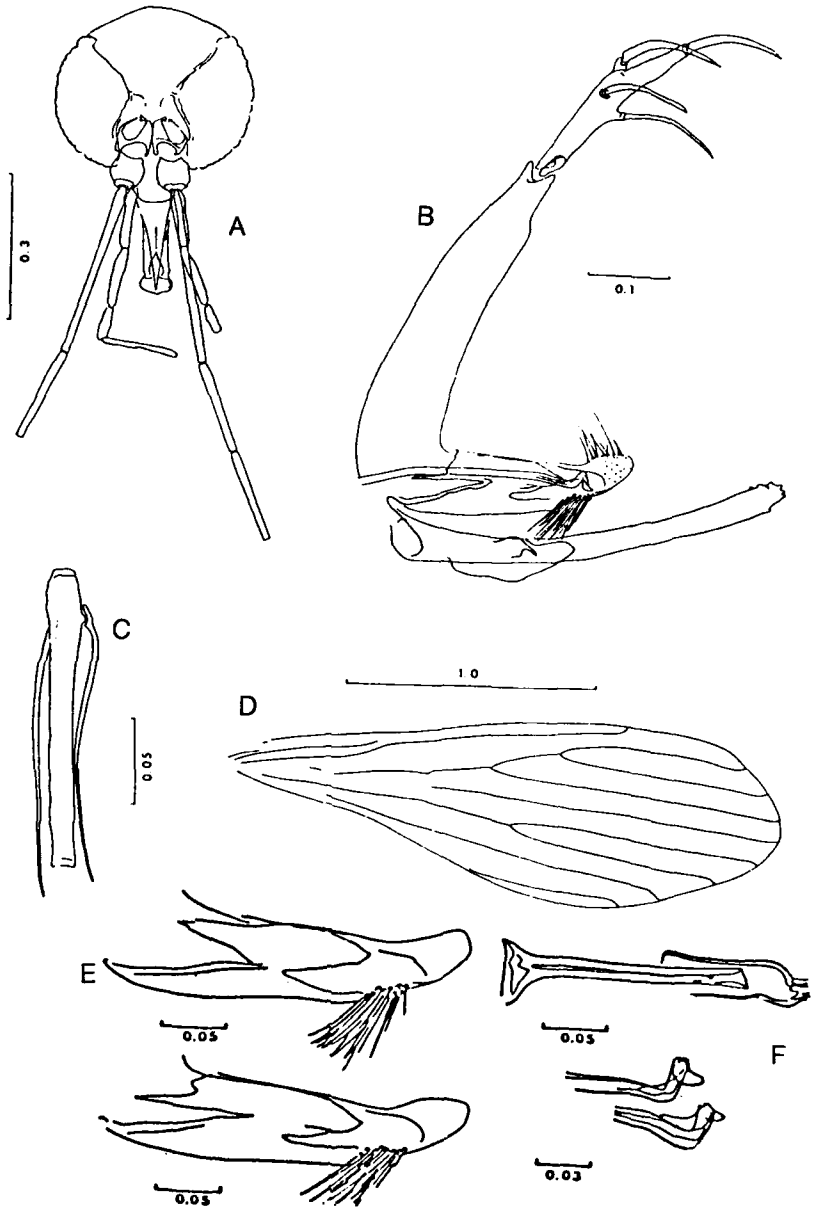


FIG. 163. ***Lutzomyia antezanai.*** A. Male head; B. Male terminalia; C. Male flagellomere; D. Male wing; E. Parameres; F. Genital pump & filaments (figs. from Le Pont et al. 1990).

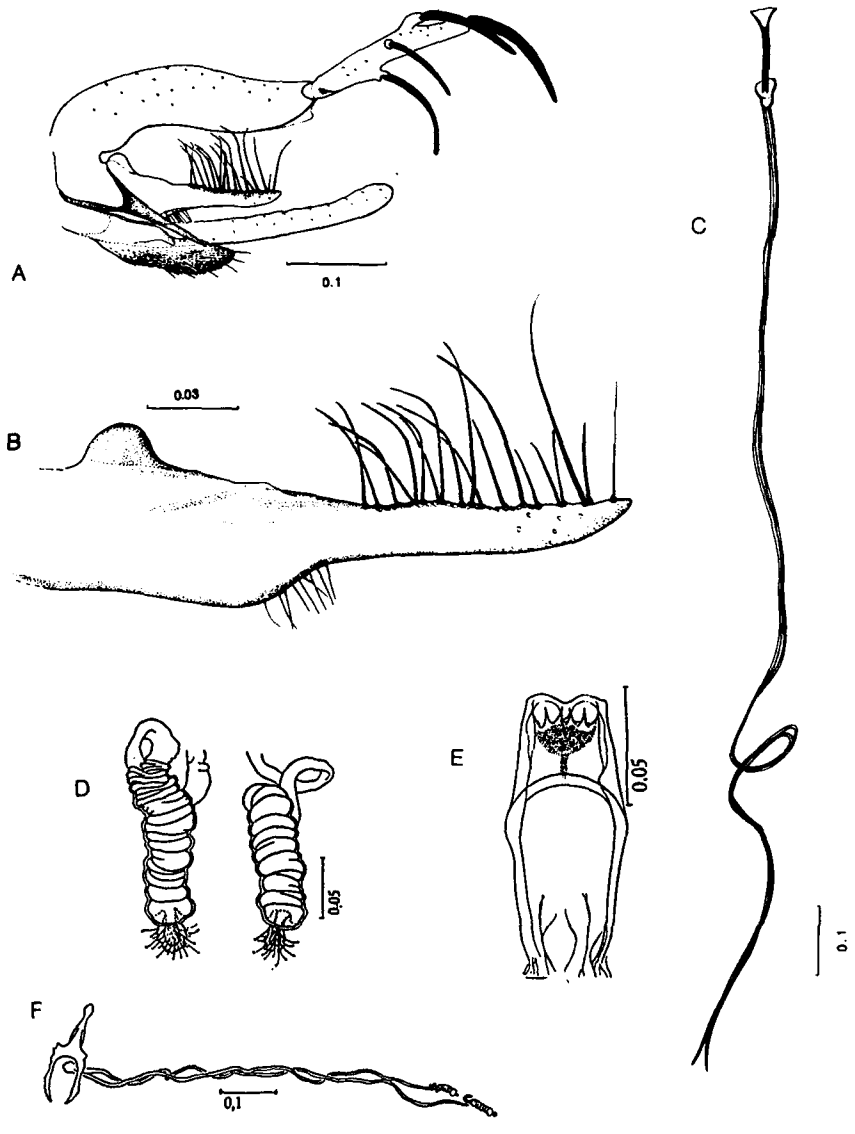
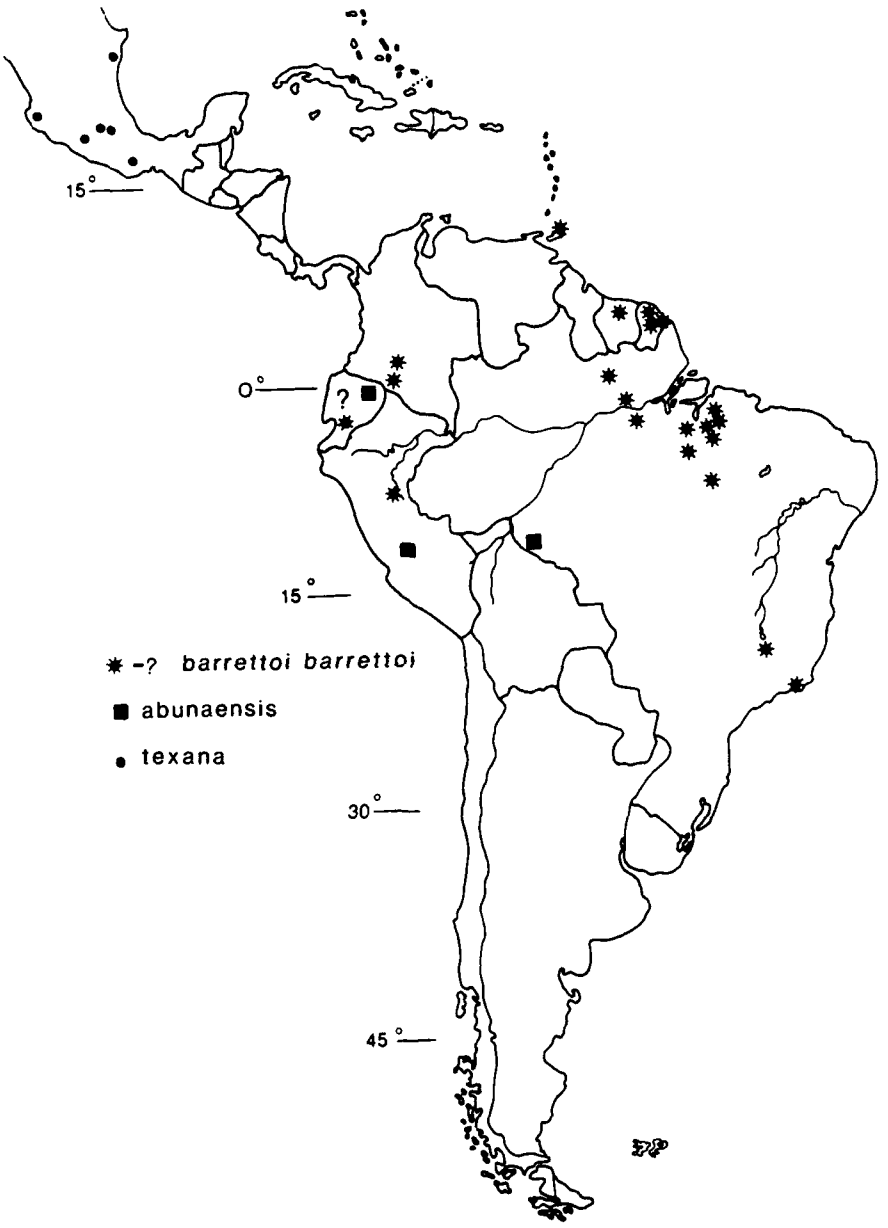
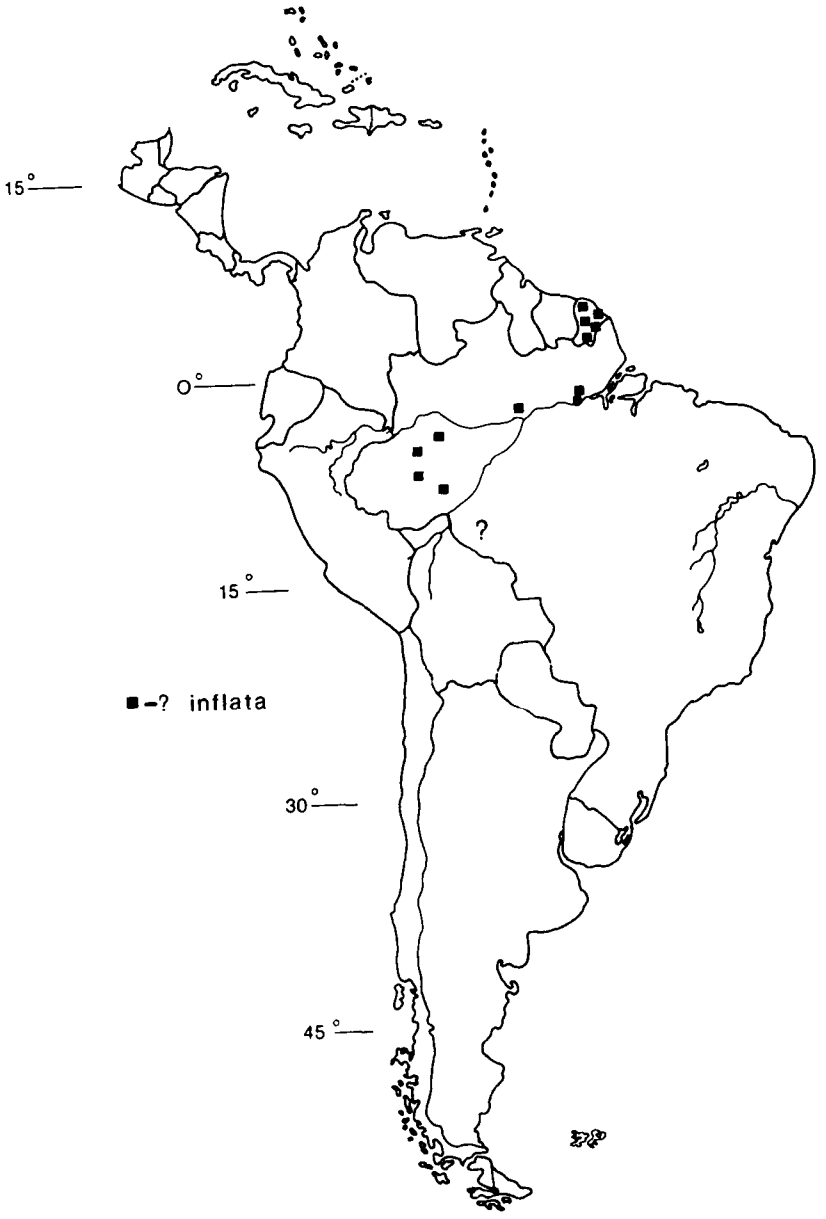


FIG. 164. ***Lutzomyia brasiliensis***. A. Male terminalia; B. Paramere; C. Genital pump & filaments; D. Spermathecae; E. Female cibarium; F. Spermathecae showing individual ducts (♀ figs. after Mangabeira & Sherlock 1962).

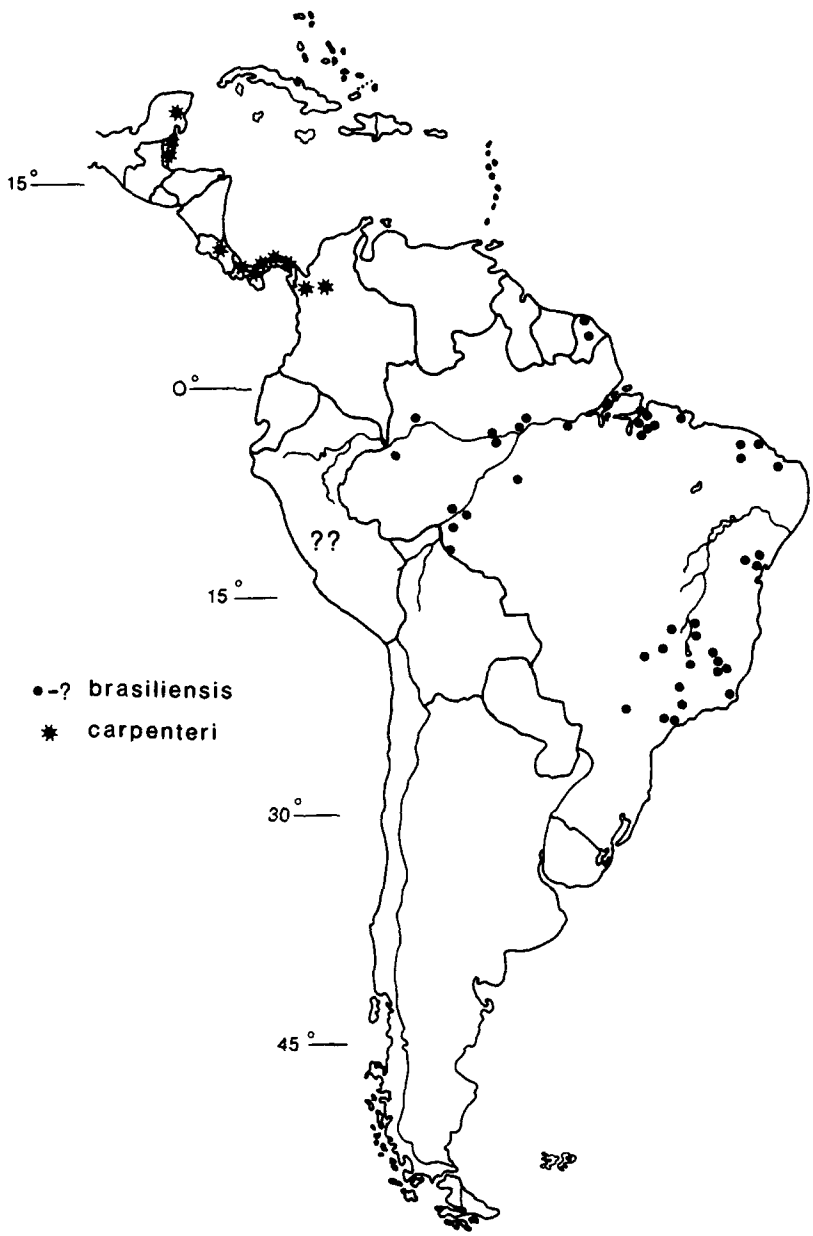


Map 78

Map 79

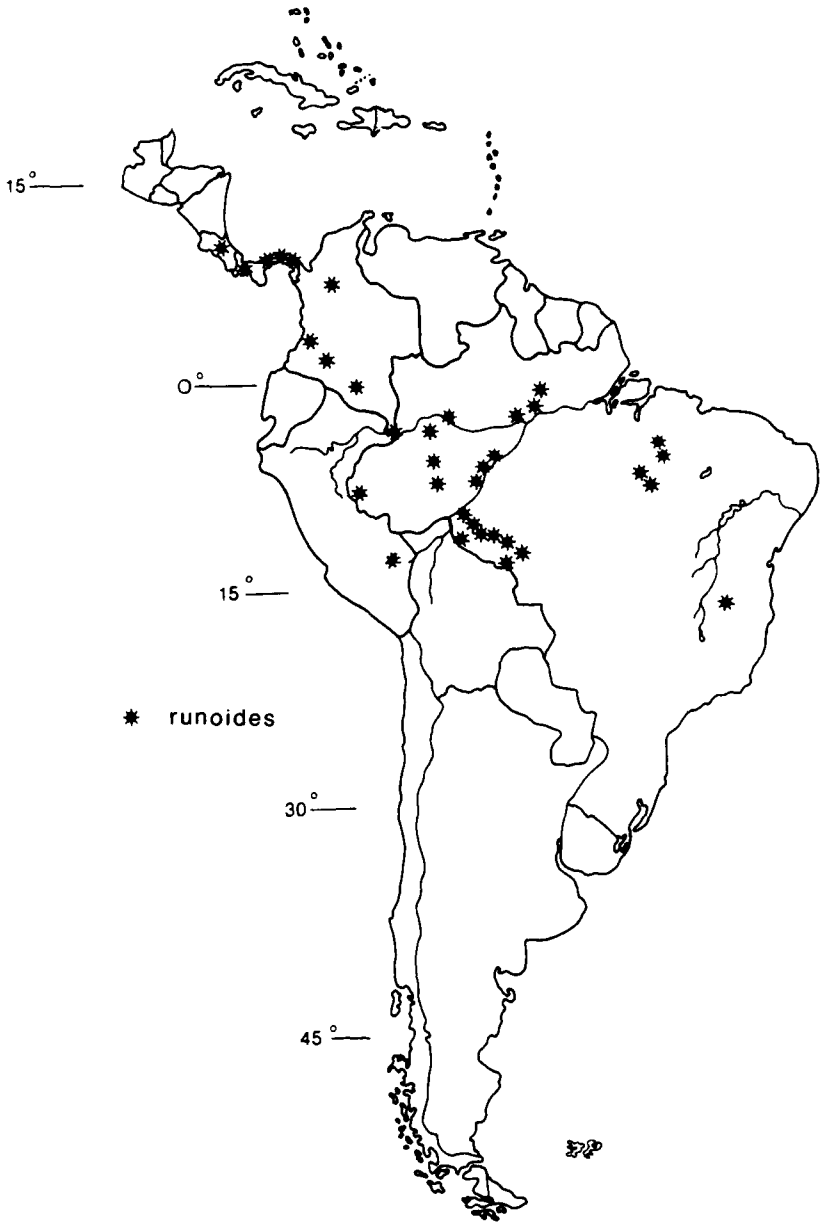


Map 80

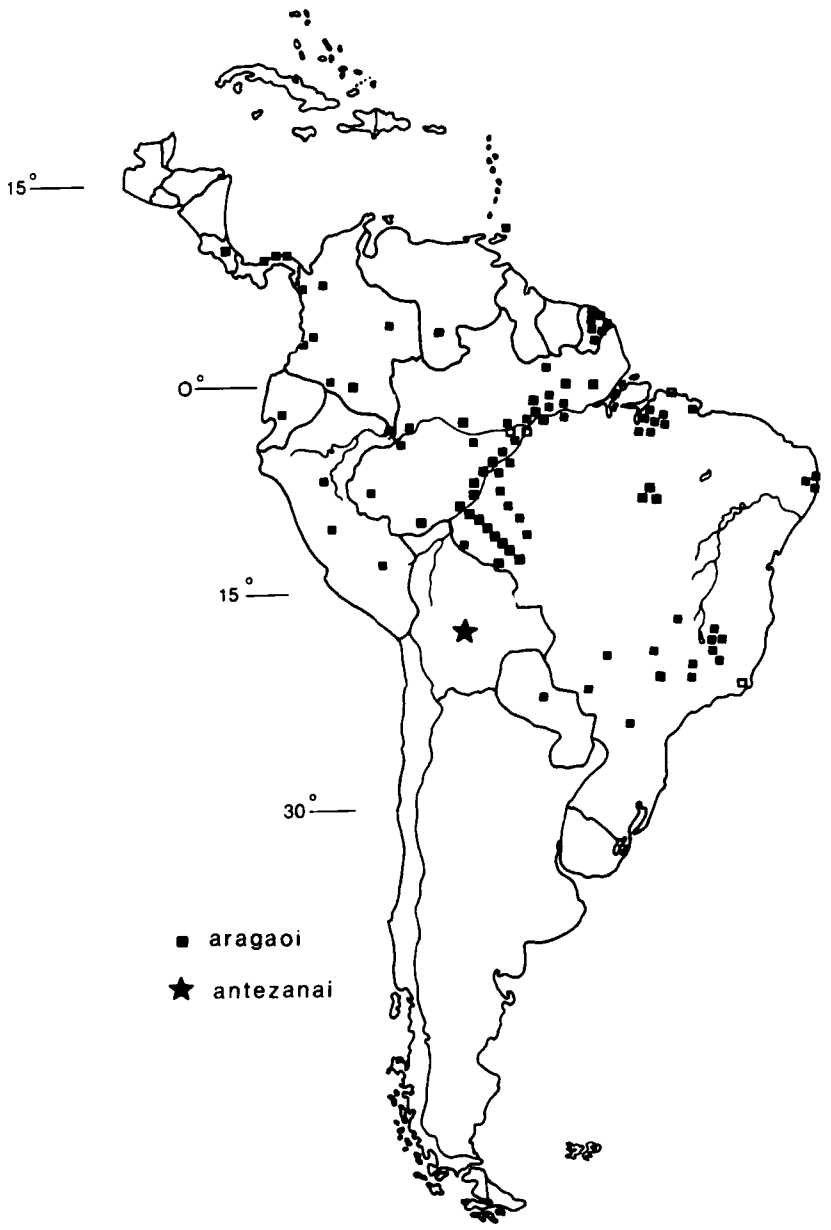


Map 81

Map 82



Map 83



Map 84

SPECIES GROUP *LANEI*

Lutzomyia species group *lanei* Theodor 1965: 184. Lewis et al. 1977: 325. Martins et al. 1978: 147 (defined).
Lutzomyia, subgenus *Trichopygomyia* (in part): Forattini 1971a: 101; 1973: 292.
Psathyromyia, subgenus *Psathyromyia*: Artemiev 1991: 73 (in part).

Identification. Coloration dusky, moderately pigmented. Antennal ascoids with short proximal spurs. Palpomere 5 relatively short, less than palp. 3 + 4. ♀ cibarium with 4 horizontal teeth, 1 or 2 rows of vertical teeth; complete arch & conspicuous pigment patch. Pharynx unarmed. Spermathecae annulated; individual ducts longer than common duct. ♂ *genitalia.* Coxite lacking persistent setae, strongly arched. Style with 4 spines; no subterminal seta. Paramere arched dorsally. Genital filament tips bluntly rounded & slightly sinuous.

The 3 species in this group closely resemble some of those in the subgenus *Psathyromyia*. The strongly arched coxite is typical of the *lanei* group males but this may prove to be of little importance when other character states are considered.

Medical Importance. Unknown; the females have not been reported feeding on man.

Key to the Males of the Species Group *Lanei*

1. Paramere ending in a finger-like lobe 2
   Paramere otherwise . . . . . *L. pelloni* (Fig. 165)

2. Paramere gently tapering towards apex; relatively slender with longitudinal row of setae above ventral margin with recurved, swollen tips . . . . . *L. lanei* (Fig. 166A)
   Paramere taping abruptly before apex; relatively broad with <10 such setae . . . . . *L. digitata* (Fig. 166D)

Lutzomyia pelloni (Sherlock & Alencar)
Fig. 165

Phlebotomus pelloni Sherlock & Alencar 1959: 119 (♂, Poçoes, Bahia, Brazil).
Lutzomyia pelloni: Theodor 1965: 185 (listed). Forattini 1971a: 102 (listed); 1973: 314 (♂ figs., tax.) Martins et al. 1978: 148 (refs., dist.). Vexenat et al. 1986b: 296 (Bahia, Brazil).

Distribution (Map 85). BRAZIL (Martins et al. 1978; Vexenat et al. 1986b).

Remarks. We identified sand flies collected in a light trap at Três Braços, Bahia, Brazil, 15 Jan. 1986 (A.L. Hoch). Included in the catch were 3 males of *L. pelloni* and 1 female which we associated on the basis of structure and coloration. The female of *L. lanei* appears to be indistinguishable from *L. pelloni* but males of the former species have not been taken at Três Braços. The female of *L. pelloni* has not been described previously.

♀ (n = 1, measurements in mm). Wing length 1.86; width 0.54. Whole insect moderately pigmented but scutum darker than pleura. Head height 0.35; width 0.32. Eyes separated by 0.10 or by distance = to 5.7 facet diameters. Flagellomere I, 0.30 long; II+III = 0.26; ascoids with short posterior spurs; those on II extending beyond end of segment; on all flags. except last 2 (XIII-XIV). Labrum 0.25 long. Length of palpomeres: 1, 0.04; 2, 0.12; 3, 0.12; 4, 0.06; 5, 0.18; palpal sensilla (ca. 12) loosely arranged at & beyond middle of 3. Cibarium with 4 sharp, equidistant horizontal teeth; ca. 14 subequal vertical teeth in an irregular row. Pigment patch subtriangular, moderately pigmented; arch complete. Pharynx 0.15 long, unarmed. Pleura with 6-7 upper & 1-2 lower episternal setae. Length of wing vein sections: α, 0.40; ß, 0.23; δ, 0.10; γ, 0.16. Length of femur, tibia & basitarsus of hindleg (other legs missing); 0.71, 1.40, 0.95. Spermathecae as shown, with 12+ annulations; individual sperm duct ca. 4.5X longer than common duct.

Lutzomyia lanei (Barretto & Coutinho)
Fig. 166 A & B

Phlebotomus lanei Barretto & Coutinho 1941c: 184 (♂, Casa Grande, São Paulo, Brazil). Coutinho & Barretto 1941b: 76 (♀).

Lutzomyia lanei: Theodor 1965: 185 (figs.). Forattini 1971a: 102 (listed); 1973: 306 (figs., tax.). Martins et al. 1978: 147 (refs, dist.). Aguiar et al. 1985c: 467 (seasonal dist., Brazil).

Distribution (Map 86). BRAZIL (Martins et al. 1978); PARAGUAY (8 ♂♂, Sommerfield, Yhú, tree holes & Shannon trap, 1950, M. Hertig; 1 ♂, 1 ♀, Acá-Poi, San Pedro, same data).

Remarks. This species has not been reported previously in Paraguay. The immature stages were described and illustrated by Barretto (1941).

Lutzomyia digitata (Damasceno & Arouck)
Fig. 166 C & D

Flebotomus digitatum Damasceno & Arouck 1950: 465 (♂, Banco Central, Ilhéus, Bahia, Brazil).

Lutzomyia digitatum: Theodor 1965: 185 (listed).

Lutzomyia digitata: Forattini 1971a: 102 (listed); 1973: 306 (♂ fig., tax.). Martins et al. 1978: 147 (refs., dist.).

Distribution (Map 86). BRAZIL (Martins et al. 1978).

Remarks. *Lutzomyia digitata* is a little-known species from Bahia State, Brazil. The female is undescribed.

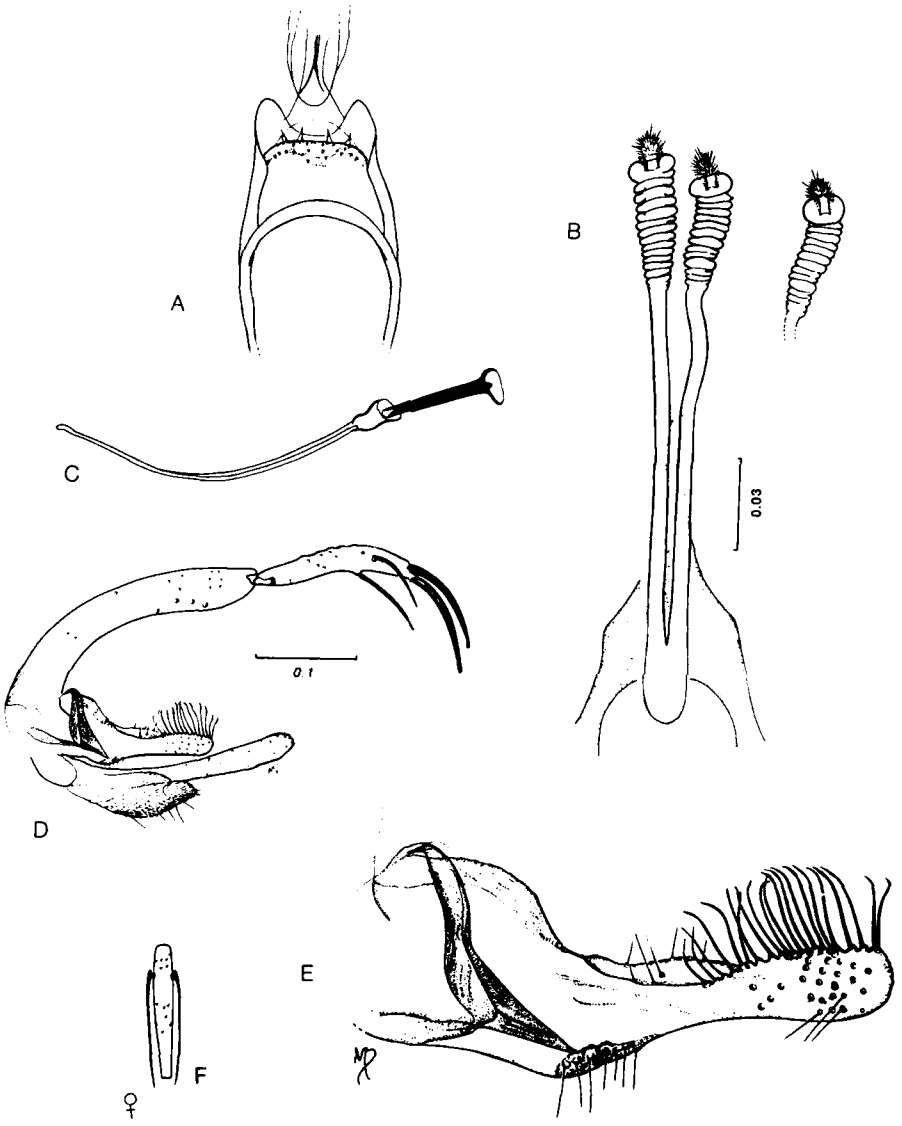


FIG. 165. ***Lutzomyia pelloni.*** A. Female cibarium; B. Spermathecae; C. Genital pump & filaments; D. Male terminalia; E. Paramere; F. Flagellomere II showing base of ascoid.

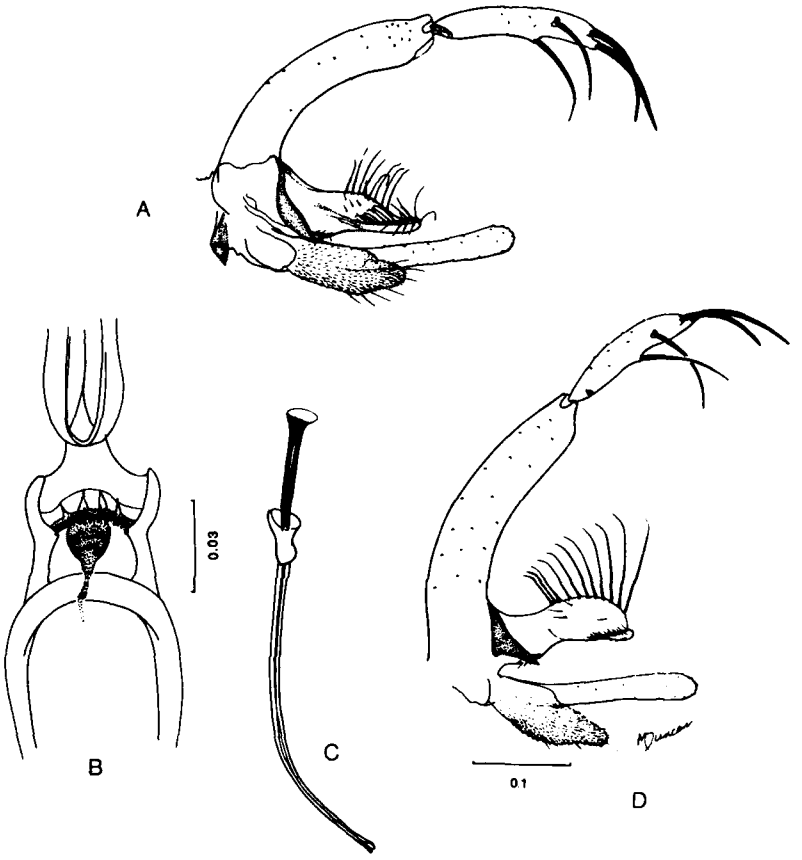
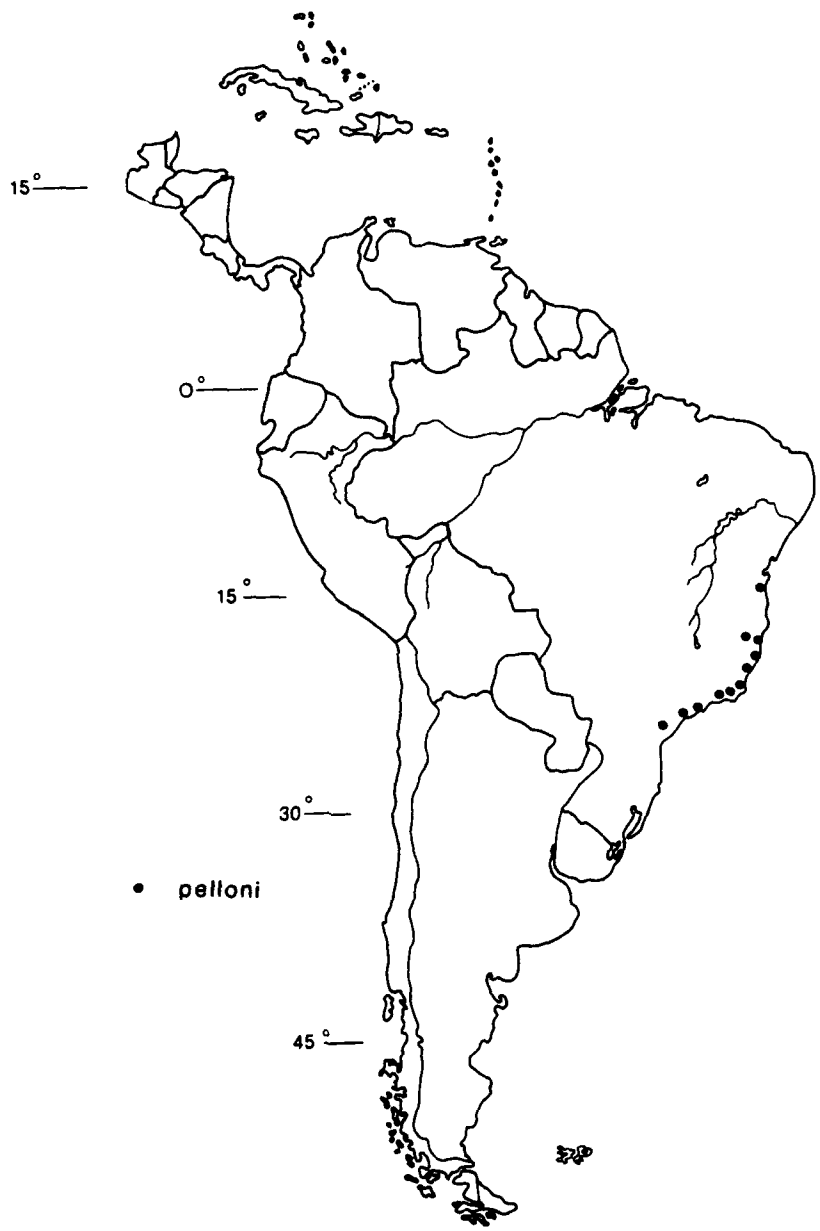
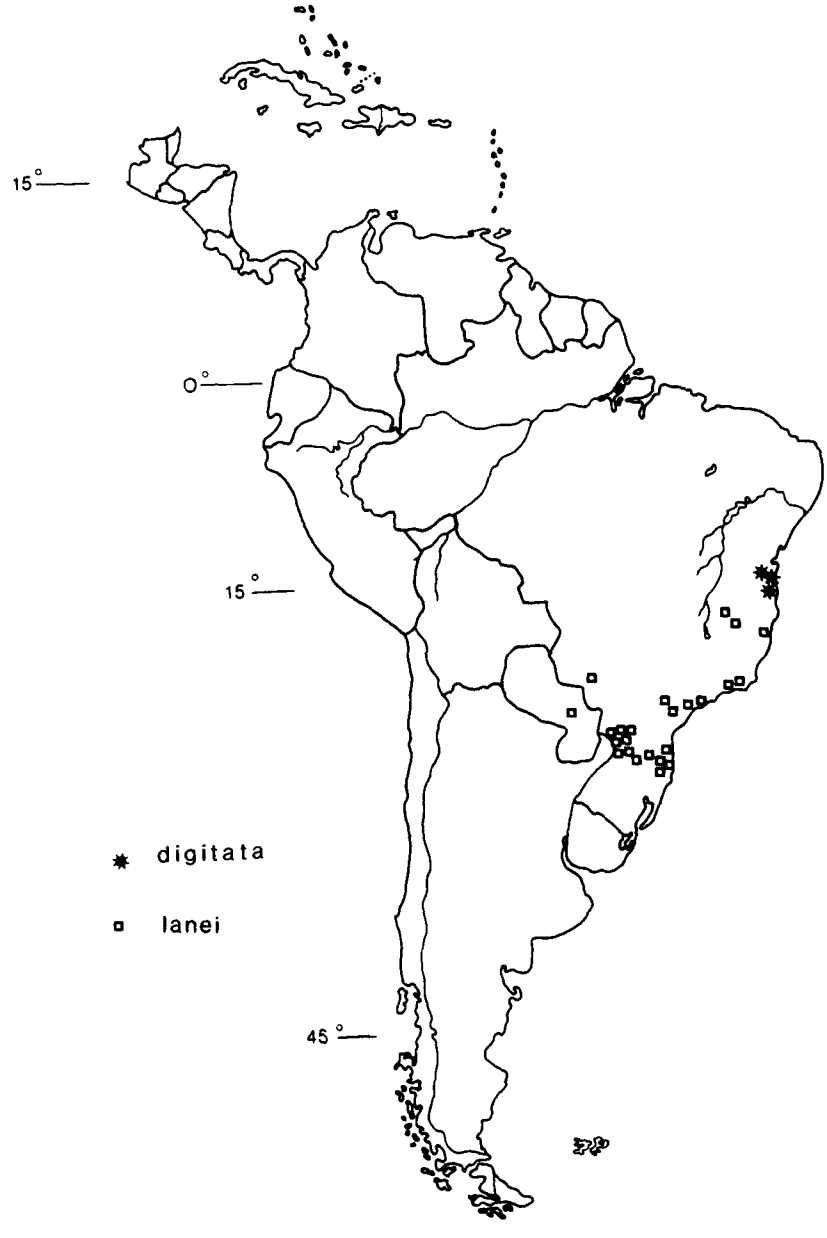


FIG. 166. ***Lutzomyia lanei.*** A. Male terminalia; B. Female cibarium.
Lutzomyia digitata. C. Genital pump & filaments; D. Male terminalia.



Map 85



Map 86

SPECIES GROUP *DREISBACHI*

Lutzomyia species group *dreisbachi*: Lewis et al. 1977: 325. Martins et al. 1978: 152.

Lutzomyia, subgenus *Xiphomyia* Artemiev 1991: 73 [type species: *Psathyromyia aclydifera* (Fairchild & Hertig) by orig. designation], *not Xiphomyia* Alexander, 1916, p. 125. **(NEW HOMONYMY)**

Identification. Coloration dusky. Antennal ascoids with long proximal spurs. Palpomere 5 shorter than palps. 3 + 4. ♀ cibarium with 10 or more horizontal teeth; a complete arch; broad pigment patch with numerous vertical teeth. Pharynx unarmed. Spermathecae strongly annulated, sometimes imbricated; terminal knob large, symmetrical or not; individual ducts relatively thin, longer than common duct. ♂ *genitalia.* Style with 4 large spines inserted at different levels, no subterminal seta. Coxite bearing 3-4 subapical recurved setae; other persistent setae sometimes present (*L. aclydifera*). Paramere variable, divided or not. Lateral lobe with 7-10 large dorsal setae at, or near, its distal end (e.g., Fig. 168).

As noted on p. 33, the name *Xiphomyia* was first used by Alexander (1916) who described *Xiphomyia gladiatrix*, a Panamanian muscoid fly. Therefore, it is a junior homonym as used by Artemiev (1991) for a subgenus of Phlebotominae.

The males in this species group resemble those in the *baityi* group in having long persistent setae near the end of each coxite but the antennal ascoids are simple in the *baityi* group. Their styles have a small subterminal seta and the parameres are quite different. The spermatheca of the *dreisbachi* group females are similar to those of *L. ignacaoi* and some species of *Psathyromyia* but these females have only 4 horizontal teeth in their cibaria.

Martins et al. (1978) tentatively included *L. omagua* in the *dreisbachi* group but the female, described in the present paper, definitely belongs in the subgenus *Trichophoromyia*. Two other species, *L. dasymera* and *L. campbelli*, are also placed with the *dreisbachi* species by Martins et al. (1978) but we provisionally retain them in the subgenus *Psathyromyia*.

Medical Importance. Unknown. Females are not anthropophilic.

Keys to Males of the Species Group *Dreisbachi*

1. Coxite with 2-3 modified setae near middle. Paramere with dorsal basal hump bearing numerous thin setae & with a slender leaf-like seta at apex . . . . . *L. aclydifera* (Fig. 167)

Coxite without persistent setae near middle. Paramere bifurcate or with relatively long dorsal arm, without modified seta at apex 2

2. Paramere with dorsal arm bearing setae 3
Paramere with blade-like dorsal arm without setae . . *L. ruparupa* (Fig. 169)

3. Paramere with very slender, arched dorsal arm; lower arm much wider with a dorsal subterminal hump bearing some recurved setae . . . . . *L. hermanlenti* (Fig. 168H&I)
Paramere with thicker dosal arm; lower arm more or less subequal in width throughout, without a dorsal subterminal hump or recurved setae . . . . . *L. dreisbachi* (Fig. 168F)

The *dreisbachi* group females are not keyed because they are structurally similar; however, the spermathecae of *L. dreisbachi* have an irregularly shaped terminal knob unlike those of *L. aclydifera* and *L. hermanlenti*. The female of *L. ruparupa*, not yet fully described, resembles other females in this group.

Lutzomyia aclydifera (Fairchild & Hertig)
Fig. 167

Phlebotomus aclydiferus Fairchild & Hertig 1952: 511 (♂, ♀, Panama Canal Zone).
Lutzomyia aclydifera: Theodor 1965: 193. Martins et al 1978: 153 (dist.). Young 1979: 137 (full refs.). Lewis & Macfarlane 1981: 170 (mite parasite). Christensen et al. 1983: 469 (coll. data, Panama). Zeledón & Murillo 1983: 280 (Nicaragua). Young and Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 125 (figs., Costa Rica). Le Pont & Desjeux 1986: 314 (Bolivia). Rowton et al. 1991: 501 (Guatemala). Alexander et al. 1992a: 36 (Ecuador records); 1992c: 124 (Ecuador).
Psychodopygus aclydiferus: Forattini 1971a: 105 (listed); 1973: 463 (figs., redescript.)

Distribution (Map 87). SOUTHERN MEXICO to ECUADOR (Young 1979; Alexander et al. 1992a,c); NICARAGUA (Zeledón & Murillo 1983); GUATEMALA (Rowton et al. 1991).

Remarks. This species is readily attracted to light (Young 1979) and is commonly found in mammal burrows in Panama (Christensen et al. 1983). Le Pont & Desjeux (1986) reported *L. aclydifera* from Bolivia in human bait collections but these specimens (2 ♀♀ probably represent females of *L. ruparupa*, the males of which have been found in the same area.

Lutzomyia dreisbachi (Causey & Damasceno)
Fig. 168 A-F

Flebotomus dreisbachi Causey & Damasceno 1945b: 645 (♂, Brazil, Amazonas, Municip. Coari). Barretto 1947a: 197.
Phlebotomus dreisbachi: Floch & Abonnenc 1952: 85 (figs., review).
Lutzomyia dreisbachi: Theodor 1965: 185. Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 154 (dist.). Young 1979: 139. Morales & Minter 1981: 96 (Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Young et al. 1985: 143 (Peru). Ryan 1986: 27 (figs.). Lehbe et al. 1987: 28 (computer aided ident.). Feliciangeli et al. 1988a: 13 (Amazonas, Venezuela).
Psychodopygus dreisbachi: Forattini 1971a: 1973: 463 (figs., redescript.).

Distribution (Map 87). COLOMBIA (Young 1979; Morales & Minter 1981); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); PERU (Young et al. 1986); FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. The habits of *L. dreisbachi* are little-known. Specimens have been collected in armadillo burrows in Brazil (Causey & Damasceno 1945b; Ryan 1986) and in light and flight traps. The asymmetrical terminal knob of the spermatheca (Fig. 168E) of a Peruvian female may not be as marked in females from other localities but it was observed also in two females from Manaus, Amazonas, Brazil.

Lutzomyia hermanlenti Martins, Silva & Falcão
Fig. 168 G-I

Lutzomyia hermanlenti Martins, Silva & Falcão 1970b: 547 (♂ ♀, Brazil, Minas Gerais, Municip. Arinos). Martins et al 1978: 155 (dist.).
Psychodopygus hermanlenti: Forattini 1973: 468.

Distribution (Map 87). BRAZIL (Martins et al. 1978).

Lutzomyia ruparupa Martins, Llanos & Silva
Fig. 169

Lutzomyia ruparupa Martins, Llanos & Silva 1976a: 491 (♂, Peru, Huanuco Dept., Cachicoto)

Distribution (Map 87). PERU (Martins et al. 1976a; Pérez et al. 1991); BOLIVIA (♂, La Paz Dept., Serrania de Marimonos, F. Le Pont).

Remarks. The *L. ruparupa* female will be fully described by E. Peréz in a forthcoming publication dealing with Peruvian phlebotomines. We illustrate the spermathecae and cibarium for comparative purposes.

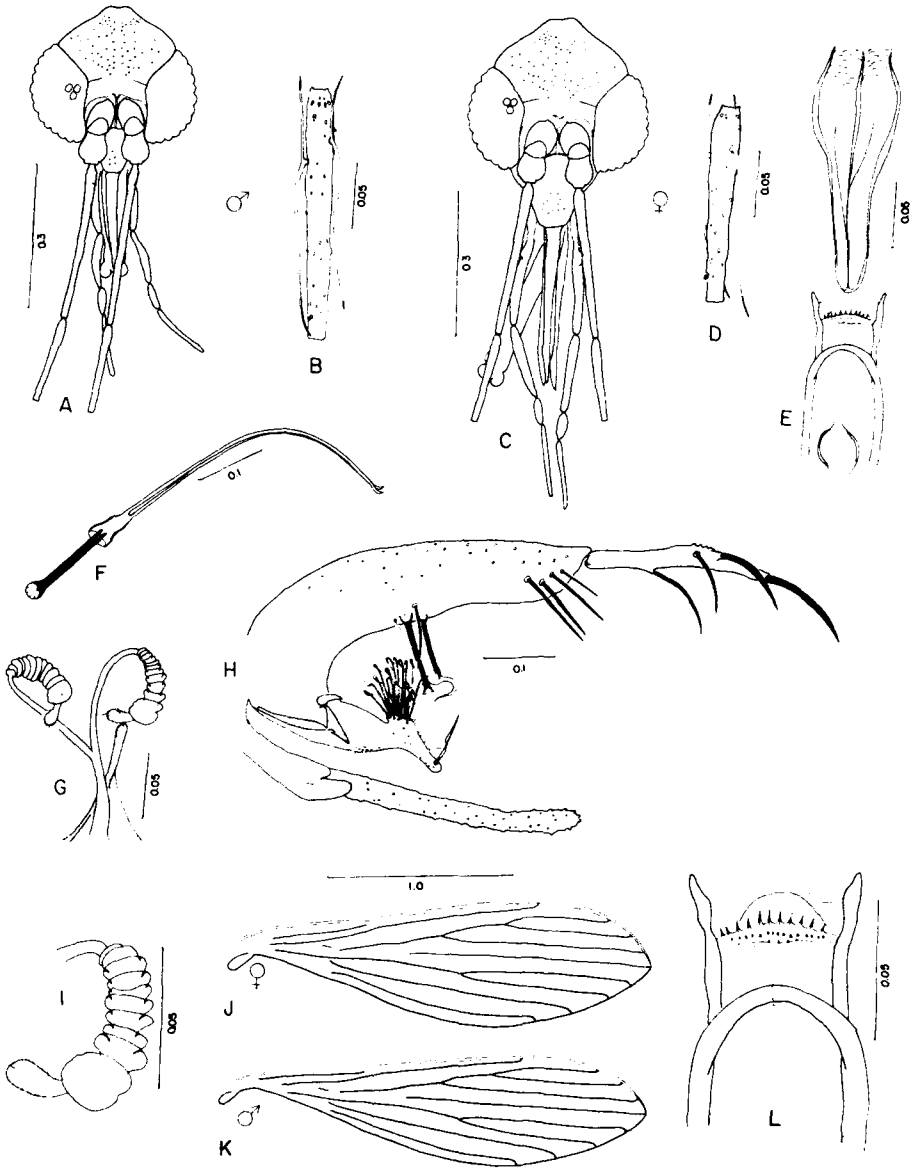


FIG. 167. ***Lutzomyia aclydifera.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filament; G. Spermathecae; H. Male terminalia; I. Body of spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

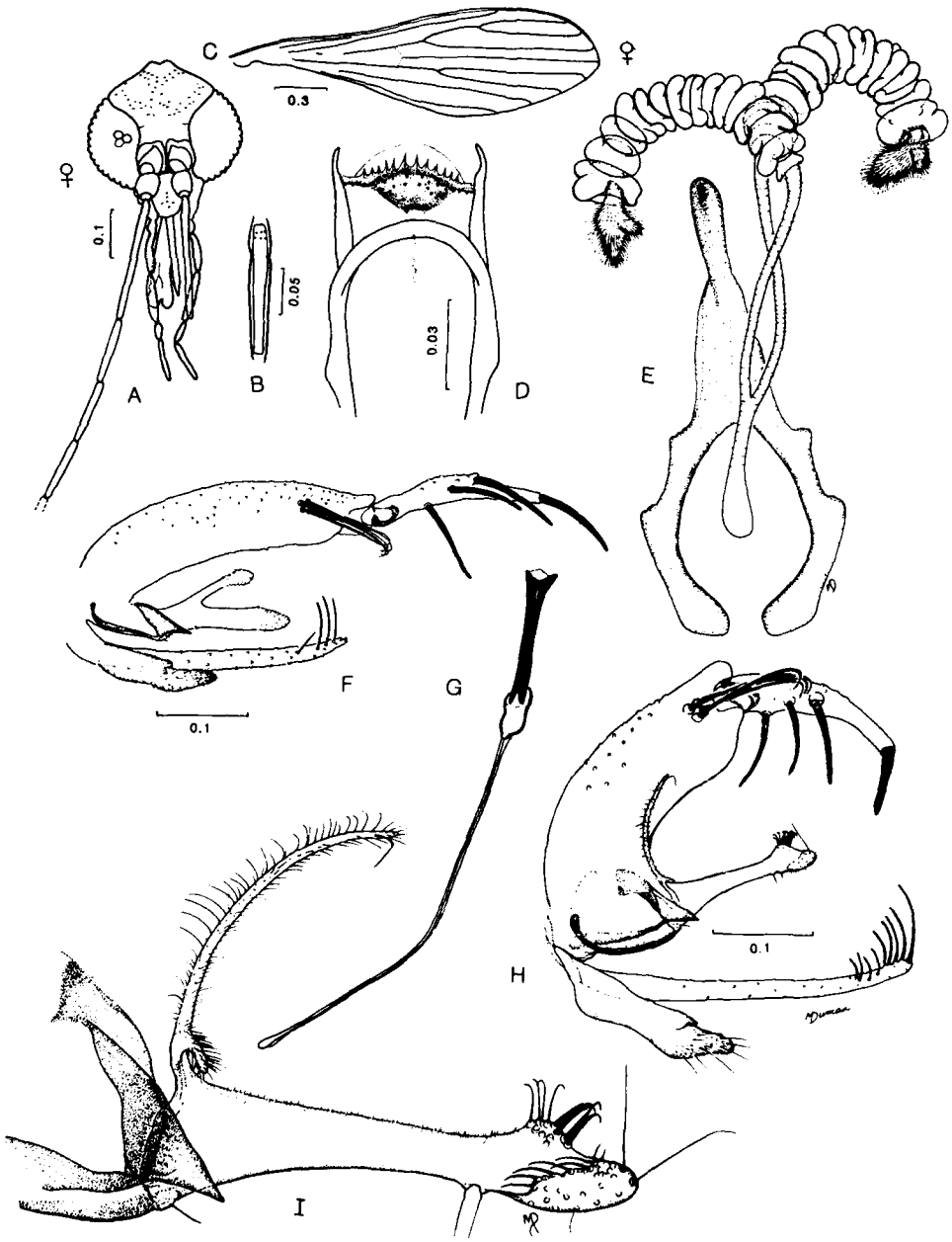


FIG. 168. ***Lutzomyia dreisbachi.*** A. Female head; B. Flagellomere II showing posterior spurs on ascoids; C. Female wing; D. Female cibarium; E. Spermathecae; F. Male terminalia (Fig. F from Young 1979). ***Lutzomyia hermanlenti.*** G. Genital pump & filaments; H. Male terminalia; I. Aedeagus & paramere, enlarged.

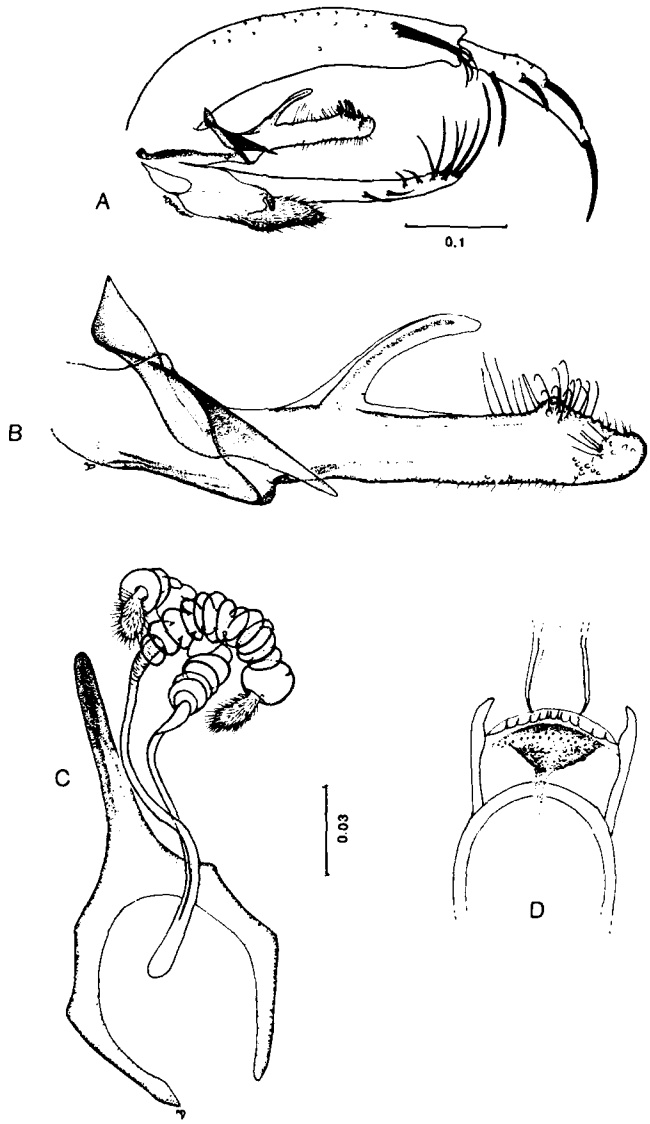
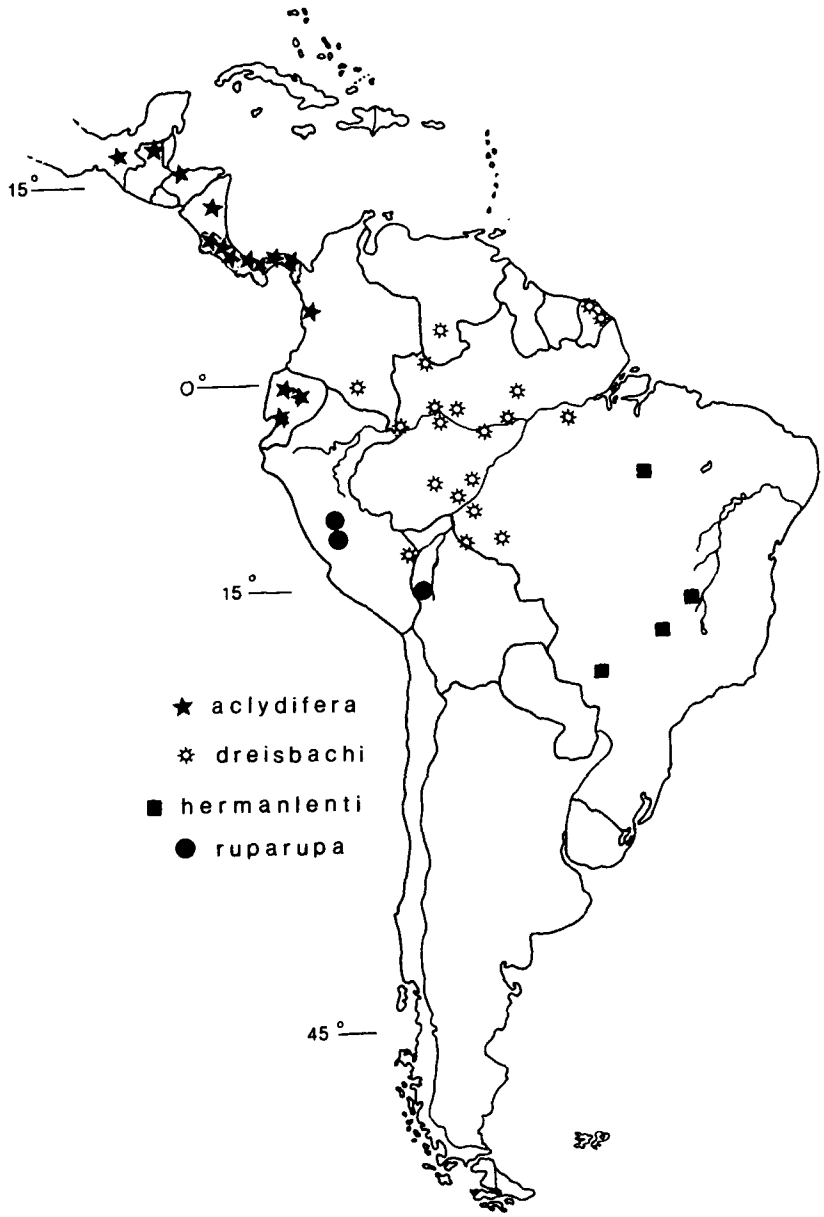


FIG. 169. ***Lutzomyia ruparupa.*** A. Male terminalia; B. Paramer & aedeagus; C. Spermathecae; D. Female cibarium.



Map 87

SUBGENUS *TRICHOPYGOMYIA* BARRETTO

Lutzomyia, subgenus *Trichopygomyia* Barretto 1962: 98 (type species: *Flebotomus longispinus* Mangabeira by orig. designation). Forattini 1971a: 102 (in part); 1973: 292. Martins et al. 1978: 112 (defined). Arias et al. 1983: 449 (defined, review, figs.). Artemiev 1991: 74.

Lutzomyia species group *longispina* Theodor 1965: 189. Lewis et al. 1977: 325 (listed).

Identification. Coloration dusky. Antennal ascoids simple, reaching to (or beyond) distal fourth of flagellomere II. Palpomere 5 longer than palps. 2 + 3. ♀ cibarium with 4 equidistant horizontal teeth, 1 or 2 rows of vertical teeth; arch complete or nearly complete; pigment patch subtriangular, conspicuous. Spermatheca subspherical or pear-shaped with fine transverse striations; individual ducts longer than common duct, smooth-walled or convuluted. ♂ *genitalia*. Coxite without setal tuft but with numerous long ventral setae. Style with 4 large spines inserted at different levels & subterminal seta. Paramere bifurcate or trifurcate.

Forattini (1971a, 1973) expands this subgenus by adding a number of species that we and others place in other subgenera and species groups. The females are difficult to identify with certainty but Arias et al. (1983) provide a key to some of the species. Feliciangeli (1989b) also discusses the included species.

Most *Lutzomyia* (*Trichopygomyia*) spp. are readily attracted to light and are also commonly found resting in armadillo burrows.

Medical Importance. Unknown; females are not anthropophilic.

Key to the Males of the Subgenus *Trichopygomyia*

1. Paramere trifurcate 2
   Paramere bifurcate 5

2. Paramere with arched dorsal arm bearing 10 or more foliaceous apical setae . . . . . *L. elegans* (Fig. 170)
   Paramere with dorsal arm bearing slender apical setae 3

3. Aedeagus very broad, nearly as wide as long; dorsal margin markedly humped. Paramere with dorsal arm directed anteriorly, not curved & with relatively short setae . . . . . *L. martinezi* (Fig. 171)
   Aedeagus much longer than wide. Paramere with arched dorsal arm directed posteriorly & bearing numerous long setae at apex 4

4. Paramere with median arm nearly as long as lower arm & bearing setae; dorsal arm with straight apical setae . . . . . *L. triramula* (Fig. 172)
   Paramere with median arm without setae & reduced to a cylindrical lobe, much shorter than lower arm . . . . . *L. gantieri* (Fig. 173)

5. Aedeagus modified with dorsal extension 6
   Aedeagus simple without dorsal extension 8

6. Paramere with long dorsal arm, reaching to or beyond end of lower arm. . . Aedeagus as shown . . . . . *L. conviti* (Fig. 174)
   Paramere with shorter dorsal arm ending well before end of lower arm. Aedeagus otherwise 7

7. Aedeagus with dorsal extension clubbed, its maximum width greater than that of paramere . . . . . *L. dasypodogeton* (Fig. 175)
   Aedeagus with unclubbed dorsal extension, its maximum width subequal to width of paramere beyond dorsal arm . . . . . *L. pinna* (Fig. 176)

8. Paramere with long & slender dorsal arm, its width less than 1/2 width of lower arm . . . . . *L. trichopyga* (Fig. 177)
   Paramere with broader dorsal arm, its width greater than 1/2 width of lower arm 9

9. Paramere wrench-shaped . . . . . *L. rondoniensis* (Fig. 178)
   Paramere otherwise 10

10. Paramere with ventral arm extending well beyond end of dorsal arm . . . . . *L. witoto* (Fig. 179)
    Paramere otherwise, its ventral arm ending before, at, or but slightly beyond dorsal arm 11

11. Paramere with dorsal arm or lobe at least twice as large as reduced ventral arm . . . . . *L. ferroae* (Fig. 180)
    Paramere with dorsal arm less than twice the width of ventral arm 12

12. Paramere with dorsal arm tubular at apex & bearing few small setae . . . . . *L. ratcliffei* (Fig. 181)
    Paramere with dorsal arm otherwise 13

13. Paramere with dorsal arm larger than ventral arm . . . *L. wagleyi* (Fig. 182)
    Paramere with dorsal arm smaller than ventral arm *L. longispina* (Fig. 183)

Lutzomyia (Trichopygomyia) elegans Martins, Falcão & Silva
Fig. 170

Lutzomyia elegans Martins, Llanos & Silva 1976a: 488 (♂, ♀, Cachicoto, Huanuco, Peru). Martins et al. 1978: 114; 1983b: 229 (keyed). Arias et al. 1983: 453 (♂, ♀ figs., refs.).

Distribution (Map 88). PERU (Martins et al. 1976a).

Lutzomyia (Trichopygomyia) martinezi Young & Morales
Fig. 171

Lutzomyia martinezi Young & Morales 1987: 653 (♂, ♀, Rio Iteviare, Meta, Colombia).

Distribution (Map 89). COLOMBIA (type locality).

Lutzomyia (Trichopygomyia) triramula (Fairchild & Hertig)
Fig. 172

Phlebotomus triramulus Fairchild & Hertig 1952: 517 (♂, ♀, Medio, Colon, Panama).

Lutzomyia triramula (or *triramulus*): Barretto 1962: 98 (listed). Forattini 1973: 321 (♂, ♀, figs., tax.). Martins et al. 1978: 114 (refs., dist.). Young 1979: 123 (♂, ♀, figs., refs.). Porter & De Foliart 1981: 158 (listed). Martins et al. 1983b: 229 (keyed). Arias et al. 1983: 463 (keyed, figs.). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 102 (♂, ♀, figs., Costa Rica). Loyola et al. 1988: 408 (mention). Alexander et al. 1992a: 36 (Ecuador record); 1992c: 124 (Ecuador).

Distribution (Map 88). GUATEMALA (1 ♂, 1 ♀, 12 km S. of Toquelá, Izabal, light trap, February 1981, C.H. Porter); BELIZE (Martins et al. 1978); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979); ECUADOR (Alexander et al. 1992a,c).

Remarks. The cerci of *L. triramula*, with the nipple-like ends, are characteristic of this species except for females occurring near Buenaventura, Colombia (Fig. 172).

Lutzomyia (Trichopygomyia) gantieri Le Pont & Desjeux
Fig. 173

Lutzomyia gantieri Le Pont & Desjeux 1987c: 571 (♂, ♀, Serrania de Marimonos, Alto Beni, Bolivia).

Distribution (Map 88). BOLIVIA (type locality).

Remarks. The male of *L. gantieri* differs from *L. elegans* in the shape and setation of the parameres. The setae at the end of the dorsal arm are simple, not spatulate, and the median lobe is larger than that of *L. elegans*.

Lutzomyia (Trichopygomyia) conviti Ramirez Pérez, Martins & Ramirez
Fig. 174

Lutzomyia conviti Ramirez Pérez, Martins & Ramirez 1976: 599 (♂, ♀, Amazonas, Venezuela). Feliciangeli 1980: 254 (keyed). Martins et al. 1983b: 229 (♂, keyed). Arias et al 1983: 451 (♂ figs., keyed). Young & Morales 1987: 664 (♂, Meta, Colombia). Feliciangeli 1989b: 558 (Venezuela record).

Distribution (Map 90). VENEZUELA (Ramirez Pérez et al. 1976; Feliciangeli 1989b); COLOMBIA (Young & Morales 1987).

Remarks. Arias et al. (1983) suggested that *L. conviti* and *L. rondonensis* may be conspecific but the modified aedeagus of the *conviti* male differs markedly from that of the latter species.

Lutzomyia (Trichopygomyia) dasypodogeton (Castro)
Fig. 175

Flebotomus dasypodogeton Castro 1939: 4 (♂, Belém, Pará, Brazil). Barretto 1947a: 196 (refs.).

Lutzomyia dasypodogeton (or *dasipodogeton*): Barretto 1962: 98 (listed). Forattini 1973: 303 (♂ fig.). Ward et al. 1973b: 178. Lewis 1975a: 503 (mouthpart morphol.). Martins et al. 1978: 114 (refs., dist.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Martins et al. 1983b: 223 (♂, ♀ figs., tax., dist.). Arias et al. 1983: 451 (figs., refs., dist.). Ryan 1986: 39 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (nat. flagellate infections, Brazil). Feliciangeli 1989b: 560 (cf. to *L. pinna*).

Distribution (Map 91). BRAZIL (Martins et al. 1983b; Arias et al. 1983; Ryan 1986); BOLIVIA (1 ♂, Beni, Guayaramerin, J. Velasco).

Remarks. Martins et al (1983b) discussed the obscure original description of this species, noting that the spelling of the specific name was *dasypodogeton* and not *dasipodogeton* of various authors (unjustified emendation).

The male is easily recognized by the bulbous dorsal extension of the aedeagus.

Lutzomyia (Trichopygomyia) pinna Feliciangeli, Ramirez Pérez & Ramirez
Fig. 176

Lutzomyia pinna, Feliciangeli, Ramirez Pérez & Ramirez, in Feliciangeli 1989b: 558 (♂, Waramaisen, Bolivar, Venezuela; ♀, same data but Quebrada Jaspe).

Distribution (Map 89). VENEZUELA (Feliciangeli 1989b).

Remarks. The male aedeagus resembles that of *L. dasypodogeton* but it is less clubbed, more slender, and unique among males in the subgenus.

Lutzomyia (Trichopygomyia) trichopyga (Floch & Abonnenc)
Fig. 177

Phlebotomus trichopygus Floch & Abonnenc 1945d: 2 (♂, ♀, Crique Anguille, French Guiana; 1952: 92.

Lutzomyia trichopyga: Barretto 1962: 98 (listed). Forattini 1973: 320 (♂, ♀ figs., tax.). Lewis 1975a: 497 (mouthpart morphol.). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 113 (refs., dist.); 1983b: 229 (keyed). Arias et al. 1983: 462 (refs., ♂, ♀ figs.). Ready et al. 1983a: 780 (Pará, Brazil). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 33 (armadillo burrows, Pará, Brazil). Ryan 1986: 42 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 30 (computer aided ident.).

Distribution (Map 92). SURINAME (Hudson & Young 1985); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); BRAZIL (Martins et al. 1978; 1983b; Arias et al. 1983; Ryan 1986).

Lutzomyia (Trichopygomyia) rondonensis Martins, Falcão & Silva
Fig. 178

Lutzomyia rondonensis Martins, Falcão & Silva 1965: 12 (♂, Abuna, Rondônia, Brazil). Forattini 1973: 318 (♂ fig., tax.). Martins et al. 1978: 114 (ref.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Martins et al. 1983b: 230 (♂ keyed). Arias et al. 1983: 460 (♂ fig., keyed, dist.).

Distribution (Map 93). BRAZIL (Martins et al. 1978; Arias et al. 1983; 3 ♂♂, Itiatuba, Pará, light trap, Sept. 1972, D. Young).

Lutzomyia (Trichopygomyia) witoto Young & Morales
Fig. 179

Lutzomyia witoto Young & Morales 1987: 655 (♂, Leticia, Amazonas, Colombia).

Distribution (Map 89). COLOMBIA (type locality).

Lutzomyia (Trichopygomyia) ferroae Young & Morales
Fig. 180

Lutzomyia ferroae Young & Morales 1987: 651 (♂, ♀, near Arboledas, Norte de Santander, Colombia).
Lutzomyia (Trichophoromyia) sp.: Young et al. 1987: 558 (neg. for flagellates, Colombia).

Distribution (Map 93). COLOMBIA (Young & Morales 1987 & ♂♂, ♀♀, Durania, Norte de Santander, rock crevices, 1987, J.B. Alexander & C. Ferro).

Lutzomyia (Trichopygomyia) ratcliffei Arias, Ready & Freitas
Fig. 181

Lutzomyia ratcliffei Arias, Ready & Frietas 1983: 456 (♂, Manaus, Amazonas, Brazil).

Distribution (Map 90). BRAZIL (Arias et al. 1983).

Remarks. The males of *L. ratcliffei* and *L. longispina* are structurally similar but the shape of the parameres serves to distinguish the taxa.

Lutzomyia (Trichopygomyia) wagleyi (Causey & Damasceno)
Fig. 182

Flebotomus wagleyi Causey & Damasceno 1945a: 25 (♂, São Paulo de Olivença, Amazonas, Brazil).
Lutzomyia wagleyi: Barretto 1962: 98 (listed). Forattini 1973: 325 (♂ fig., tax.). Martins et al 1978: 115. Morales & Minter 1981: 101 (♀). Arias et al. 1983: 466 (refs., ♂, ♀ figs., dist.). Martins et al. 1983b: 230 (keyed). Feliciangeli et al. 1988a: 49 (Venezuela). Feliciangeli 1989b: 558 (Venezuela records).

Distribution (Map 90). BRAZIL (Arias et al. 1983); COLOMBIA (Morales & Minter 1981). VENEZUELA (Feliciangeli et al. 1988a; Feliciangeli 1989b).

Lutzomyia (Trichopygomyia) longispina (Mangabeira)
Fig. 183

Flebotomus longispinus Mangabeira 1942a: 186 (♂, Aurá, Pará, Belém); 1942d: 251 (♀, immatures).
Lutzomyia longispina: Barretto 1962: 98 (listed). Theodor 1965: 189 (♂, ♀ figs.). Forattini 1973: 309 (♂, ♀ figs., tax.). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 114 (refs., dist. ♂ figs.). Young 1979: 121 (refs., figs.). Feliciangeli 1980: 253 (keyed). Biancardi et al. 1982: 168 (Rondônia, Brazil).

Martins et al. 1983b: 229 (keyed). Arias et al. 1983: 456 (refs., figs.); 1985: 1101 (neg. for flagellates, Brazil). Lebbe et al. 1987: 30 (computer aided ident.). Hashiguchi et al. 1992: 139 (coll. data, ♀♀ only, Paraguay).

Distribution (Map 88). FRENCH GUIANA (Léger et al. 1977); COLOMBIA (Osorno-Mesa et al. 1972b); BRAZIL (Arias et al. 1983); VENEZUELA (Pifano & Ortiz 1952).

Remarks. The records of *L. longispina* in Venezuela, Colombia French Guiana and Paraguay are based only on females and therefore require confirmation when males become available.

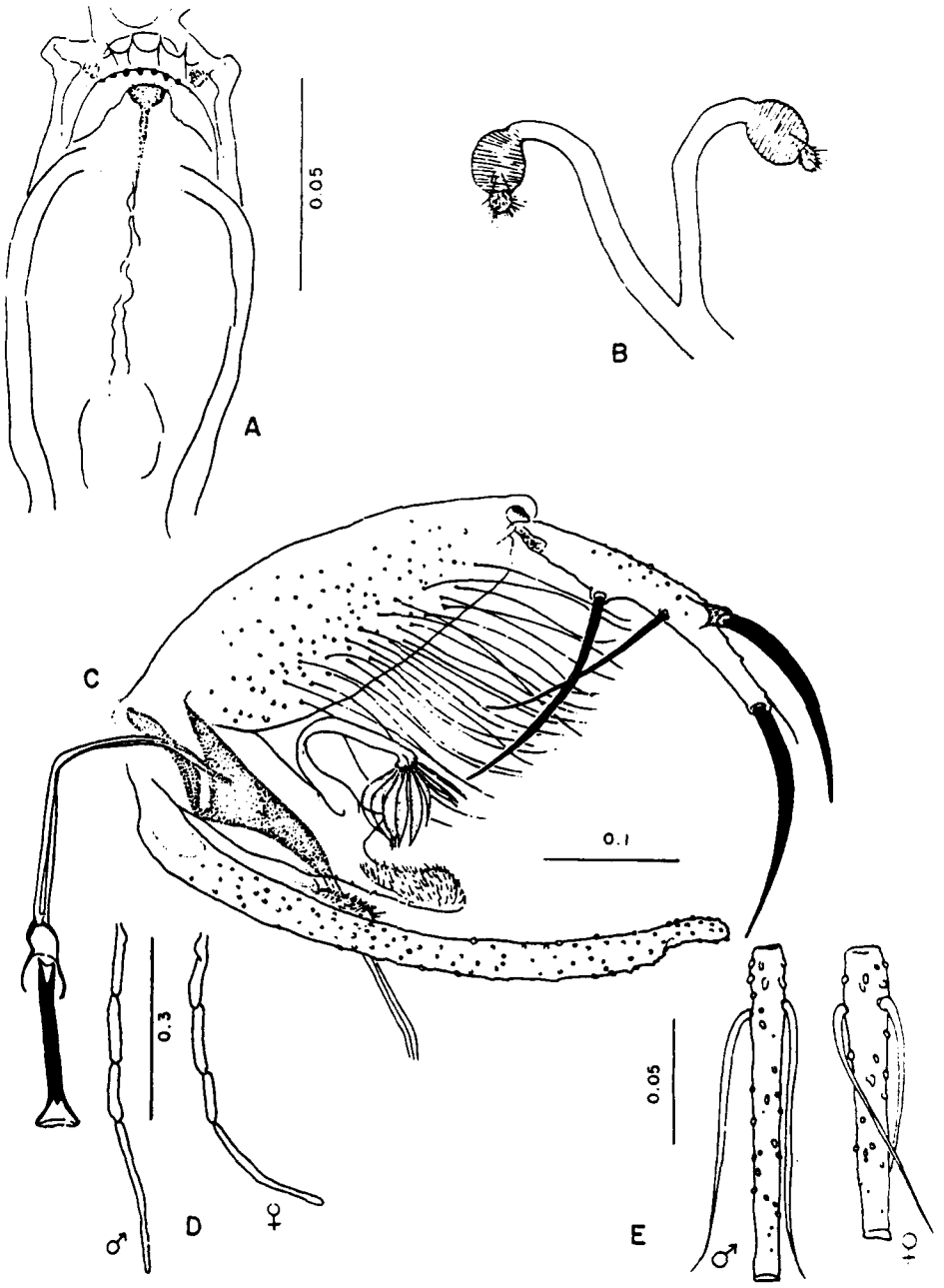


FIG. 170. ***Lutzomyia elegans.*** A. Female cibarium; B. Spermathecae; C. Male terminalia; D. Male & female palps; E. Male & female flagellomeres (figs. from Arias et al. 1983).

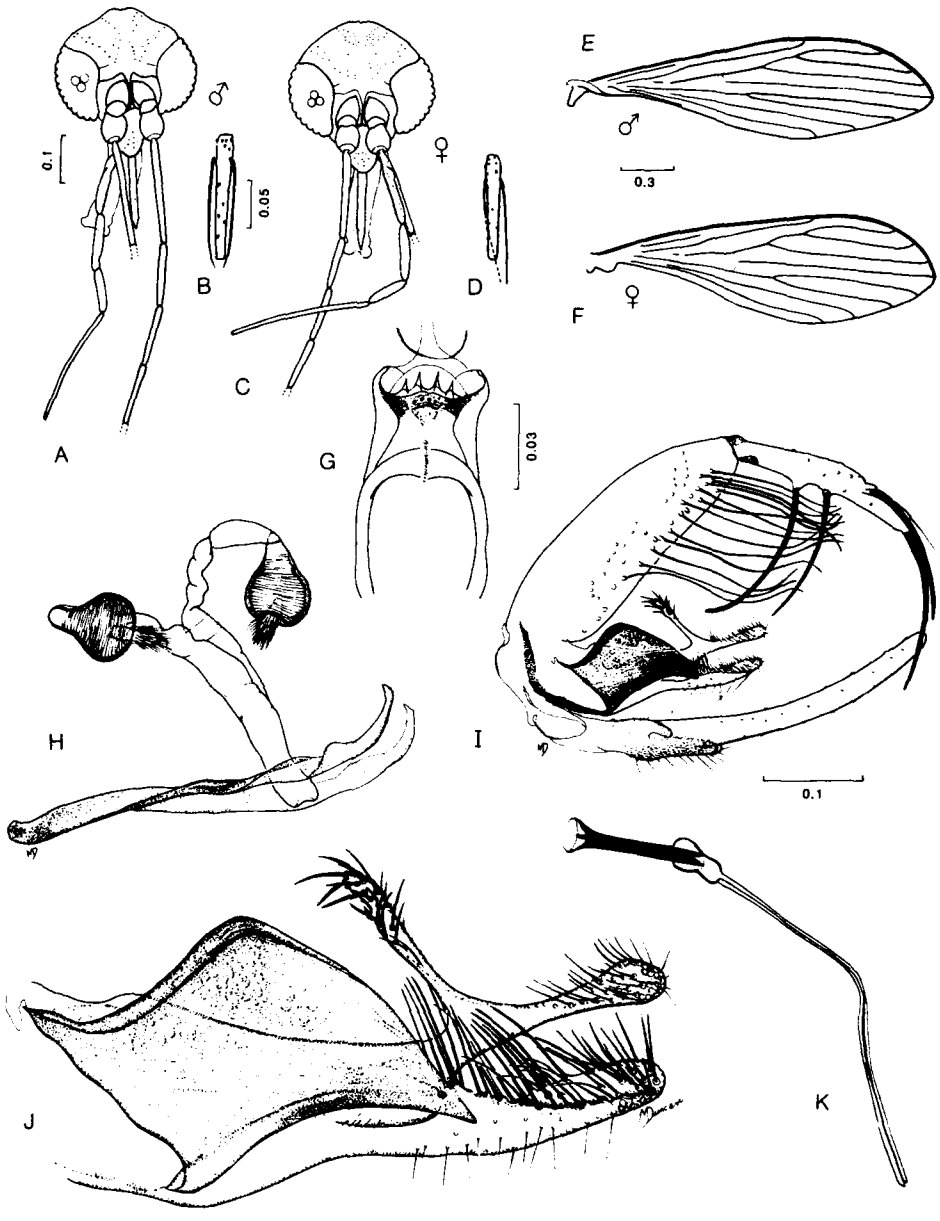


FIG. 171. ***Lutzomyia martinezi.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Male wing; F. Female wing; G. Female cibarium; H. Spermathecae; I. Male terminalia; J. Paramere & aedeagus; K. Genital pump & filaments (figs. after Young & Morales 1987).

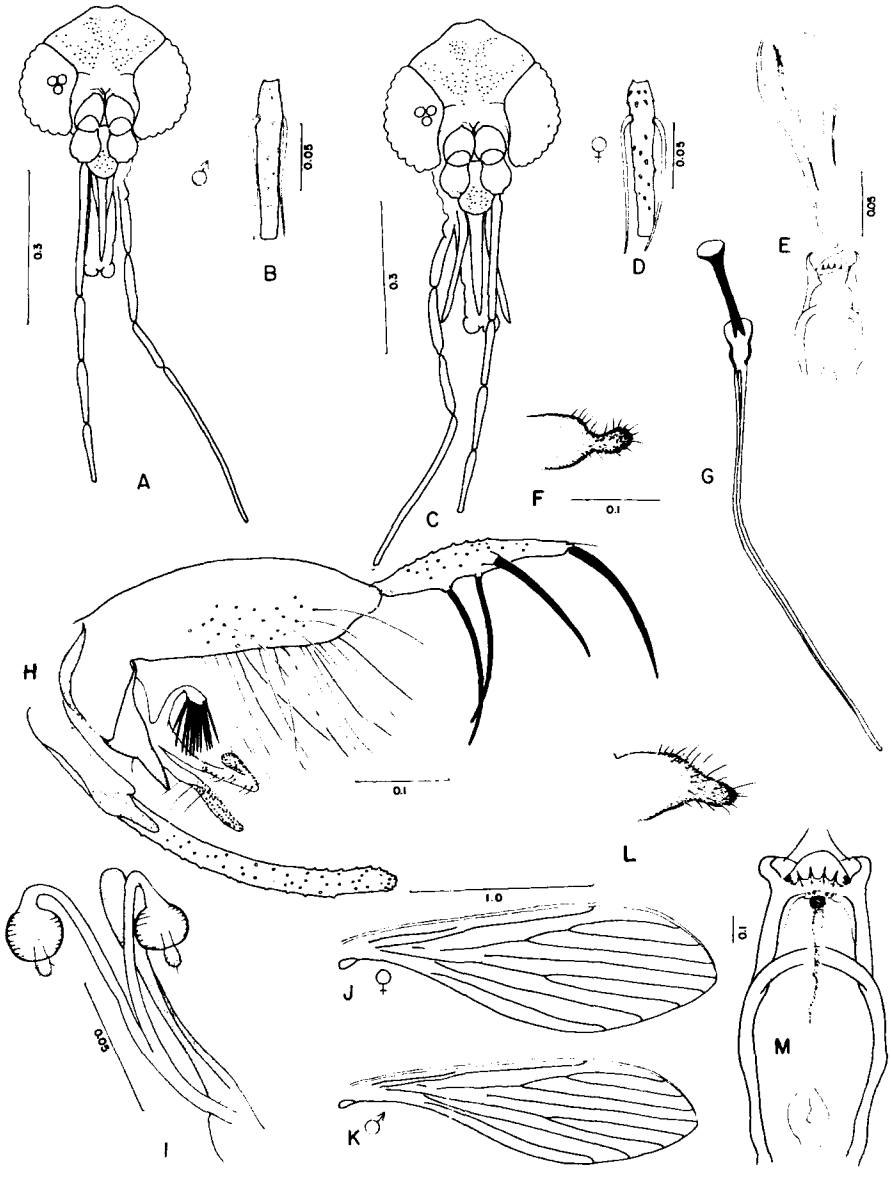


FIG. 172. ***Lutzomyia triramula.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Female cercus; G. Genital pump & filaments; H. Male terminalia; I. Spermathecae; J. Female wing; K. Male wing; L. Female cercus, specimens from Valle Dept., Colombia; M. Female cibarium (from Young 1979).

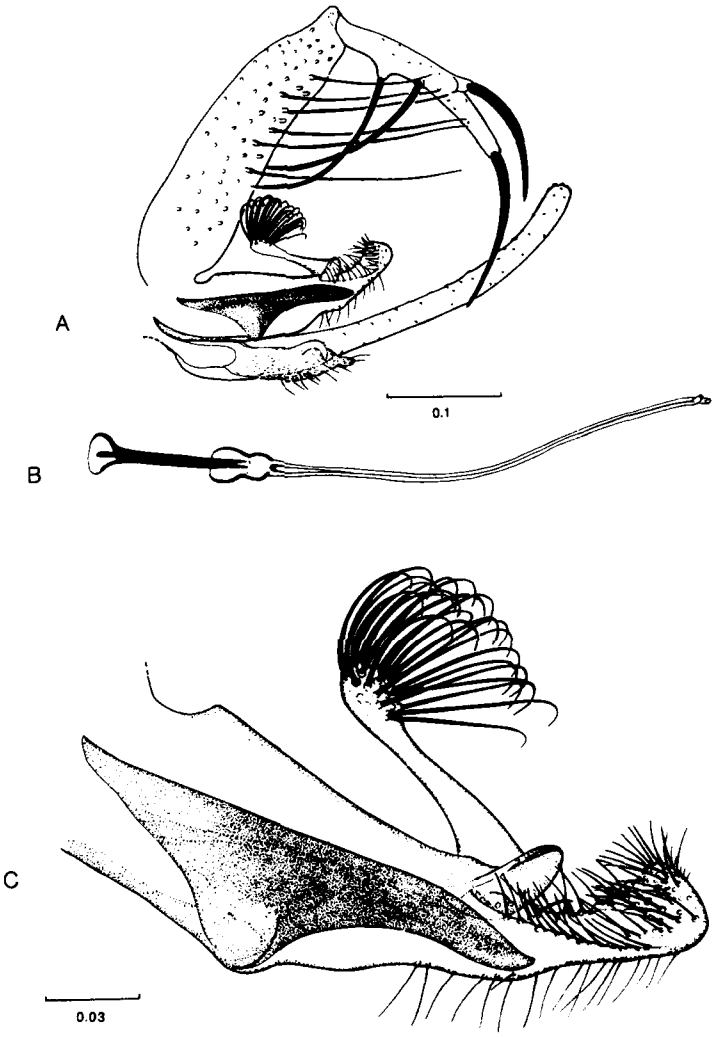


FIG. 173. ***Lutzomyia gantieri***. A. Male terminalia; B. Genital pump & filaments; C. Paramere & aedeagus.

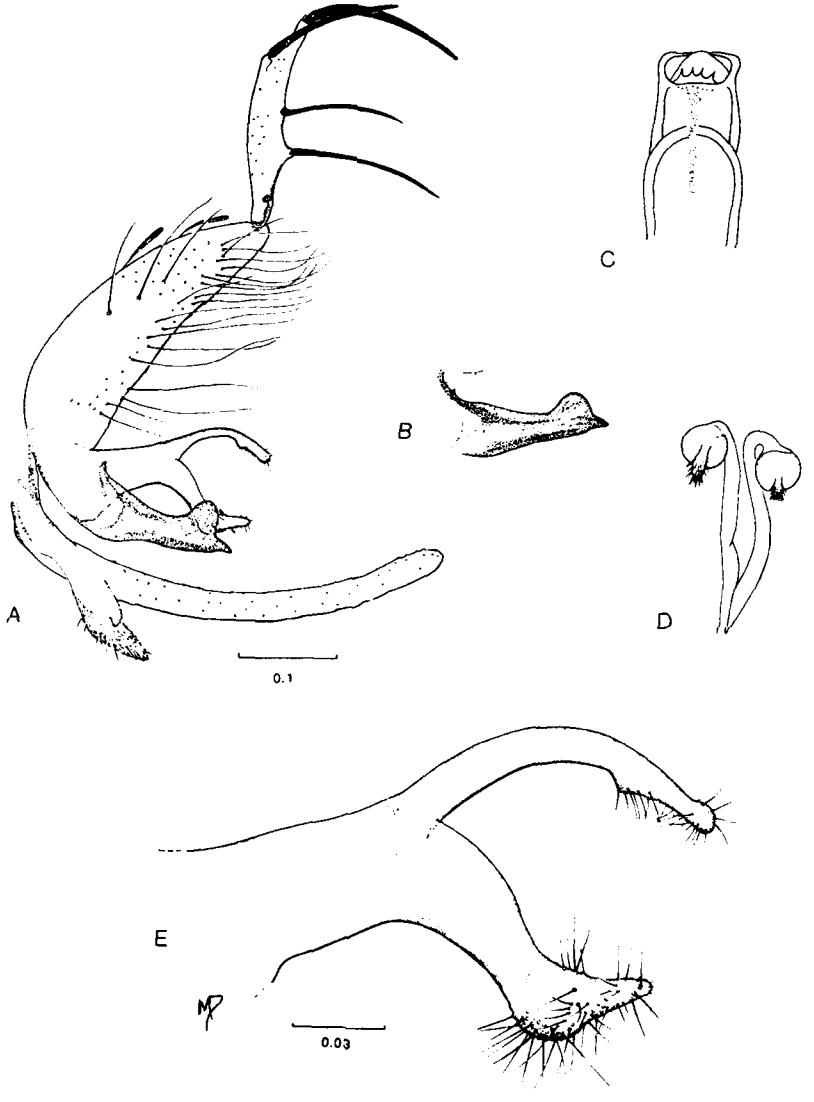


FIG. 174. ***Lutzomyia conviti.*** A. Male terminalia; B. Aedeagus; C. Female cibarium; D. Spermathecae; E. Paramere (female figs. from Ramirez Peréz et al. 1976).

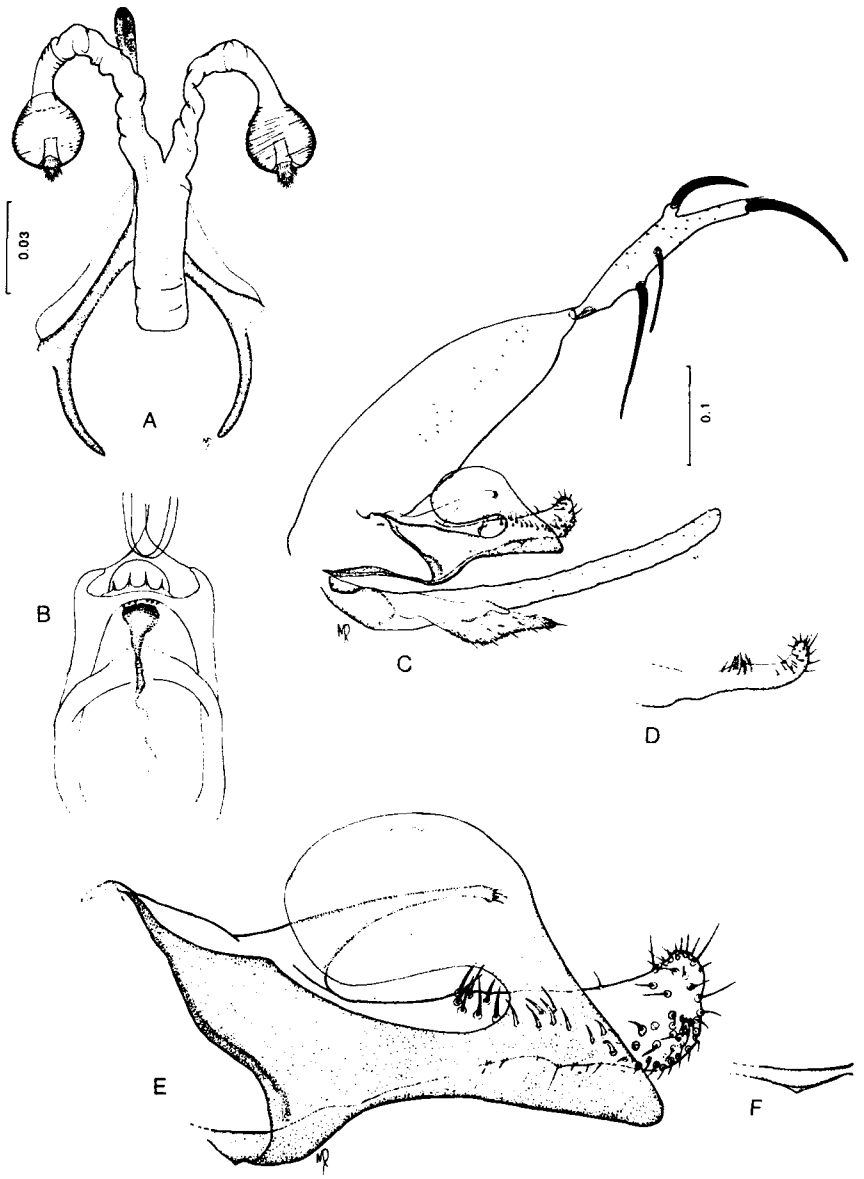


FIG. 175. ***Lutzomyia dasypodogeton.*** A. Spermathecae; B. Female cibarium; C. Male terminalia; D. Paramere (different aspect); E. Paramere & aedeagus; F. Tip of genital filament.

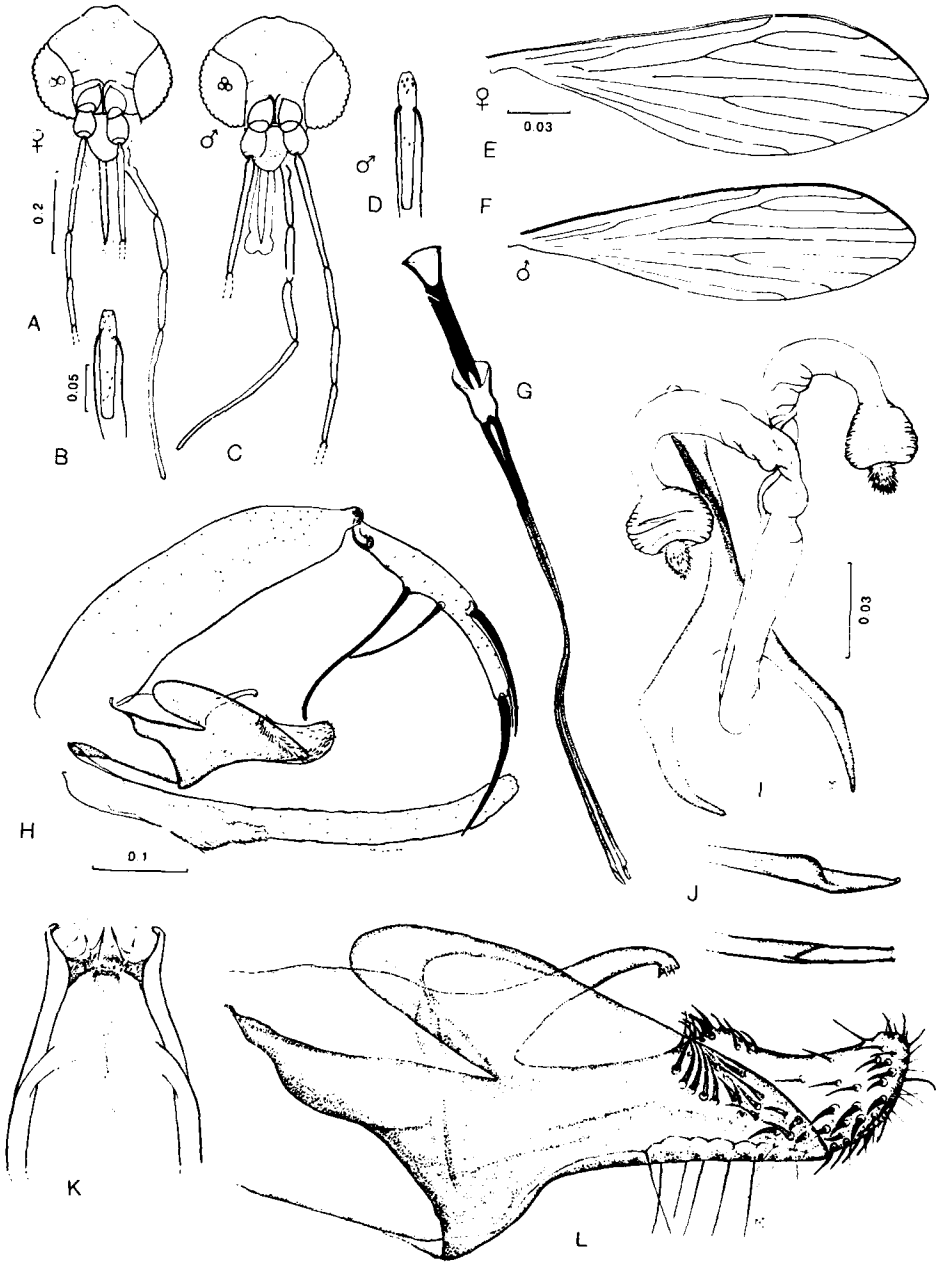


FIG. 176. ***Lutzomyia pinna.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Male terminalia; I. Spermathecae; J. Tips of genital filaments; K. Female cibarium; L. Paramere & aedeagus (figs. from Feliciangeli 1989b).

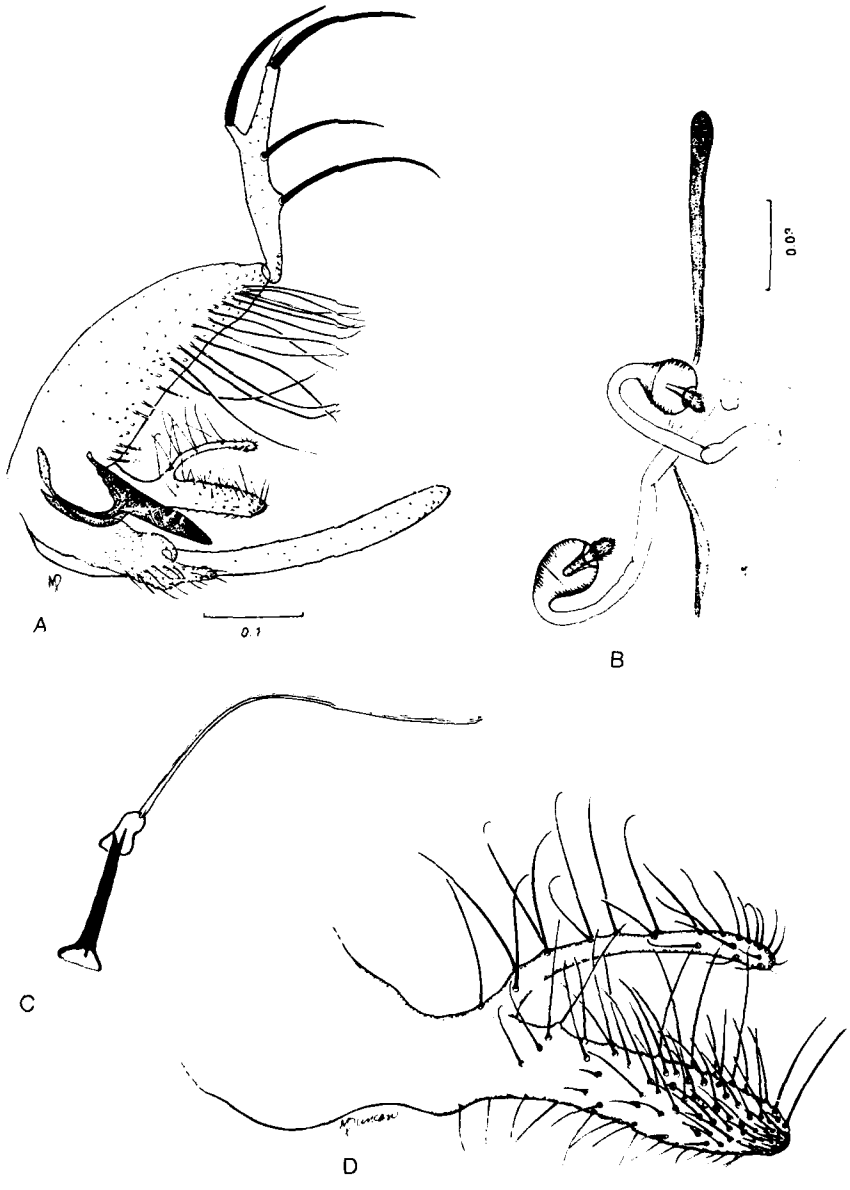


FIG. 177. ***Lutzomyia trichopyga.*** A. Male terminalia; B. Spermathecae; C. Genital pump & Filaments; D. Paramere.

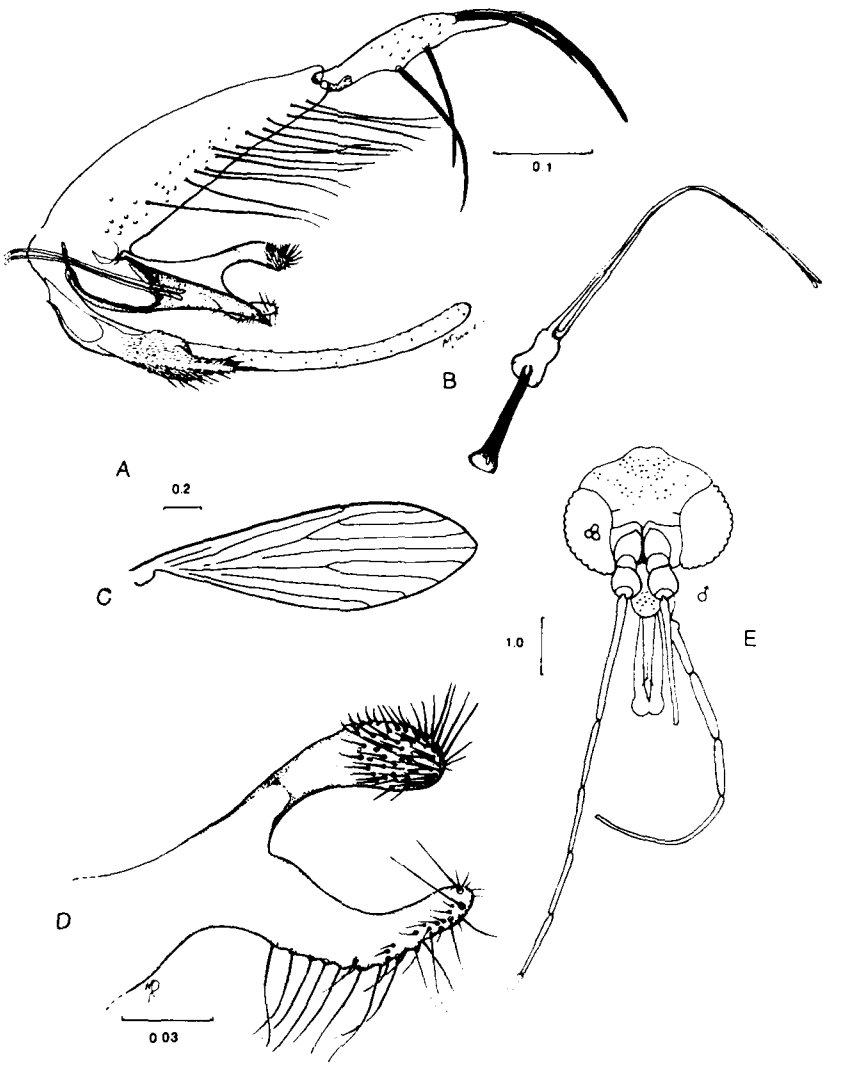


FIG. 178. ***Lutzomyia rondonensis.*** A. Male terminalia; B. Genital pump & filaments; C. Male wing; D. Paramere; E. Male head.

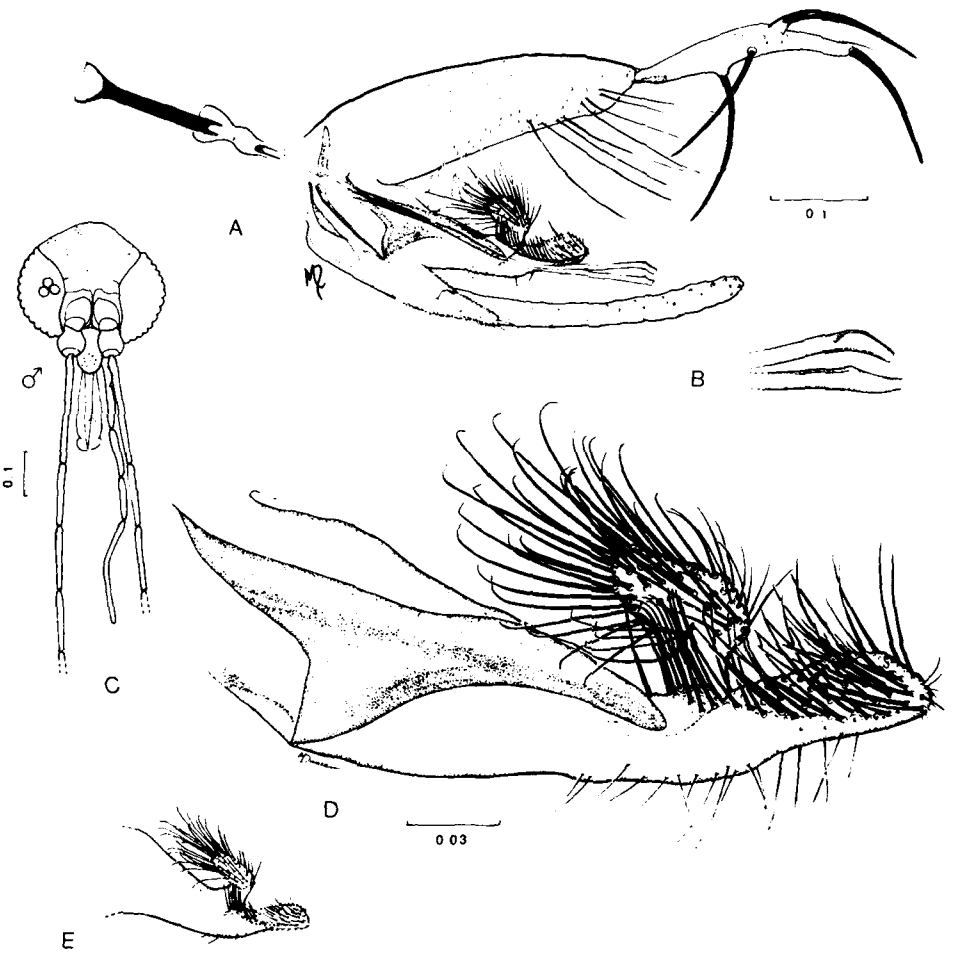


FIG. 179. ***Lutzomyia witoto.*** A. Male terminalia; B. Tips of genital filaments; C. Male head; D. Paramere & aedeagus; E. Paramere (figs. from Young & Morales 1987).

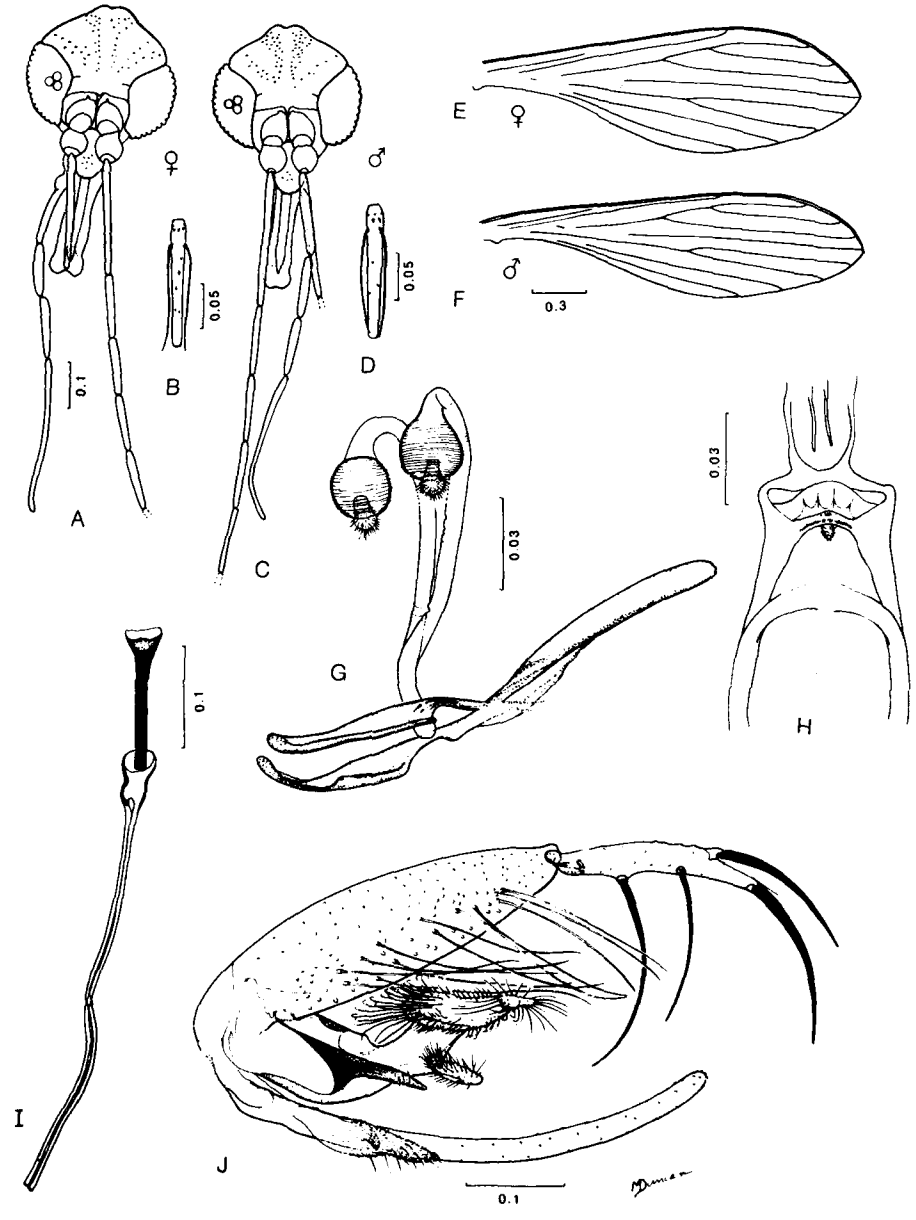


FIG. 180. ***Lutzomyia ferroae.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Male terminalia (figs. from Young & Morales 1987).

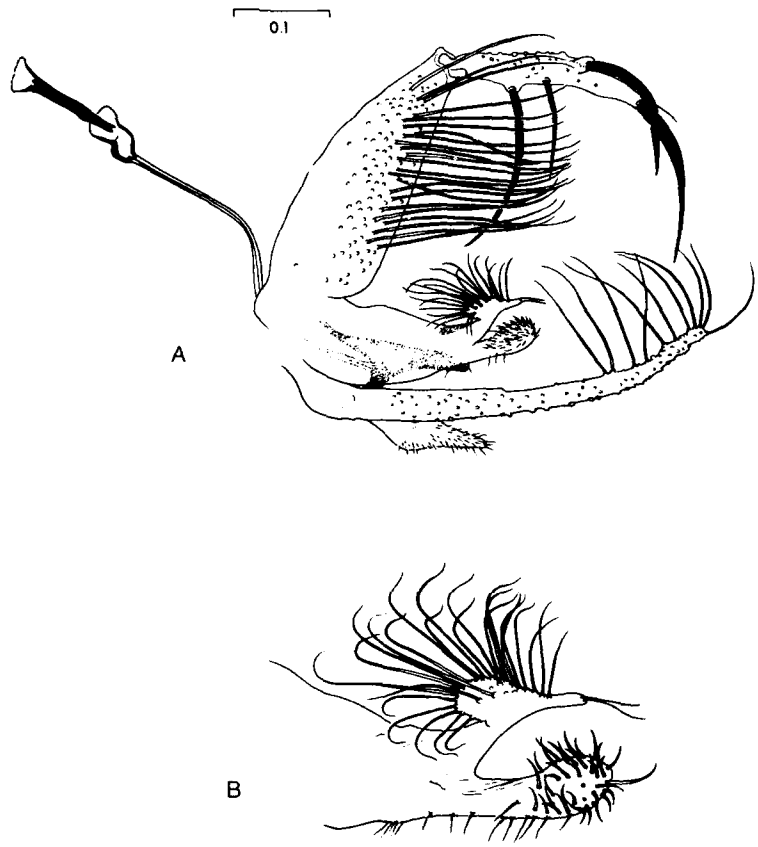


FIG. 181. ***Lutzomyia ratcliffei.*** **A. Male terminalia; B. Paramere (figs. from Arias et al. 1983).**

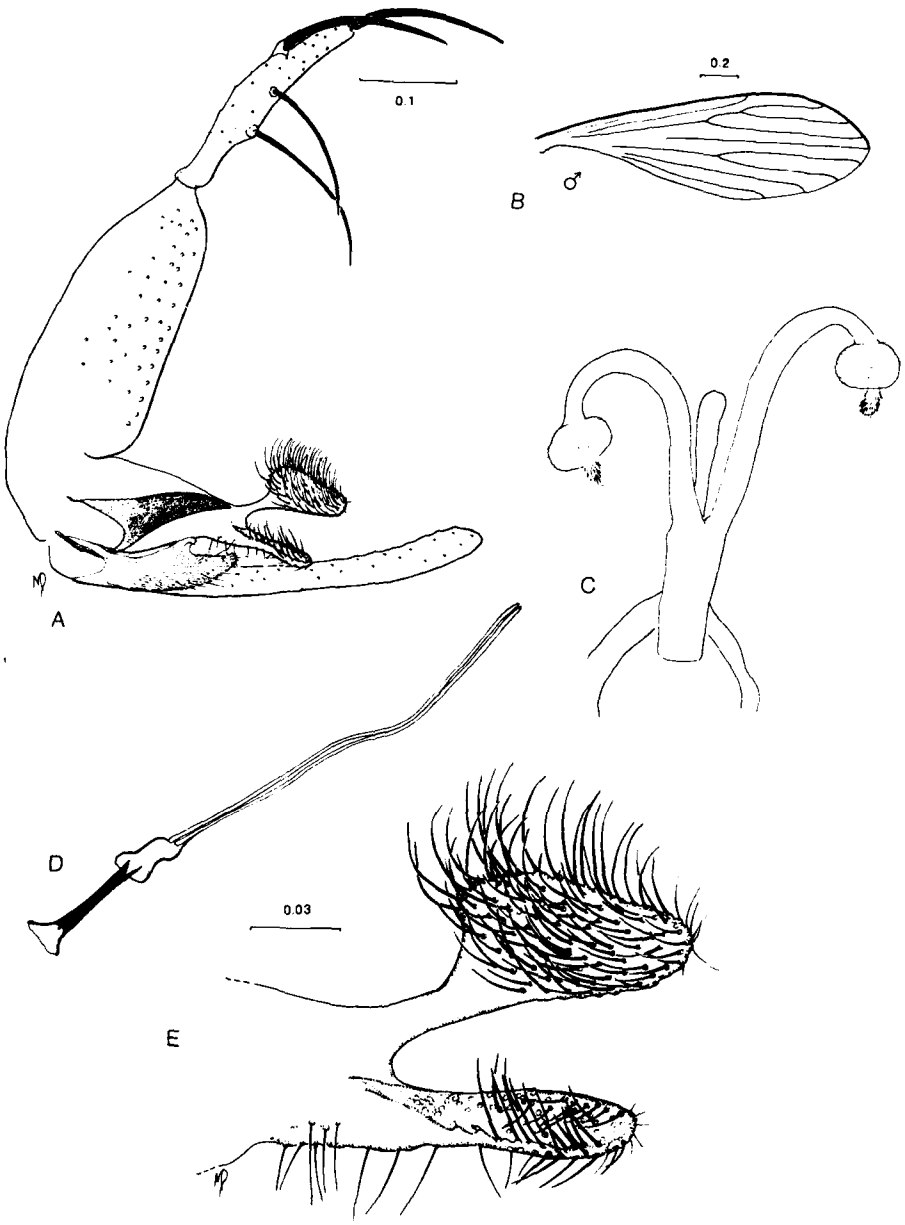


FIG. 182. ***Lutzomyia wagleyi.*** A. Male terminalia; B. Male wing; C. Spermathecae; D. Genital pump & filaments; E. Paramere.

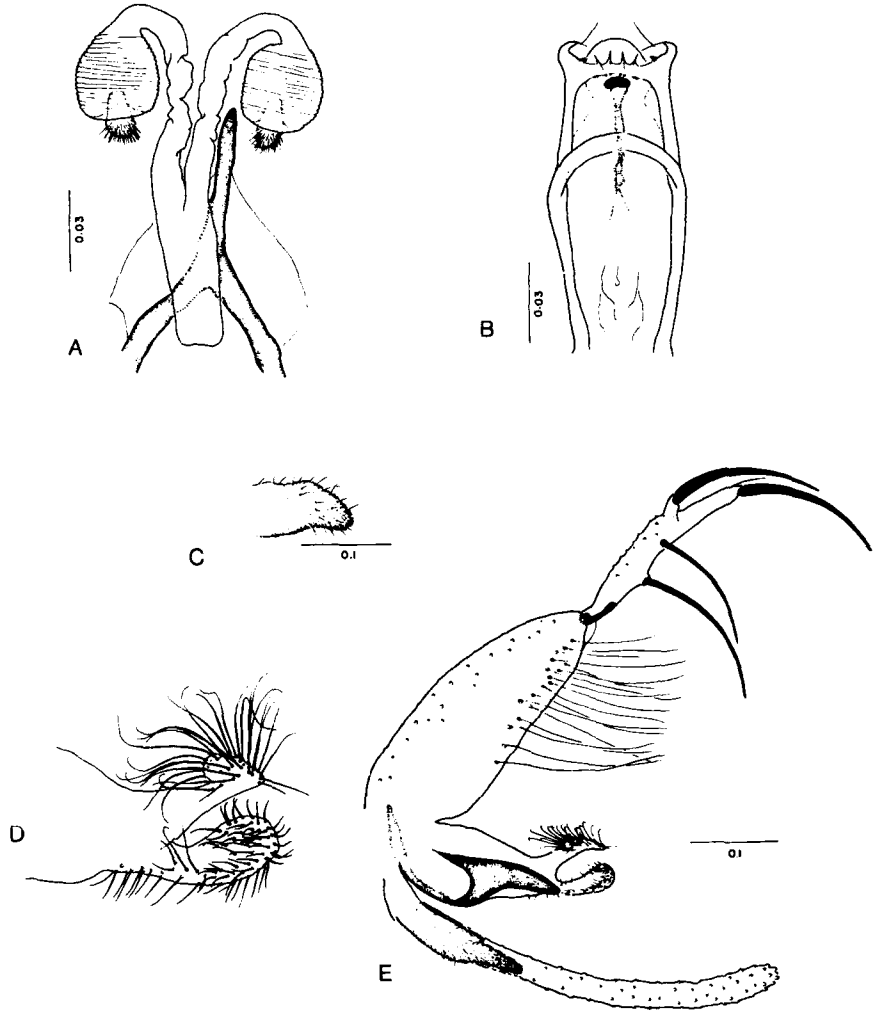
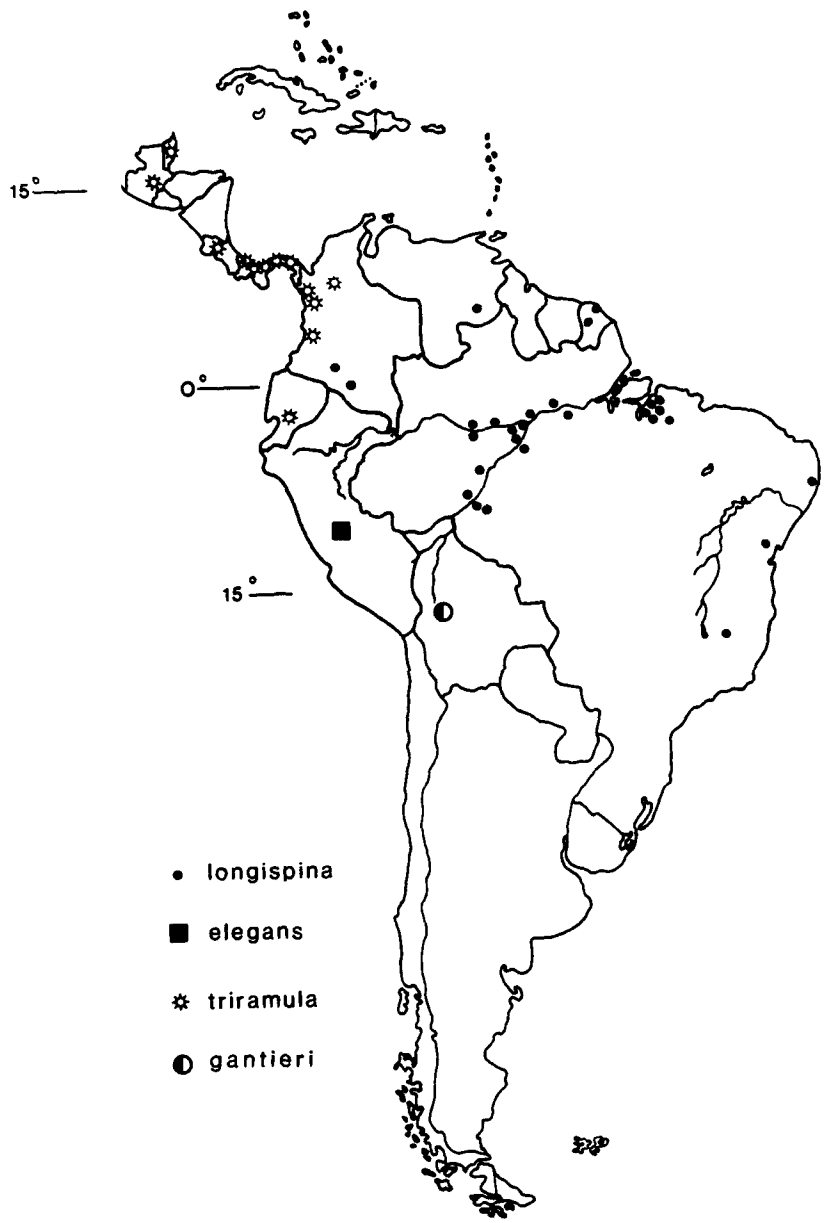
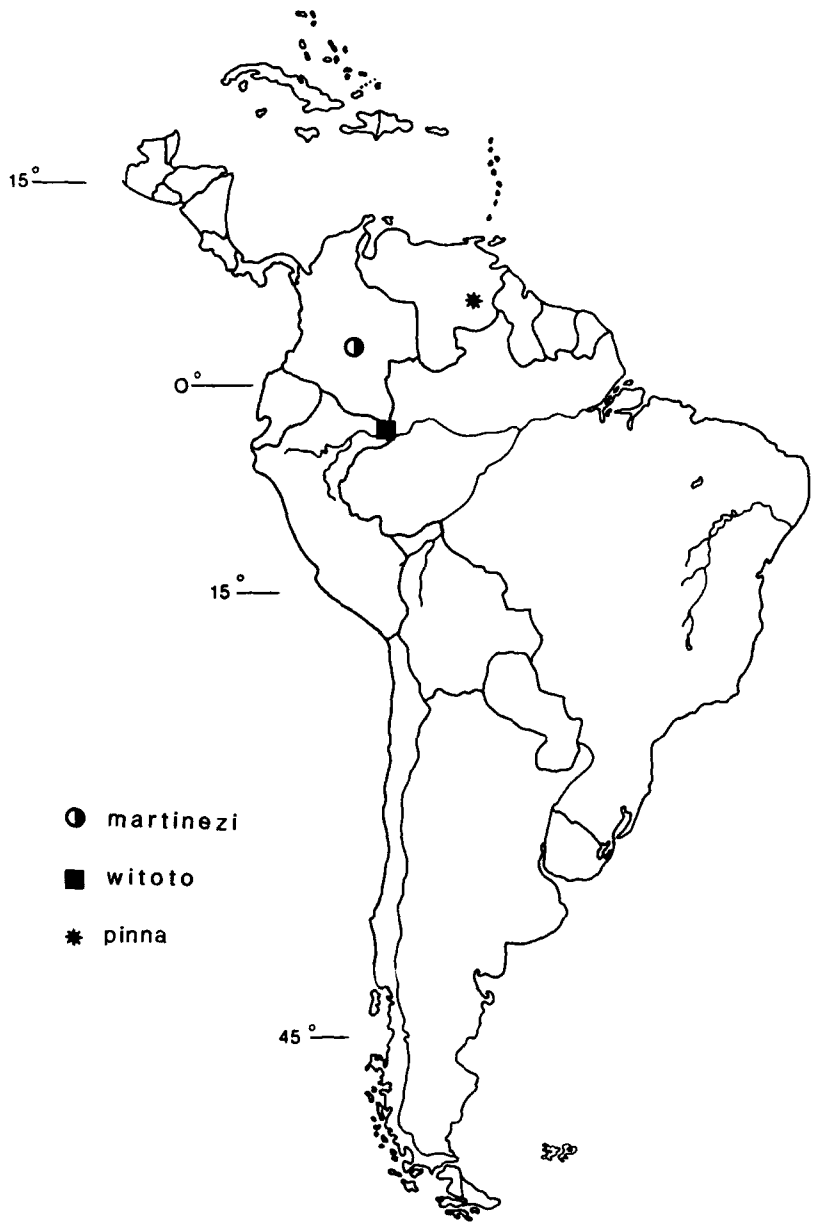


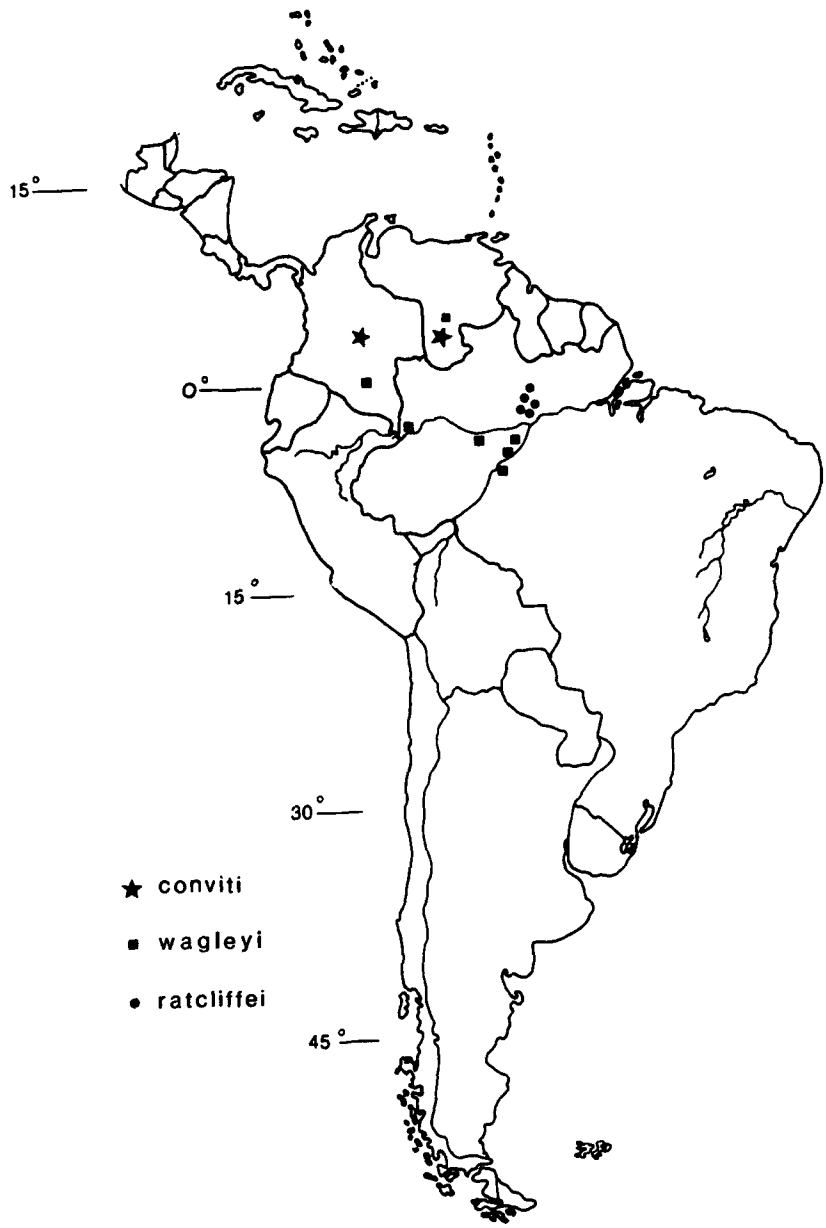
FIG. 183. ***Lutzomyia longispina.*** A. Spermathecae; B. Female cibarium; C. Female cercus; D. Paramere; E. Male terminalia (fig. D from Arias et al. 1983; others from Young 1979).



Map 88



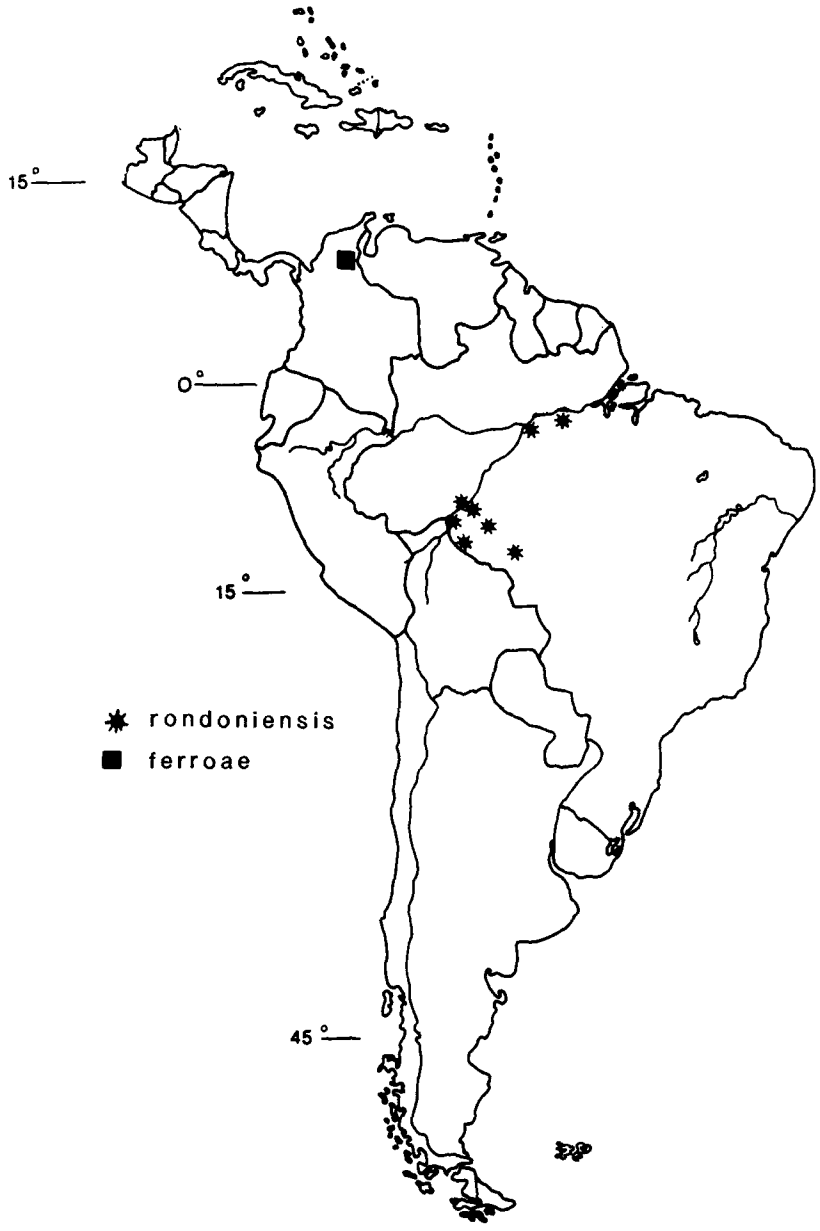
Map 89



Map 90

Map 91

Map 92



Map 93

SUBGENUS *NYSSOMYIA* BARRETTO

Lutzomyia, subgenus *Nyssomyia* Barretto 1962: 98 (type species: *Phlebotomus intermedius* Lutz & Neiva by orig. designation). Lewis et al. 1977: 325. Martins et al. 1978: 94 (defined). Ready & Fraiha 1981: 705 (defined, ♂♂, ♀♀ keyed).

Lutzomyia species group *intermedia* Theodor 1965: 184 (defined).

Psychodopygus, subgenus *Trichophoromyia*: Forattini 1971a: 105; 1973: 415 (in part, defined).

Nyssomyia, genus: Artemiev 1991: 73.

Nyssomyia, subgenus *Bichromomyia* Artemiev 1991: 73 (type species: *Nyssomyia flaviscutellata* Mangabeira by orig. designation).

Identification. Coloration variable, pale to well-pigmented. Antennal ascoids simple. Palpomere 5 usually shorter than palp. 3 (*L. waltoni* is exception). ♀ cibarium with 6 or more horizontal teeth & complete arch. Spermathecae annulated, longer than wide; terminal knob large. ♂ *genitalia*: Coxite with or without persistent setae (if present, they are simple & inserted at or near middle of coxite). Style with 4 spines, none of which is inserted on a long tubercle or process; subterminal seta absent. Paramere undivided with simple setae.

Species in the subgenus *Trichophoromyia* Barretto, as defined in the present review, share many character states with the *Nyssomyia* species but the antennal ascoids have short (barely discernible) spurs, the pleura are nearly as dark as the scutum in most species and the female cerci are characteristically short and broad.

Members of the *flaviscutellata* complex (Lewis 1975b), within the subgenus, are easily recognized by their striking coloration. Artemiev (1991) has formally named this group, *Bichromomyia*, which he treats as a subgenus in the genus *Nyssomyia*.

Medical Importance. Considerable; Most species in this subgenus are anthropophilic, the degree varying according to species. Several species are suspected or proven vectors of leishmaniasis and arboviruses.

Key to the males of the subgenus *Nyssomyia**

1. Style with isolated basal spine. Coxite with median group of 20+ long setae 2

   Style with paired basal spines. Coxite with or without median group of 20+ long setae 3

*Modified from Ready & Fraiha (1981).

2. Pronotum & parategite pale . . . . . *L. richardwardi* (Fig. 202E)
   Pronotum & parategite very dark . . . . . *L. shawi* (Fig. 202I)

3. Coxite with a median group of 20+ simple setae . . . *L. antunesi* (Fig. 189)
   Coxite without a group of persistent setae 4

4. Scutum pale, with little or no pigmentation 5
   Scutum pigmented, contrasting with pale pleura 8

5. Genital filament tips with 1 or 2 barbs . . . . . *L. yuilli yuilli* (Fig. 200H)
   L. yuilli pajoti
   Genital filament tips without such barbs 6

6. Gential filament tips forked; one fork spatulate, the other pointed and shorter . . . . . *L. anduzei* (Fig. 194)
   Genital filament tips simple, slightly expanded 7

7. Palpomere 5 subequal in length to palp. 3 . . . . . *L. trapidoi* (Fig. 198)
   Palpomere 5 much longer than palp. 3 . . . . . *L. waltoni* (Fig. 201)

8. Scutum bicolored; anterior 1/2 of scutum & pronotum heavily pigmented; posterior 1/2 of scutum & scutellum pale 9
   Scutum unicolored, scutellum also with faint or moderate pigmentation . 13

9. Genital pump relatively large, filaments shorter than 2.5X pump length . 10
   Genital pump shorter, filaments longer than 2.8X pump length 11

10. Lateral lobe 0.28 mm or longer, reaching well beyond end or parameres . . . . . *L. reducta* (Fig. 185)
    Lateral lobe <0.23 mm, extending slightly beyond end of parameres . . . . . *L. flaviscutellata* (Fig. 184B)

11. Palpomere 5 about same length as palpomere 3. Lateral lobe longer than 0.36 mm or as long as coxite . . . . . *L. olmeca olmeca* (Fig. 186)
    Palpomere 5 shorter than palpomere 3. Lateral lobe shorter than 0.35 mm or coxite 12

12. Lateral lobe <0.25 mm long. Flagellomere I <0.35 mm. Eyes larger, separated by distance = to only 0.035-0.040 mm; interocular suture usually absent . . . . . *L. olmeca nociva* (Fig. 188)
    Lateral lobe >0.25 mm. Flagellomere I longer than 0.38 mm. Eyes smaller, separated by at least 0.075 mm; interocular suture not complete, represented by reduced suture lines between eyes . . . . . *L. olmeca bicolor* (Fig. 187)

13. Style with proximal 2 spines inserted within distal 1/3 of structure . . . . . *L. inornata* (Fig. 184F)
    Style with proximal 2 spines inserted at middle 1/3 of structure 14

14. Genital filaments shorter, equal to, or slightly longer than 2X pump length 15
    Genital filaments at least 2.3X pump length 19

15. Style with 2 terminal spines close together, separated by distance = to greatest width of terminal spine 16
    Style with terminal spines more widely separated 17

16. Pronotum and paratergite heavily infuscated . . . . . *L. edentula* (Fig. 196)
    Pronotum and paratergite pale . . . . . *L. ylephiletor* (Fig. 199)

17. Genital filament tips spatulate, not forked. Prescutum heavily pigmented . . . . . *L. intermedia* (Fig. 193)
    Gential filament tips simple or forked. Prescutum pale or lightly pigmented 18

18. Genital filament tips forked . . . . . *L. umbratilis* (Fig. 195)
    Gential filaments tips not forked, slightly dilated . . . *L. trapidoi** (Fig. 198)

19. Genital filaments longer than 3.3X length of pump . . . . . *L. whitmani* (Fig. 191)
    Genital filaments shorter than 3.3X length of pump . . . . . *L. hernandezi* (Fig. 190)
    L. sylvicola (Fig. 192)

Key to Females of the Subgenus *Nyssomyia*†

1. Common sperm duct long, extending to distal 1/3 of genital fork or beyond 2
    Common sperm duct absent or short, not extending to distal 1/3 of genital fork 7

2. Spermatheca with fewer than 8 distinct annuli, its length (including terminal knob) about 1/2 length of individual sperm duct. Head height subequal to its width. Scutum not bicolored . . . . . *L. antunesi* (Fig. 189)

*Specimens of *L. trapidoi*, or unnamed sibling species, occurring in Pacific Coast forests of Colombia and Ecuador are moderately infuscated, unlike the type material from Panama (Young 1979).

†The females of *L. sylvicola* and *L. inornata* have not been described.

Spermatheca with 8 or more distinct annuli, its length subequal to, or longer than, individual sperm duct. Head longer than wide. Scutum bicolored, anterior 1/2 of scutum & pronotum heavily pigmented; posterior 1/2 of scutum & scutellum pale 3

3. Individual sperm ducts short, less than half length of spermatheca . . . . . *L. reducta* (Fig. 185)
Individual sperm ducts longer, subequal or longer than spermatheca 4

4. Cibarium with 6-7 horizontal teeth. Stem of genital fork slender . . . . . *L. flaviscutellata* (Fig. 184C&E)
Cibarium with 8-12 (rarely 7) horizontal teeth. Stem of genital fork broad, blade-like 5

5. Spermatheca with short & broad terminal knob & ca. 12-13 distinct annuli . . . . . *L. olmeca olmeca* (Fig. 186)
Spermathecae with longer, more slender terminal knob & 9-12 distinct annuli 6

6. Common & individual sperm ducts subequal in length . . . . . *L. olmeca nociva* (Fig. 188)
Common sperm duct much longer than individual sperm duct . . . . . *L. olmeca bicolor* (Fig. 187)

7. Individual sperm ducts with refringent excressences or papules 8
Individual sperm ducts either smooth walled, without refringent excressences, or with transverse striations 9

8. Individual sperm ducts with widely-spaced, spherical papules; width of individual ducts subequal throughout . . . . *L. yuilli pajoti* (Fig. 200J)
Individual sperm ducts mostly with continuous, elongate papules forming a feather-like pattern, those at base larger than others; basal portion of individual duct wider than distal portion . . . *L. yuilli yuilli* (Fig. 200I)

9. Spermatheca subequal to or longer than individual duct 10
Spermatheca shorter than individual duct 12

10. Common & individual sperm ducts with distinct transverse striations. Mesonotum lightly to moderately infuscated . . *L. umbratilis* (Fig. 195)
Common & individual sperm ducts completely or mostly smooth-walled. Mesonotum strongly infuscated 11

11. Pronotum & prescutum strongly infuscated. Individual sperm ducts greater than 1/2 length of spermatheca . . . . . *L. shawi* (Fig. 202G&I)
Pronotum & prescutum pale or nearly pale. Individual sperm ducts only about 1/3 length of spermatheca . . . . . *L. richardwardi* (Fig. 202E&F)

12. Spermatheca with 5-7 distinct annuli. Pronotum pale 13
Spermathecae with 8 or more distinct annuli. Pronotum dark 16

13. Individual sperm duct shorter than 2X length of spermatheca. Incipient annuli usually present at base of spermatheca; basal annuli smaller than distal annuli 14
Individual sperm duct longer, 2X or more length of spermatheca. Incipient annuli absent at base of spermatheca, all spermathecal annuli, except sometimes the most basal, subequal in size 15

14. Mesonotum strongly infuscated. Terminal knob of spermatheca as broad as terminal annulus . . . . . *L. ylephiletor* (Fig. 199)
Mesonotum pale or nearly so. Terminal knob of spermatheca more slender than terminal annulus . . . . . *L. anduzei* (Fig. 194)

15. Common sperm duct present & nearly as long as spermatheca; individual ducts long and with fine transverse striations throughout . . . . . *L. waltoni* (Fig. 201)
Common sperm duct absent; individual ducts shorter & completely smooth-walled . . . . . *L. trapidoi* (Fig. 198)

16. Spermatheca with 26-33 annuli; individual sperm ducts tapered towards junction with spermatheca . . . . . *L. bibinae* (Fig. 197)
Spermathecae with 20 or fewer annuli; individual sperm ducts tapered or not 17

17. Spermatheca with 8-10 annuli; individual sperm ducts increasing in width from base to junction of spermathecae 18
Spermatheca with 12 or more annuli; individual sperm ducts subequal in width throughout 19

18. Spermatheca with annuli increasing in size from base to apex. Common sperm duct present, relatively wide & long . . . . . *L. edentula* (Fig. 196)
- Spermatheca with annuli subequal in size. Common duct, if visible, much shorter . . . . . *L. intermedia* (Fig. 193)

19. Individual sperm duct 3-4X length of spermatheca . . *L. whitmani* (Fig. 191)
Individual sperm duct less than 2.5X length of spermatheca . . . . . *L. hernandezi* (Fig. 190)

Lutzomyia (Nyssomyia) flaviscutellata (Mangabeira)
Fig. 184 A-E

Flebotomus flaviscutellatus Mangabeira 1942a: 144 (♂, Aurá, Belém, Pará, Brazil). Barretto 1947a: 201 (refs.).

Phebotomus apicalis Floch & Abonnenc 1943a: 25 (♂, ♀ French Guiana). Barretto 1946b: 534 (as junior synonym of *flaviscutellatus*).

Lutzomyia flaviscutellata: Barretto 1962: 98 (listed). Theodor 1965: 184 (listed). Fairchild & Theodor 1971: 153 (♂, ♀, tax. review). Llanos 1973: 32 (Peru, figs.). Lewis 1975a: 501 (mouthpart morphol.); 1975b: 363 (tax.). Ward & Ready 1975: 128 (egg descript.). Ward 1976: 230 (tax., larva, pupa). Léger et al. 1977: 220 (French Guiana). Arias & Freitas 1977b: 511 (in part, coll. data, Amazonas, Brazil); 1978: 391 (in part, neg. for flagellates). Fraiha et al. 1978: 136 (N. Brazil). Ramirez Pérez et al. 1978: 49 (? misident., Venezuela, figs.). Ward et al. 1978: 272 (feeding through membranes). Martins et al. 1978: 98 (refs., dist.). Young 1979: 153 (♂, ♀, refs., figs.). Lainson et al. 1979: 241 (neg. for flagellates, Pará, Brazil). Léger et al. 1980: 116 (French Guiana). Feliciangeli 1980: 246. Fraiha et al. 1980a: 21 (Peru). Ramirez Pérez et al. 1981: 124 (? misident., Venezuela). Ready & Fraiha 1981: 708 (keyed). Shaw 1981: 232 (as exp. host for *Endotrypanum*). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young & Arias 1982: 136 (tax.). Ready et al. 1983a: 780 (Pará, Brazil). Lainson et al. 1983: 326 (Marajó Island, Pará, Brazil). Ready et al. 1984c: 641 (age grading). Young & Rogers 1984: 599 (Ecuador). Herve et al. 1984: 207 (vertical transmission, Pacui virus). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Dedet et al. 1985: 305 (seasonal dist., nat. *Leishmania* infections, French Guiana). Young et al. 1985: 143 (Peru). Cuba Cuba et al. 1985: 503 (exp. infections with (*Leishmania*). Hudson & Young 1985: 418 (Suriname). Ward 1985: 205 (ecology). Le Pont & Desjeux 1986: 314 (Bolivia). Ready et al. 1986: 29 (Pará, Brazil). Ryan 1986: 64 (refs., figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Ryan et al. 1987a: 356 (nat. flagellate infections, Pará, Brazil). Feliciangeli 1988: 104 (Venezuela records). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela). Le Pont 1990: 672 (coll. data, French Guiana). Alexander et al. 1992a: 36 (Ecuador); 1992c: 124.

Psychodopygus flaviscutellatus: Forattini 1971a: 105 (listed); 1973: 170 (gen. review).

Distribution (Map 94). COLOMBIA (Young 1979; ♂♂, ♀♀, Rio de Oro, Norte de Santander, A. Morales); VENEZUELA (Pifano et al. 1973; Feliciangeli 1988); SURINAME (Martins et al. 1978; Hudson & Young 1985); FRENCH GUIANA (Martins et al. 1978; Léger et al. 1977); BRAZIL (Martins et al. 1978; Fraiha et al. 1978; Bianchardi et al. 1982; Arias & Freitas 1982; Ryan 1986); PERU (Llanos 1973; 1981; Young et al. 1985); ECUADOR (Young 1979; Alexander et al. 1992a,c); BOLIVIA (Le Pont & Desjeux 1986); TRINIDAD (Tikasingh 1975).

Remarks. *Lutzomyia flaviscutellata* is a proven vector of *Leishmania amazonensis* in Brazil and French Guiana (see Young & Lawyer 1987 & Arias et al. 1987). Several arboviruses, including Pacui, Icuaraci and Inhangapi, have been isolated

from wild-caught specimens of *L. flaviscutellata* in Brazil & Trinidad (Aitken et al. 1975).

This species was reported in Aragua State, Venezuela by Ramirez Pérez et al. (1978) but their illustrations are more suggestive of *L. olmeca bicolor*.

The status of specimens from Salvador, Bahia, Brazil, reported as *L. flaviscutellata* by Sherlock & Carnheiro (1962) remains to be clarified (Lewis 1975a).

Lutzomyia (Nyssomyia) reducta Feliciangeli, Ramirez Pérez & Ramirez
Fig. 185

Lutzomyia olmeca reducta Feliciangeli, Ramirez Pérez & Ramirez 1988a: 54 (♂, ♀, Cerro La Neblina, Amazonas, Venezuela). Feliciangeli 1988: 105 (listed).
Lutzomyia reducta Freitas, Barrett & Naiff 1989: 363 (as a distinct species; Brazilian records; nat. infected with *Leishmania amazonensis*).

Distribution (Map 95). VENEZUELA (type locality); BRAZIL (Freitas et al. 1989).

Remarks. Freitas et al. (1989) observed that *L. reducta*, *L. olmeca nociva* and *L. flaviscutellata* occur together in parts of Rondônia and Amazonas states, Brazil. They therefore concluded that *L. reducta* originally described as a subspecies of *L. o. olmeca*, should be treated as a distinct species. One out of 300 *reducta* females that were examined for *Leishmania* in Rondônia State had a heavy infection of *Leishmania amazonensis* (Freitas et al. 1989).

Lutzomyia (Nyssomyia) inornata Martins, Falcão & Silva
Fig. 184 F-H

Lutzomyia inornata Martins, Falcão & Silva 1965: 14 (♂, Guajará-Mirim, Rondônia, Brazil). Martins et al. 1978: 99 (dist.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ready & Fraiha 1981: 709 (keyed). Young & Arias 1982: 134 (cf. to other *flaviscutellata* complex spp.).
Psychodopygus inornatus: Forattini 1971a: 105 (listed); 1973: 471.

Distribution (Map 96). BRAZIL (Martins et al. 1978; Biancardi et al. 1982).

Remarks. We have not seen specimens referable to *L. inornata*, the female of which remains unknown. The record of this species in French Guiana (Léger et al. 1977) was a misidentification of *L. flaviscutellata* (Young & Arias 1982). The males of the two species are not structurally separable with certainty and we believe they may be conspecific.

Lutzomyia (*Nyssomyia*) *olmeca olmeca* (Vargas & Nájera)
Fig. 186

Phlebotomus olmecus Vargas & Najera 1959: 147 (♂, Tabasco. , Mexico; ♀ allotype = *P. ylephiletor* Fchld. & Hertig, not *P. olmecus*).

Phlebotomus apicalis (not *P. apicalis* Floch & Abonnenc): Lewis & Garnham 1959: 89 (♂, ♀, Belize, figs.).

Lutzomyia olmeca: Barretto 1962: 98. Theodor 1965: 184. Williams 1970b: 333 (Belize). Zeledón & Murillo 1983: 280 (Nicaragua); Murillo & Zeledón 1985: 51 (dist. Costa Rica, figs).

Phlebotomus flaviscutellatus (not *P. flaviscutellatus* Mang.): Biagi et al. 1965: 267 (as vector of *Leishmania*, Mexico); 1966a: 141 (♀ fig., Mexico). Biagi 1966: 370 (keyed).

Lutzomyia olmeca olmeca: Fairchild & Theodor 1971: 153 (tax. review, figs., refs.). Lewis 1975a: 501 (mouthpart morphol.); 1975b: 363 (tax.). Ready & Fraiha 1981: 708 (keyed), Young & Arias 1982: 136 (tax.). Porter et al. 1987: 929 (Guatemala). Rowton et al. 1991: 501 (human bait collections, Guatemala).

Psychodopygus olmecus: Forattini 1971a: 105; 1973: 434 (tax., figs.).

Distribution (Map 96). MEXICO (Martins et al. 1978); BELIZE (Williams 1970); GUATEMALA (Porter et al. 1987); HONDURAS (Fairchild & Theodor 1971); NICARAGUA (Zeledón & Murillo 1983); COSTA RICA (Murillo & Zeledón 1985, in part).

Remarks. *Lutzomyia olmeca olmeca* is a proven vector of *Leishmania mexicana* among rodents and man in Mexico and Belize (see Williams 1970 for refs. & detailed information). Its geographic range extends into Costa Rica where J. Murillo & R. Zeledón (pers. comm.) have captured specimens in the Valle de la Estrella, Limon Prov. and in La Virgen District, Heredia Prov.

Lutzomyia (*Nyssomyia*) *olmeca bicolor* Fairchild & Theodor
Fig. 187

Lutzomyia olmeca bicolor Fairchild & Theodor 1971: 157 (♂, ♀, Panama Canal Zone). Lewis 1975b: 363 (tax.). Martins et al. 1978: 101 (dist.). Young 1979: 155 (refs, figs.). Christensen & Herrer 1980b: 523 (feeding habits). Ready & Fraiha 1981: 708 (keyed). Arias & Frietas 1982: 401 (Acre, Brazil). Chaniotis et al. 1982: 3 (Panama, control trials). Young & Arias 1982: 136 (cf. to *L. olmeca nociva*). Christensen et al. 1983: 466 (relative abundance, Panama). Bonfante-Garrido 1983: 740 (Venezuela); 1984: 850 (Venezuela). Young & Rogers 1984: 599 (listed, Ecuador). Feliciangeli 1987a: 122; 1987b: 127; 1988: 104 (coll. data, Venezuela). Alexander et al. 1992c: 124 (Ecuador). Feliciangeli et al. 1993: 652 (egg morphol.).

Lutzomyia flaviscutellata (not *P. flaviscutellatus* Mang.): Ramirez Pérez et al. 1978: 54 (Aragua, Venezuela).

Psychodophygus olmecus (in part): Forattini 1973: 434.

Distribution (Map 96). COSTA RICA (Young 1979; Murillo & Zeledón 1985, in part); PANAMA (Fairchild & Theodor 1971; Young 1979); COLOMBIA (Martins et al. 1978; Young 1979); ECUADOR (Young 1979; Alexander et al. 1992c); PERU (♂, Tambopata Reserve, Madre de Dios, E. Peréz & D. Young); VENEZUELA (Bonfante-Garrido 1984; Feliciangeli 1988; 1987b); BRAZIL (Arias & Freitas 1982).

Remarks. *Lutzomyia olmeca bicolor*, a suspected vector of *Leishmania aristidesi* among rodents and marsupials at Sasardi, Panama (Christensen et al. 1972), is not strongly anthropophilic. It occurs with *L. flaviscutellata* in the Rio de Oro area of Norte de Santander Department, Colombia (A. Morales, pers. comm.), at Leticia, Colombia (Young 1979), and in Madre de Dios Department, Peru. Populations of this subspecies and *L. o. olmeca* are apparently allopatric in Costa Rica (J. Murillo & J. Peterson, pers. comm.).

Lutzomyia (*Nyssomyia*) *olmeca nociva* Young & Arias
Fig. 188

Lutzomyia olmeca nociva Young & Arias 1982: 134 (♂, ♀, near Manaus, Amazonas, Brazil). Ward 1985: 205. Arias et al. 1985: 1101 (neg. for flagellates, Brazil); 1987: 48 (nat. infections of *Leishmania amazonensis*, Manaus, Brazil).

Distribution (Map 96). BRAZIL (Young & Arias 1982; J. Arias, unpubl. records).

Remarks. Females of this subspecies were among the five most common sand flies captured on human bait in the Manaus, Brazil area where some were found naturally infected with *Leishmania amazonensis* (Arias et al. 1987).

Lutzomyia (*Nyssomyia*) *antunesi* (Coutinho)
Fig. 189

Flebotomus antunesi Coutinho 1939: 181 (♂, Manacapurú, Amazonas, Brazil). Barretto 1947a: 185 (full refs.).

Phlebotomus balourouensis Floch & Abonnenc 1944b: 1 (♂, Balouron, French Guiana).

Phlebotomus machicouensis Floch & Abonnenc 1944d: 8 (♀, Machicou, French Guiana); 1952: 184 (redescript.). Martins et al. 1965: 2 (resembles *antunesi*). Theodor 1965: 184 (as synonym of *antunesi*).

Lutzomyia antunesi: Barretto 1962: 97 (listed). Lainson et al. 1976a: 57. Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 97 (refs., dist.). Fraiha et al. 1978: 136 (Brazil). Young 1979: 151 (refs, figs.). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 96 (Colombia). Ready & Fraiha 1981: 709 (keyed). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ramírez Pérez et al. 1982b: 57 (♂, ♀ figs., Tachira, Venezuela). Llanos 1983: 183 (listed, Peru). Lainson et al. 1983: 326 (Marajó

Island, Brazil). Ryan et al. 1984: 547 (nat. infected with promastigotes, Brazil). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 63 (♂, ♀ figs, Brazil). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Feliciangeli 1988: 104 (Venezuela). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Silveira et al. 1991: 128 (nat. *Trypanosoma* infection, Brazil).

Distribution (Map 97). COLOMBIA (Young 1979; Morales & Minter 1981); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1982b; Feliciangeli 1988); TRINIDAD (Aitken et al. 1968; Young 1979); SURINAME (Wijers & Linger 1966); FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); BRAZIL (Fraiha 1978; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Lainson et al. 1983; Ryan 1986); PERU (Llanos 1983; Young et al. 1985); BOLIVIA (♂, ♀, Guayamarin, Beni, J. Velasco).

Remarks. *Lutzomyia antunesi*, an anthropophilic species has been found naturally infected with flagellates in Brazil (Ryan et al. 1984; Silveira et al. 1991). It is widespread in the Amazon basin. Some females from Peru, illustrated and identified as *L. antunesi* by Llanos (1973) actually represented *L. yuilli yuilli*.

Ward (1976) described and illustrated the fourth instar larva of *L. antunesi*. The egg shell structure was earlier illustrated by a SEM micrograph (Ward & Ready 1975).

Lutzomyia (*Nyssomyia*) *hernandezi* (Ortiz)
Fig. 190

Phlebotomus hernandezi Ortiz 1965c: 412 (♂, near Caja Seca, Trujillo, Venezuela).
Psychodopygus hernandezi: Forattini 1971a: 105; 1973: 468 (♂).
Lutzomyia hernandezi: Martins et al. 1978: 99 (refs.). Ramirez Pérez et al. 1979: 259 (♂, ♀, Tachira, Venezuela). Feliciangeli 1980: 246. Ready & Fraiha 1981: 709 (♂, keyed). Ramirez Perez et al. 1982b: 50 (♂, ♀ figs, Tachira, Venezuela). Arias et al. 1984: 326 (cf. to *waltoni*). Young & Morales 1987: 651 (Colombia). Añez et al. 1988: 457 (Mérida, Venezuela). Feliciangeli 1988: 104 (Venezuela).

Distribution (Map 95). VENEZUELA (Ortiz 1965c; Ramirez Pérez et al. 1982b; Añez et al. 1988; Feliciangeli 1988); COLOMBIA (Young & Morales 1987).

Remarks. Both sexes of *L. hernandezi* resemble those of *L. whitmani* but, among other differences noted in the keys, the pronotum is more heavily pigmented in the former species.

Lutzomyia (Nyssomyia) whitmani (Antunes & Coutinho)
Fig. 191

Flebotomus whitmani Antunes & Coutinho 1939: 448 (♂, ♀ Ilheus, Bahia, Brazil). Barretto 1947a: 230 (full refs., synonyms).

Phlebotomus intermedius (not *intermedius* Lutz & Neiva) Floch & Abonnenc 1941a: 2 (♂, French Guiana).

Phlebotomus intermedius longiductus Floch & Abonnenc 1942a: 3 (♂, French Guiana).

Phlebotomus intermedius acutus Floch & Abonnenc 1942a: 3 (♂, French Guiana).

Phlebotomus longiductus (not *longiductus* Parrot) Floch & Abonnenc 1944e: 10 (♂, French Guiana).

Phlebotomus elongatus Floch & Abonnenc 1945d: 1 (new name for *longiductus* Floch & Abonnenc).

Flebotomus elongatus: Barretto 1947a: 197 (refs.).

Lutzomyia elongata: Barretto 1962: 98 (listed). Theodor 1965: 184 (listed). Léger et al. 1977: 223 (as synonym of *whitmani*). Martins et al. 1978: 98. Ready & Fraiha 1981: 710 (as valid species, distinct from *whitmani*).

Lutzomyia whitmani: Barretto 1962: 98 (listed). Theodor 1965: 184 (listed). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Léger et al. 1977: 223 (French Guiana). Martins et al. 1978: 102 (refs., dist.). Lainson et al. 1979: 240 (nat. infect with *Leishmania*, Pará, Brazil). Mayrink et al. 1979: 131 (nat. infected with gregarines, fungi, bacteria, Minas Gerais, Brazil). Léger et al. 1980: 117 (French Guiana). Ready & Fraiha 1981: 708 (keyed). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Ready et al. 1986: 27 (NE Brazil). Vexenat et al. 1986a: 125 (exp. infections with *Leishmania braziliensis*); 1986b: 296 (Bahia, Brazil). Ryan 1986: 69 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (nat. *Leishmania* infections, Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Rosa et al. 1988: 409 (as *Leishmania* vector, Bahia, Brazil). Gomes et al. 1989a: 32 (biting activity). Lainson et al. 1989: 204 (nat. infections of *Le. shawi*, Brazil). Ryan et al. 1990: 786 (nat. leishmanial infections, Brazil). Azevedo et al. 1990: 251 (nat. leishmanial infections, Brazil). Queiroz et al. 1991: 159 (coll. data, Brazil). Hashiguchi et al. 1992: 139 (Paraguay).

Psychodopygus whitmani: Forattini 1971a: 105 (listed); 1973: 425 (♂, ♀ figs., tax., gen. review).

Distribution (Map 98). FRENCH GUIANA (Floch & Abbonnenc 1952: Léger et al. 1977); BRAZIL (Lainson et al. 1976; Martins et al. 1978; Lima et al. 1981; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); PERU (Young et al. 1985); PARAGUAY and ARGENTINA (Martins et al. 1978; Hashiguchi et al. 1992).

Remarks. *Lutzomyia whitmani* has been found naturally infected with *Leishmania braziliensis*, or closely related parasite on several occasions from 1985 to 1987 in the vicinity of Três Braços, Bahia, Brazil where it is a common man-biter (Hoch et al. 1986; Ryan et al. 1990). *Leishmania guyanensis* has been recovered from *whitmani* females in Amazonas and Pará, Brazil where it is regarded as a secondary vector (Arias & Freitas 1978; Lainson et al. 1979). In addition, this sand fly may be a vector of *Le. shawi* in northern Brazil (Lainson et al. 1989).

Forattini (1973) treated *L. elongata* as a junior synonym of *L. whitmani*, an erroneous conclusion according to Ready & Fraiha (1981) owing to differences in the lengths of the genital filaments (6X length of pump for *L. elongata* vs. 3-4.1 for *L. whitmani*). However, measurements of the filament & pump illustration (Fig. 46 of Floch & Abonnenc 1952) indicate that the filaments of *L. elongata*, the holotype, are but 5.1X the pump length. Our examination of the holotype of *L. elongata* in 1987 shed little light on its status. The genital filaments are broken, but the tips are like those of *whitmani*. The head and thorax are crushed, perhaps due to remounting in 1973, and no appendages are complete.

Only this one specimen of *L. elongata* is known and therefore if its genital filament length represents extreme variation of a *L. whitmani* male then the synonym must be upheld. Additional specimens from French Guiana, at or near the type locality, are needed to definitely solve this problem.

The immature stages of *L. whitmani* were studied by Barretto (1941).

Lutzomyia (Nyssomyia) sylvicola (Floch & Abonnenc)
Fig. 192

Phlebotomus sylvestris Floch & Abonnenc (not *sylvestris* Sinton) 1944b: 3 (♂, Saul, French Guiana).

Phlebotomus sylvicolus Floch & Abonnenc 1945d: 1 (new name for *sylvestris* Floch & Abonnenc).

Lutzomyia sylvicola: Barretto 1962: 98 (listed). Martins & Silva 1964: 130 (Acre, Brazil). Theodor 1965: 171 (listed). Ready & Fraiha 1981: 708 (♂ keyed, tax.). Arias & Freitas 1982: 406 (listed, Acre, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus monticolus: Forattini 1973: 474 (as senior synonym of *sylvicolus* Floch & Abonnenc).

Lutzomyia monticola: Léger et al. 1977: 222 (as senior synonym of *sylvicolus*).

Distribution (Map 99). FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); ? BRAZIL (Martins & Silva 1964a).

Remarks. We examined the holotype of *L. sylvicola* (no. 516) from Saul, French Guiana through the courtesy of F. Rodhain, Institute Pasteur, Paris. The specimen was remounted in 1973; the terminalia are clearly visible and in excellent condition. The head is ruptured and palpomeres 3-5 are missing. The scutum, pronotum, and head are well pigmented, apparently unlike the male of *L. sylvicola* (no. 554) from French Guiana that Ready & Fraiha (1981) studied. The genital filaments, although separated from the genital pump of the holotype, are 2.41X the length of the pump, not 3 to 3.5X as stated and illustrated by Floch & Abonnenc (1944b, 1952). The filament tips are downwardly turned, difficult to observe.

It is clear the *L. sylvicola* is distinct from *L. monticola* (Costa Lima), a synonym proposed by Forattini (1973) but shown to be incorrect by Ready & Fraiha (1981). *Lutzomyia hernandezi* is structurally similar to *L. sylvicola* and may prove to be conspecific with it.

The record of *L. sylvicola* from Acre State, Brazil (Martins & Silva 1964) requires confirmation.

Lutzomyia (Nyssomyia) intermedia (Lutz & Neiva)
Fig. 193

Phlebotomus intermedius Lutz & Neiva 1912: 92 (♂, ♀ southern Brazil in states of Rio de Janeiro, São Paulo & Minas Gerais).
Phlebotomus lutzi Manson-Bahr 1925: 144 (name mentioned).
Phlebotomus neivai Pinto 1926: 371 (♂, São Paulo, Brazil).
Phlebotomus mazzai Paterson 1926: 305 (♂, ♀ San Pedro, Jujuy, Argentina).
Flebotomus intermedius: Barretto 1947a: 204 (full refs., synonyms).
Lutzomyia intermedia: Martins, Godoy & Silva 1961c: 310 (southern Brazil). Barretto 1962: 98 (listed). Theodor 1965: 184 (♂, ♀ figs., listed). Martins et al. 1978: 99 (♂, ♀ figs., refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Ready & Fraiha 1981: 708 (keyed). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Rangel et al. 1984: 395 (nat. infection of *Leishmania*, Rio de Janeiro, Brazil). Arias et al. 1984: 326 (cf. to *waltoni*). Barros et al. 1985: 150 (Espirito Santo, Brazil), Rangel et al. 1985c: 219 (lab rearing). Lima 1986: 102 (ecology, Brazil). Oliviera-Neto et al. 1988: 427 (common man-biter near Rio de Janeiro). Gomes et al. 1989a: 32 (biting activity, Brazil). Gomes & Galati 1989: 136 (coll. data). Brazil et al. 1991: 113 (resting sites, chicken coop). Hashiguchi et al. 1992: 139 (Paraguay).
Psychodopygus intermedius: Forattini 1971a: 105 (listed); 1973: 417 (♂, ♀ figs, gen. review). Gomes et al. 1986: 280 (ecology, São Paulo, Brazil); 1989b: 193 (mention).

Distribution (Map 100). BRAZIL; PARAGUAY & ARGENTINA (Martins et al. 1978; Hashiguchi et al. 1992).

Remarks. Females of *L. intermedia* are highly anthropophilic and locally common. Promastigotes, presumably *Leishmania braziliensis*, have been found in naturally infected *L. intermedia* in the states of Rio de Janeiro and São Paulo, Brazil (Forattini & Santos 1952; Forattini et al. 1972; Rangel et al. 1984). Records of this species from Venezuela (Pifano & Ortiz 1952), Colombia (Morales et al. 1969a), northern Brazil (Forattini 1960a), Peru (Root 1934) and French Guiana (see Floch & Abonnenc 1952) represent other *Nyssomyia* species, not *L. intermedia* (Lutz & Neiva).

Barretto (1941) described the immature stages of this species and Carneiro & Sherlock (1964) included the pupa in an identification key.

Lutzomyia (*Nyssomyia*) *anduzei* (Rozeboom)
Fig. 194

Phlebotomus anduzei Rozeboom 1942: 91 (♀, Gran Sabana, Venezuela). Fairchild & Hertig 1959: 121 (Costa Rica, Panama).

Lutzomyia anduzei: Barretto 1962: 98. Theodor 1965: 184. Ward 1976: 228 (larva). Ward & Fraiha 1977: 313 (tax., ♀, figs.). Léger et al. 1977: 217 (dist., French Guiana). Arias & Freitas 1977a: 294 (nat. infections, *Leishmania*); 1977b: 511 (coll. data, Brazil); 1978: 391 (nat. infection *Le. guyanensis*). Martins et al. 1978: 95 (dist., in part). Pajot & Le Pont 1979: 37 (♂, French Guiana, figs.). Lainson et al. 1979: 240 (dissection data, Pará, Brazil). Young 1979: 160 (cf. to *L. umbratilis*). Le Pont et al. 1980: 133 (dissection data, French Guiana). Léger et al. 1980: 117 (French Guiana). Feliciangeli 1980: 246. Fraiha et al. 1981: 702 (cf. to *L. shawi*). Ready & Fraiha 1981: 708 (keyed). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983a: 780 (Pará, Brazil), Murillo & Zeledón 1985: 59 (Costa Rica). Ready et al. 1985: 27. Arias et al. 1985: 1101 (flagellate infections, Brazil). Ryan 1986: 62 (figs., Brazil). Ready et al. 1986: 25 (NE Brazil). Lebbe et al. 1987: 29 (computer aided identification). Ryan et al. 1987a: 356 (dissection data, Brazil). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela). Feliciangeli 1988: 104 (Venezuela records). Rogers et al. 1988: 436 (nat. infection of *Endotrypanum*, Brazil). Le Pont 1990: 671 (coll. data, French Guiana).

Psychodopygus anduzei: Forattini 1971a: 105; 1973: 437 (in part).

Distribution (Map 101). COSTA RICA (Murillo & Zeledón 1987); PANAMA (Fairchild & Hertig 1959); VENEZUELA (Rozeboom 1942; Feliciangeli 1988); FRENCH GUIANA (Léger et al. 1977: Lebbe et al. 1987); BRAZIL (Ward & Fraiha 1977; Martins et al. 1978, in part; Ryan 1986).

Remarks. Before 1977, many citations dealing with this species in Brazil, French Guiana and Suriname referred to *L. umbratilis*, not *L. anduzei*. Ward & Fraiha (1977) discussed these misidentifications.

Three females from Panama (Almirante, Bocas del Toro Prov.) in the Florida State Collection of Arthropods represent the total number of specimens known from that country. They and a single female from Costa Rica (not examined) were identified as *L. anduzei* (Rozeboom) by Fairchild & Hertig (1959). The Panama specimens, although heavily stained, appear to be naturally pale and the spermathecae and ducts closely resemble those of *L. anduzei*.

Arias & Freitas (1978) isolated *Leishmania* (probably *Le. guyanensis*) from wild-caught *L. anduzei* females collected near Manaus, Brazil. Subsequent isolations of this parasite in Pará, Brazil from *L. anduzei*, in addition to other observations on its abundance and feeding habits, indicate that this species is a secondary vector of *Le. guyanensis* (Lainson et al. 1979).

Lutzomyia (*Nyssomyia*) *umbratilis* Ward & Fraiha
Fig. 195

Lutzomyia sp. 260.31 Ward et al. 1973b: 178. Fraiha et al. 1978: 136 (N. Brazil).

Lutzomyia anduzei (not *P. anduzei* Rozeboom): Lainson et al. 1976b: 171. Ward & Fraiha 1977: 313 (refs.).

Lutzomyia umbratilis Ward & Fraiha 1977: 314 (♀, Rio Jari, Pará, Brazil). Arias & Freitas 1978: 391 (nat. infected with *Leishmania guyanensis*, Brazil). Lainson et al. 1979: 240 (nat. infected with *Trypanosoma* & *Leishmania*, Brazil). Young 1979: 160 (tax., figs., refs.). Pajot & Le Pont 1979: 38 (cf. to *anduzei*). Léger et al 1980: 116 (French Guiana). Fraiha et al. 1980a: 21 (Peru). Le Pont et al. 1980: 133 (nat. infected with *Leishmania guyanensis*, French Guiana). Morales & Minter 1981: 96 (Colombia). Ready & Fraiha 1981: 709 (keyed). Fraiha et al. 1981: 702 (cf. to *Shawi*). Lewis & Macfarlane 1981: 181 (mite parasites, Brazil). Le Pont 1982: 269 (seasonal dist., French Guiana). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Travassos da Rosa et al. 1983: 1166 (Munguba virus). Ready et al. 1983a: 780 (Pará, Brazil). Hudson & Young 1985: 418 (Suriname). Feliciangeli et al. 1985: 878 (Venezuela). Ready et al. 1985: 27 (control trials, Brazil). Esterre et al. 1986: 559 (control program, French Guiana). Geoffroy et al. 1986: 486 (resting site study, French Guiana). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 68 (♂, ♀ figs., dist.). Ready et al. 1986: 21 (ecology, Pará, Brazil). Killick-Kendrick 1986: 135 (listed). Ryan et al. 1987a: 356 (dissection results, flagellates, Brazil). Lebbe et al. 1987: 29 (computer aided identification). Young et al. 1987: 589 (nat. infection of *Le. guyanensis*, Colombia). Feliciangeli 1988: 104 (Venezuela). Rogers et al. 1988: 436 (nat. *Endotrypanum* infections, Brazil). Le Pont 1990: 671 (coll. data, French Guiana).

Distribution (Map 102). VENEZUELA (Feliciangeli et al. 1985; Feliciangeli 1988); COLOMBIA (Young 1979; Morales & Minter 1981); SURINAME (Hudson & Young 1985); FRENCH GUIANA (Floch & Abonnenc 1952, as *anduzei*; Geoffroy 1986; other refs. listed above); BRAZIL (Arias & Freitas

1978, 1982; Biancardi et al. 1982; Ready et al. 1986; Ryan 1986); PERU (Fraiha et al. 1980a); BOLIVIA (Le Pont & Desjeux 1986).

Remarks. *Lutzomyia umbratilis* is a proven, and the most important, vector of *Leishmania guyanensis* to man in French Guiana, Northern Brazil and probably elsewhere in Amazónia (see Young & Lawyer 1987 for references). Munguba *Phlebovirus* was isolated from pools of *L. umbratilis* collected at Monte Dourado, Jari, Pará, Brazil (Travassos da Rosa et al. 1983). *Endotrypanum schaudinni*, a sloth parasite, was identified by DNA hybridization in many female flies captured near Manaus, Brazil (Rogers et al. 1988). Females are suitable laboratory hosts for *Le. amazonensis* (Ryan et al. 1986b).

The ecology of this species has been well studied in French Guiana and northern Brazil.

Lutzomyia* (*Nyssomyia*) *edentula (de Leon)
Fig. 196

Phlebotomus edentulous León 1971: 192 (♀, probably El Chaguiton, Esquipulas, Guatemala). Martins et al. 1978: 168 (as inadequately described species).
Lutzomyia edentula: Murillo & Zeledón 1985: 59 (♂, ♀ figs., dist. Costa Rica.

Distribution (Map 100). GUATEMALA (León 1971; 16 Montana del Mico, Rio Blanco, human bait, J. Boshell; ♀ topotypes, C..H. Porter); HONDURAS (15 ♀♀, Tela, Lancetilla Valley, W. Hils); COSTA RICA (Murillo & Zeledón 1985; 2 ♀♀, Moravia, Chirripo, Shannon trap, R. Zeledón); PANAMA (9 ♀♀, El Volcan de Chiriqui, Chiriqui, light traps, F.S. Blanton; 1 ♂, 1 ♀, Palo Santo, Chiriqui, biting man & tree trunk, R. Hartmann; 1 ♀, La Tula, Chiriqui, biting man, R. Hartmann; 1 ♀, Santa Clara, Chiriqui, Shannon trap, R. Hartmann.

Remarks. Through the courtesy of C.H. Porter, we studied two females of *L. edentula* (slides 697 & 963a) from León's collection. These specimens were those that León (1971) described and illustrated but neither was given type status. Both were captured at El Chaguiton, Esquipulas, Guatemala by León on 5 May 1970. We designate slide 963a as the lectotype.

The female of *L. edentula*, in contrast to León's original description, has well-defined horizontal teeth in the cibarium (Murillo & Zeledón 1985 and Fig. of present review). Both sexes differ from those of *L. ylephiletor* and *L. trapidoi* by their heavily infuscated pronotum that is pale in the latter two species. In addition, the female of *L. edentula* has widely tapered individual ducts & wide common duct.

After discovering that *L. edentula* was structurally close to these two other species, we re-examined slide material in the collection at the Florida State

Collection of Arthropods. Two of the *L. ylephiletor* paratypes (♂ slide no. 2953, Palo Santo, Panama & ♀ slide no. 2271, La Tula, Panama) represent not that species but *L. edentula*.

Females of *L. edentula* are anthropophilic and probably, locally common. The species has been captured with *L. trapidoi* and *L. ylephiletor* at Tello, Honduras and solely from higher elevations in Chiriqui Prov., Panama (ca. 1,600 m a.s.l.).

Lutzomyia (*Nyssomyia*) *bibinae* Léger & Abonnenc
Fig. 197

Lutzomyia bibinae Léger & Abonnenc 1988: 136 (♀, Saül, French Guiana).

Distribution (Map 103). FRENCH GUIANA (type locality).

Remarks. This species, known only from a single female captured on a tree trunk, closely resembles *L. edentula* but we have not examined the holotype of *L. bibinae*.

Lutzomyia (*Nyssomyia*) *trapidoi* (Fairchild & Hertig)
Fig. 198

Phlebotomus trapidoi Fairchild & Hertig 1952: 524 (♂, ♀, Almirante, Bocas de Toro, Panama).

Lutzomyia trapidoi: Barretto 1962: 98 (listed). Martins et al. 1978: 102 (refs., dist.). Young 1979: 157 (refs., figs., dist.). Christensen & Herrer 1980b: 523 (feeding habits). Porter & De Foliart 1981: 81 (ecology, Colombia). Ready & Fraiha 1981: 708 (keyed). Morales et al. 1981: 198 (♀ figs., nat. infected with *Leishmania panamensis*, see Young et al. 1987). Chaniotis et al. 1982: 3 (pilot control trial, Panama). Zeledón & Murillo 1983: 280 (Nicaragua). Young & Rogers 1984: 605 (Ecuador). Arias et al. 1984: 326 (cf. to *waltoni*). Murillo & Zeledón 1985: 52 (♂, ♀ figs., dist. Costa Rica). Hashiguchi et al. 1985a: 533 (biting activity, Ecuador); 1985b: 440 (nat. *Leishmania* infections, Ecuador). Chaniotis 1986: 163 (lab. rearing). Young et al. 1987: 589 (nat. infections of *Leishmania panamensis*, Colombia). Loyola et al. 1988: 408 (man biting data, Colombia). Kreutzer et al. 1988: 453 (karyotyping). Rowton et al. 1991: 501 (human bait, Guatemala). Alexander et al. 1992a: 36 (Ecuador records); 1992b: 28 (as possible vector of *Leishmania*, Ecuador); 1992c: 124 (Ecuador). Eshita et al. 1992: 22 (nat. *Leishmania* infections, Ecuador).

Psychodopygus trapidoi: Forattini 1971a: 105 (listed); 1973: 123 (figs., refs., gen. review).

Distribution (Map 95). GUATEMALA (Rowton et al. 1991); HONDURAS (Fairchild & Hertig 1959); NICARAGUA (Zeledón & Murillo 1983); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA

(Young 1979; Morales et al. 1981); ECUADOR (Young 1979; Alexander et al. 1992a,c).

Remarks. Other references pertaining to *L. trapidoi* and written before 1978 are given by Young (1979).

Lutzomyia trapidoi is a putative vector of *Leishmania panamensis* in Panama, Colombia and probably Ecuador (see Young & Lawyer 1987 & Alexander et al. 1992c for specific references). Tesh et al. (1974) isolated many arboviruses from pools of female and male *L. trapidoi* in Panama.

Specimens of this species from the Pacific Coast region of Colombia, notably in Valle Depart., and in Pichincha Prov., Ecuador are darker than elsewhere. Recent isozyme comparisons between these populations (Paláu et al. 1987) suggest they may not be conspecific. The dark form has been identified as *L. ylephiletor* in Colombia by Paláu et al. (1987) and in Ecuador by Arzube (1960) but these populations are probably not conspecific with *L. ylephiletor.*

Lutzomyia* (*Nyssomyia*) *ylephiletor (Fairchild & Hertig)
Fig. 199

Phlebotomus ylephiletor Fairchild & Hertig 1952: 520 (♂, Almirante, Bocas del Toro, Panama; ♀, Cacique, Colon, Panama); 1959: 122 (dist.).
Phlebotomus olmecus Vargas & Nájera 1959: 147 (in part, ♀ only).
Lutzomyia ylephiletor (or *ylephiletrix*): Barretto 1962: 98 (listed). Theodor 1965: 184. Martins et al. 1978: 104 (refs., dist.). Young 1979: 162 (refs., figs., dist.). Ready & Fraiha 1981: 709 (keyed). Zeledón et al. 1982: 276 (Honduras). Christensen et al. 1983: 466 (rel. abundance, Panama). Arias et al. 1984: 326 (cf. to *waltoni*). Murillo & Zeledón 1985: 55 (♂, ♀, figs, dist., Costa Rica). Killick-Kendrick 1986: 135 (listed). Porter et al. 1987: 929 (nat. infection of *Leishmania mexicana*, Guatemala). Rowton et al. 1991: 501 (nat. infections of *Leishmania braziliensis*, Guatemala).
Psychodopygus ylephiletor: Forattini 1971a: 106 (listed); 1973: 123 (figs., dist., tax.).

Distribution (Map 99). MEXICO (Vargas & Nájera 1953b; Fairchild & Hertig 1959); BELIZE (Williams 1970; Martins et al. 1978); GUATEMALA (Porter et al. 1987); HONDURAS (Fairchild & Hertig 1959; Zeledón et al. 1982); NICARAGUA (Fairchild & Hertig 1959); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979).

Remarks. The recent discovery of *Leishmania mexicana* in a naturally infected female of *L. ylephiletor* from Guatemala (Porter et al. 1987) represents the first isolation of this parasite from a sand fly, other than *L. o. olmeca*, and indicates that more studies are needed to clarify the epidemiology of cutaneous leishmaniasis caused by *Leishmania mexicana* in Guatemala. *Lutzomyia*

ylephiletor is one of the suspected vectors of *L. panamensis* in Panama (Christenson & Herrer 1973) and in Costa Rica (Zeledón 1985). Four *L. ylephiletor*, out of 6,413 females examined in Guatemala, had natural infections of flagellates, 3 of which proved to be *Leishmania braziliensis*; the other remained unidentified (Rowton et al. 1991).

Lutzomyia (*Nyssomyia*) *yuilli yuilli* Young & Porter
Fig. 200 A-I, K

Lutzomyia yuilli Young & Porter 1972: 524 (♂, ♀, Rio Anori, Antioquia, Colombia). Ward & Ready 1975: 128 (egg). Llanos et al. 1975b: 669 (Peru). Lainson et al. 1976a: 57 (nat. flagellate infection, Mato Grosso, Brazil). Martins et al. 1978: 104 (dist., refs.). Fraiha et al. 1978: 136 (Brazil). Abonnenc et al. 1979: 75 (cf. to *L. yuilli pajoti*). Young 1979: 164 (tax. review, refs). Fraiha et al. 1980a: 21 (Peru). Lewis & Macfarlane 1981: 708 (keyed). Ready & Fraiha 1981: 708 (keyed). Porter & DeFoliart 1981: 81 (man biting habits, Colombia). Morales & Minter 1981: 96 (Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Llanos 1983: 183. Young & Rogers 1984: 599 (Ecuador). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 71 (♂, ♀, figs., Pará, Brazil). Vexenat et al. 1986b: 295 (Bahia, Brazil, = *L. fraihai*). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Alexander et al. 1992c: 124 (Ecuador records).

Lutzomyia antunesi (not *P. antunesi* Coutinho): Llanos 1973: 42 (♀ figs., Peru).

Lutzomyia fraihai: Martins, Falcão & Silva 1979a: 357 (♂, ♀, Três Braços, Bahia, Brazil). Fraiha et al. 1981: 702 (cf. to *shawi*).

Distribution (Map 104). COLOMBIA (Young 1979; Morales & Minter 1981); ECUADOR (Young 1979; Alexander et al. 1992c); PERU (Fraiha et al. 1980a; Llanos 1983; Young et al. 1985; Pérez et al. 1991); BRAZIL (Lainson et al. 1976; Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); BOLIVIA (Le Pont & Desjeux 1986); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. A pale sand fly, *L. y. yuilli* is widespread, locally common, in forests in South America. Flagellates found in naturally infected females in Brazil (Lainson et al. 1976; Arias et al. 1985) have not been identified with certainty.

Ward & Ready (1975) illustrated (SEM micrograph) the egg surface structure of *L. y. yuilli*.

Lutzomyia (*Nyssomyia*) *yuilli pajoti* Abonnenc, Léger & Fauran
Fig. 200 J

Phlebotomus sp. de Souvenir, Floch & Abonnenc 1944d: 9 (♀, Souvenir, Haute-Mana, French Guiana)

Lutzomyia yuilli pajoti Abonnenc, Léger & Fauran 1979: 75 (♂, ♀, Saul, French Guiana). Léger et al. 1980: 116 (French Guiana). Ready & Fraiha 1981: 708 (keyed). Ready et al. 1983a: 780 (N. Brazil). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 25 (N. Brazil). Ryan 1986: 70 (♂, ♀, figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 104). FRENCH GUIANA (Floch & Abonnenc 1944d; Abonnenc et al. 1979; Léger et al 1980); SURINAME (Hudson & Young 1985); BRAZIL (Ryan 1986); PERU (♂♂, ♀♀, near Iquitos, Loreto).

Remarks. Léger et al (1980) captured females of *L. y. pajoti* on human bait in French Guiana. One of us (D.Y.) recently identified males and females from northern Peru collected by E. Rogers & R. Falcon who will give specific information in a forthcoming paper. The nominate subspecies was taken near the same locality, indicating that *L. y. pajoti* should be treated as a full species.

Lutzomyia* (*Nyssomyia*) *waltoni Arias, Freitas & Barrett
Fig. 201

Lutzomyia waltoni Arias, Freitas & Barrett 1984: 325 (♂, ♀, near Ji-Paraná, Rôndonia, Brazil).

Distribution (Map 95). BRAZIL (Arias et al. 1984).

Remarks. This pale species is readily identified by the relatively long palpomere 5 and sexual character states (Arias et al. 1984).

Lutzomyia* (*Nyssomyia*) *richardwardi Ready & Fraiha
Fig. 202 A-F

Lutzomyia sp. 260.44 Ward & Ready 1975: 128 (egg descript.). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (coll. data, Brazil).
Lutzomyia richardwardi Ready & Fraiha 1981: 705 (♂, ♀, Pará, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young et al 1985: 143 (Madre de Dios, Brazil). Ryan 1986: 66 (♂, ♀, figs., dist., Pará, Brazil). Young & Morales 1987: 664 (Meta, Colombia).

Distribution (Map 100). BRAZIL (Lainson et al 1976b; Fraiha et al 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); PERU (Young et al. 1985); COLOMBIA (Young & Morales 1987).

Remarks. The males of *L. richardwardi* and *L. shawi* are distinguished by the distribution of pigmentation of the thorax (see keys). Males from the Tambopata Reserve, Madre de Dios, Peru (Young et al. 1985) were provisionally identified as *L. richardwardi* but we are now confident of these determinations.

Lutzomyia* (*Nyssomyia*) *shawi Fraiha, Ward & Ready
Fig. 202 G-I

Lutzomyia sp. 260.43. Ward et al. 1973b: 178 (Pará, Brazil). Ward & Ready 1975: 128 (egg descript.). Fraiha et al. 1978: 136 (coll. data, Brazil).

Lutzomyia shawi Fraiha, Ward & Ready 1981: 699 (♂, ♀, Serra dos Carajas, Pará, Brazil). Ready & Fraiha 1981: 708 (keyed). Ryan 1986: 67 (♂, ♀ figs., dist. Pará, Brazil). Ryan et al. 1986b: 165 (lab. host of *Le. amazonensis*). Le Pont & Desjeux 1986: 314 (nat. flagellate infections, Bolivia). Ryan et al. 1987a: 356 (nat. *Leishmania* infections, Brazil).

Distribution (Map 103). BRAZIL (Fraiha et al. 1981; Ryan 1986); BOLIVIA (Le Pont & Desjeux 1986); PERU (Young et al. 1985; Pérez et al. 1991).

Remarks. In Bolivia, Le Pont & Desjeux (1986) found peripylarian flagellate infections in several sand flies including four that were identified as a species near *L. shawi*. Parasites from at least one of these sand flies was presumed to be *Leishmania* based on symptoms exhibited by an inoculated hamster. Ryan et al. (1987a) identified *Leishmania*, isolated from *L. shawi* in Brazil, as *Leishmania braziliensis*-like parasites.

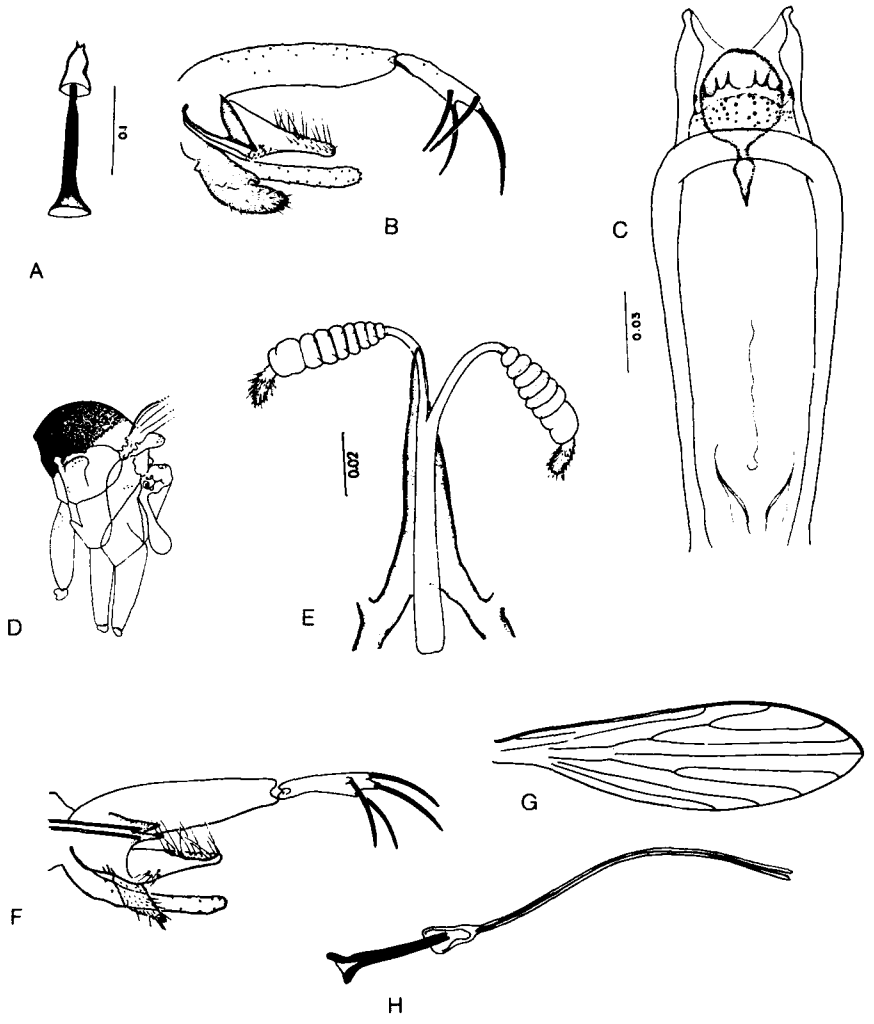


FIG. 184. ***Lutzomyia flaviscutellata.*** A. Genital pump, same scale as B; B. Male terminalia; C. Female cibarium; D. Thorax; E. Spermathecae (fig. E from Young & Arias 1982).
Lutzomyia inornata. F. Male terminalia; G. Male wing; H. Genital pump & filaments (all figs. from Martins et al. 1965).

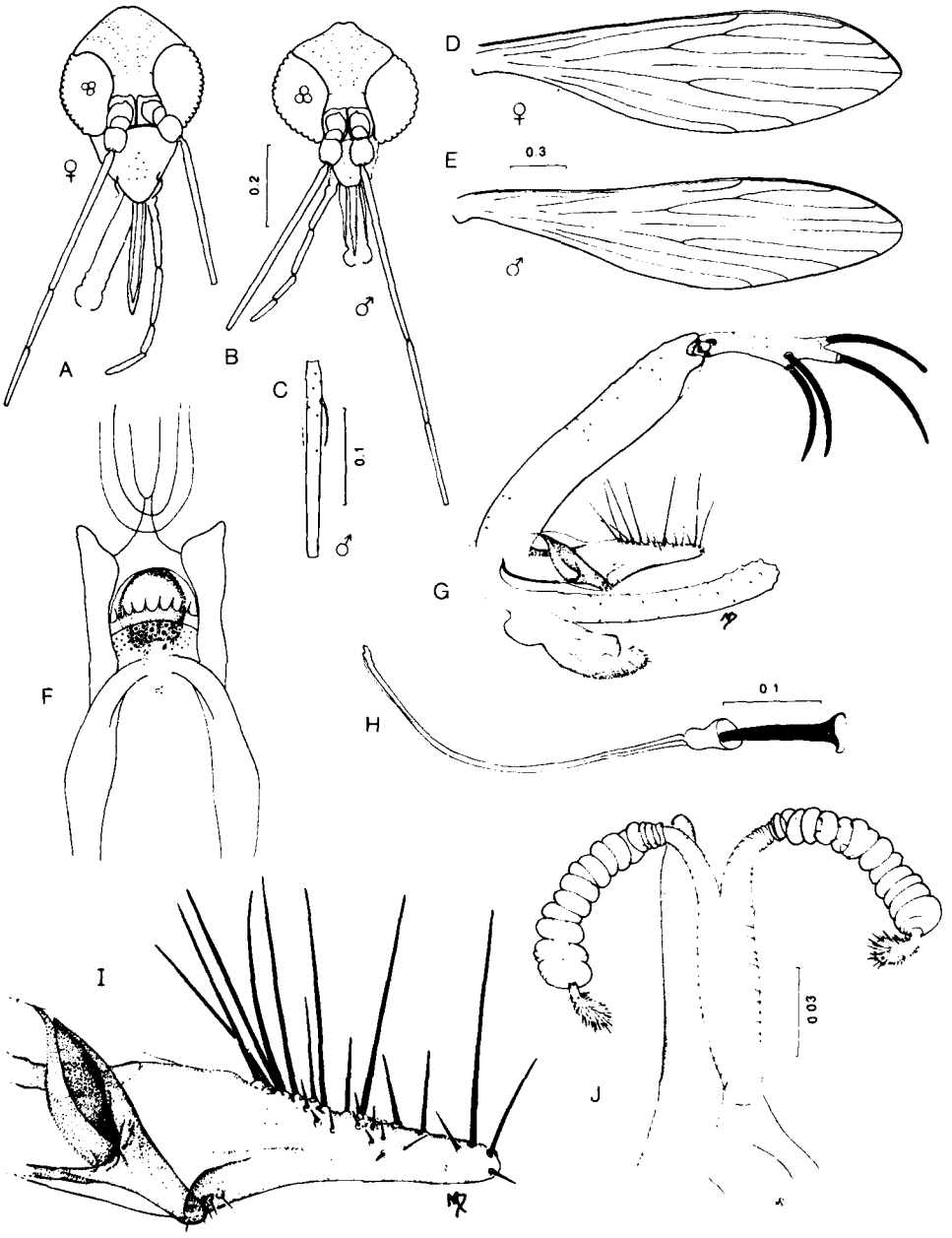


FIG. 185. ***Lutzomyia reducta.*** A. Female head. B. Male head; C. Male flagellomere; D. Female wing; E. Male wing; F. Cibarium; G. Male terminalia; H. Genital pump & filaments; I. Paramere; J. Spermathecae (from Feliciangeli et al. 1988a).

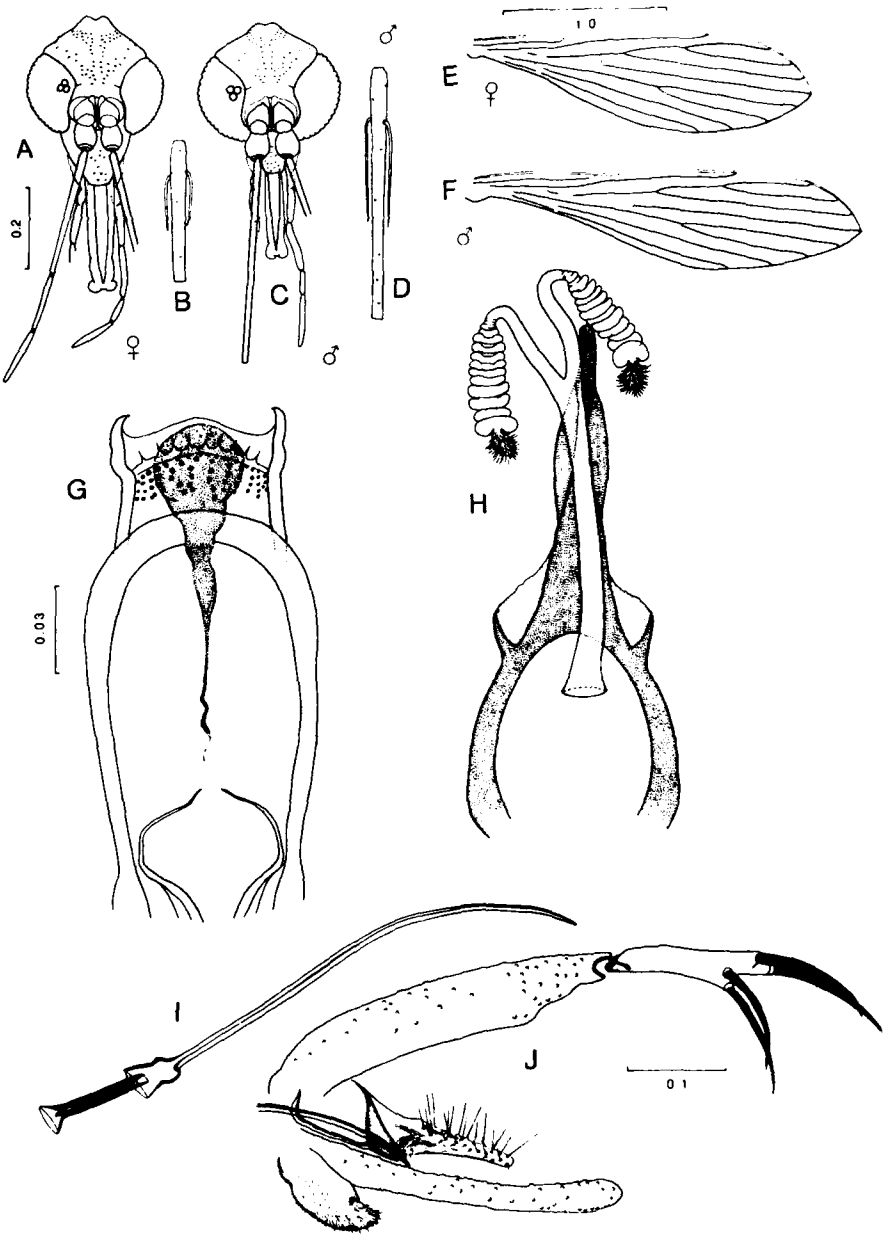


FIG. 186. ***Lutzomyia olmeca olmeca.*** A. Female head; B. Female flagellomere; C. Male head; D. Male flagellomere; E. Female wing; F. Male wing; G. Female cibarium; H. Spermathecae; I. Genital pump & filaments; J. Male terminalia.

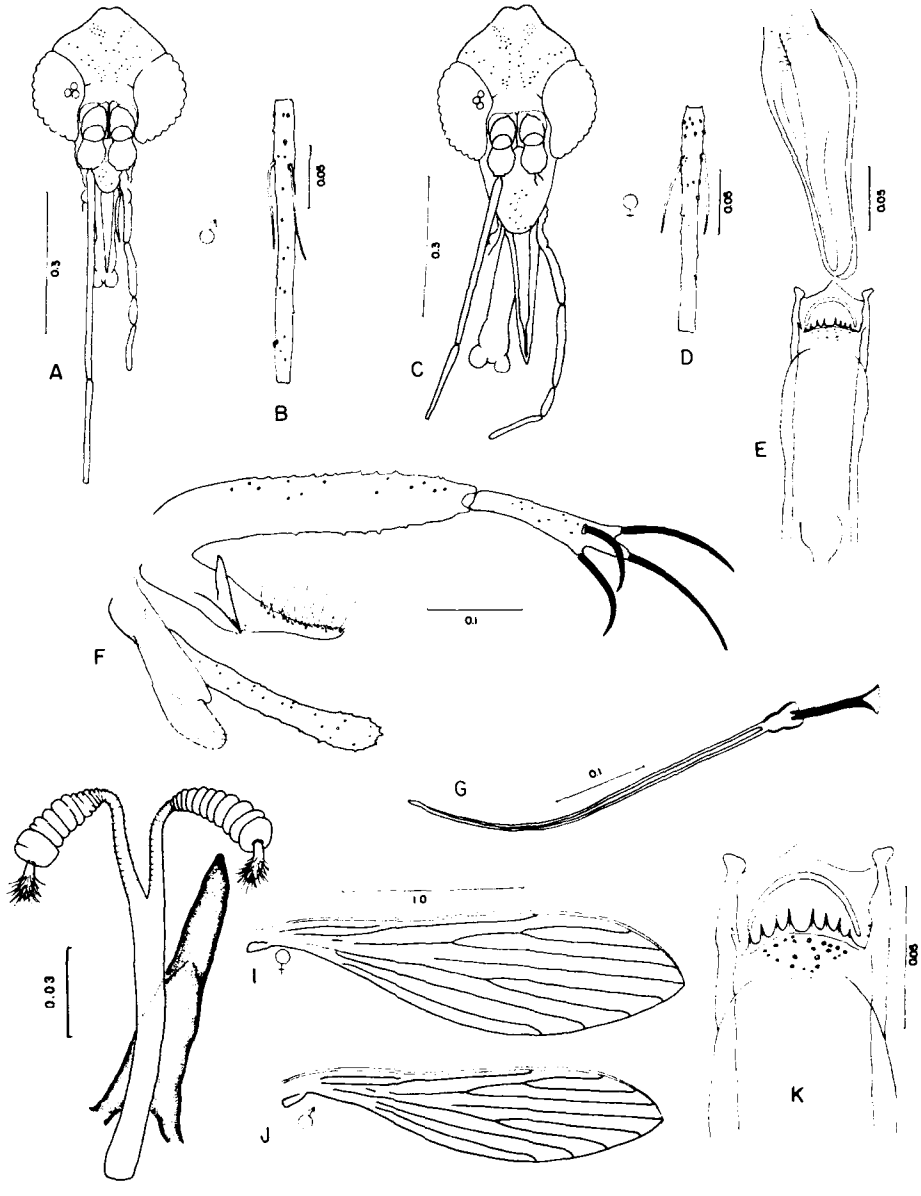


FIG. 187. ***Lutzomyia olmeca bicolor.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (fig. H from Young & Arias 1982; others from Young 1979).

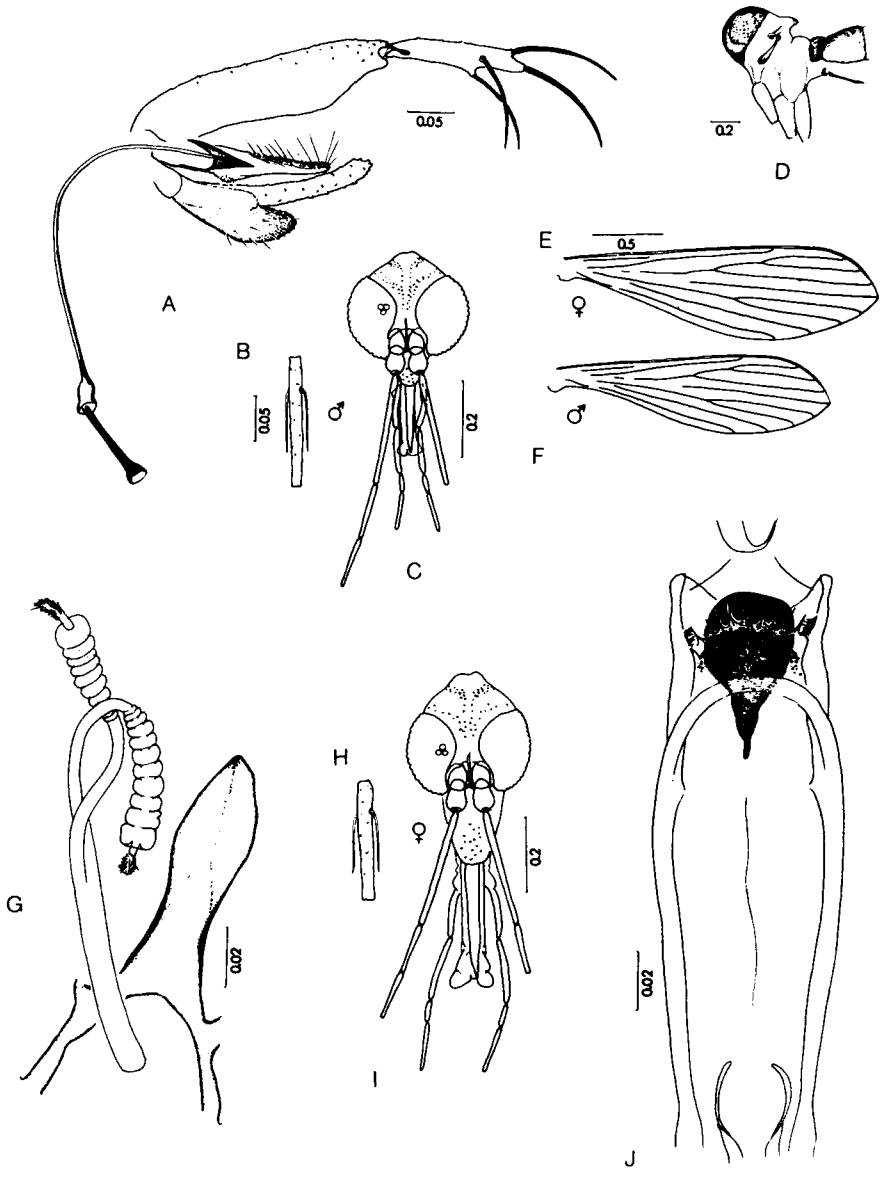


FIG. 188. ***Lutzomyia olmeca nociva.*** A. Male terminalia; B. Male flagellomere II; C. Male head; D. Thorax & proximal part of abdomen; E. Female wing; F. Male wing; G. Spermathecae; H. Female flagellomere II; I. Female head; J. Female cibarium (all figs. from Young & Arias 1982).

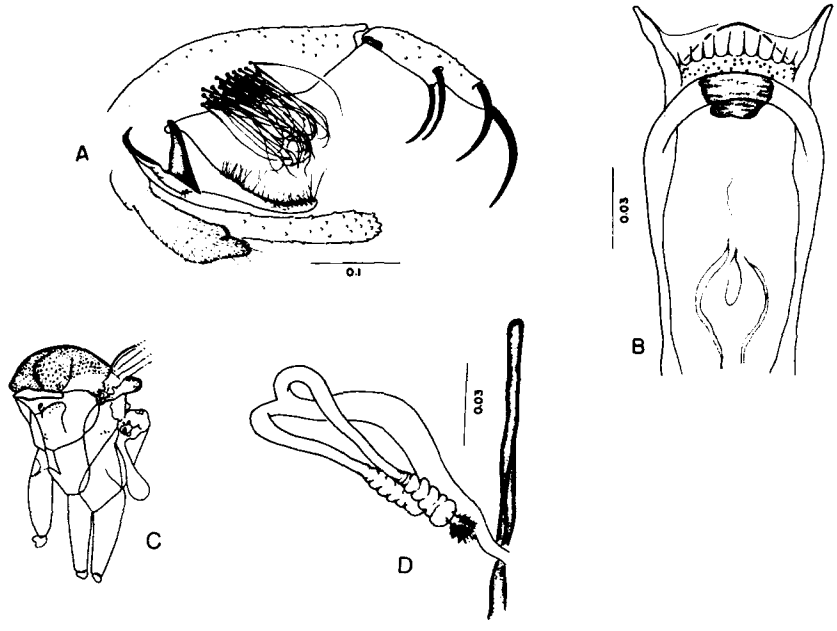


FIG. 189. ***Lutzomyia antunesi.*** A. Male terminalia; B. Female cibarium; C. Thorax; D. Spermathecae (all figs. except C from Young 1979).

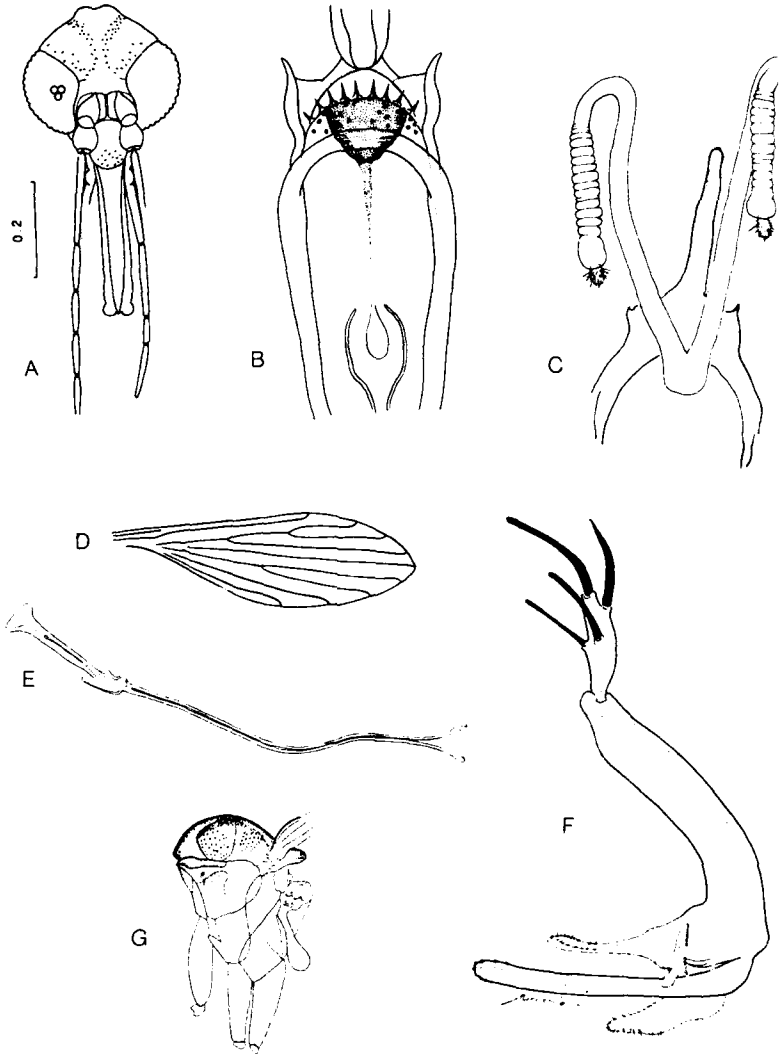


FIG. 190. ***Lutzomyia hernandezi.*** A. Female head; B. Female cibarium; C. Spermathecae; D. Male wing; E. Genital pump & filaments; F. Male terminalia; G. Female thorax (male figs. from Ramirez Pérez et al. 1979).

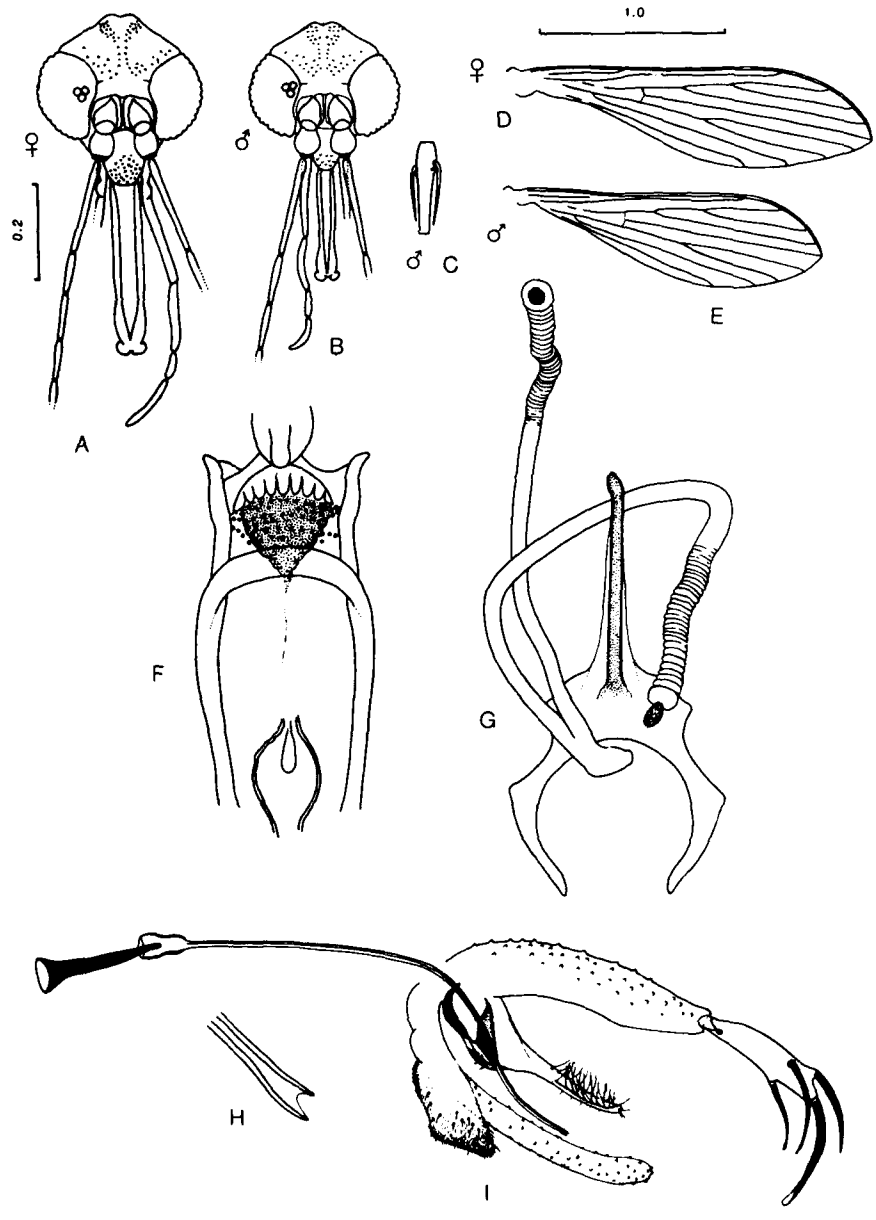


FIG. 191. ***Lutzomyia whitmani.*** A. Female head; B. Male head; C. Male flagellomere II; D. Female wing; E. Male wing; F. Female cibarium; G. Spermathecae; H. Tip of genital filament; I. Male terminalia.

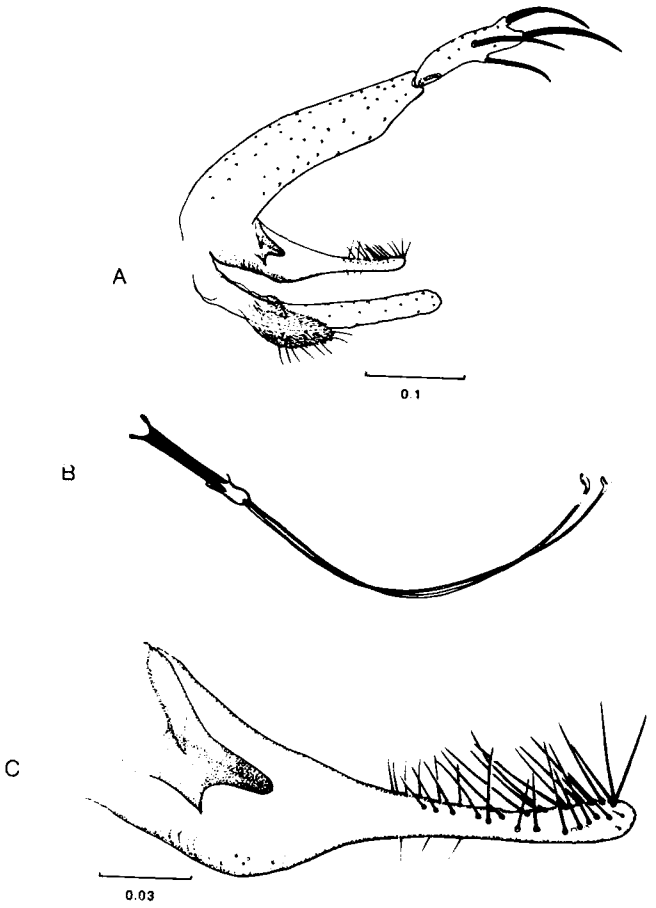


FIG. 192. ***Lutzomyia sylvicola***. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

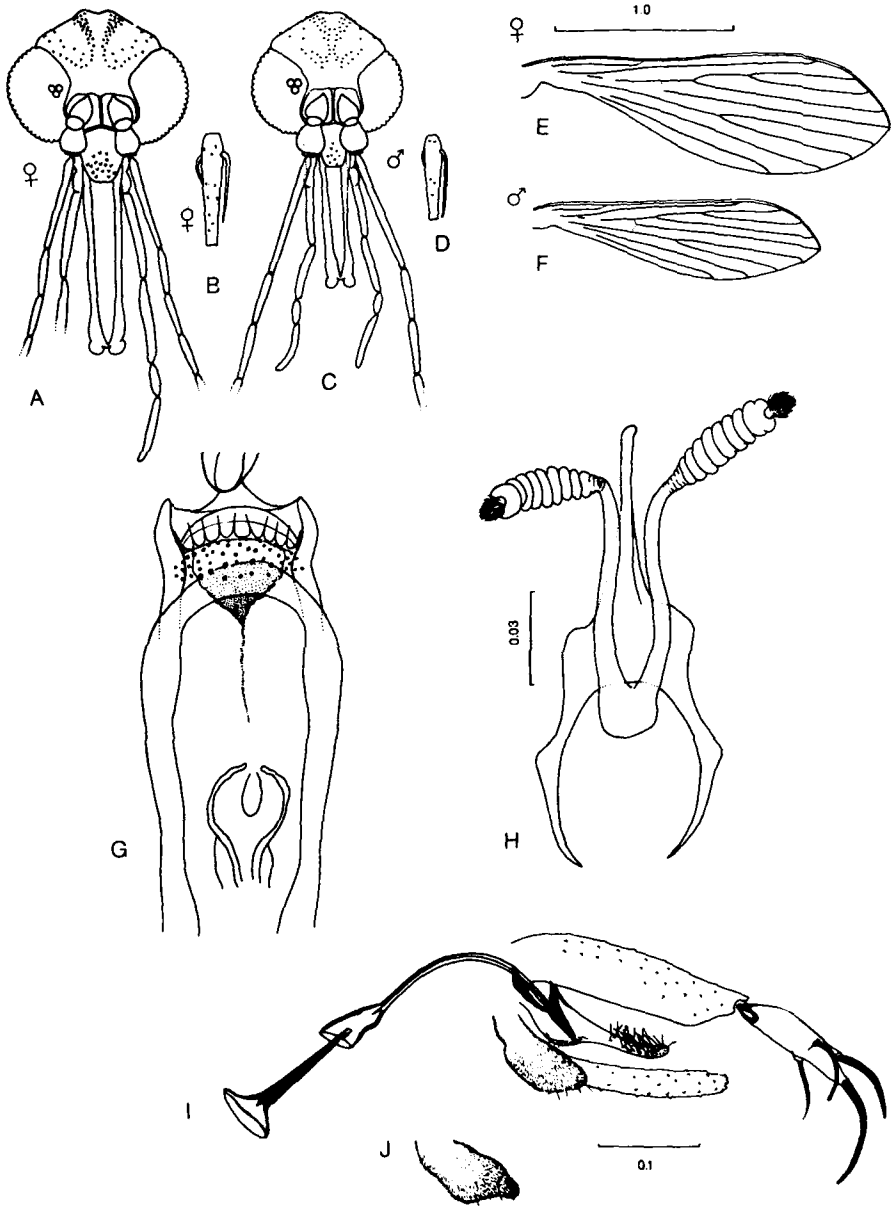


FIG. 193. ***Lutzomyia intermedia.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Female cibarium; H. Spermathecae; I. Male terminalia; J. Cercus.

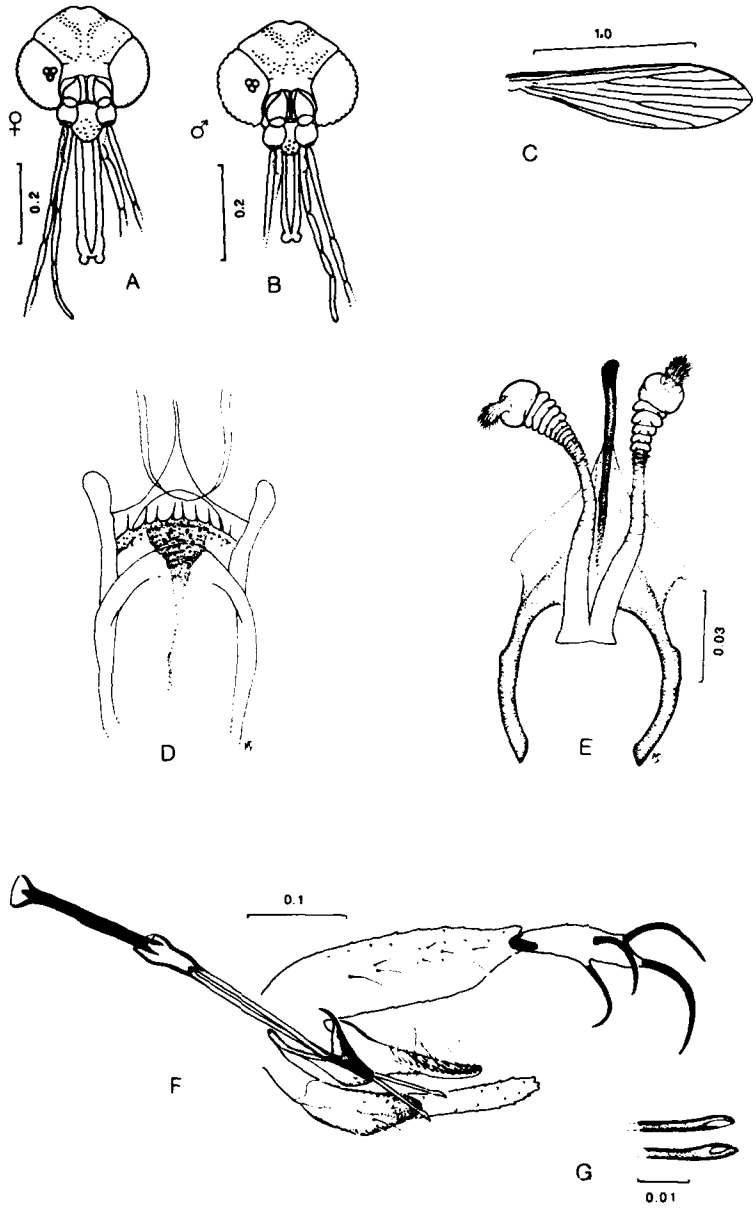


FIG. 194. ***Lutzomyia anduzei.*** A. Female head; B. Male head; C. Male wing; D. Female cibarium; E. Spermathecae; F. Male terminalia; G. Tips of genital filaments.

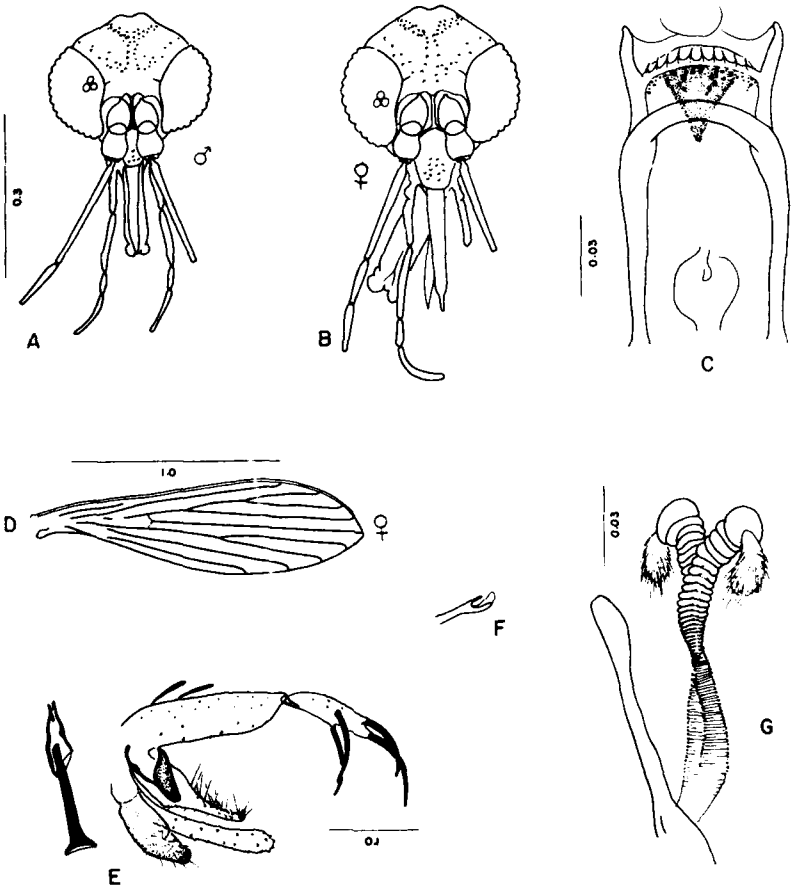


FIG. 195. ***Lutzomyia umbratilis***. A. Male head; B. Female head; C. Female cibarium; D. Female wing; E. Male terminalia with genital pump; F. Tip of genital filament; G. Spermathecae (from Young 1979).

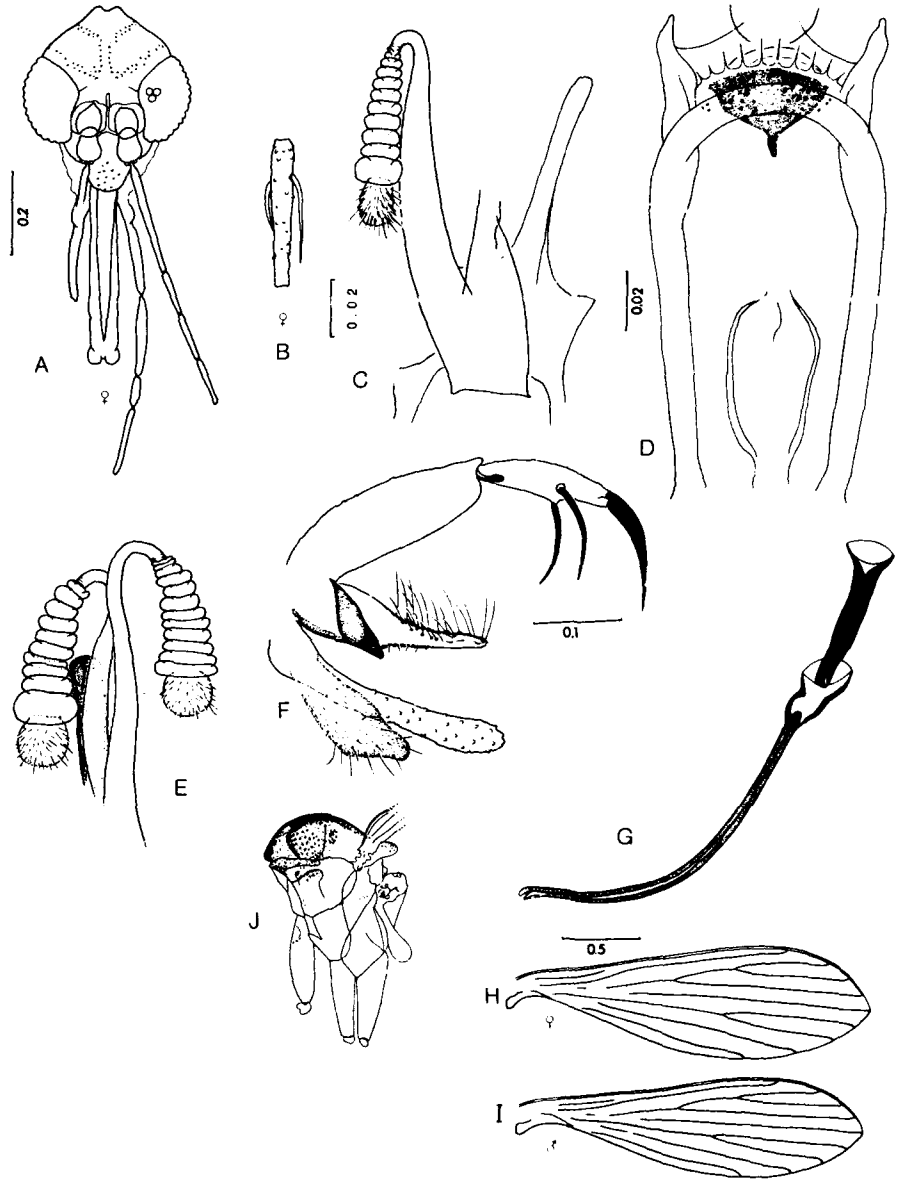


FIG. 196. ***Lutzomyia edentula.*** A. Female head; B. Female flagellomere II; C. Spermathecae; D. Female cibarium; E. Spermathecae, from type specimen; F. Male terminalia; G. Genital pump & filaments; H. Female wing; I. Male wing; J. Thorax.

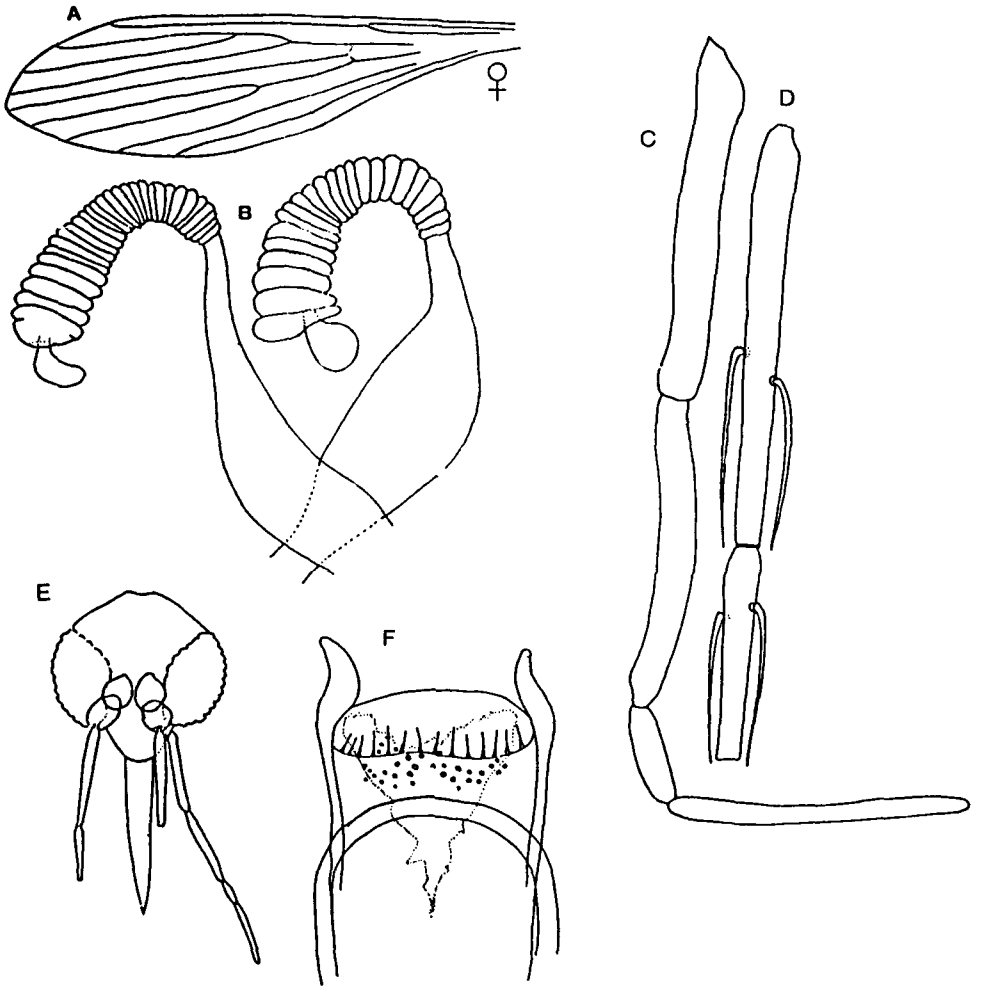


Fig. 197. ***Lutzomyia bibinae.*** A. Female wing; B. Spermathecae; C. Palpomere; D. Flagellomeres I & II; E. Female head; F. Cibarium (Figs. from Léger & Abonnenc 1988).

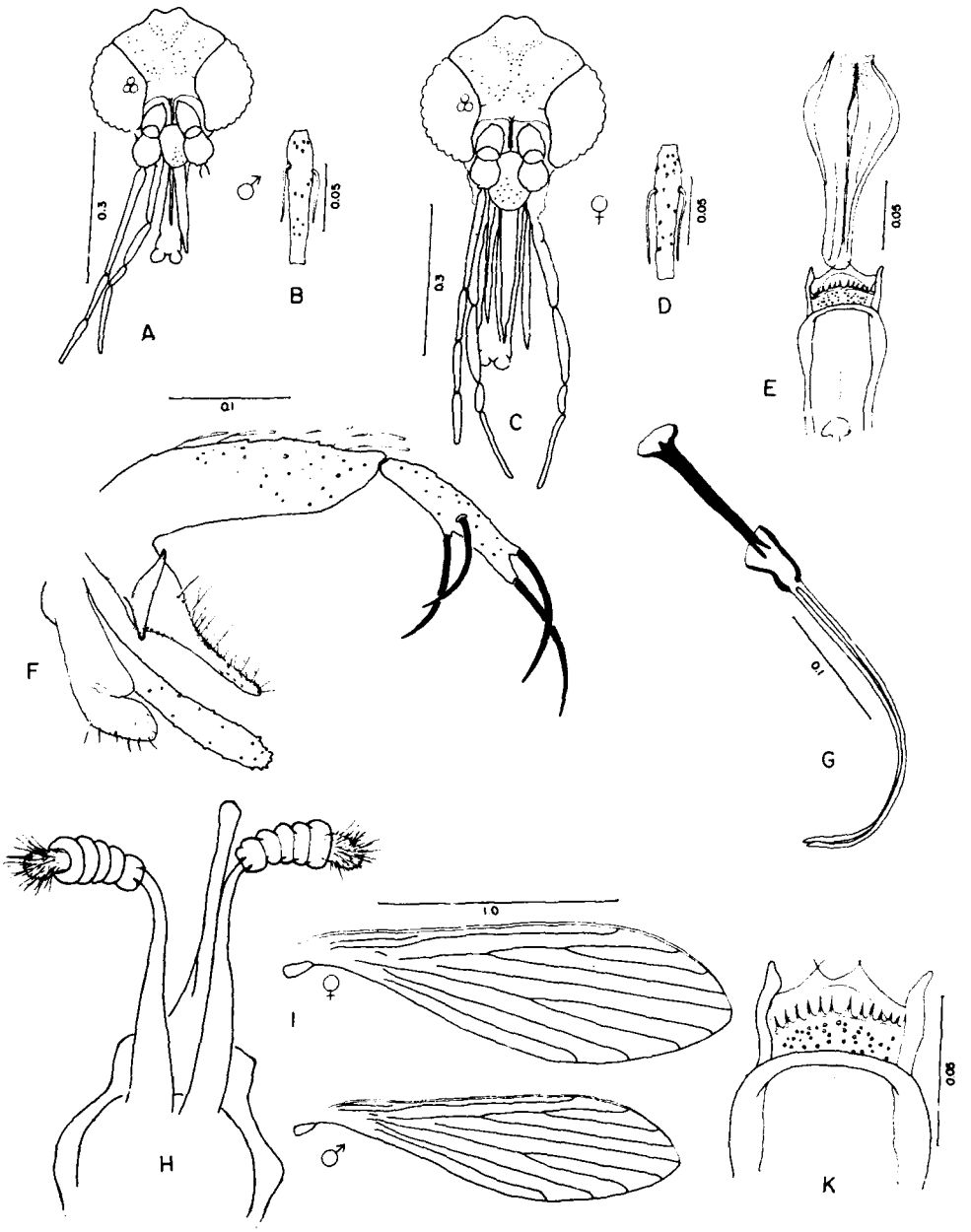


FIG. 198. ***Lutzomyia trapidoi.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (all figs. except H, from Young 1979).

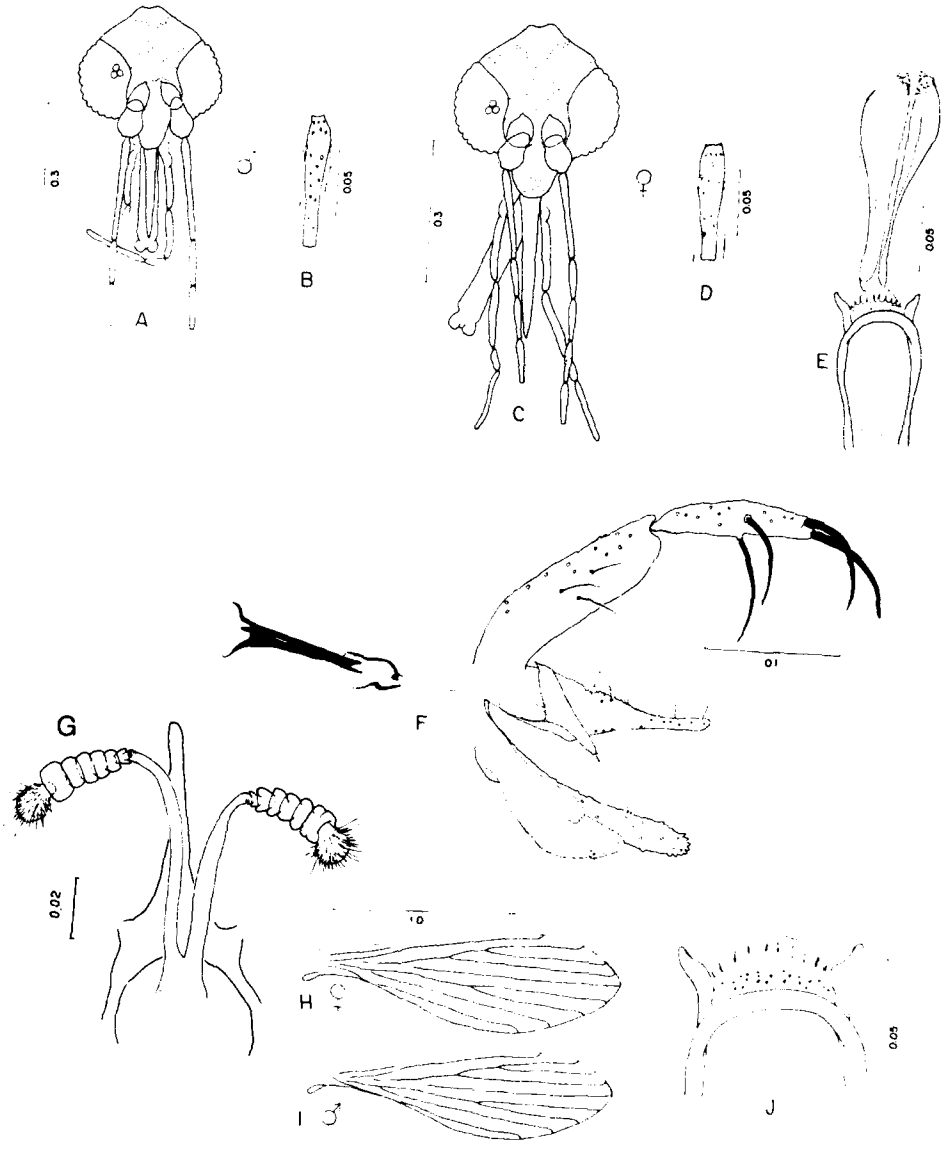


FIG. 199. ***Lutzomyia ylephiletor.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Spermathecae; H. Female wing; I. Male wing; J. Female cibarium (all figs. except G from Young 1979).

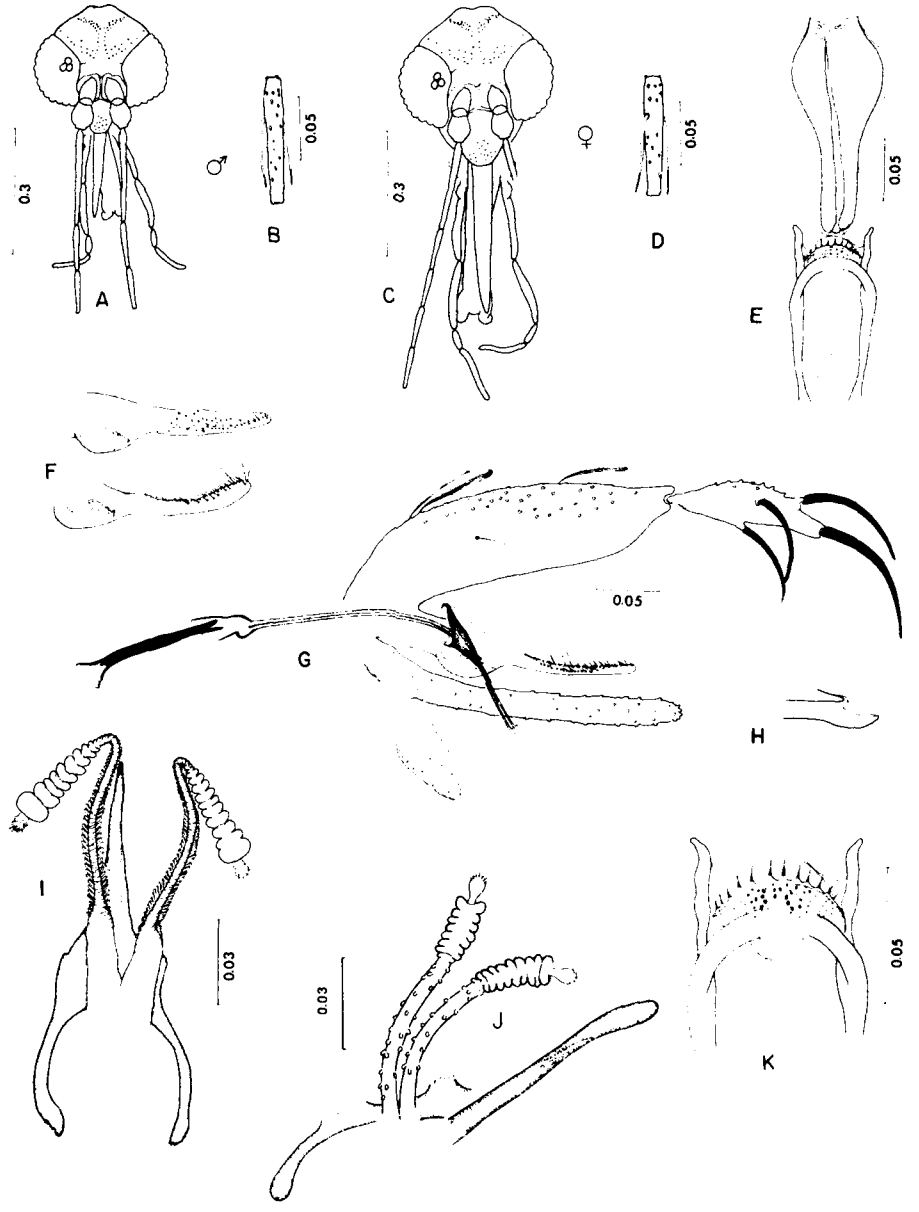


FIG. 200. ***Lutzomyia yuilli yuilli.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Parameres; G. Male terminalia; H. Tip of genital filament; I. Spermathecae; K. Female cibarium (all figs. from Young & Porter 1972).
Lutzomyia yuilli pajoti. J. Spermathecae.

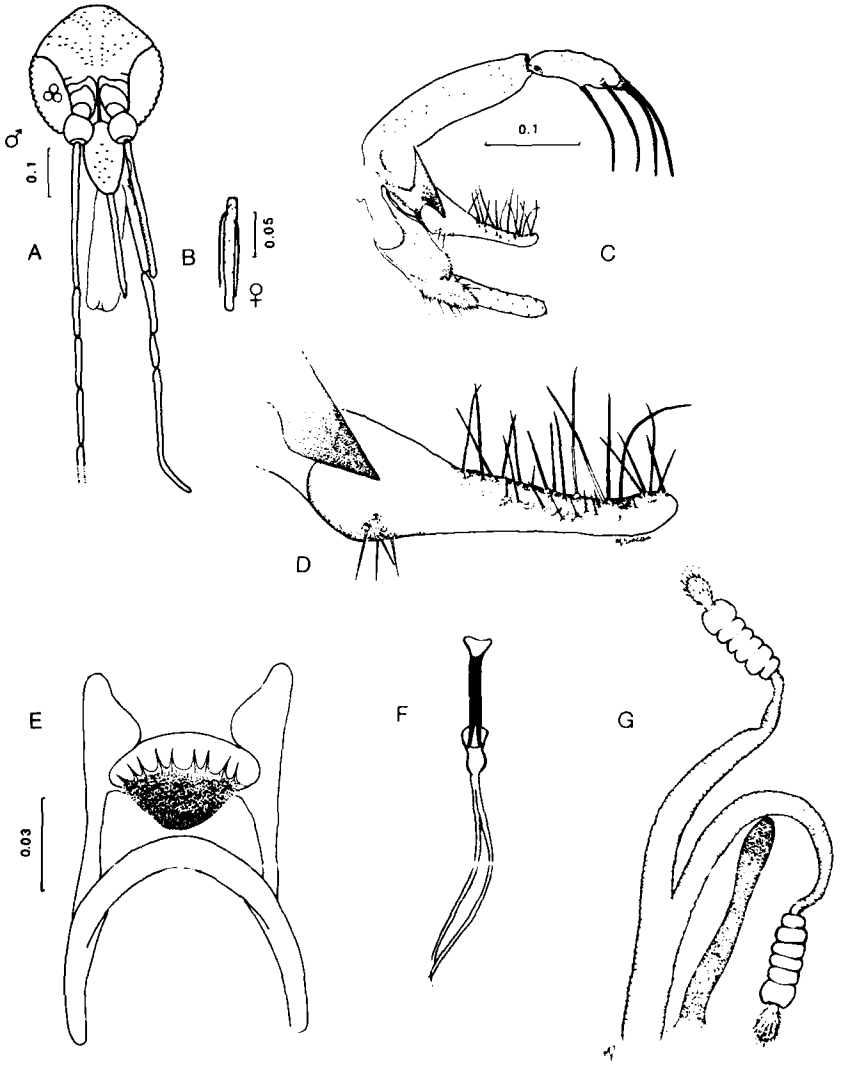


FIG. 201. ***Lutzomyia waltoni.*** A. Male head; B. Female flagellomere II; C. Male terminalia; D. Paramere; E. Female cibarium; F. Genital pump & filaments; G. Spermathecae.

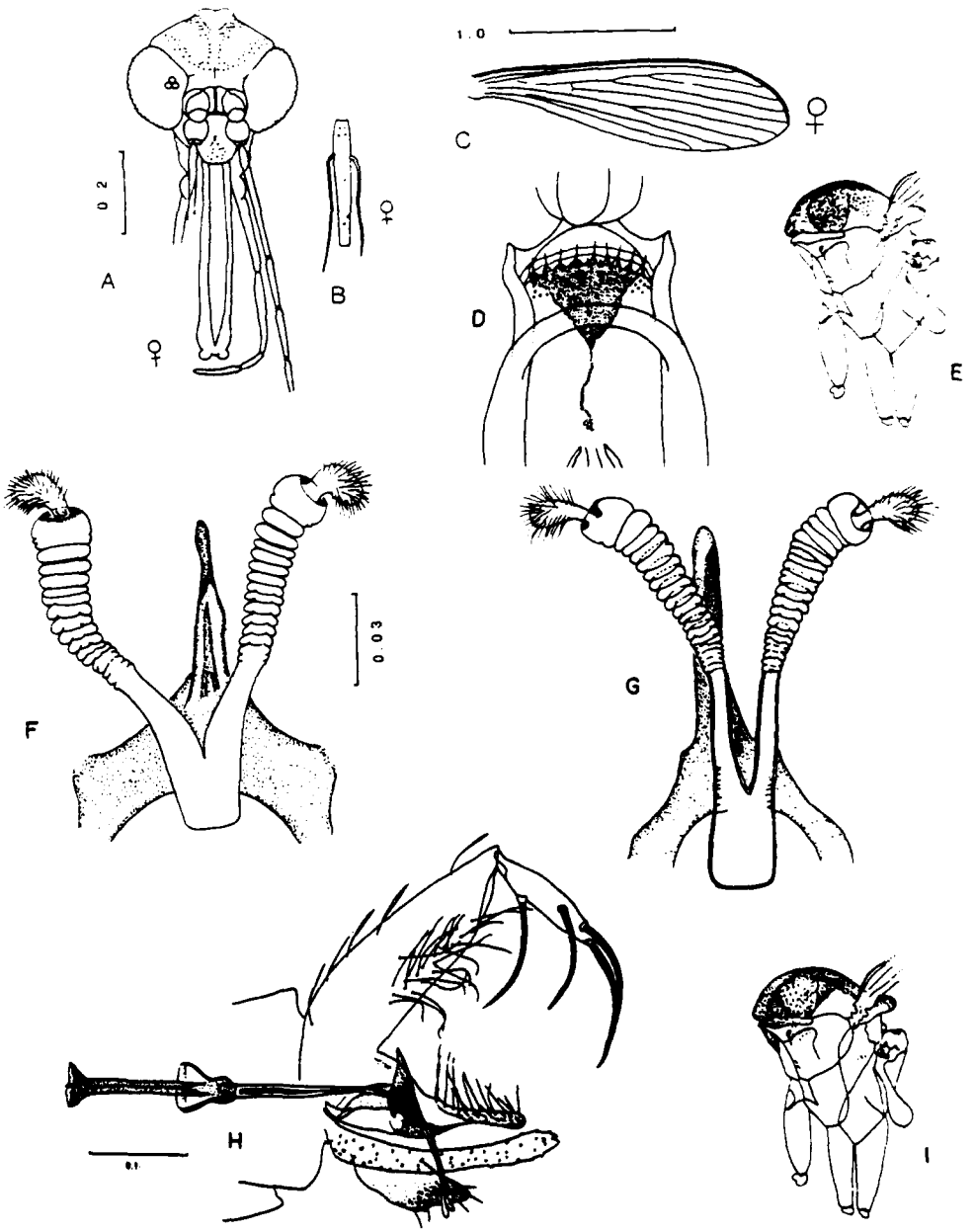
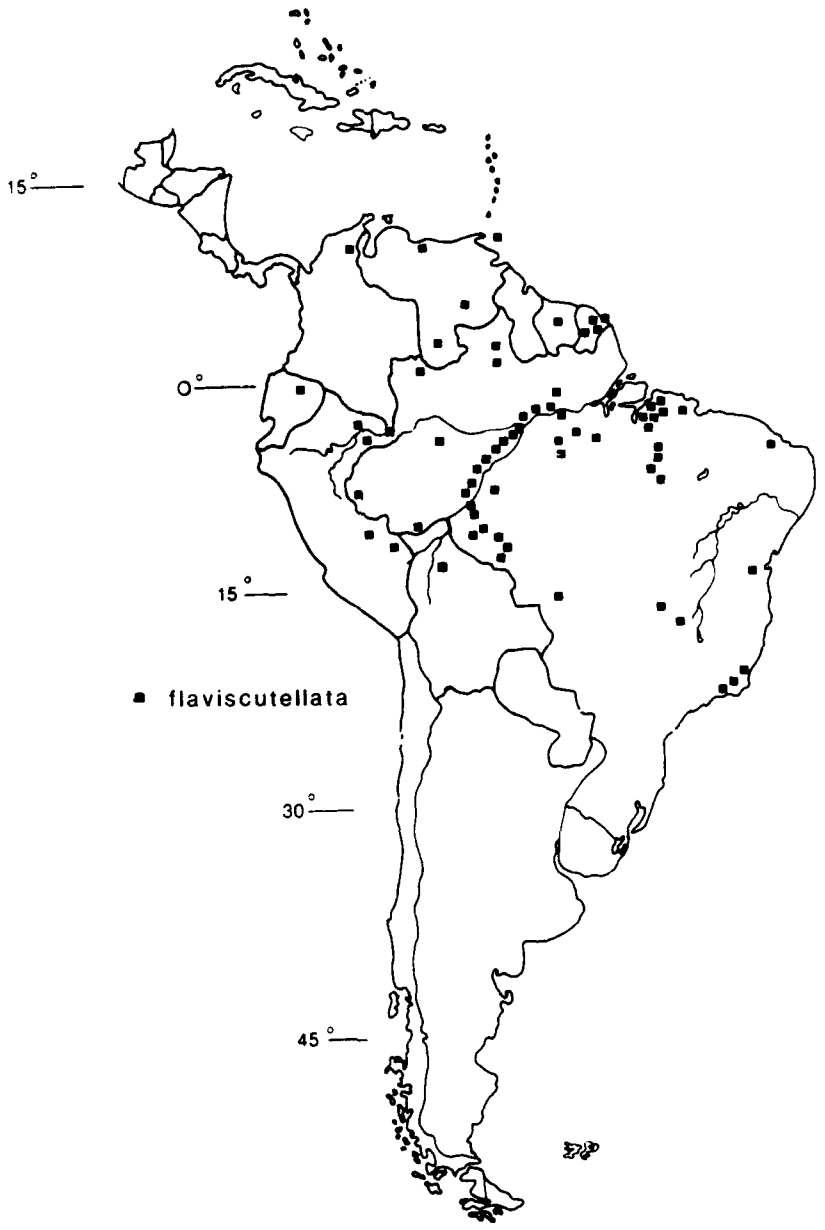
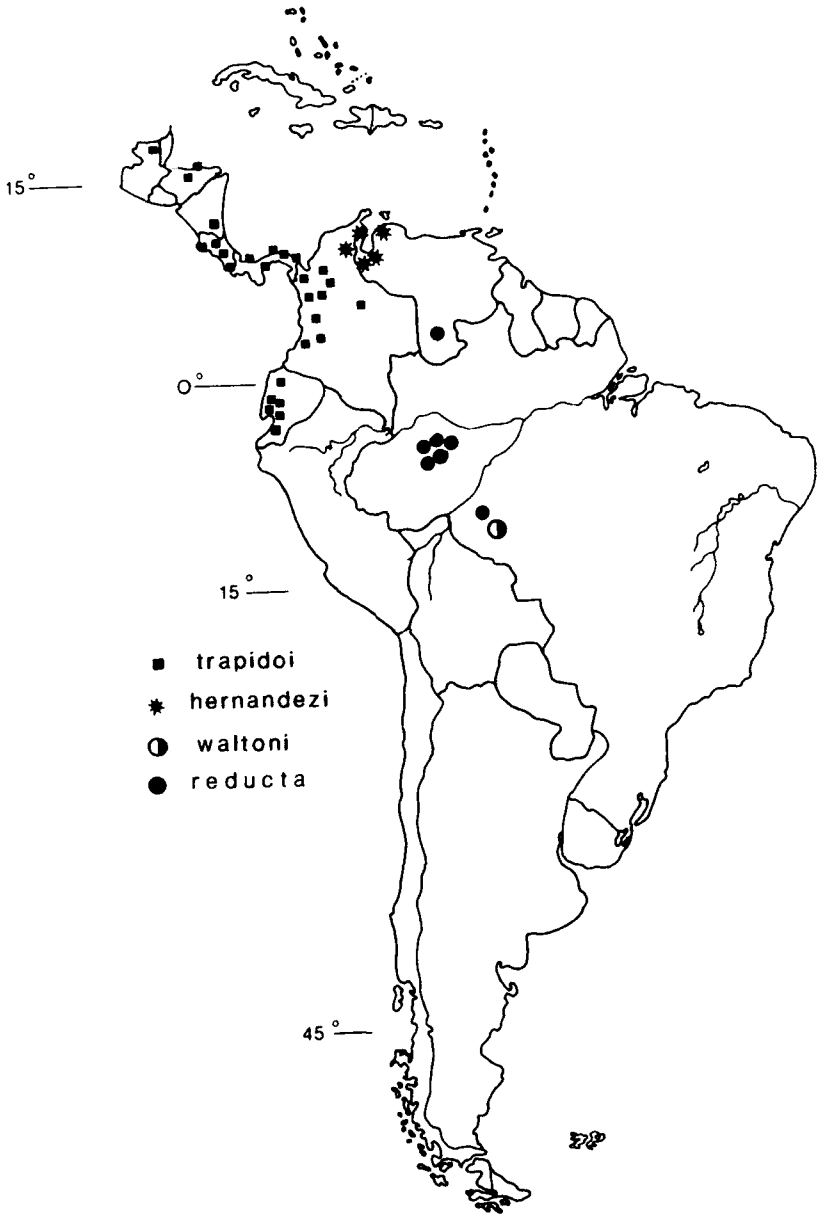


FIG. 202. ***Lutzomyia richardwardi.*** A. Female head; B. Female flagellomere II; C. Female wing; D. Female cibarium; E. Thorax; F. Spermathecae.
Lutzomyia shawi. G. Spermathecae; H. Male terminalia; I. Thorax (Fig. H from Fraiha et al. 1981).



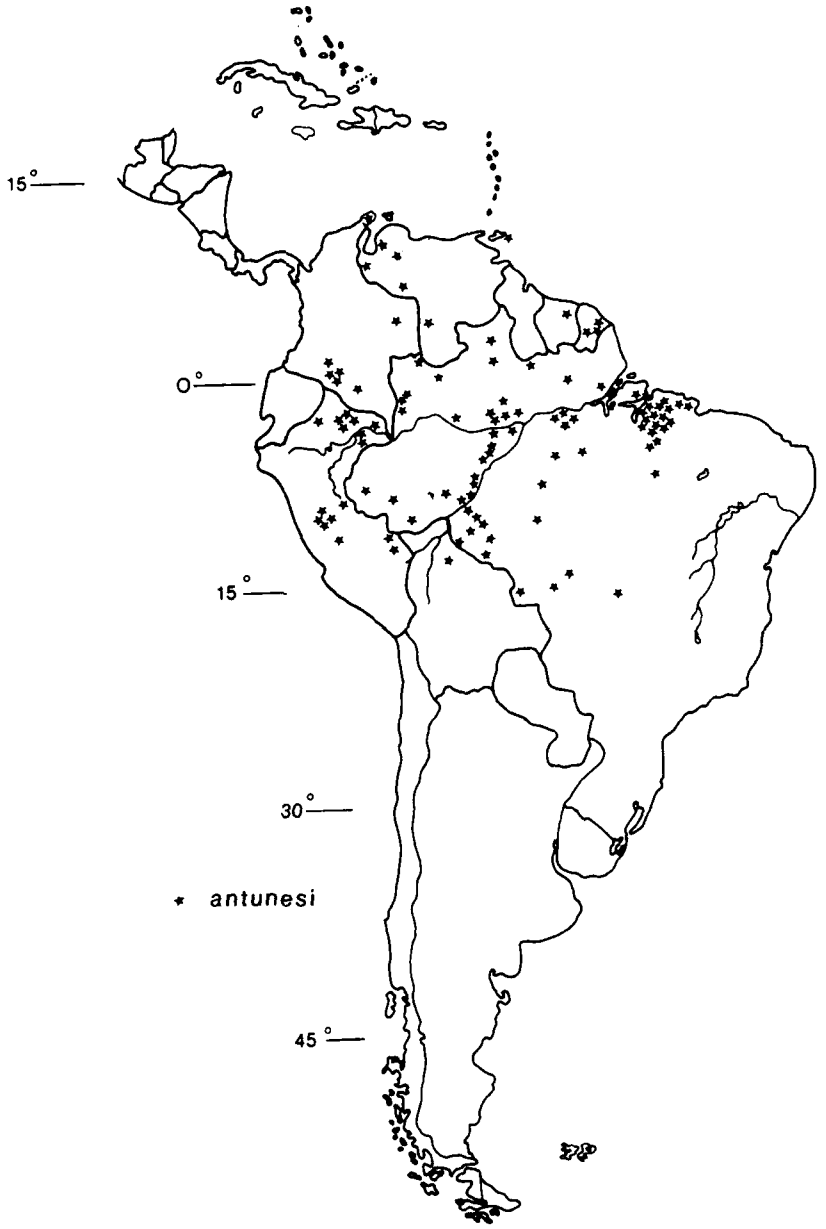
Map 94



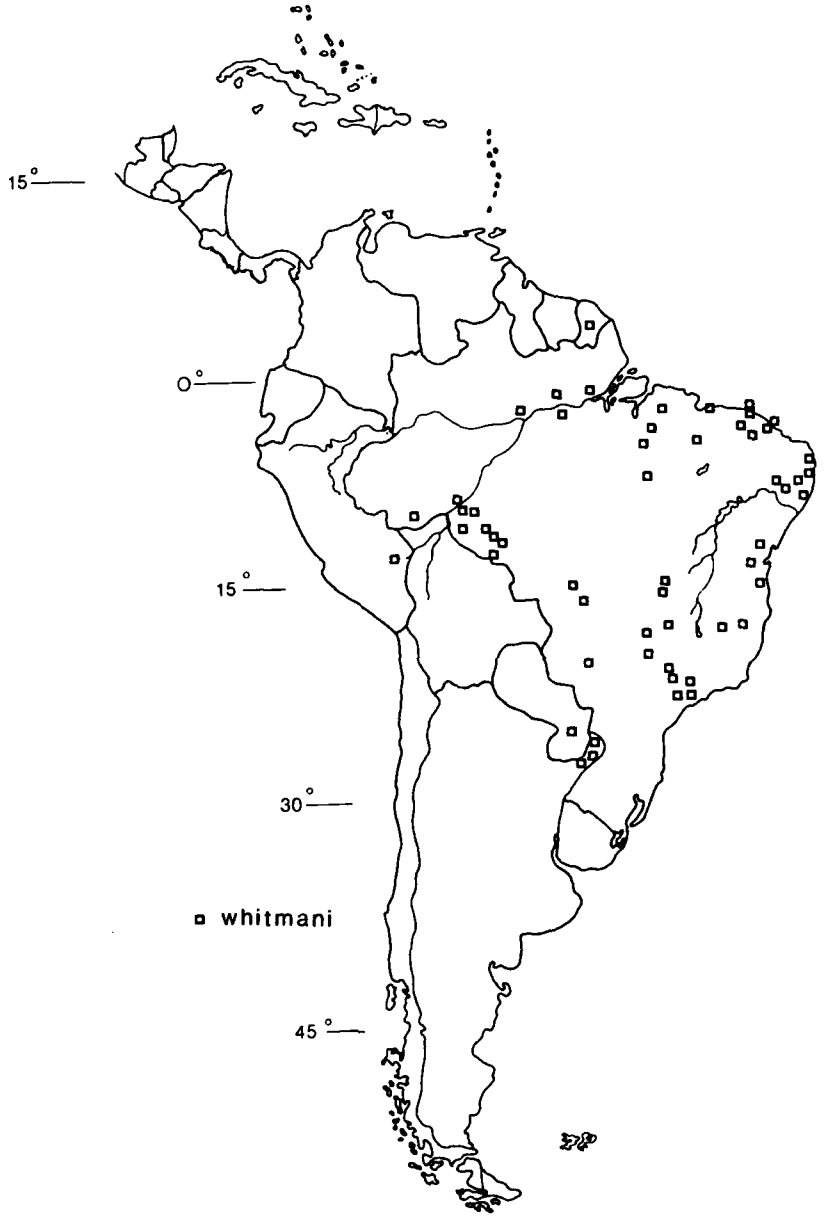
Map 95


15°
0°
15°
?
• olmeca olmeca
✲ olmeca bicolor
■ olmeca nociva
◑ inornata

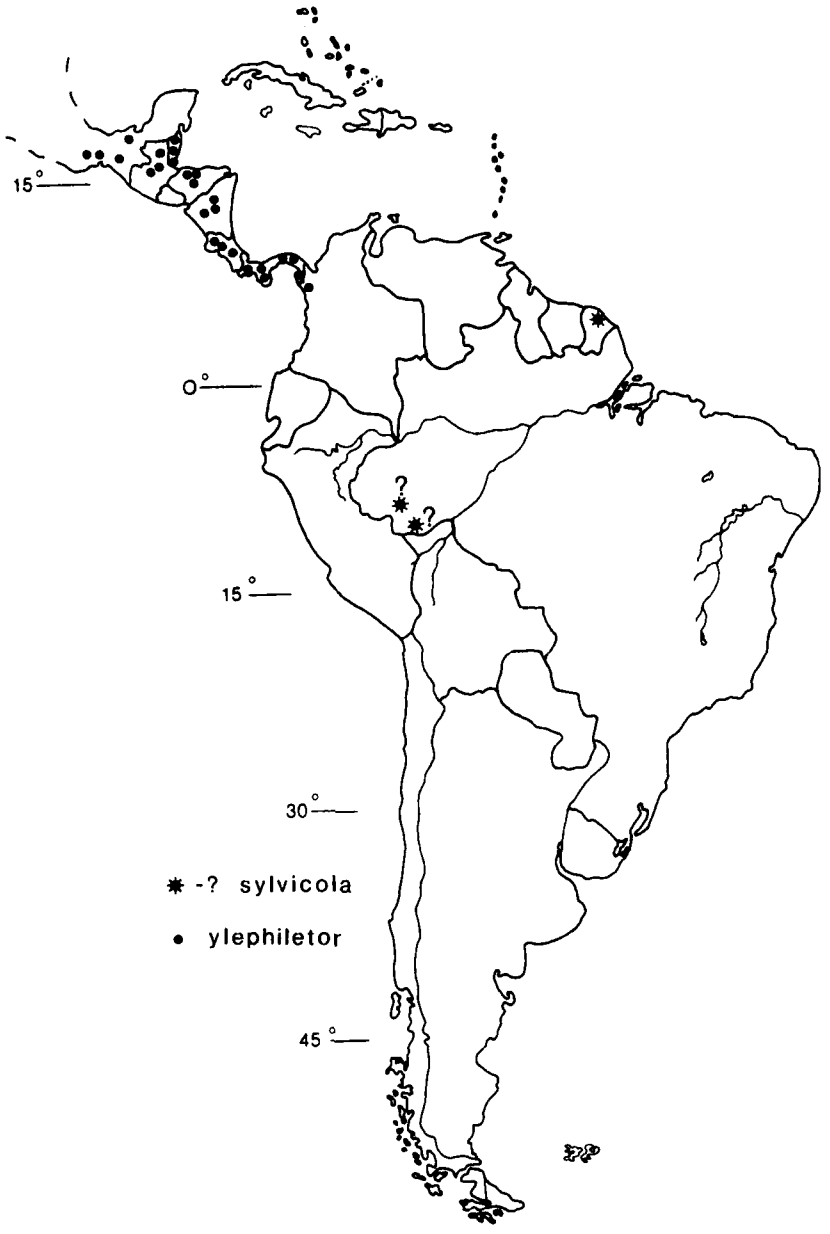
Map 96



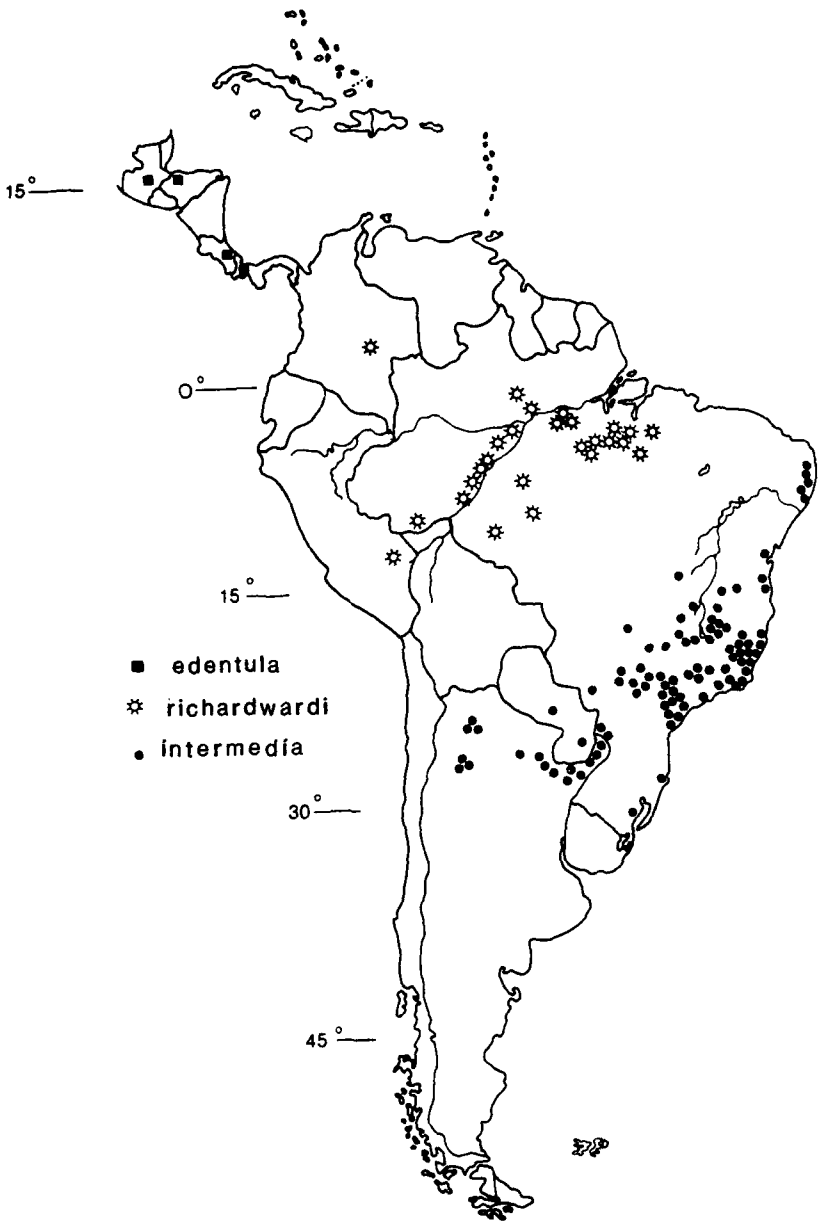
Map 97



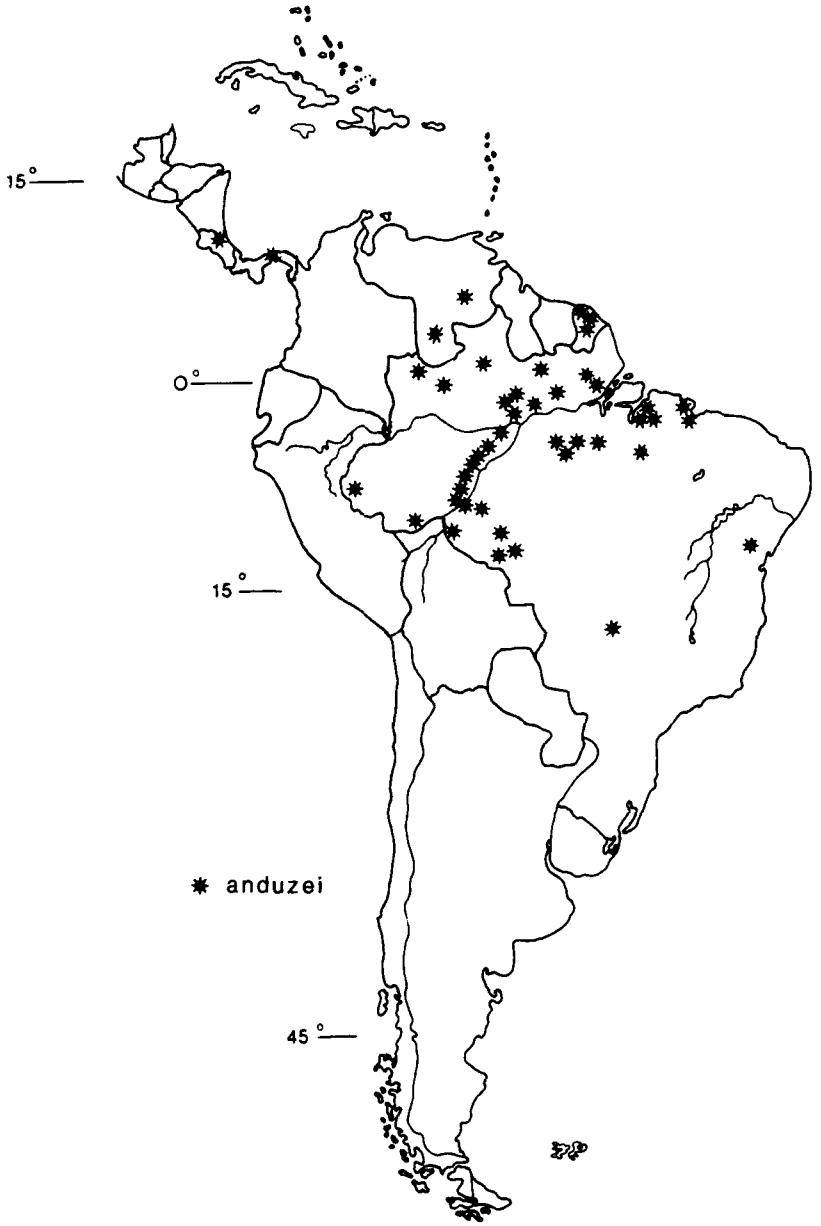
Map 98



Map 99

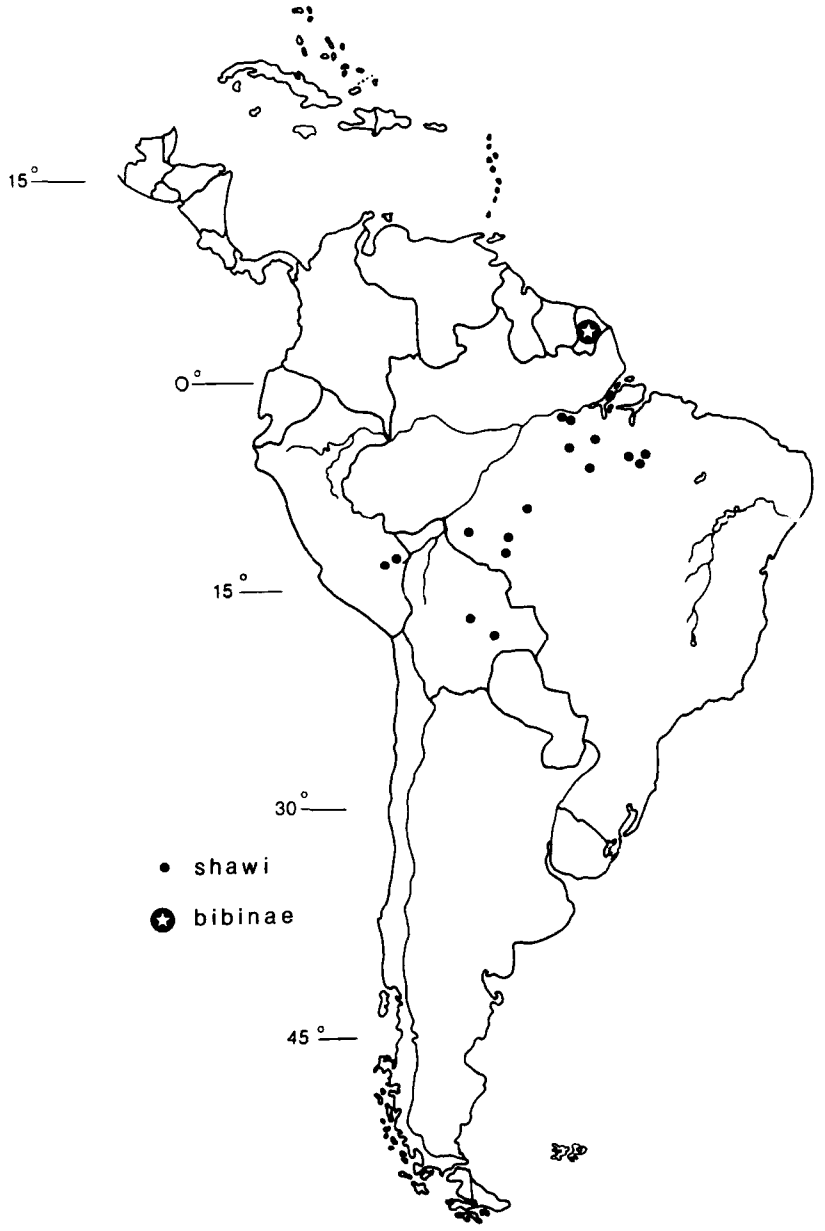


Map 100

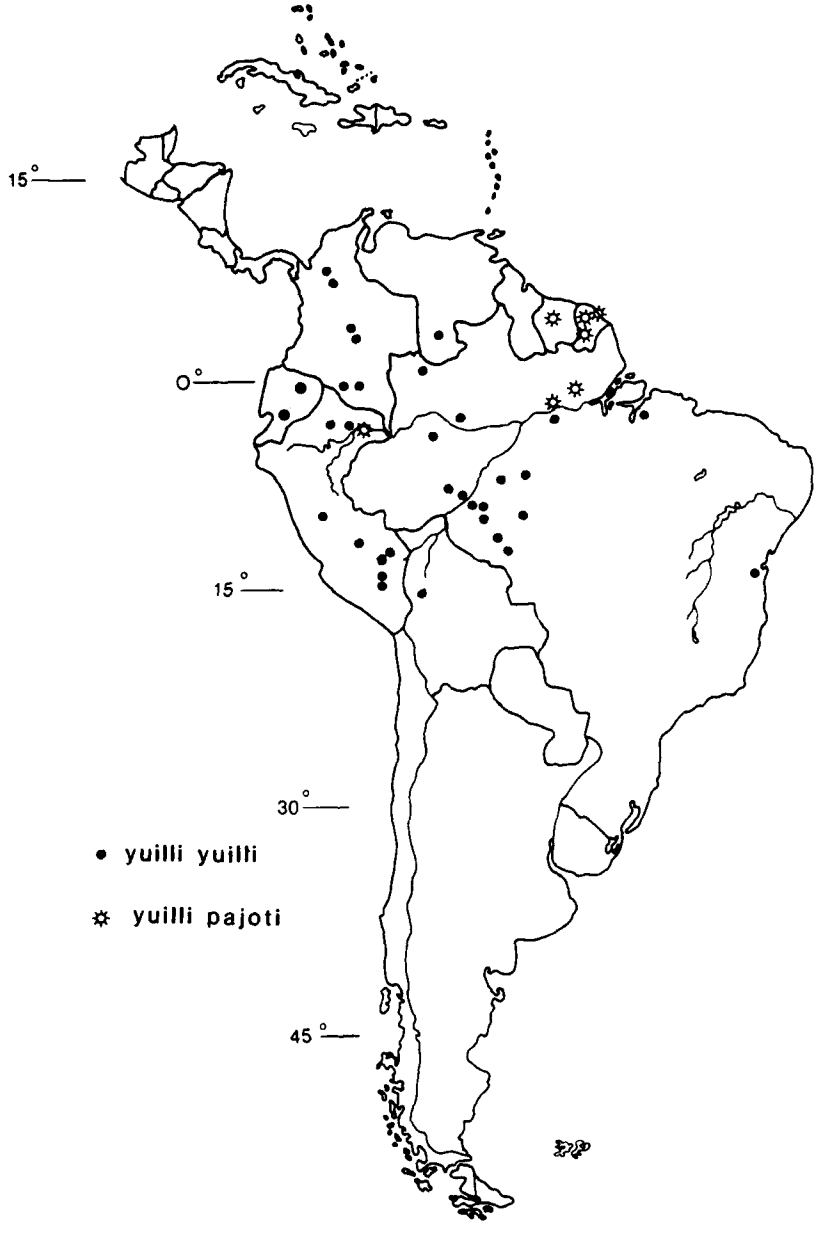


Map 101

Map 102



Map 103



Map 104

SUBGENUS *TRICHOPHOROMYIA* BARRETTO

Lutzomyia, subgenus *Trichophoromyia* Barretto 1962: 96 (type species: *Flebotomus ubiquitalis* Mangabeira by orig. designation). Sherlock & Guitton 1970: 137 (reviewed, keys, figs.). Martins et al. 1978: 81 (defined).
Lutzomyia species group *auraensis*: Theodor 1965: 185.
Lutzomyia species group *castanheirai*: Theodor 1965: 193.
Psychodopygus, subgenus *Trichophoromyia* (in part): Forattini 1971a: 105; 1973: 425 (defined).
Trichophoromyia, genus: Artemiev 1991: 73.

Identification. Coloration dusky to dark; no completely pale species known. Antennal ascoids long, with short, barely discernible, posterior spurs. Palpomere 5 relatively short, less than combined length of palps. 3 + 4. ♀ cibarium with 6 or more horizontal teeth & numerous vertical teeth; pigment patch dark & arch incomplete. ♀ pharynx unarmed. Spermathecae annulated, terminal annulation of most spp. much larger than others; ducts thin-walled, variable in length; smooth walled or not. ♀ cercus broad & short. ♂ *genitalia*. Coxite with 1 or more groups of persistent setae. Style with 4 spines inserted at different levels; subterminal seta absent. Aedeagus well pigmented, its width & length usually subequal. Paramere variable. Lateral lobe with largest dorsal setae near, and at, apex.

Except for *L. reburra* which occurs west and north of the Andes mountains, the remaining *Lutzomyia* (*Trichophoromyia*) spp. inhabit Amazonian forests where many of the species appear to have limited geographic ranges.

The 4 species in the *dreisbachi* species group share many character states with the *Trichophoromyia* species but their antennal ascoids have long posterior spurs. Also, some of the *Lutzomyia* (*Nyssomyia*) species, especially females, resemble those of *Trichophoromyia* but they can be distinguished by minor but consistent character states as discussed on p. 445.

In general, the *Trichophoromyia* females are remarkably similar in structure and it is impossible to create a utility key to this sex based on morphology. Many species are known only from the male.

Medical Importance. Unknown; females are not anthropophilic. Some observations (Ryan 1986; F. Le Pont, pers. comm.) suggest that birds may serve as hosts for some species. However, *Leishmania lainsoni* were recently detected in 8 wild-caught *L. ubiquitalis* females from Pará (Silveira et al. 1991).

Key to the Males of the Subgenus *Trichophoromyia*

1. Paramere with 1 apical & 3-4 ventral peg-like setae with rounded tips & a distinct dorsal group of 15 long setae, downwardly bent with rounded tips . . . . . *L. reinerti* (Fig. 203)

   Paramere without such peg-like setae or group of long modified setae . . . 2

2. Genital filaments shorter than 4X length of genital pump 3
   Genital filaments longer than 4X length of genital pump 6

3. Paramere with most of dorsal setae sinuous. Genital filament tips slender, acute . . . . . *L. reburra* (Fig. 204)
   Paramere with nonsinuous dorsal setae. Genital filament tips slightly expanded, rounded 4

4. Lateral lobe longer (ca. 0.50 mm) extending to level of proximal spine on style. Coxite with group of persistent setae inserted mainly at basal third of structure . . . . . *L. meirai* (Fig. 205)
   Lateral lobe shorter than 0.45 mm, ending before level of proximal spine on style. Coxite with basal median group of persistent setae 5

5. Paramere as shown, distal third upturned . . . . . *L. omagua* (Fig. 206)
   Paramere otherwise, more slender, distal third not upturned . . . . . *L. ubiquitalis* (Fig. 207A)

6. Coxite with one or more spine-like setae, subequal in width to proximal spine on style 7
   Coxite without such large setae 12

7. Paramere with slender dorsal tubercle, bearing 2 recurved seta, between proximal dorsal lobe & end of paramere . . . . . *L. gibba* (Fig. 208)
   Paramere without such a tubercle, isolated setae between proximal dorsal lobe & end of paramere present or not 8

8. Paramere with upturned, truncated end; dorsal lobe relatively large. Coxite with 3 large spine-like setae & no other basal or median persistent setae . . . . . *L. dunhami* (Fig. 209)
   Paramere otherwise; dorsal lobe smaller. Coxite with spine-like setae in a group with other, smaller persistent setae 9

9. Paramere with dorsal group of 2 to 5 long setae isolated from others & between proximal lobe & end of paramere 10
   Paramere without such a group of isolated setae 11

10. Coxite with persistent setae including 2 spine-like setae, larger than others. Lateral lobe shorter than 0.50 mm. Paramere relatively slender at apex as shown . . . . . *L. viannamartinsi* (Fig. 210)
    Coxite with 4-7 spine-like setae included in group of numerous thinner setae. Lateral lobe longer than 0.50 mm. Paramere broader at apex as shown . . . . . *L. brachipyga* (Fig. 211)

11. Paramere, beyond proximal lobe upturned; its length about 4X height of proximal lobe. Coxite with 6-10 very thick setae . *L. bettinii* (Fig. 212)
    Paramere, beyond proximal lobe, curved downwards or straight; its length subequal to height of dorsal lobe. Coxite with 3-4 very thick setae . . . . . *L. readyi* (Fig. 213)

12. Coxite with subterminal group of 4-6 long, straight setae; other persistent setae lacking . . . . . *L. saltuosa* (Fig. 214H)
    Coxite with basal and/or median groups of persistent setae 13

13. Paramere with distinct tubercle bearing apical setae at base of proximal lobe 14
    Paramere without such a setiferous tubercle 16

14. Paramere as shown, with proximal lobe bearing long apical setae, some of which are longer than 2X maximum width of style. Coxite with fewer than 16 persistent setae loosely grouped at & near middle of structure . . . . . *L. castanheirai* (Fig. 215)
    Paramere otherwise, with proximal lobe bearing apical setae shorter than maximum width of style. Coxite with compact tuft of 19 or more setae 15

15. Paramere with subterminal dorsal projection, similar in size & shape to end of paramere & ventral projection. Coxite with compact tuft of setae at base & separate median group . . . . . *L. lopesi* (Fig. 216)
    Paramere otherwise, without ventral projection. Coxite with single compact group of persistent setae . . . . . *L. eurypyga* (Fig. 217)

16. Paramere, at greatest width, & including dorsal lobe (if present), at least 2X width of lateral lobe at middle of structure. Genital filament tips not inflated 17
    Paramere, at greatest width, less than 2X width of lateral lobe at middle of structure. Genital filament tips inflated or not 18

17. Paramere with group of 10+ curved setae at apex of dorsal lobe; most other setae subequal in size . . . . . *L. melloi* (Fig. 218B)

Paramere without such a group of setae on dorsal lobe but with longitudinal row of 6-10 short, broad setae distinctly wider than others . . . . . *L. innini* (Fig. 218A)

18. Paramere with small lobe or appendage arising from lateral ventral margin 19
Paramere lacking such a lobe 20

19. Paramere with dorsal setae restricted to distal third of structure, most shorter than maximum width of paramere. Genital filament tips inflated, spear-shaped . . . . . *L. acostai* (Fig. 219)
Paramere broader, with dorsal setae on distal half of structure, at least 10 of which are longer than maximum width of paramere. Genital filaments not inflated or spear-shaped . . . . . *L. flochi* (Fig. 220)

20. Coxite with 2-3 distinct median groups of persistent setae (excluding subapical setae) 21
Coxite with 1 distinct median group of persistent setae (excluding subapical setae) 25

21. Paramere concave on dorsal margin from dorsal lobe to end of paramere 22
Paramere not concave on dorsal margin 24

22. Coxite with ventral group of setae in addition to lateral median group; coxite base without inner group of persistent setae. Parameres as shown . . 23
Coxite without ventral group of setae but with basal group of 2-5 slender setae. Paramere otherwise . . . . . *L. sinuosa* (Fig. 222)

23. Paramere with 2-3 long recurved setae at apex . . . *L. napoensis* (Fig. 221)
Paramere with shorter & straight setae at apex . . . . . *L. velascoi*

24. Paramere subtriangular, narrowing to apex. Coxite with ventral group of 4-5 setae between smaller basal group and median group . . . . . *L. cellulana* (Fig. 223)
Paramere otherwise. Coxite without ventral group of persistent setae . . . . . *L. octavioi* (Fig. 224)

25. Paramere almost truncate, broad apically with subapical dorsal group of 5 strong, straight setae . . . . . *L. wilkersoni* (Fig. 225)
Paramere otherwise, without such setae 26

26. Coxite with median group of 10 or fewer setae 27
Coxite with median group of 12 or more setae 28

27. Paramere with conspicuous dorsal lobe . . . . . *L. clitella* (Fig. 226)
Paramere without dorsal lobe . . . . . *L. nemorosa* (Fig. 227)

28. Coxite with median group of 25 or fewer setae 29
Coxite with group of 30 or more persistent setae 31

29. Paramere with prominent high dorsal hump beyond which paramere is slender & slightly clubbed apically . . . . . *L. beniensis* (Fig. 228)
Paramere with or without dorsal hump (if present it is shorter & broader). Paramere beyond hump relatively broad 30

30. Coxite with persistent setae having recurved tips. Paramere with distal third wider than width of lateral lobe . . . . . *L. incasica* (Fig. 229)
Coxite with persistent setae not recurved at their tips. Paramere otherwise, more slender than width of lateral lobe . . . . . *L. rostrans* (Fig. 230)

31. Paramere with conspicuous dorsal lobe or hump 32
Paramere without dorsal lobe or hump 34

32. Coxite tuft of 35 or more setae, all inserted very close together at middle of segment. Paramere with mostly straight dorsal setae 33
Coxite tuft less compact but with fewer setae. Paramere with many setae having recurved tips . . . . . *L. loretonensis* (Fig. 231)

33. Paramere with 4-6 long setae near lateral ventral margin of apex . . . . . *Lutzomyia* sp. #1 of Araracuara (Fig. 232B)
Paramere lacking such setae . . . . . *L. howardi* (Figs. 214A & 232A)

34. Genital filament tips simple, not expanded & spear-shaped. Paramere as shown . . . . . *L. ruii* (Fig. 233)
Genital filament tips expanded, spear-shaped. Paramere otherwise . . . . . *L. auraensis* (Fig. 207C)

Lutzomyia (Trichophoromyia) reinerti Young & Duncan, n.sp.
Fig. 203

Holotype ♂ (measurements in mm). Wing length 2.06, width 0.59. Mesonotum darker than pleura but only teneral ♂ available. Head height from vertex to tip of clypeus 0.37, head width 0.38. Eyes separated by 0.13 or by distance equal to 8 facet diameters. Flagellomere I 0.24 long, II+III = 0.25; ascoids simple, those on II extending beyond tip of flagellomere, present on flags. II-XI. Labrum 0.20 long. Length of palpomeres: 1, 0.03; 2, 0.08; 3, 0.12; 4, 0.06; 5, 0.13; palpal sensilla (ca. 14) visible on inner side of palp. 3. Cibarium unarmed; arch conspicuous only at sides; pigment patch not visible. Pharynx

0.157 long, unarmed. Pleura with 9-10 upper & 4 lower episternal setae. Length of wing vein sections: α, 0.156; ß, 0.076; γ, 0.05; δ, 0.10. Length of femora, tibiae & basitarsi: foreleg, 0.82, 1.08, 0.68; midleg, 0.84, 1.30, 0.80; hindleg, 0.88, 1.54, 0.91. *Genitalia*. Style 0.27 long, with 4 spines inserted at different levels; no subterminal seta. Coxite 0.42 long with 2 groups of persistent setae; basal group of ca. 22 generally longer, stronger setae as shown. Paramere upturned with circular patch of ca. 15 modified long setae (recurved apically) near middle & ventral row of 3-4 short peg-like setae (one apical, others subapical). Aedeagus short, subtriangular. Genital pump 0.18 long, each filament 0.87 long or 4.8 fold length of pump, filament tips subacute, slightly expanded. Lateral lobe 0.51 long.

Type Material (Map 105). *Holotype* ♂. **BRAZIL**: Pará, 164 km W of Altamira, 12 Nov. 1974, flight trap, J.F. Reinert.

Remarks. This distinctive species, known only from a single teneral male, differs from other males in this subgenus by the presence of the modified setae forming a compact group at the dorsum of the paramere. There are also unusual peg-like setae at the paramere apex & along the ventral margin.

The species is named for our colleague, Dr. John F. Reinert, who collected phlebotomines along the Transamazonian highway of Brazil in 1974. The holotype will be deposited in the collection at the Centro de Pesquisas René Rachou, Belo Horizonte, Brazil.

Lutzomyia (*Trichophoromyia*) *reburra* (Fairchild & Hertig)
Fig. 204

Phlebotomus reburrus Fairchild & Hertig 1961b: 246 (♂, La Zumbadora, Cerro Azul, Panama; ♀, Rio Mandinga, Panama).

Lutzomyia reburra: Barretto 1962: 97 (listed). Martins et al. 1978: 87 (refs., dist.). Young 1979: 146 (full refs.). Young & Rogers 1984: 599 (Ecuador). Murillo & Zeledón 1985: 48 (♂, ♀, Costa Rica). Alexander et al. 1992a: 36 (Ecuador); 1992c: 124 (Ecuador).

Psychodopygus reburrus: Forattini 1971a: 105 (listed); 1973: 477 (♂, ♀ figs.).

Distribution (Map 106). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Fairchild & Hertig 1961b); COLOMBIA (Young 1979); ECUADOR (Young & Rogers 1984; Alexander et al. 1992a,c).

Remarks. The female of this species is distinguished from other *Lutzomyia* (*Trichophoromyia*) females by the presence of spherical excrescences on most of the individual sperm ducts. The female of *L. yuilli pajoti* in the subgenus *Nyssomyia* has similar structures but this species is nearly pale and has much shorter sperm ducts.

Lutzomyia (Trichophoromyia) meirai (Causey & Damasceno)
Fig. 205

Flebotomus meirai Causey & Damasceno 1945b: 654 (♂, São Paulo de Olivença, Amazonas, Brazil).
Lutzomyia meirai: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Sherlock & Guitton 1970: 146 (keyed, fig.). Martins et al. 1978: 86 (refs., dist.).
Psychodopygus meirai: Forattini 1971a: 105 (listed); 1973: 472 (♂ fig., dist.).

Distribution (Map 107). BRAZIL (Martins et al. 1978).

Remarks. We examined & partially illustrated the holotype male housed in the USNM in 1986. The parameres are slightly compressed and the ventral heel is not as pronounced as shown by Causey & Damasceno (1945b). In many aspects, this little-known species resembles *L. omagua*. The female of *L. meirai* remains unknown.

Lutzomyia (Trichophoromyia) omagua Martins, Llanos & Silva
Fig. 206

Lutzomyia omagua Martins, Llanos & Silva 1976b: 496 (♂, Pucallpa, Loreto, Peru). Martins et al. 1978: 155 (listed). Llanos 1981: 183 (listed). Young et al. 1985: 143 (Madre de Dios, Peru).

Distribution (Map 108). PERU (refs. cited above).

Remarks. Martins et al. (1976b; 1978) provisionally placed *L. omagua* in the species group *dreisbachi* but the male lacks long posterior spurs of the antennal ascoids as well as persistent setae near the apex of the coxite. The female, described below, was captured with males at Tambopata Reserve, Madre de Dios, Peru (measurements in mm). ♀ (n=1). Wing length 2.18; width 0.66. Whole insect well pigmented. Head height 0.37; width 0.36. Eyes large, separated by 0.14 or by distance = to 9 facet diameters. Flagellomere I, 0.25 long; II+III = 0.25; ascoids with short posterior spurs, those on II reaching to III, distal ? flagellomeres missing. Labrum 0.32 long. Length of palpomeres: 1, 0.050; 2, 0.14; 3, 0.16; 4, 0.058; 5, 0.10 (shrunken); palpal sensilla at distal 1/3 of palp. 2 and along inner margin of 3. Cibarium with row of 14 sharp equidistant horizontal teeth & 4 irregular rows of ca. 14 vertical teeth; pigment patch very dark, prominent; cibarial arch complete, crossing cibarium at level of pigment patch. Pharynx 0.17 long, unarmed. Pleura with 24-25 upper & 9-10 lower episternal setae. Length of wing vein sections: α, 0.76; β, 0.30; δ, 0.53; γ, 0.47. Legs missing. Spermathecae with 25+ annuli as shown; terminal knob spherical; ducts as shown, smooth-walled.

Lutzomyia (*Trichophoromyia*) *ubiquitalis* (Mangabeira)
Fig. 207 A & B

Flebotomus ubiquitalis Mangabeira 1942a: 158 (♂, Aurá, Belém, Pará, Brazil).
Phlebotomus basispinosus Barretto & Coutinho 1943: 185 (♂, San José dos Campos, São Paulo, Brazil). Barretto 1954: 124 (as synonym of *ubiquitalis*).
Phlebotomus cauchensis Floch & Abonnenc 1943a: 22 (♂, French Guiana). Barretto 1954: 124 (as synonym of *ubiquitalis*).
Lutzomyia ubiquitalis: Barretto 1962: 97 (listed). Martins et al. 1978: 82, 87 (♂, ♀ figs., dist.). Léger et al. 1977: 218 (French Guiana). Young 1979: 149 (♂ figs., refs.). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 96 (Colombia). Arias & Young 1982: 251 (♀ fig.). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Young et al. 1985: 143 (Peru). Geoffroy et al. 1986: 486 (French Guiana). Ryan et al. 1987a: 356 (nat. infections, unidentified *Leishmania* Brazil). Lebbe et al. 1987: 30 (computer aided ident.). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela). Silveira et al. 1991: 127 (nat. infections, *Le. lainsoni*, Brazil). Alexander et al. 1992c: 124 (Ecuador). Lainson et al. 1992: 437 (as vector of *Le. lainsoni*, Brazil).
Psychodopygus ubiquitalis: Forattini 1971a: 105 (listed); 1973: 481 (figs., dist.).

Distribution (Map 106). COLOMBIA; BRAZIL; VENEZUELA; FRENCH GUIANA (Martins et al. 1978 & subsequent refs. given above); PERU (Young et al. 1985); SURINAME (♂♂, Patamakka & Gran Santi, 1983-1984, A.M. Burgos); ECUADOR (Alexander et al. 1992b).

Remarks. The recent discovery of *Leishmania lainsoni* in wild-caught females of *L. ubiquitalis* in Brazil (Silveira et al. 1991) represents the first time that any members of this subgenus have been found naturally infected with these protozoans. Lainson et al. (1992) recovered this parasite from other *L. ubiquitalis* females in Pará State and recorded that this sand fly will bite man under natural conditions.

Lutzomyia (*Trichophoromyia*) *gibba* Young & Arias, n.sp.
Fig. 208

Holotype ♂ (measurements in mm). Many structures, especially appendages, missing. Wing twisted but at least 1.5 long. Most of insect heavily infuscated, coxites very deeply pigmented. Head height from vertex to tip of clypeus 0.33; width 0.34. Eyes separated by 0.13 or by distance equal to 7 facet diameters. Flagellomere I 0.22 long; II+III = 0.24; ascoids not observable. Labrum 0.21 long. Length of palpomeres: 1, 0.035; 2, 0.88; 3, 0.126; 4, 0.055; 5, 0.154; palpal sensilla not seen. Cibarium with 6 irregular rows of subequal vertical teeth; no pigment patch; arch most conspicuous at sides. Pharynx 0.17 long, unarmed but with posterior ridges. Pleura with 15 upper & 2 lower episternal

setae. Wing venation not observable. Legs missing. *Genitalia*. Style 0.30 long, with 4 large spines inserted at different levels, thinnest is basal spine; no subterminal seta. Coxite 0.44 long & very broad, 0.23, its dorsum markedly convex; median tuft of 4-7 very strong setae with apically recurved tips & 4-5 smaller setae. Paramere as shown with a dorsobasal setose lobe, a median tubular arm bearing 2 apical setae, & upturned, foot-shaped apex. Aedeagus short, triangular with subacute end. Genital pump 0.19 long, each filament 0.98 long or 5.15X length of pump; filament tips acute, not inflated. Lateral lobe 0.59 long.

Type Material (Map 109). *Holotype* ♂. **BRAZIL**: Amazonas, km 100, BR. 319 (Manaus-Porto Velho highway) 26 Jan. 1979, J. Arias. *Paratypes*. 2 ♂♂, same data but km 102 17 June 1979.

Remarks. The male of *L. gibba* n.sp. differs readily from those of *L. brachypyga* and *L. viannamartinsi* by the presence of the slender setiferous tubercle between the proximal lobe and end of paramere. Such a tubercle is lacking in these other species.

The holotype was remounted from water soluble mounting medium into Canada balsam. The paratypes are in poor condition but the important diagnostic features of the genitalia are clearly visible. The type specimens will be deposited at the Centro de Pesquisas René Rachou, Belo Horizonte, Brazil.

This species is named "*gibba*" owning to the humpbacked appearance of the coxite.

Lutzomyia (Trichophoromyia) dunhami (Causey & Damasceno)
Fig. 209

Flebotomus dunhami Causey & Damasceno 1945a: 17 (♂, Coimbra, Benjamin Constant, Amazonas, Brazil, Fig. 22 *not* 20).
Lutzomyia dunhami: Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 144 (♂ fig., keyed). Martins et al. 1978: 84 (refs., dist.).
Psychodopygus dunhami Forattini 1971a: 105 (listed); 1973: 463 (♂ fig., tax.).

Distribution (Map 105). BRAZIL (Martins et al. 1978).

Remarks. *Lutzomyia dunhami* is a poorly known sand fly. The holotype (Fig. 209) is housed in the USNM collection and was studied by us in 1986.

Lutzomyia (*Trichophoromyia*) *viannamartinsi* Sherlock & Guitton
Fig. 210

Lutzomyia viannamartinsi Sherlock & Guitton 1970: 137 (♂, Municipio de Urucuca, Bahia, Brazil); 1976: 7 (as valid species, distinct from *brachipyga*). Martins et al. 1978: 88 (listed, dist.).

Phlebotomus brachipygus (not *brachypygus* Mangabeira): Sherlock & Carneiro 1962: 427 (♀ descript.).

Lutzomyia brachipyga: Vexenat et al. 1986b: 296 (Bahia, Brazil).

Psychodopygus viannamartinsi: Forattini 1973: 459 (as synonym of *brachipyga*).

Distribution (Map 106). BRAZIL (type locality; 42 ♂♂, 18 ♀♀, Três Braços, Bahia, light traps, 1986, A.L. Hoch).

Remarks. Forattini (1973) treats *L. viannamartinsi* and *L. brachipyga* as conspecific but we support the conclusions of Sherlock & Guitton (1976) who pointed out consistent structural differences between the males. That of the former species has but 2 large spine-like setae, not 5 as in *brachipyga*, inserted among thinner setae on the coxite. Other metrical differences are apparent between these males but the females are not distinguishable with certainty.

Lutzomyia (*Trichophoromyia*) *brachipyga* (Mangabeira)
Fig. 211

Flebotomus brachipygus Mangabeira 1942a: 173 (♂, Aurá, Belém, Pará, Brazil).

Phlebotomus brachipygus: Fauran 1960: 2 (♂, French Guiana).

Lutzomyia brachipyga (or *brachypyga*): Barretto 1962: 97 (listed). Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 144 (♂ fig., keyed). Lewis 1975a: 502 (mouthpart morphol.). Sherlock & Guitton 1976: 7 (cf. to *viannamartinsi*). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 84 (refs., dist.). Ready et al. 1983a: 780 (Pará, Brazil). Ryan 1986: 98 (♀ descript., ♂ fig., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Lebbe et al 1987: 30 (computer aided tax.).

Psychodopygus brachipygus: Forattini 1971a: 105; 1973: 459 (in part, ♂, ♀).

Distribution (Map 110). BRAZIL (Martins et al. 1978; Ryan 1986); FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977).

Remarks. Records of *L. brachipyga* in Bahia State, Brazil, at Três Braços (Vexenat et al. 1986b) are misidentifications of *L. viannamartinsi*.

Fauran (1960) noted that a male *brachipyga* from Grand-Santi, French Guiana differed from that described by Mangabeira (1942a) in details of the coxite setation and paramere structure. The French Guiana male, with a slender

tubercle on the dorsum of the paramere, resembles *L. gibba* more than *L. brachipyga* from Pará, Brazil and suggests that the forms may not be conspecific. However, none of 10 ♂♂ from French Guiana (Prapock & Cayenne) that we studied, through the courtesy of J.-P. Dedet, had such tubercles on their parameres.

Lutzomyia (Trichophoromyia) bettinii Feliciangeli, Ramirez Pérez & Ramirez
Fig. 212

Lutzomyia bettinii Feliciangeli, Ramirez Pérez & Ramirez 1988a: 52 (♂, ♀, Cerro la Neblina, Amazonás, Venezuela).

Distribution (Map 111). VENEZUELA (type locality).

Remarks. The closest relatives are *L. brachipyga*, *L. viannamartinsi* and *L. gibba* from which the male differs in the shape and setation of the parameres and size and number of spine-like setae on the coxite.

Lutzomyia (Trichophoromyia) readyi Ryan
Fig. 213

Lutzomyia readyi Ryan 1986: 103 (♂, ♀, Transamazon Highway, Itaituba-Altamira, km 25, Pará, Brazil).

Distribution (Map 109). BRAZIL (type locality).

Remarks. We examined a topotype male of *L. readyi* and noted that the dorsal lobe of the paramere was bent downwards due to the pressure of the coverslip (Fig. 213B and Ryan 1986). The normal position is shown in Fig. 213C.

Lutzomyia (Trichophoromyia) saltuosa Young
Fig. 214 G-L

Lutzomyia saltuosa Young 1979: 148 (♂, Leticia, Amazonas, Colombia).

Distribution (Map 108). COLOMBIA (type locality).

Remarks. At present, the male of *L. saltuosa* is the sole member of the subgenus that lacks a median group of setae on the coxite.

Lutzomyia (Trichophoromyia) castanheirai (Damasceno, Causey & Arouck)
Fig. 215

Flebotomus castanheirai Damasceno, Causey & Arouck 1945: 15 (♂, Itaúna, Amazonas, Brazil).
Lutzomyia castanheirai: Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 140 (♂ fig., keyed). Martins et al. 1978: 84 (refs., dist.). Ryan 1986: 100 (♂, ♀, Pará, Brazil).
Psychodopygus castanheirai: Forattini 1971a: 105; 1973: 462 (figs., tax.).

Distribution (Map 112). BRAZIL (Martins et al. 1978; Ryan 1986).

Lutzomyia (Trichophoromyia) lopesi (Damasceno, Causey & Arouck)
Fig. 216

Flebotomus lopesi Damasceno, Causey & Arouck 1945: 13 (♂, Tefé, Rio Solimoẽs, Amazonas, Brazil).
Lutzomyia lopesi: Barretto 1962: 97 (listed). Theodor 1965: 194. Sherlock & Guitton 1970: 145 (♂ fig., keyed). Martins et al. 1978: 85 (refs., dist.).
Psychodopygus lopesi: Forattini 1971a: 105 (listed); 1973: (♂ fig., tax.).

Distribution (Map 107). BRAZIL (type locality).

Remarks. The male of *L. lopesi* is easily recognized by the distinctive shape of the parameres, shown on Fig. 216 and drawn from the male holotype in the USNM. The female is undescribed.

Lutzomyia (Trichophoromyia) eurypyga Martins, Falcão & Silva
Fig. 217

Lutzomyia eurypyga Martins, Falcão & Silva 1963: 336 (♂, ♀, Pissarreira, Caracaraí, Roraima, Brazil). Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 145 (♂ fig., keyed). Martins et al. 1978: 85 (refs., dist.). Ryan 1986: 102 (♂, ♀ figs., Pará, Brazil). Feliciangeli 1988: 108 (Venezuela).
Psychodopygus eurypygus: Forattini 1971a: 105 (listed); 1973: 465 (♂ fig., tax.).

Distribution (Map 105). BRAZIL (Martins et al. 1978; Ryan 1986); VENEZUELA (Feliciangeli 1988).

Remarks. The male of *L. eurypyga* resembles *L. brachipyga*, *L. viannamartinsi* and *L. gibba* in having enormous terminalia but the coxite tuft consists of numerous, subequal setae.

Lutzomyia* (*Trichophoromyia*) *melloi (Causey & Damasceno)
Fig. 218 B-D

Flebotomus melloi Causey & Damasceno 1945: 20 (♂, Coari, Amazonas, Brazil).
Lutzomyia melloi: Barretto 1962: 97. Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 146 (♂ fig., keyed). Martins et al. 1978: 86 (refs., dist.).
Psychodopygus melloi: Forattini 1971a: 105 (listed); 1973: 474 (♂ fig., tax.).

Distribution (Map 113). BRAZIL (type locality; 5 ♂♂, Labrea, Amazonas, light trap, 10 Oct. 1972, D. Young).

Remarks. The record of *L. melloi* in Suriname (Hudson & Young 1985) should be changed to *L ininni*, a closely related species considered erroneously to be a junior synonym of *L. melloi* by Arias & Young (1982). The shape and setation of the parameres differ between the males of these species.

Lutzomyia* (*Trichophoromyia*) *ininii (Floch & Abonnenc)
Fig. 218 A & E

Phlebotomus ininii Floch & Abonnenc 1943a: 20 (♂, Caux, French Guiana); 1944d: 6 (♀); 1952: 88 (♂, ♀).
Lutzomyia ininii: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Sherlock & Guitton 1970: 145 (♂ fig., keyed). Léger et al. 1977: 221 (French Guiana). Martins et al. 1978: 85 (refs., dist.). Geoffroy et al. 1986: 486 (French Guiana). Lebbe et al. 1987: 30 (computer aided ident.).
Lutzomyia melloi (not *melloi* Causey & Damasceno): Hudson & Young 1985: 418 (Suriname).
Psychodopygus ininii: Forattini 1971a: 105 (listed); 1973: 471 (♂ fig., tax.).

Distribution (Map 113). SURINAME (Hudson & Young 1985); FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977; Geoffroy et al. 1986).

Lutzomyia* (*Trichophoromyia*) *acostai (Llanos)
Fig. 219

Phlebotomus townsendi (not *P. townsendi* Ortiz). Llanos 1964: 377 (Serafin, Loreto, Peru).
Phlebotomus acostai Llanos 1966: 369 (new name).
Lutzomyia acostai: Sherlock & Guitton 1970: 144 (♂ fig., keyed). Martins et al. 1978: 82 (refs, dist.). Llanos 1983: 183 (listed).
Psychodopygus acostai: Forattini 1971a: 105 (listed); 1973: 454 (♂ fig., tax.)

Distribution (Map 106). PERU (Llanos 1964; 1983).

Remarks. One of us (D.Y.) was unable to locate the holotype, or other specimens, of *L. acostai* in the collection at the National Institute of Health, Lima, Peru, in 1988. We have not examined specimens referable to this species.

Lutzomyia* (*Trichophoromyia*) *flochi (Abonnenc & Chassignet)
Fig. 220

Phlebotomus flochi Abonnenc & Chassignet 1948: 1 (♂, Baduel, French Guiana). Floch & Abonnenc 1952: 117 (♂ figs.).
Lutzomyia flochi: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Sherlock & Guitton 1970: 145 (♂ fig., key Léger et al. 1977: 220 (French Guiana). Martins et al. 1978: 85 (refs., di Biancardi et al. 1982: 175 (Rondônia, Brazil). Arias & Freitas 1982: 40[illegible] (Acre, Brazil). Lebbe et al. 1987: 30 (computer aided ident.).
Psychodopygus flochi: Forattini 1971a: 105 (listed); 1973: 465 (♂ fig., tax.).

Distribution (Map 111). FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982).

Lutzomyia* (*Trichophoromyia*) *napoensis Young & Rogers
Fig. 221

Lutzomyia napoensis Young & Rogers 1984: 600 (♂, ♀, Limoncocha, Napo, Ecuador). Alexander et al. 1992c: 124 (listed).

Distribution (Map 112). ECUADOR (type locality).

Lutzomyia* (*Trichophoromyia*) *velascoi Le Pont & Desjeux

Lutzomyia velascoi Le Pont & Desjeux 1992a: 473 (♂, ♀, Mururata, La Paz, Bolivia).

Distribution (Map 112). BOLIVIA (Le Pont & Desjeux 1992a).

Remarks. We were not aware of the formal description and naming of this species until the present review was nearly completed. The excellent illustrations in the original description can be viewed while using the key to the species in this subgenus.

Lutzomyia* (*Trichophoromyia*) *sinuosa Young & Duncan n.sp.
Fig. 222

Phlebotomus octavioi (not *octavioi* Vargas): Llanos 1973: 30 (♂♂, Cachicote, Huánuco, Peru, & San Antonio, Loreto, Peru).

Lutzomyia octavioi (not *octavioi* Vargas): Llanos et al. 1975a: 659 (♂, ♀, figs., Quellouno, Cuzco, Peru). Young & Rogers 1984: 603 (♂ structurally distinct from *octavioi*).

Holotype ♂ (measurements in mm). Wing length 1.95; width 0.64. Whole insect moderately infuscated. Head height from vertex to tip of clypeus 0.35; width 0.35. Eyes separated by 0.18 or by distance = to 7.1 facet diameters. Flagellomere I 0.24 long; II+III = 0.27; ascoids with barely discernible posterior spurs; on flag. II, one ascoid extends beyond end of flagellomere, other is broken, distal 4 flagellomeres missing. Labrum 0.21 long. Length of palpomeres: 1, 0.034; 2, 0.09; 3, 0.13; 4, 0.05; 5 (missing); palpal sensilla (ca. 12) visible only on palp 3. Cibarium with remnants of 10 dot-like horizontal teeth in a single row; no pigment patch; arch diffuse, apparently complete. Pharynx 0.19 long, unarmed. Pleura with 15-17 upper & 4 lower episternal setae. Length of wing vein sections: α, 0.70; β, 0.24; δ, 0.50; γ, 0.23. Length of femora, tibiae & basitarsi: foreleg, 0.86, 1.07, 0.68; midleg, 0.83, 1.37, 0.75; hindleg (missing). *Genitalia*. Style 0.25 long, with 4 strong spines inserted at different levels; no subterminal seta. Coxite 0.42 long, with ca. 14 basal-median persistent seta, basal setae shorter & more slender than others. Paramere simple, arched dorsally with numerous dorsal setae (20+). Aedeagus short & broad. Genital pump 0.19 long, each filament 0.98 long or 5.2X length of pump; filament tips spear-shaped. Lateral lobe 0.51 long.

Type Material (Map 114). *Holotype* ♂. **PERU**: Huanuco, Cachicote, 17 Sept. 1965, J.C. Hitchcock. *Paratypes*. 4 ♂♂, same data as holotype.

Distribution (Map 114). PERU (above refs.).

Remarks. This species, mistakenly identified and illustrated as *L. octavioi* (Vargas) by Llanos et al. (1975a), differs in the male by the shape of the parameres and by the presence of 14 to 17 strong setae on the coxite. The male of *L. octavioi* has only 9 such setae & its paramere lacks a dorsal lobe. Sherlock & Guitton (1970) noted that Mangabeira's original illustrations of *octavioi* (1942a, as *P. affinis*) agreed perfectly with type material studied by them. We examined specimens of *L. sinuosa* n.sp. (7 ♂♂) from Cachicoto, Peru, and determined that they represented "*L. octavioi*" of Llanos et al. (1975a). Our material of *L. octavioi* from Costa Marquez, Rondônia, Brazil, is identical to *L. octavioi* Vargas, described by Mangabeira (1942a, as *P. affinis*).

The holotype and paratypes are deposited at the Florida State Collection of Arthropods, Gainesville, Florida.

Lutzomyia (Trichophoromyia) cellulana Young
Fig. 223

Lutzomyia cellulana Young 1979: 142 (♂, ? ♀, Trés Esquinas, Caqueta, Colombia). Alexander et al. 1992c: 124 (Ecuador).

Distribution (Map 108). COLOMBIA (type locality); ECUADOR (1 ♂, 25 km NE of Puerto Misahuali at Santa Rosa, Napo, light trap, 26 July 1982, D. Duckhouse; also see Alexander et al. 1992c).

Remarks. The male of *L. cellulana* from Ecuador has a slightly broader paramere than Colombian specimens but we consider them to be conspecific.

Lutzomyia (Trichophoromyia) octavioi (Vargas)
Fig. 224

Flebotomus affinis (not *P. affinis* Theodor) Mangabeira 1942a: 166 (♂, Mamoré near Brazil-Bolivia border, Mato Grosso, Brazil).
Phlebotomus octavioi Vargas 1949: 267 (new name for *affinis* Mangabeira 1942a).
Lutzomyia octavioi: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Lewis 1967a: 134 (refs.). Sherlock & Guitton 1970: 146 (♂ fig., keyed). Martins et al. 1978: 86 [in part, Peru records). Biancardi et al. 1982: 168 (Rondônia, Brazil).
Psychodopygus octavioi: Forattini 1971a: 105; 1973: 478 (in part, as synonym of *rostrans* Summers).

Distribution (Map 114). BRAZIL (Mangabeira 1942a; Biancardi et al. 1982; 5 ♂♂, Costa Marquez, Rondônia, flight trap, April 1987, T. Klein).

Remarks. Forattini (1973) regards *L. octavioi* as a junior synonym of *L. rostrans* (Summers) but the male of the latter species, as redescribed and figured by Lewis (1975b) lacks a group of 3-4 small setae at the coxite base; also, the median group of setae on the same structure are longer and more numerous. The paramere appears to be more slender than that of *L. octavioi*. In view of these observations, we can not accept the proposed synonym.

Figures 224C-E were drawn from one of the males from Costa Marquez, Rondônia, Brazil.

Lutzomyia (Trichophoromyia) wilkersoni Young & Rogers
Fig. 225

Lutzomyia wilkersoni Young & Rogers 1984: 603 (♂, ♀, near Zamora, Zamorchinchipe, Ecuador). Alexander et al. 1992c: 124 (listed).

Distribution (Map 108). ECUADOR (type locality).

Lutzomyia (Trichophoromyia) clitella Young & Pérez, n.sp.
Fig. 226

Holotype ♂ (measurements in mm). Wing length 1.91, width 0.59. Whole insect moderately infuscated. Head height from vertex to tip of clypeus 0.34, width 0.31. Eyes separated by 0.11 or by distance equal to 7.1 facet diameters. Flagellomere I 0.21 long; II+III = 0.24, other flagellomeres missing; ascoids on II long, ending at level with proximal third of flag. III. Labrum 0.20 long. Length of palpomeres: 1, 0.035; 2, 0.086; 3, 0.12; 4, 0.059; 5, 0.138; palpal sensilla visible at apex of palp. 2 & at middle 1/3 of palp. 3. Cibarium unarmed; no pigment patch, arch diffuse, but not conspicuous. Pharynx 0.14 long. Pleura with 9-11 upper & 3-5 lower episternal setae. Length of wing vein sections: α, 0.55; ß, 0.26; δ, 0.38; γ, 0.24. Length of femora, tibiae, and basitarsi: foreleg, 0.81, 1.00, 0.64; midleg, 0.74, 1.35, 0.78; hindleg, 0.83, 1.50, 0.86. *Genitalia.* Style 0.24 long with 4 large spines inserted at different levels; no subterminal seta. Coxite 0.41 long with 8-9 persistent, curved seta near middle in 3 irregular rows. Paramere simple, concave dorsally, distribution of setae as shown. Aedeagus short, broad. Genital pump 0.17 long; each filament 0.90 long or 5.29X length of pump; filament tips slightly expanded, acute. Lateral lobe 0.43 long.

Type Material (Map 111). *Holotype* ♂. **PERU**: Madre de Dios. 20 km W of Puerto Maldonado at Tambopata Reserve, 290 m a.s.l., 17-20 Feb. 1982, flight trap, R.C. Wilkerson. *Paratypes*, 1 ♂ same data. 1 ♂ same data but 1-9 Nov. 5 ♂♂ same data but 18-21 April 1983, D.G. Young & E. Pérez.

Remarks. This species was informally referred to as *Lutzomyia* (*Trichophoromyia*) sp. #2 by Young et al. (1985), but it now seems appropriate to name and describe this sand fly. The female is unknown but the male is easily distinguished from others in the subgenus by character states given in the species key. The specific name refers to "saddle" in Latin. The holotype will be deposited at the Natural History Museum, Lima, Peru. Paratypes will be deposited at the Florida State Collection of Arthropods, Gainesville, Florida.

Lutzomyia (Trichophoromyia) nemorosa Young & Pérez, n.sp.
Fig. 227

Holotype ♂ (measurements in mm). Wing length 1.82, width 0.54. Whole insect moderately infuscated. Head height from vertex to tip of clypeus 0.35; width 0.33. Eyes separated by 0.11 or by distance equal to 6.3 facet diameters. Flagellomere I 0.22 long; II+III = 0.25; ascoids with barely discernible posterior spurs, present on flagellomeres I-XII, those on II extending beyond end of flagellomere II. Labrum 0.20 long. Length of palpomeres: 1, 0.035;

2, 0.088; 3, 0.120; 4, 0.055; 5, 0.138; palpal sensilla visible near end of palp. 2 & most of palp. 3. Cibarium unarmed; no pigment patch; arch diffuse. Pharynx 0.16 long, unarmed. Pleura with 13-14 upper & 3-5 lower episternal setae. Length of wing vein sections: α, 0.53; ß, 0.25; δ, 0.39; γ, 0.22. Length of femora, tibiae and basitarsi: foreleg, 0.80, 1.02, 0.61; midleg, 0.76, 1.30, 0.74; hindleg, 0.83, 1.47, 0.83. *Genitalia*. Style 0.24 long, with 4 large spines inserted at different levels; no subterminal seta. Coxite 0.40 long, with median group of 8 curved, persistent setae. Paramere simple, without lobes but with numerous (20+) apically recurved dorsal setae & 5-7 blade-like setae at tip. Aedeagus short, broad. Genital pump 0.17 long, each filament 0.85 long or 5X length of pump. Lateral lobe 0.42 long.

Type Material (Map 109). *Holotype* ♂. **PERU**: Madre de Dios, 20 km W of Puerto Maldonado at Tambopata Reserve 290 m a.s.l., 17-20 Feb. 1982, flight trap, R.C. Wilkerson. *Paratypes*, 6 ♂♂, same data but 18-21 April 1983, D.G. Young & E. Pérez.

Remarks. Young et al. (1985) listed this species, as *Lutzomyia* (*Trichophoromyia*) sp. #1, from the type locality in Peru. Males were taken with males of *L. clitella* n.sp., along with *Trichophoromyia* females, but it is not possible to associate the sexes with certainty. The specific name refers to the shady, forested habitat of this species. The holotype is to be deposited in the collection of the National Museum of Natural History, Lima, Peru. Paratypes will be deposited at the Florida State Collection of Arthropods, Gainesville, Florida.

Lutzomyia (*Trichophoromyia*) *beniensis* Le Pont & Desjeux
Fig. 228

Lutzomyia beniensis Le Pont & Desjeux 1987a: 189 (♂, ♀, Rio Beni, Beni, Bolivia).

Distribution (Map 114). BOLIVIA (type locality).

Remarks. The shape of the parameres readily serves to distinguish this species from others in the subgenus. Females may feed on birds (Le Pont & Desjeux 1987a).

Lutzomyia (*Trichophoromyia*) *incasica* (Llanos)
Fig. 229

Phlebotomus adleri (not *P. adleri* Theodor) Llanos 1964: 379 (♂, Cahuide, Loreto, Peru).
Phlebotomus incasicus Llanos 1966: 369 (new name).
Lutzomyia incasica: Sherlock & Guitton 1970: 145 (♂ fig., keyed). Martins et al. 1978: 85 (refs., dist.). Llanos 1981: 183 (listed).

Psychodopygus incasicus: Forattini 1971a: 105 (listed); 1973: 468 (♂, fig., tax.).

Distribution (Map 105). PERU (type locality).

Remarks. We have not seen specimens referable to this species. The holotype was not located in the sand fly collection of the National Institute of Health, Lima, in 1988.

Lutzomyia* (*Trichophoromyia*) *rostrans (Summers)
Fig. 230

Phlebotomus rostrans Summers 1912: 209 (♂, ♀, Rio Javari, Amazonas, Brazil). Barretto 1947a: 221 (full refs.).
Lutzomyia rostrans: Barretto 1962: 97. Theodor 1965: 185 (listed). Lewis 1967a: 134 (♂, ♀, redescript.). Sherlock & Guitton 1970: 147 (♂ fig., keyed). Martins et al. 1978: 87 (refs., dist.).
Psychodopygus rostrans: Forattini 1971a: 105; 1973: 478 (in part, as senior synonym of *octavioi*).

Distribution (Map 115). BRAZIL (type locality).

Remarks. Lewis (1967a) carefully redescribed the holotype of *L. rostrans*, noting and illustrating character states that distinguish this male from *L. octavioi*. We have not examined this specimen, housed in the British Museum (Nat. Hist.), or others that can be assigned to this taxon. The type locality is presumed to be in Brazil, possibly near the Brazil-Peru border (Lewis 1967a).

Lutzomyia* (*Trichophoromyia*) *loretoensis (Llanos)
Fig. 231

Phlebotomus loretonensis Llanos 1964: 375 (♂, Rosario, Loreto, Peru).
Lutzomyia loretonensis: Sherlock & Guitton 1970: 146 (♂ fig., keyed). Martins et al. 1978: 82 (refs., dist.). Llanos 1983: 183 (listed). Biancardi et al. 1982: 173 (Rondônia, Brazil).
Psychodopygus loretonensis: Forattini 1973: 472 (♂ fig., tax).

Distribution (Map 112). PERU (Martins et al. 1978; Pérez et al. 1991); BRAZIL (Biancardi et al. 1982).

Remarks. We studied a male paratype of *L. loretonensis* (Fig. 231) from the type locality. There is a small, but distinct, proximal lobe on each paramere, not shown by Llanos (1964) or Forattini (1973).

***Lutzomyia* (*Trichophoromyia*)** sp. 1 de Araracuara, Morales & Minter
Fig. 232 B

Lutzomyia species 1 de Araracuara, Morales & Minter 1981: 102 (♂, ♀, Araracuara, Caqueta, Colombia).

Distribution (Map 110). COLOMBIA (Morales & Minter 1981).

Remarks. This informally named species appears to be distinct from *L. howardi*. We examined several males through the courtesy of A. Morales, Bogotá, and observed that the parameres of each had a distal row of long setae near the ventral margins. These setae are absent in *L. howardi* males. In other character states, the males are remarkably similar.

Lutzomyia* (*Trichophoromyia*) *howardi Young
Figs. 214 A-F & 232 A

Lutzomyia howardi Young 1979: 144 (♂, Leticia, Amazonas, Colombia).

Distribution (Map 110). COLOMBIA (type locality); PERU (? Pérez et al. 1991).

Remarks. The female of *L. howardi* is unknown. We have examined an additional male captured near Leticia, Colombia, in 1979 by R.C. Wilkerson. The Peruvian record of this species (Pérez et al. 1991) is considered provisional.

Lutzomyia* (*Trichophoromyia*) *ruii Arias & Young
Fig. 233

Lutzomyia ruii Arias & Young 1982: 249 (♂, ♀, 26 km E of Manaus, Amazonas, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 107 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 108). BRAZIL (refs. given above).

Lutzomyia* (*Trichophoromyia*) *auraensis (Mangabeira)
Fig. 207 C

Flebotomus auraensis Mangabeira 1942a: 161 (♂, Aurá, Belém. Pará, Brazil).
Lutzomyia auraensis: Barretto 1962: 97 (listed). Theodor 1965: 185 (♂, ♀, figs.). Sherlock & Guitton 1970: 144 (♂ fig., keyed). Martins et al. 1978: 84 (refs., dist.). Young 1979: 141 (♂ figs., full refs.). Fraiha et al. 1980a: 21. Biancardi et al. 1982: 175 (Rondônia, Brazil). Arias & Freitas 1982: 405 (Acre, Brazil). Hudson & Young 1985: 418 (Suriname). Young et al. 1985: 143 (Peru). Ryan 1986: 97 (♂ fig., Pará, Brazil). Feliciangeli 1988: 108 (Venezuela).

Psychodopygus auraensis: Forattini 1973: 416 (figs., tax.).

Distribution (Map 115). VENEZUELA (Feliciangeli 1988); SURINAME (Hudson & Young 1985); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Frietas 1982; Ryan 1986); PERU (Young et al. 1985; other records are questionable, i.e., Llanos 1964; 1983; Fraiha et al. 1980b; Pérez et al. 1991); BOLIVIA (Young 1979); COLOMBIA (Young 1979).

Remarks. Llanos (1964) illustrated a *Lutzomyia* (*Trichophoromyia*) sp. male from Dos de Mayo, Loreto Department, Peru, that she misidentified as *L. auraensis*. We have not examined these Peruvian males, but from her description they appear to represent a new taxon.

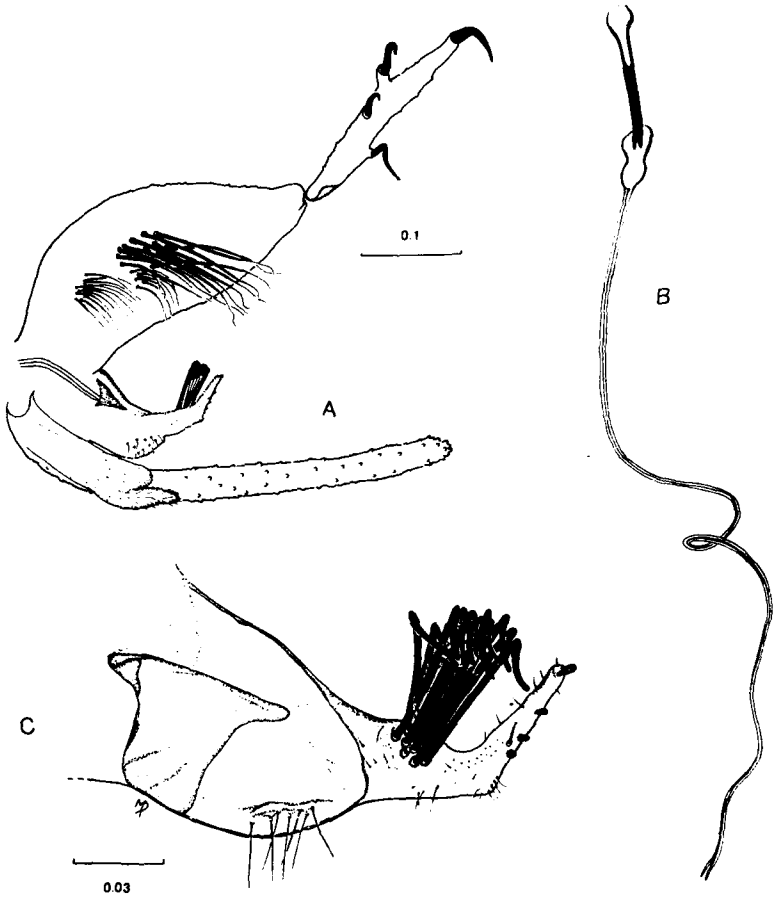


FIG. 203. ***Lutzomyia reinerti.*** A. Male terminalia; B. Genital pump & filaments; C. Paramere.

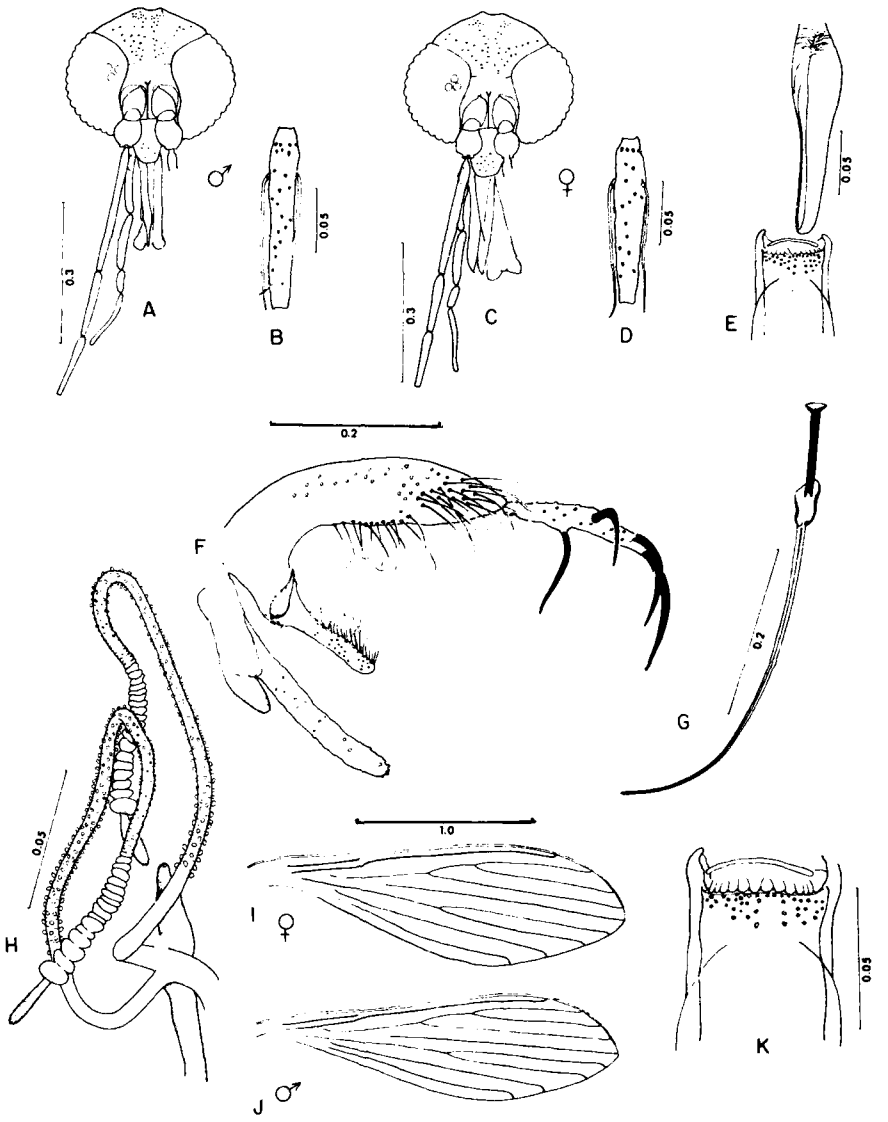


FIG. 204. ***Lutzomyia reburra.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (figs. from Young 1979).

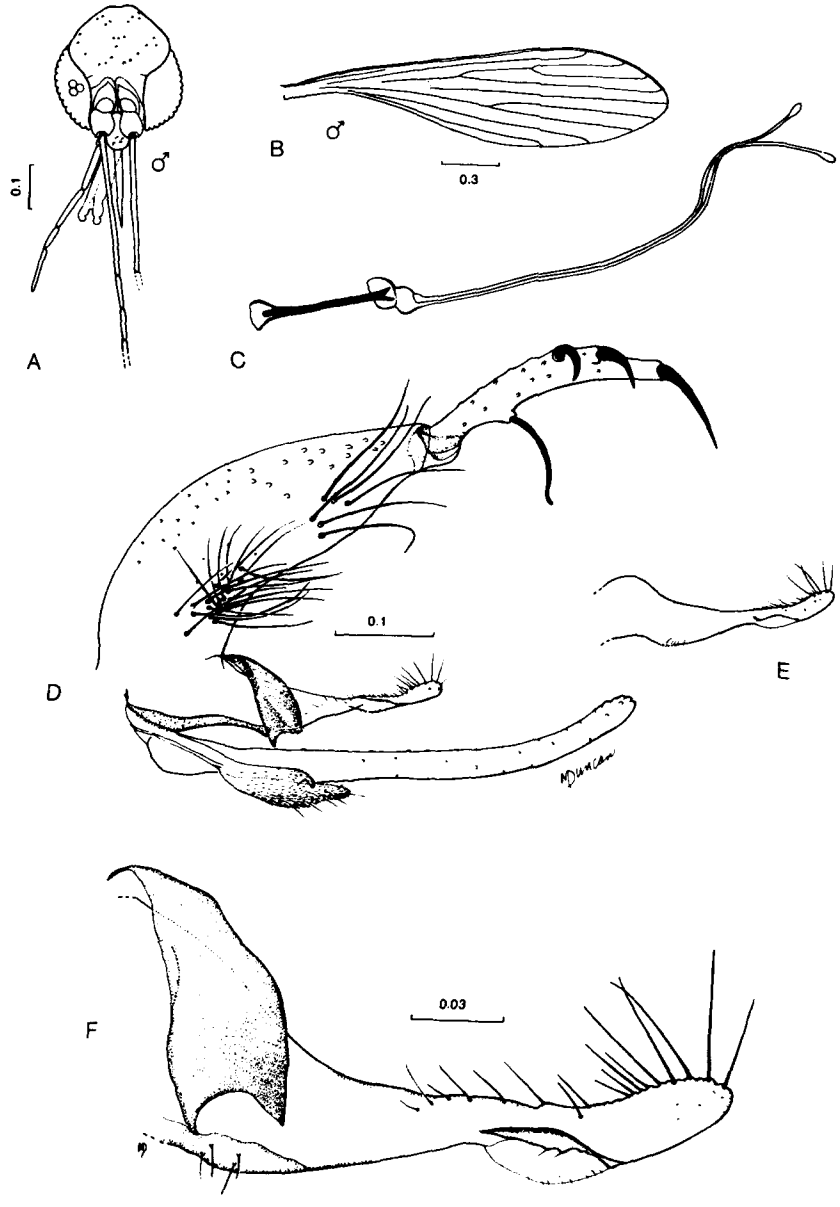


FIG. 205. ***Lutzomyia meirai.*** A. Male head; B. Male wing; C. Genital pump & filaments; D. Male terminalia; E. Paramere; F. Paramere & aedeagus.

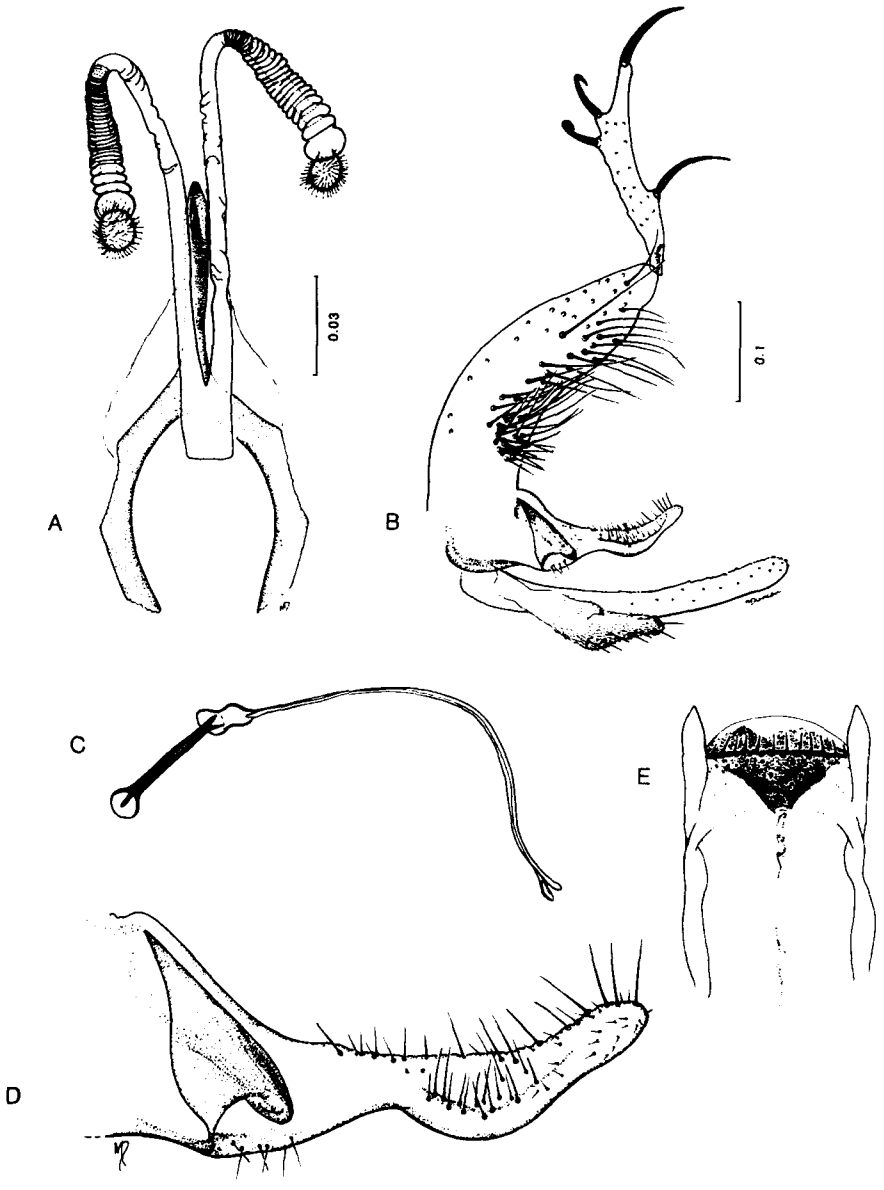


FIG. 206. ***Lutzomyia omagua.*** A. Spermathecae; B. Male terminalia; C. Genital pump & filaments; D. Paramere & aedeagus; E. Female cibarium.

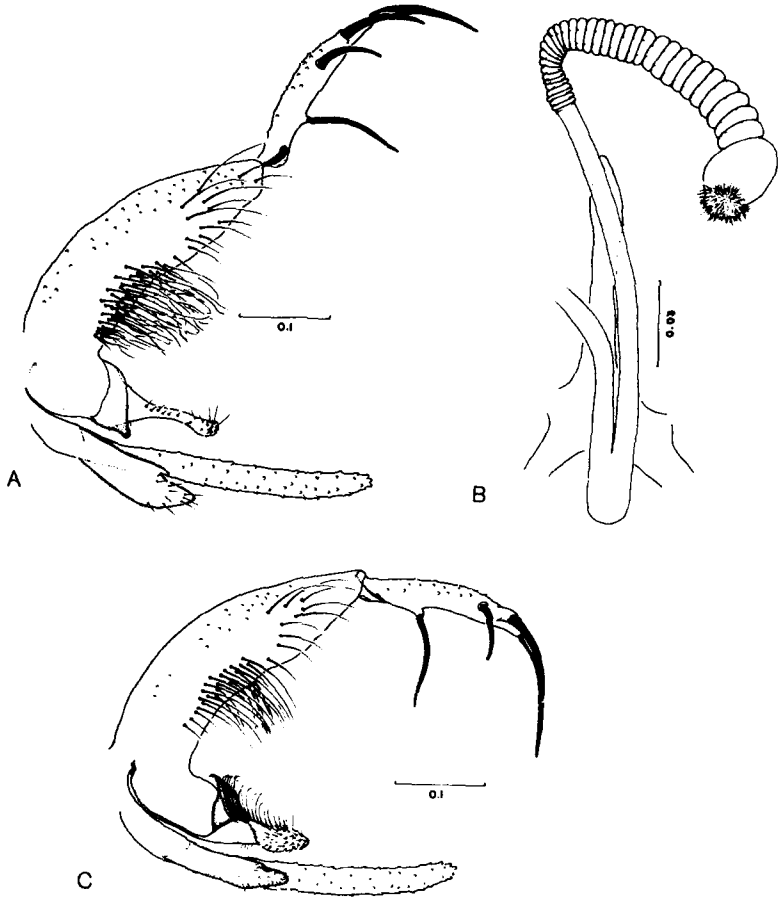


FIG. 207. ***Lutzomyia ubiquitalis.*** A. Male terminalia; B. Spermathecae (fig. A from Young 1979; B from Arias & Young 1982).
Lutzomyia auraensis. C. Male terminalia (from Young 1979).

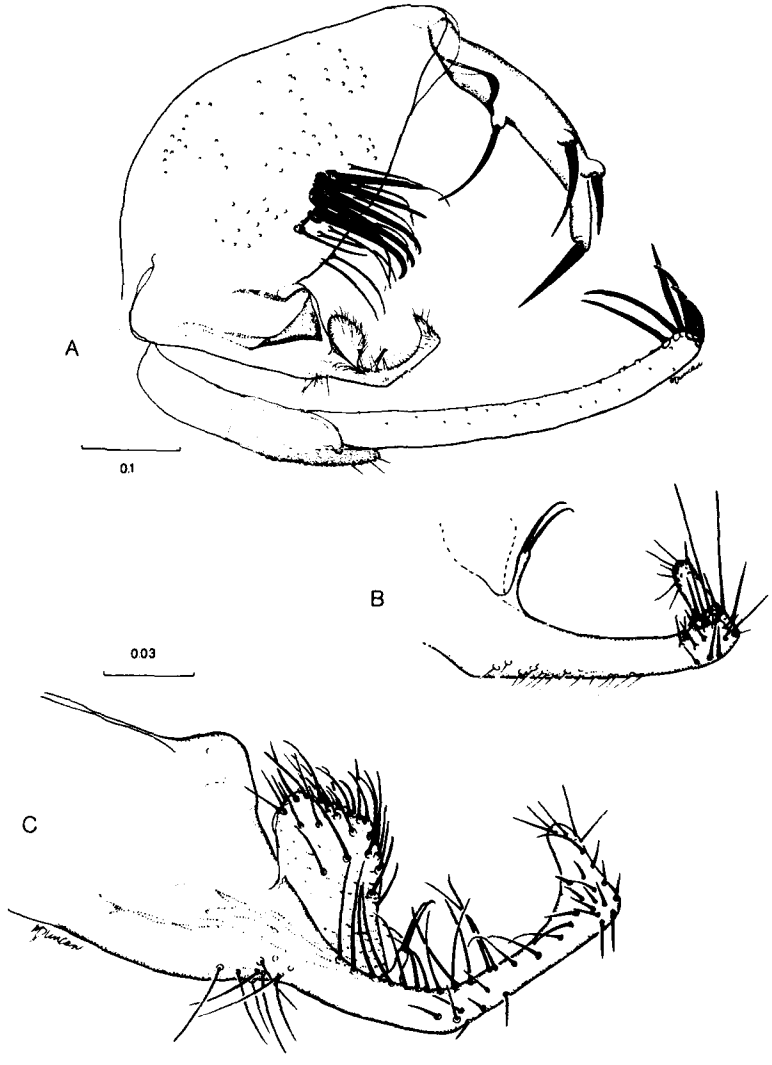


FIG. 208. ***Lutzomyia gibba.*** A. Male terminalia; B. Paramere; C. Paramere.

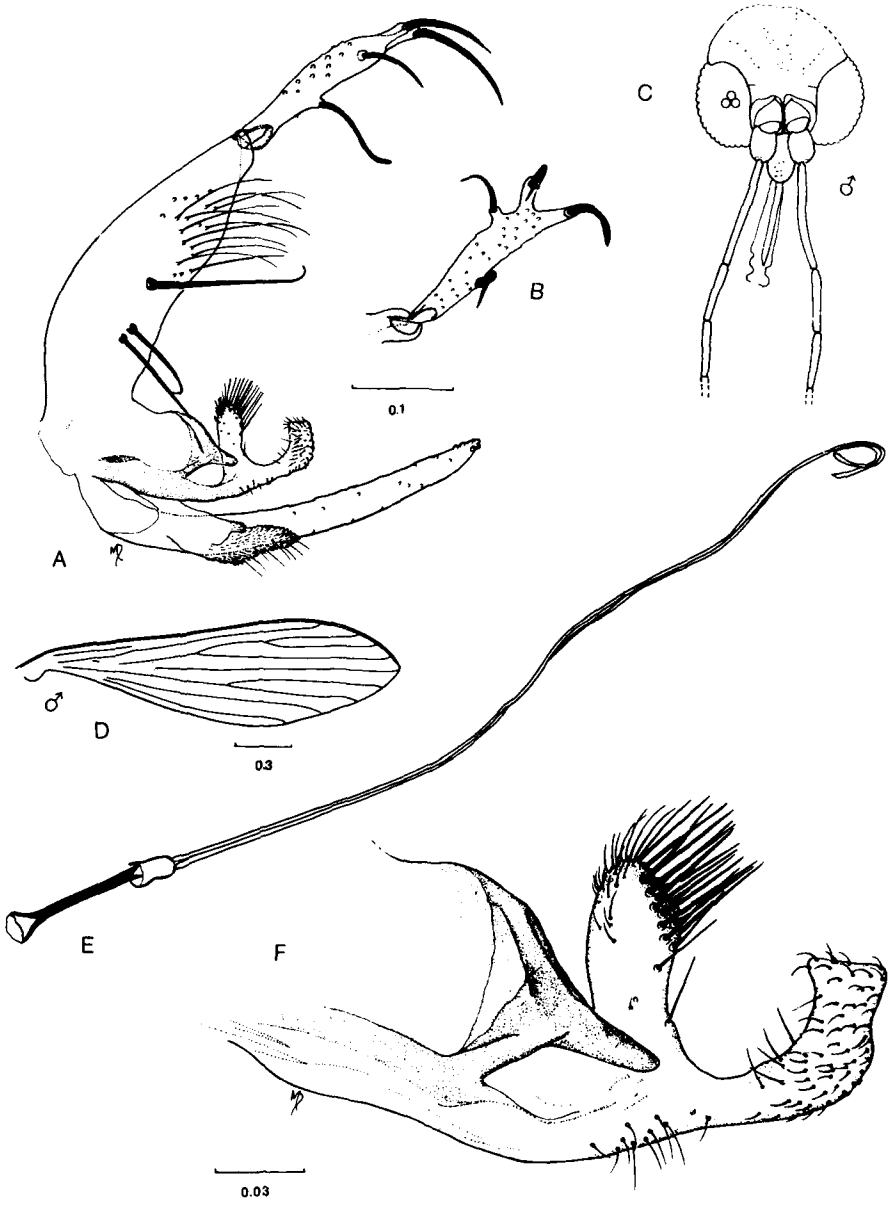


FIG. 209. ***Lutzomyia dunhami.*** A. Male terminalia; B. Style; C. Male head; D. Male wing; E. Genital pump & filaments; F. Paramere & aedeagus.

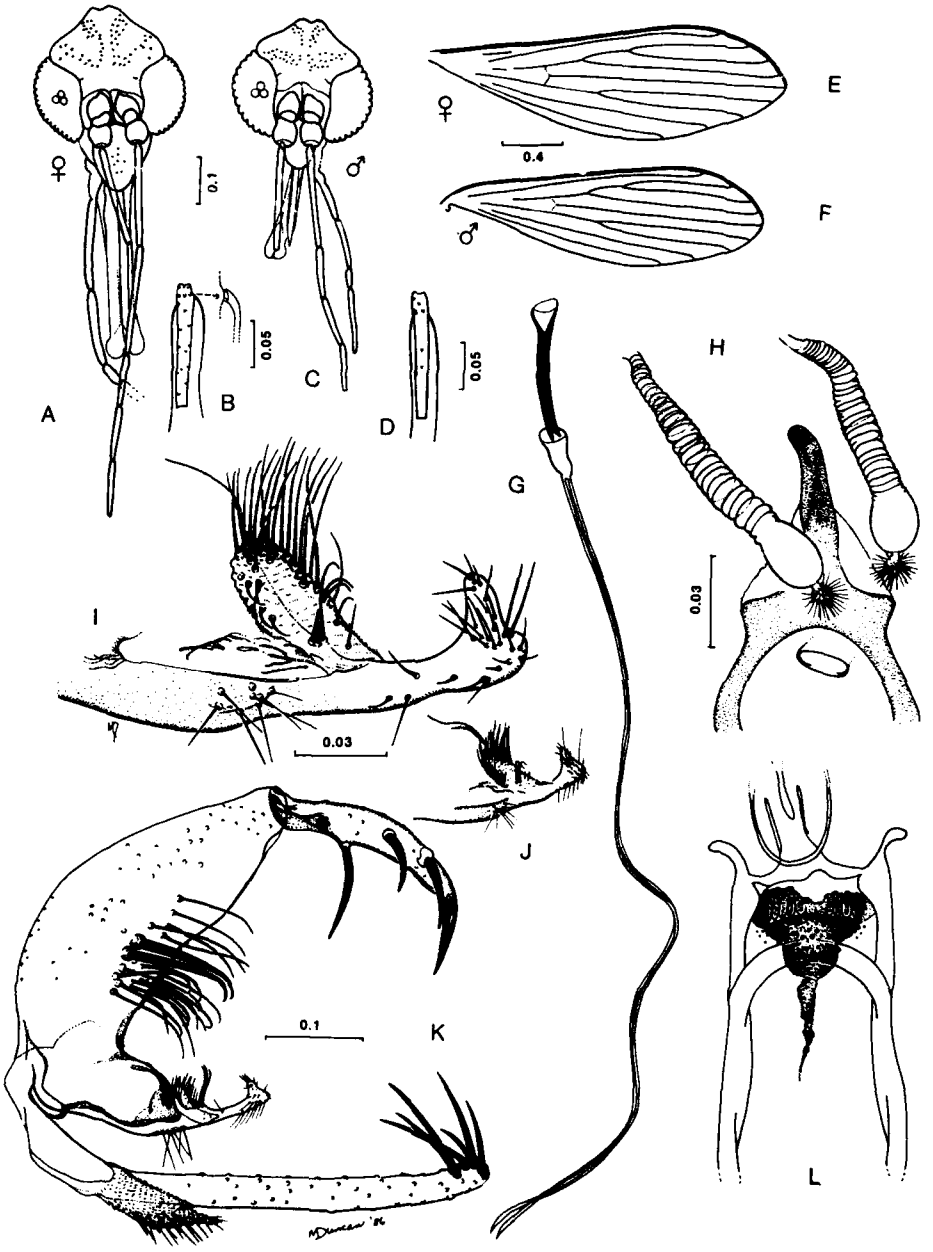


FIG. 210. ***Lutzomyia viannamartinsi.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Spermathecae; I. Paramere; J. Paramere; K. Male terminalia; L. Female cibarium.

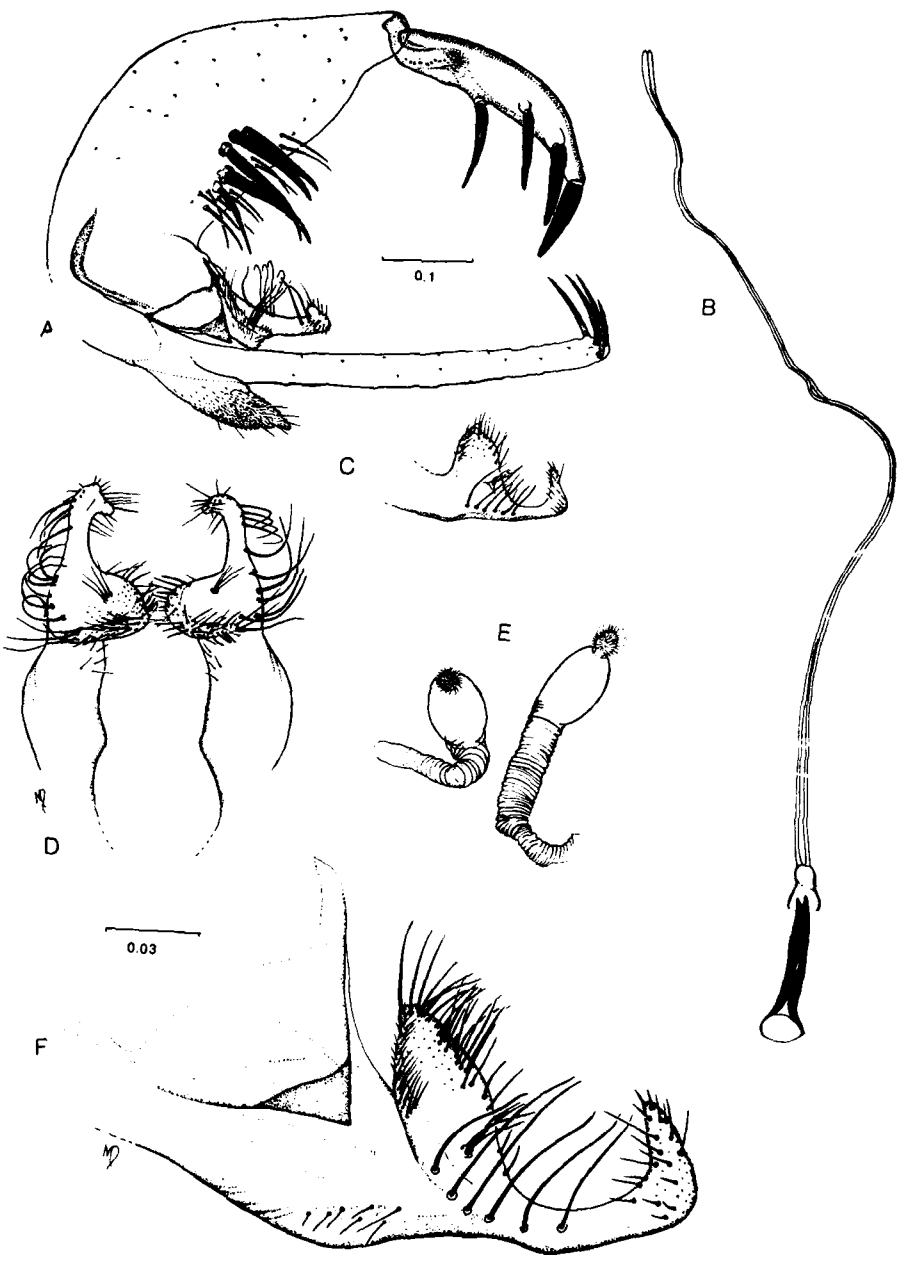


FIG. 211. ***Lutzomyia brachipyga.*** A. Male terminalia; B. Genital pump & filaments; C. Paramere (different aspect); D. Parameres, dorsal view; E. Spermathecae; F. Paramere & aedeagus.

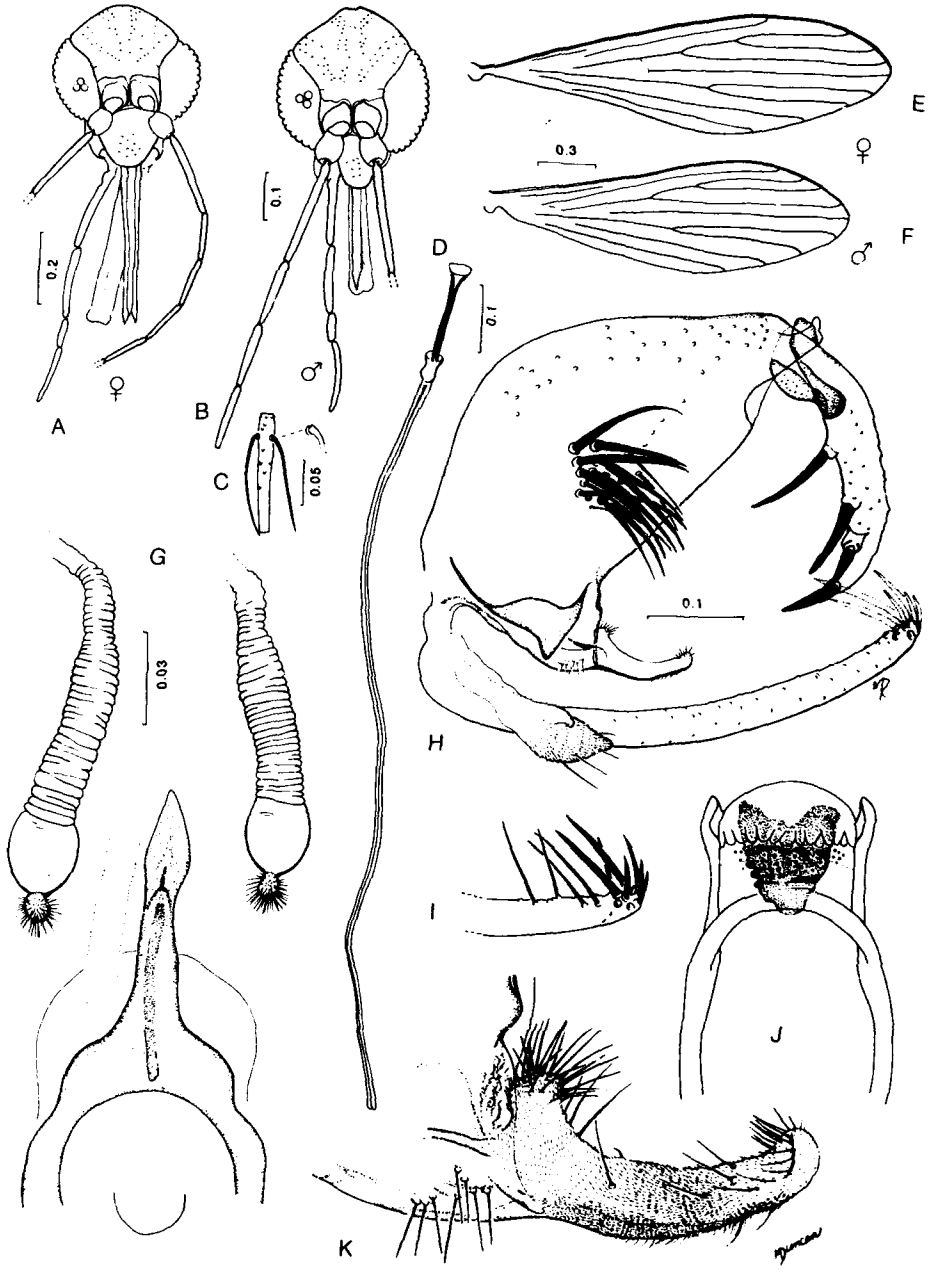


FIG. 212. ***Lutzomyia bettinii.*** A. Female head; B. Male head; C. Male flagellomere I; D. Genital pump & filaments; E. Female wing; F. Male wing; G. Spermathecae; H. Male terminalia; I. End of lateral lobe; J. Female cibarium; K. Paramere (figs. from Feliciangeli et al. 1988a).

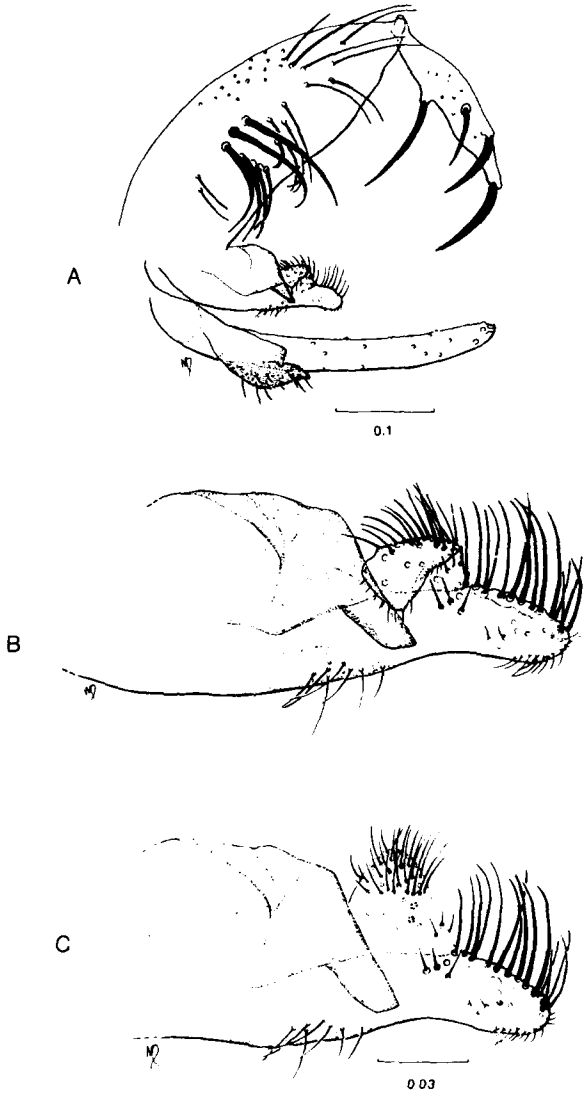


FIG. 213. ***Lutzomyia readyi.*** A. Male terminalia; B. Paramere showing dorsal lobe & aedeagus; C. Paramere with dorsal lobe in natural position (schematic).

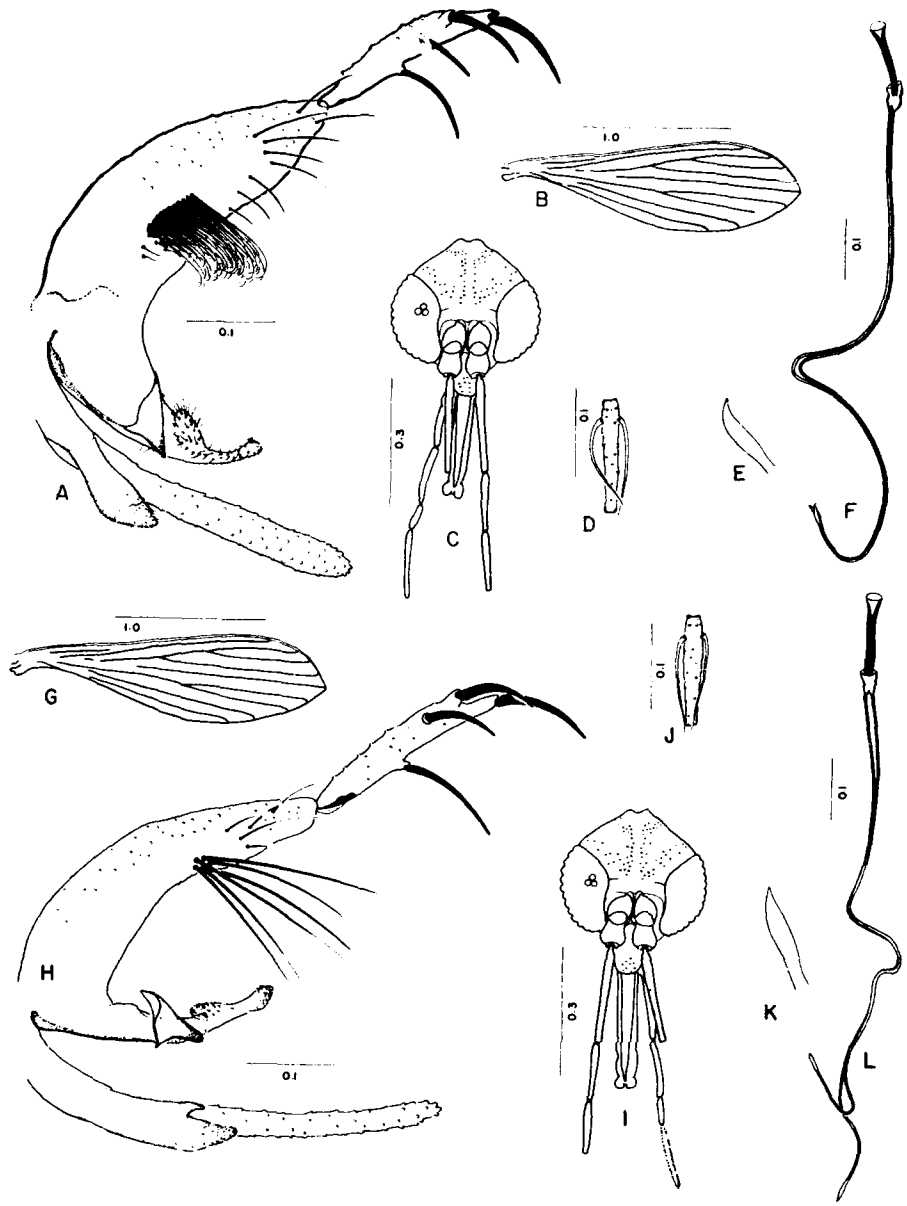


FIG. 214. ***Lutzomyia howardi.*** A. Male terminalia; B. Male wing; C. Male head; D. Male flagellomere II; E. Tip of genital filament; F. Genital pump & filaments (from Young 1979).
Lutzomyia saltuosa. G. Male wing; H. Male terminalia; I. Male head; J. Male flagellomere II; K. Tip of genital filament; L. Genital pump & filament (from Young 1979).

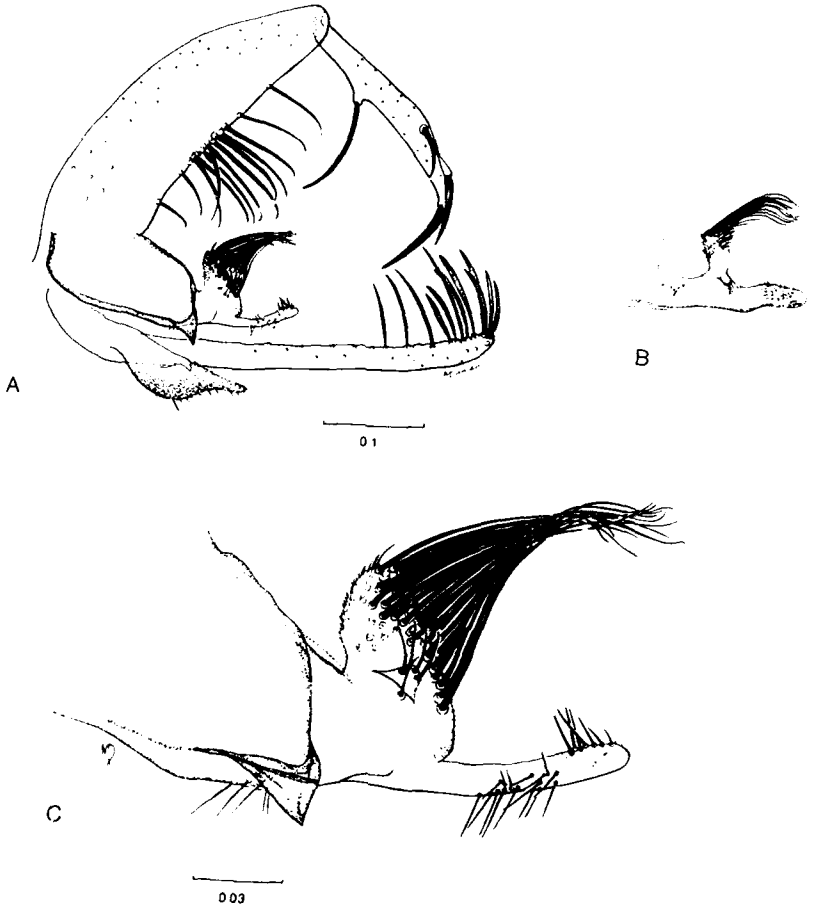


FIG. 215. ***Lutzomyia castanheirai.*** A. Male terminalia; B. Paramere (different aspect); C. Paramere & aedeagus.

FIG. 216. ***Lutzomyia lopesi.*** A. Male head; B. Male wing; C. Male terminalia; D. Paramere.

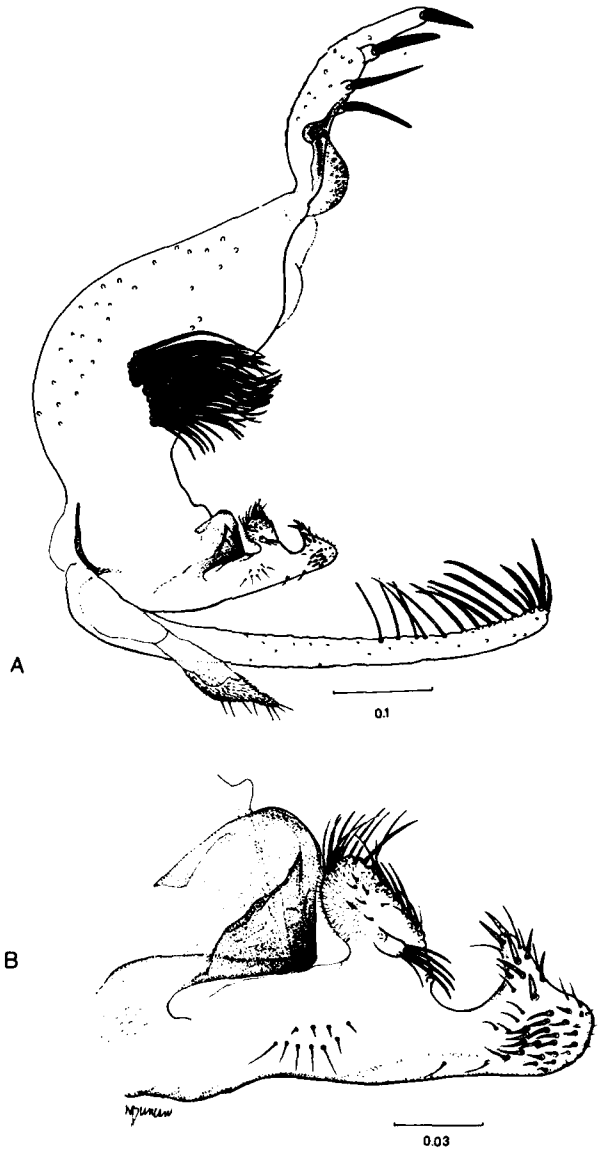


FIG. 217. ***Lutzomyia eurypyga***. A. Male terminalia; B. Paramere.

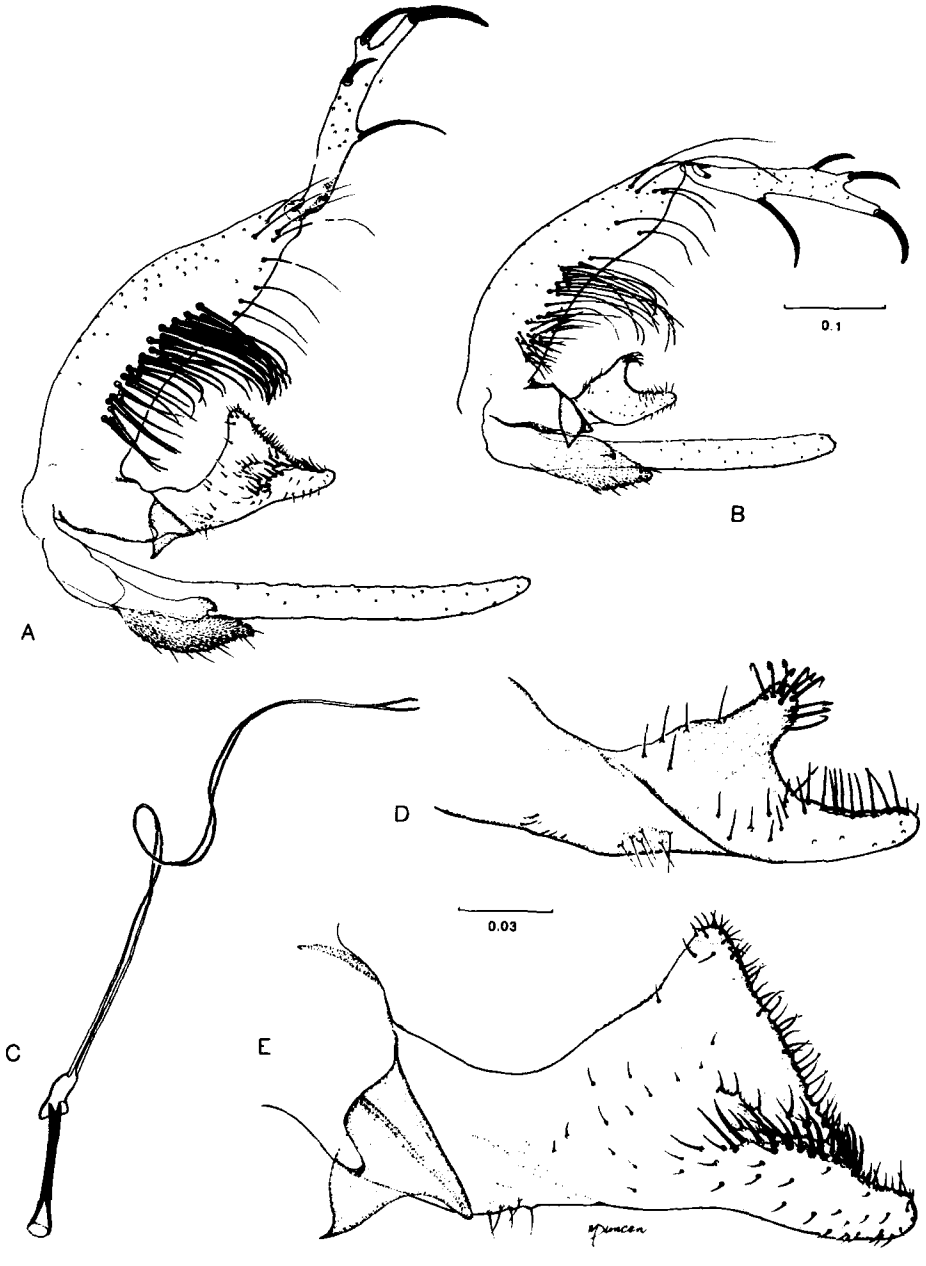


FIG. 218. ***Lutzomyia innini.*** A. Male terminalia; E. Paramere & aedeagus.
Lutzomyia melloi. B. Male terminalia; C. Genital pump & filaments; D. Paramere.

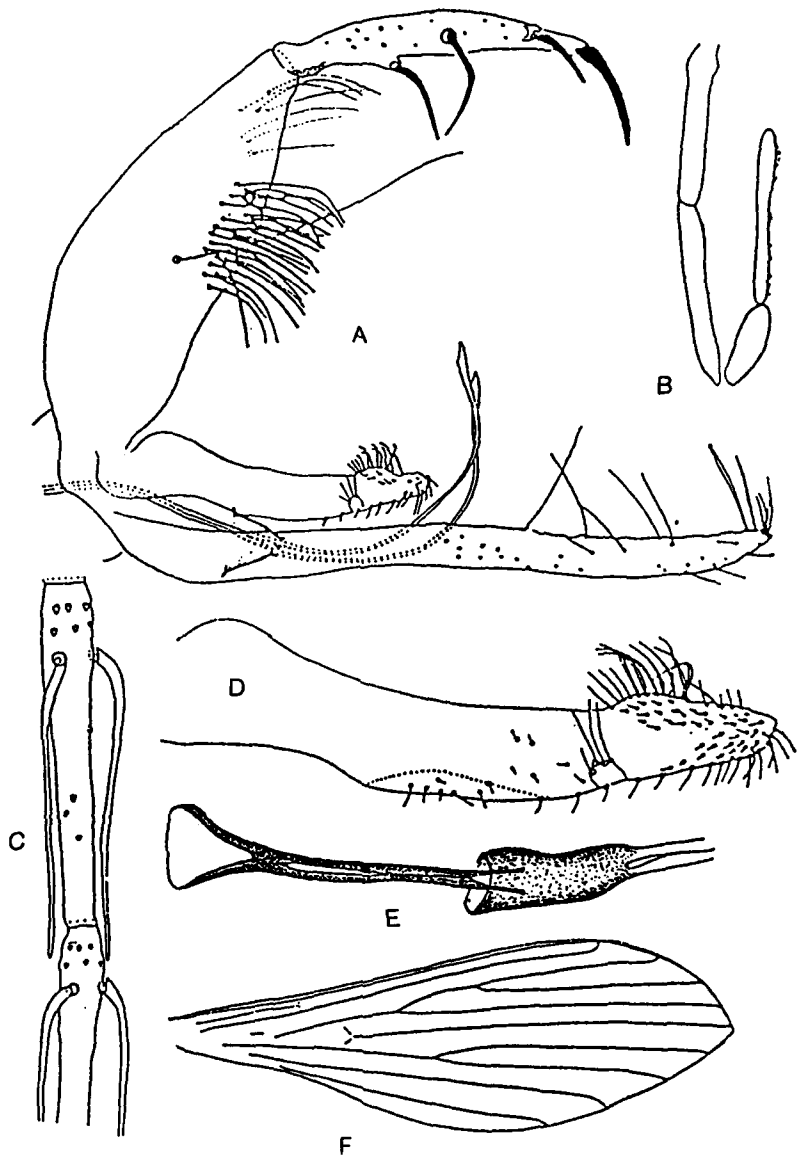


FIG. 219. ***Lutzomyia acostai.*** A. Male terminalia; B. Palpus; C. Flagellomeres showing ascoids; D. Paramere; E. Genital pump; F. Male wing (all figs. from Llanos 1964).

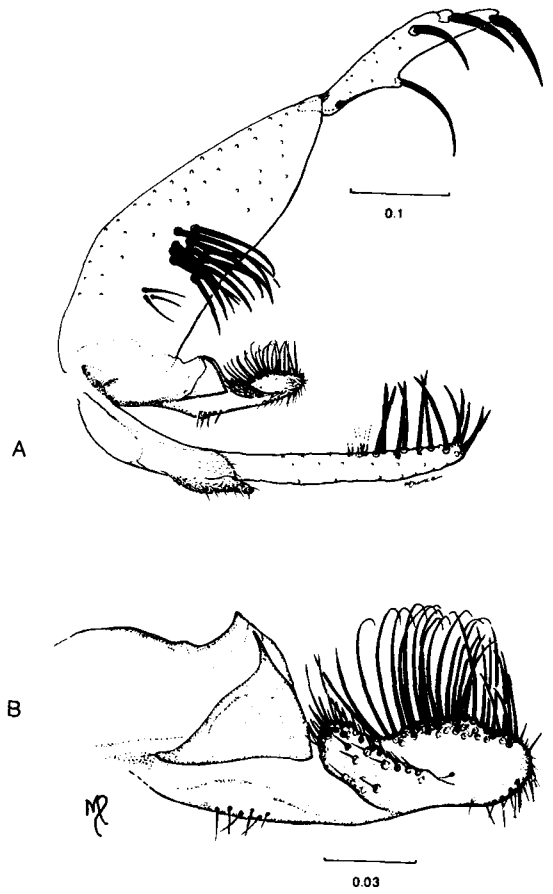


FIG. 220. ***Lutzomyia flochi.*** A. Male terminalia; B. Paramere.

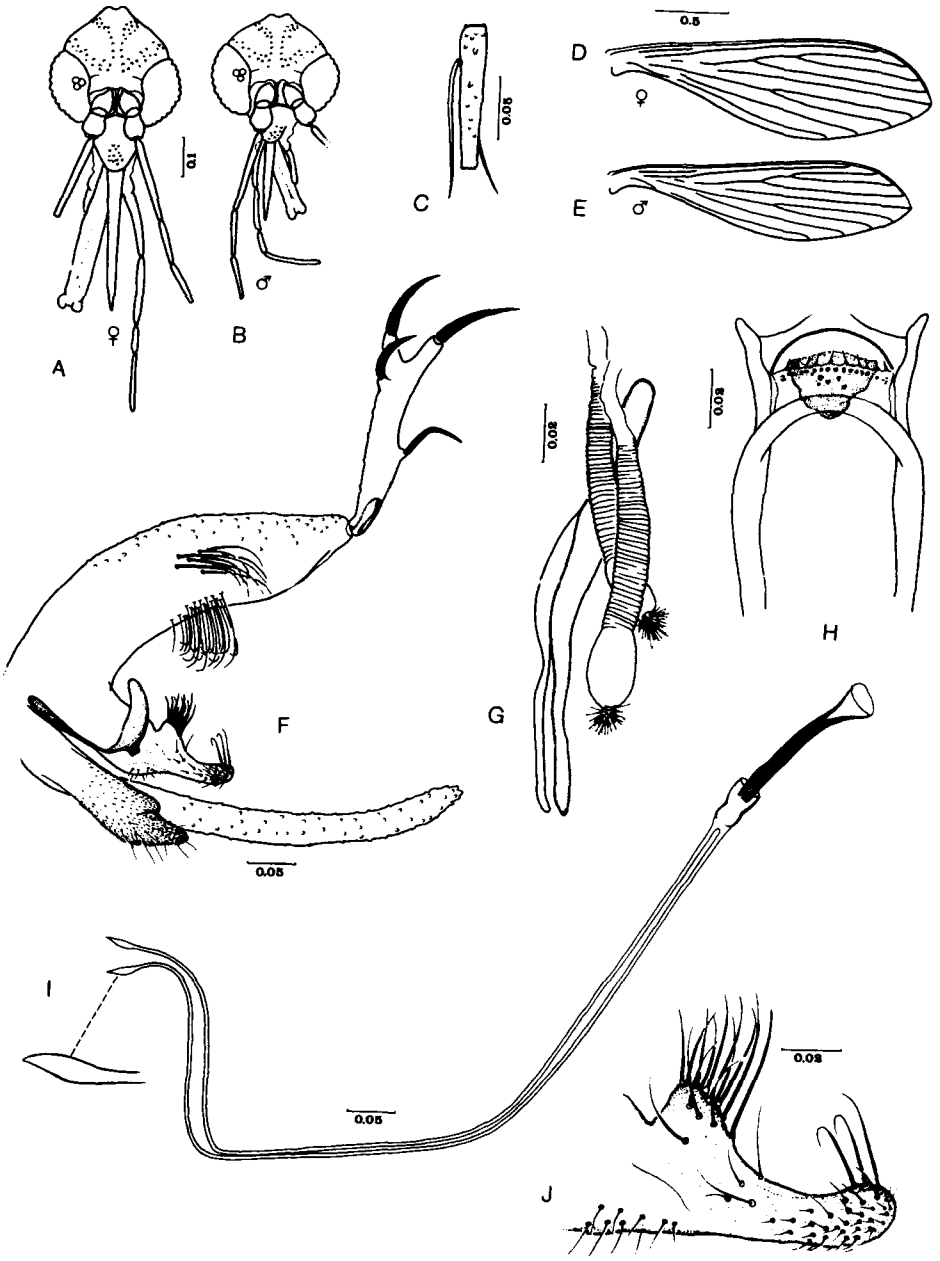


FIG. 221. ***Lutzomyia napoensis***. A. Female head; B. Male head; C. Female flagellomere II; D. Female wing; E. Male wing; F. Male terminalia; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Paramere (figs. from Young & Rogers 1984).

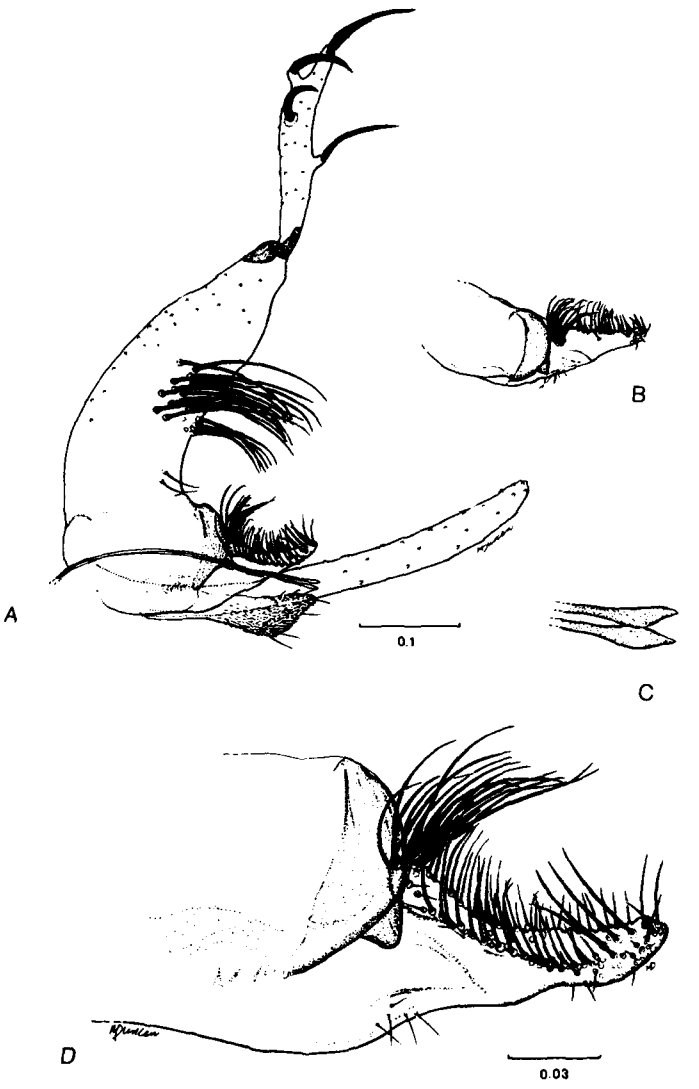


FIG. 222. ***Lutzomyia sinuosa.*** A. Male terminalia; B. Paramere; C. Tips of genital filaments; D. Paramere.

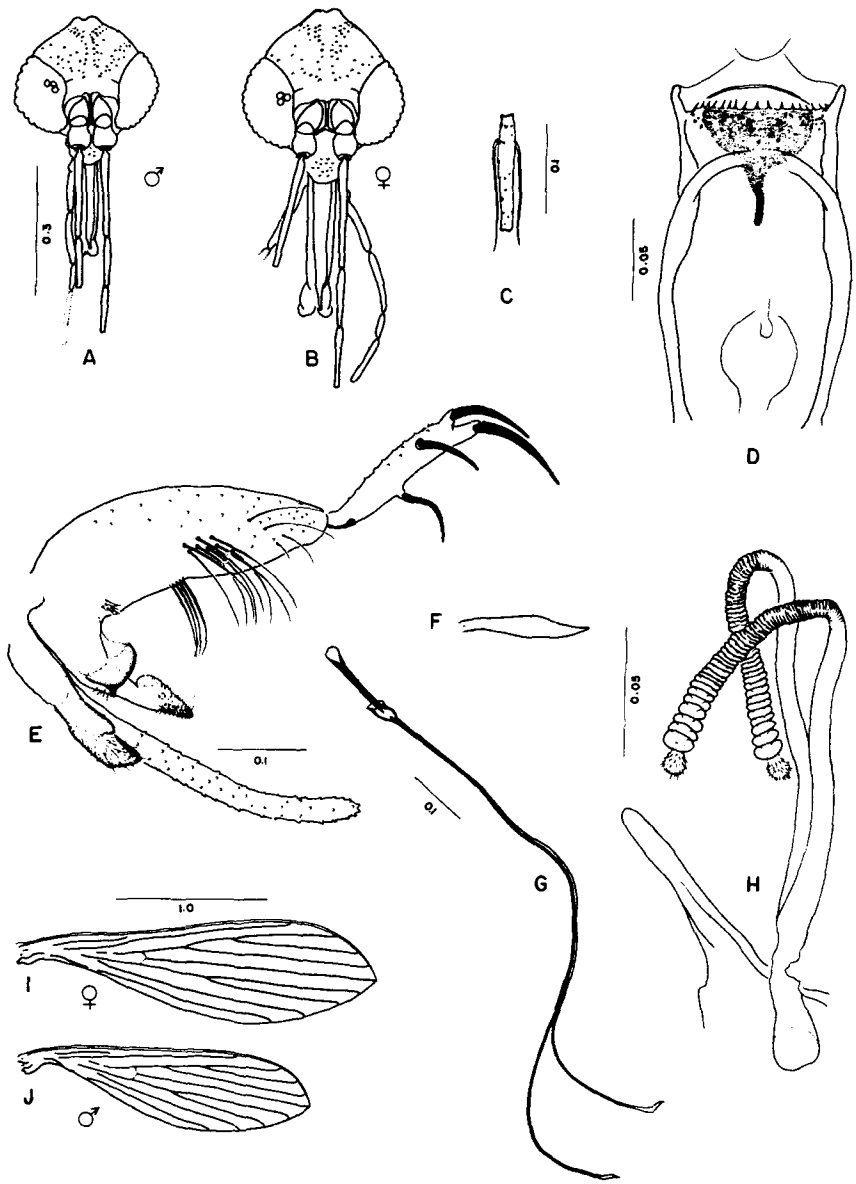


FIG. 223. ***Lutzomyia cellulana.*** A. Male head; B. Female head; C. Female flagellomere II; D. Female cibarium; E. Male terminalia; F. Tip of genital filament; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing (figs. from Young 1979).

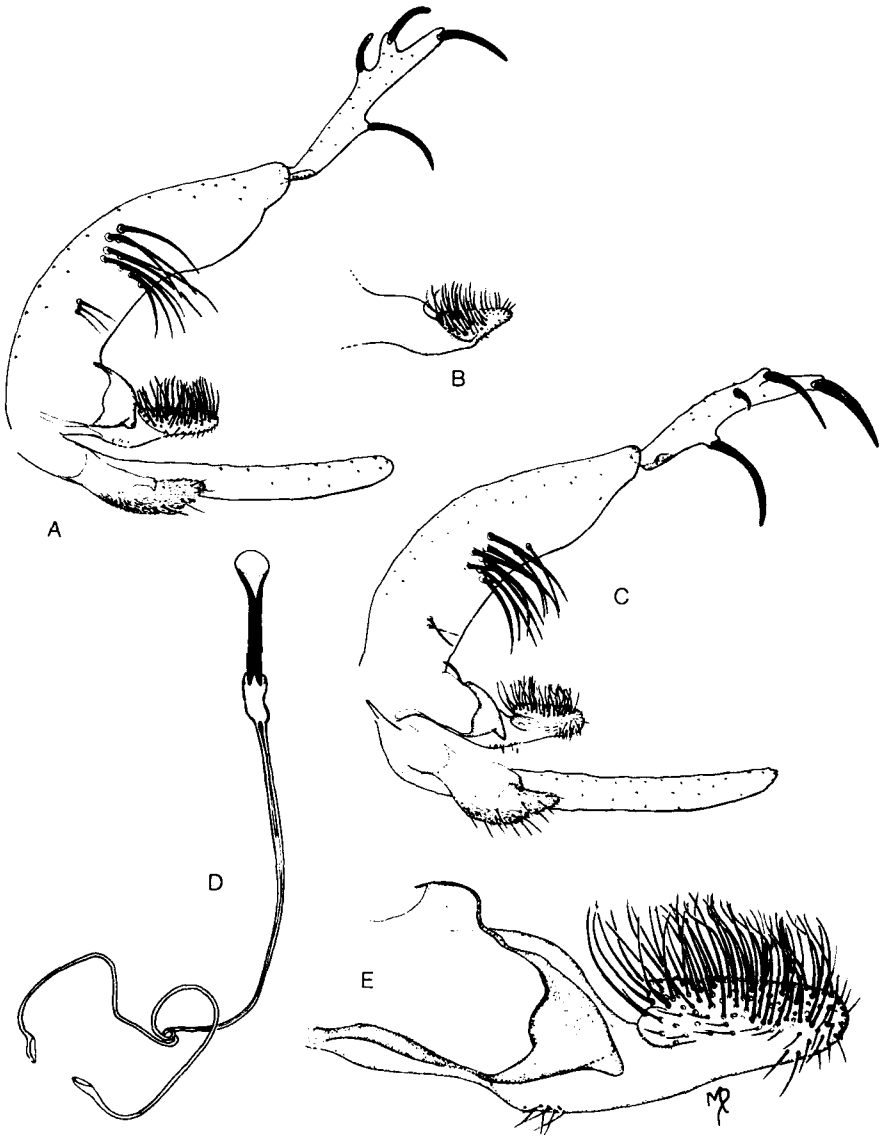


FIG. 224. ***Lutzomyia octavioi.*** A. Male terminalia; B. Paramere. C. Genitalia, different aspect; D. Genital pump & filaments; E. Paramere.

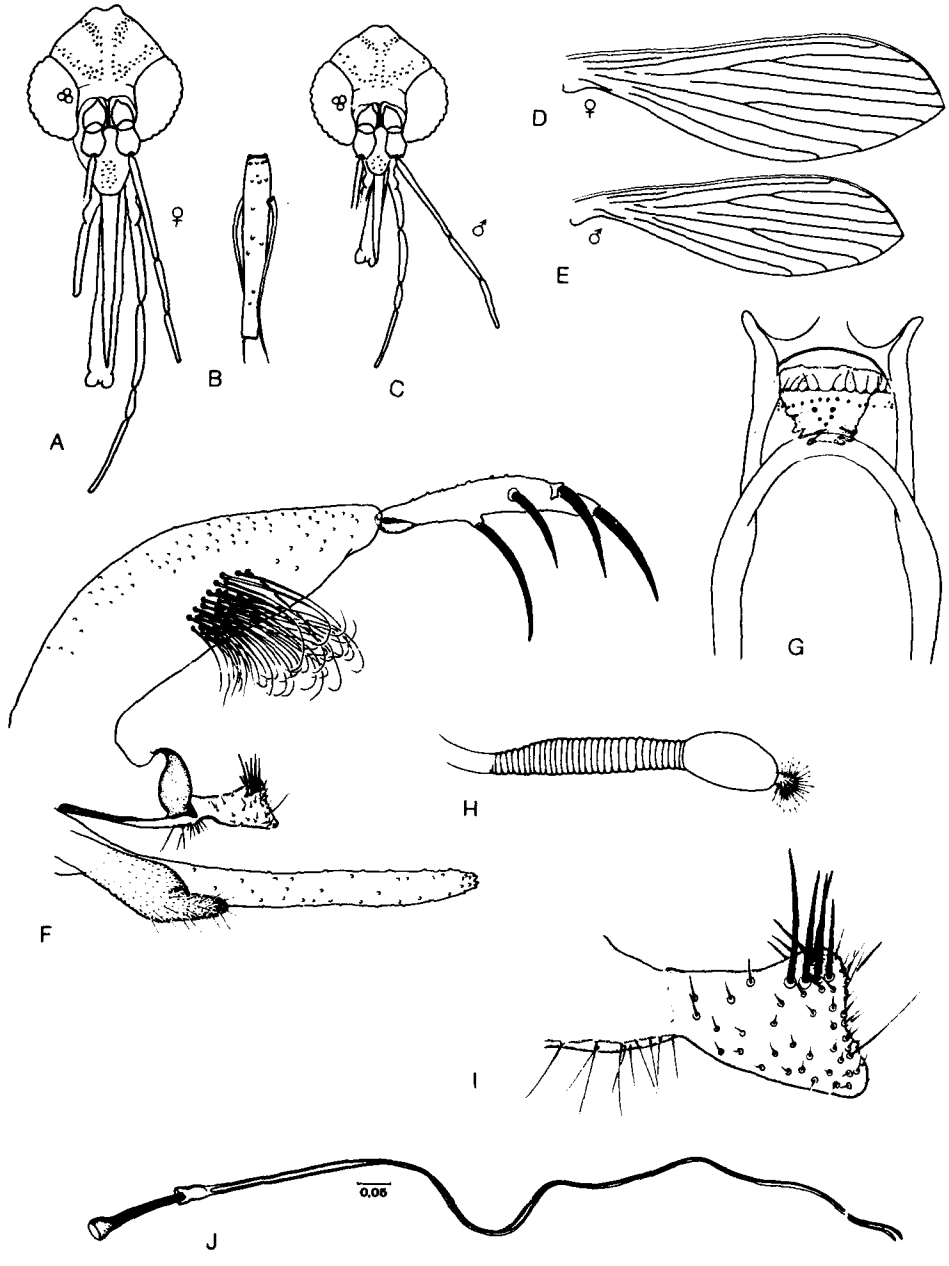


FIG. 225. ***Lutzomyia wilkersoni.*** A. Female head; B. Female flagellomere II; C. Male head; D. Female wing; E. Male wing; F. Male terminalia; G. Female cibarium; H. Spermatheca; I. Paramere; J. Genital pump & filaments (figs. from Young & Rogers 1984).

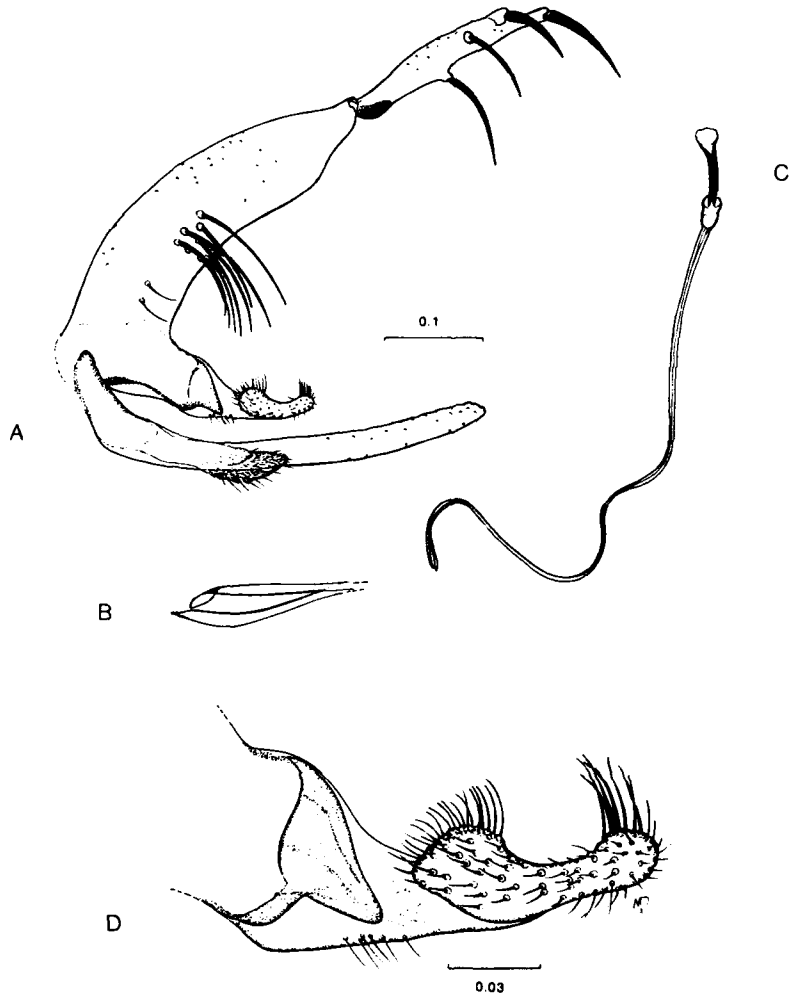


FIG. 226. ***Lutzomyia clitella.*** A. Male terminalia; B. Tips of genital filaments; C. Genital pump & filaments; D. Paramere.

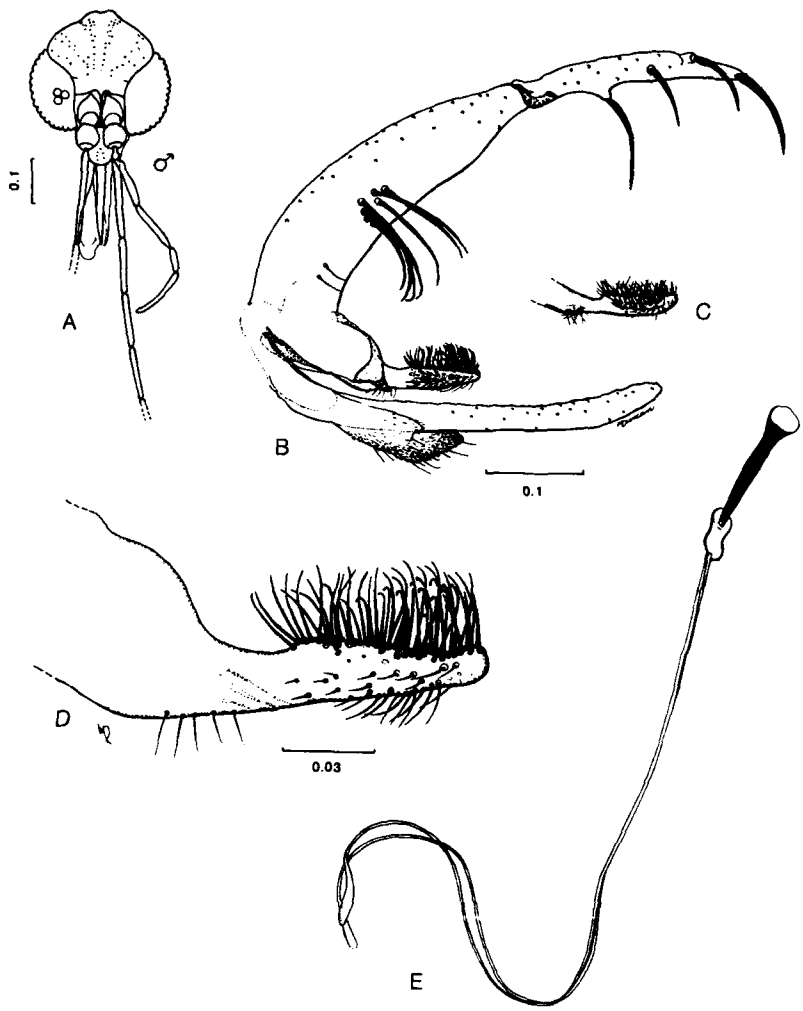


FIG. 227. ***Lutzomyia nemorosa.*** A. Male head; B. Male terminalia; C. Paramere; D. Paramere; E. Genital pump & filaments.

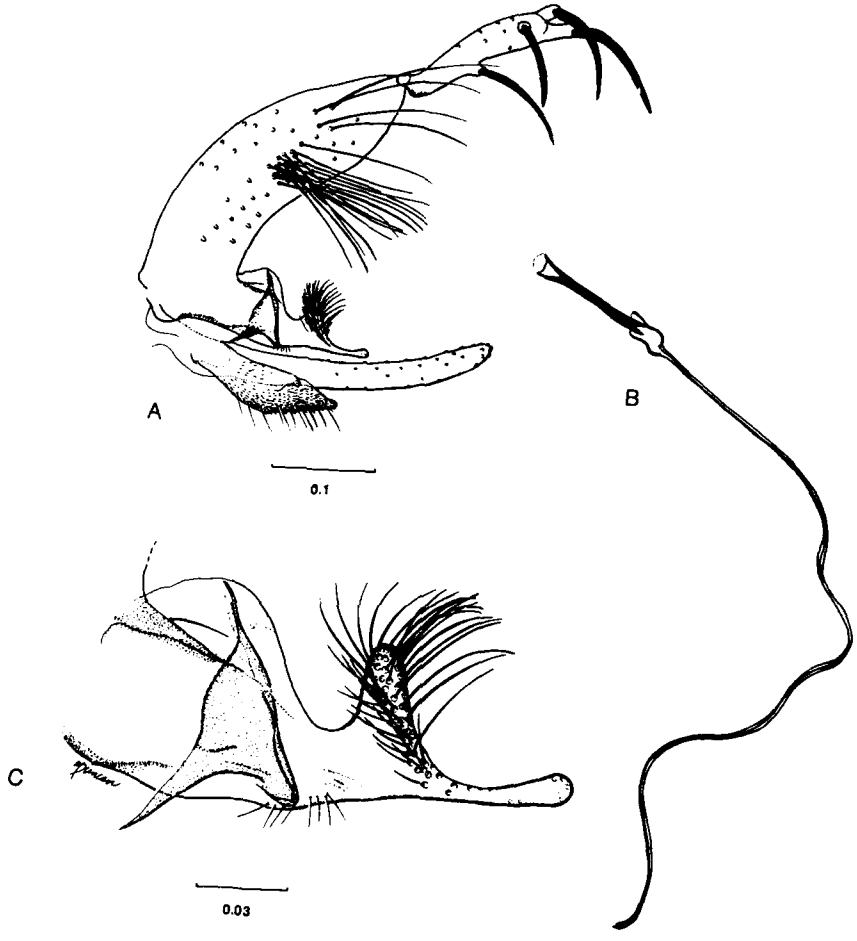


FIG. 228. ***Lutzomyia beniensis.*** A. Male terminalia; B. Genital pump & filaments; C. Paramere.

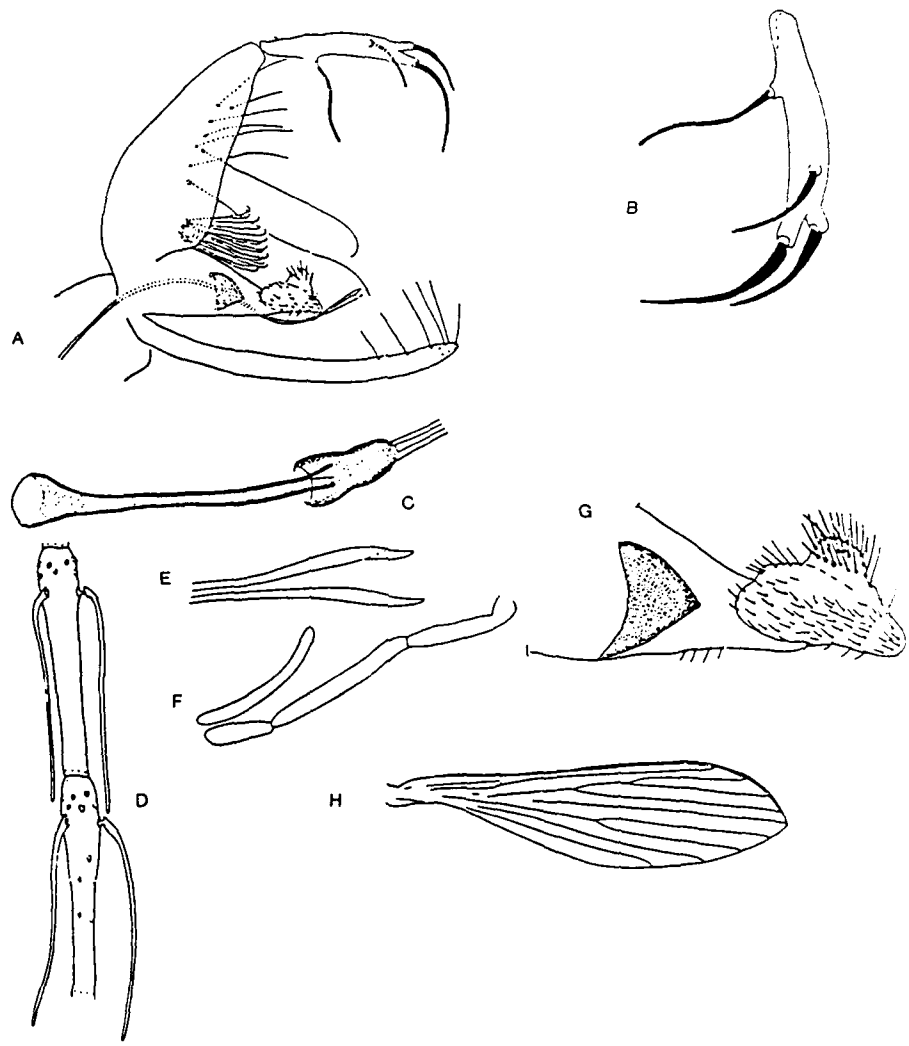


FIG. 229. ***Lutzomyia incasica***. A. Male terminalia; B. Style; C. Genital pump; D. Flagellomeres; E. Tips of genital filaments; F. Palpus; G. Paramere; H. Male wing (all figs. from Llanos 1964).

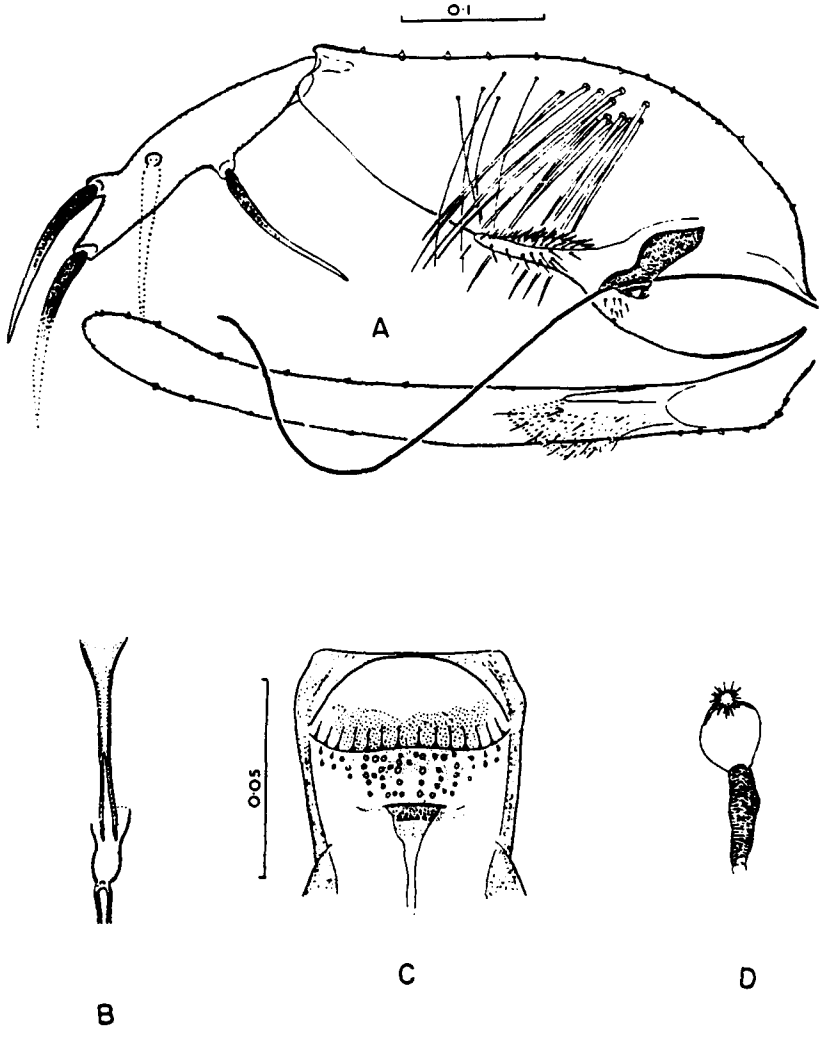


FIG. 230. ***Lutzomyia rostrans.*** A. Male terminalia; B. Genital pump; C. Female cibarium; D. Spermathecae (all figs. from Lewis 1967a).

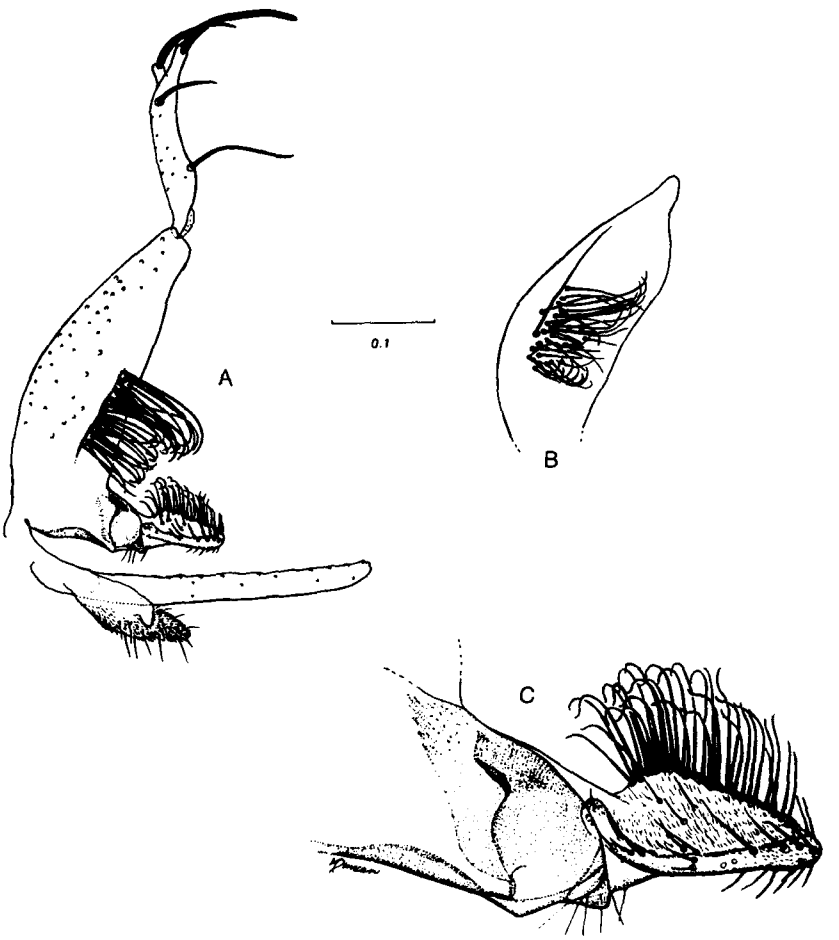


FIG. 231. ***Lutzomyia loretonensis***. A. Male terminalia; B. Coxite; C. Paramere.

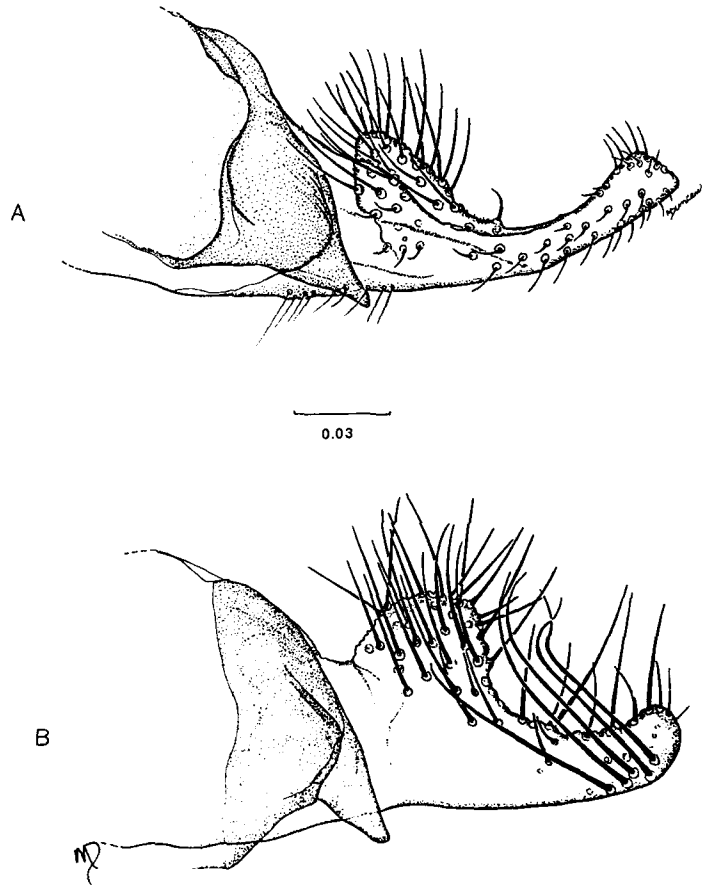


FIG. 232. ***Lutzomyia howardi.*** **A. Paramere.**
Lutzomyia **sp. #1 of Araracuara. B. Paramere.**

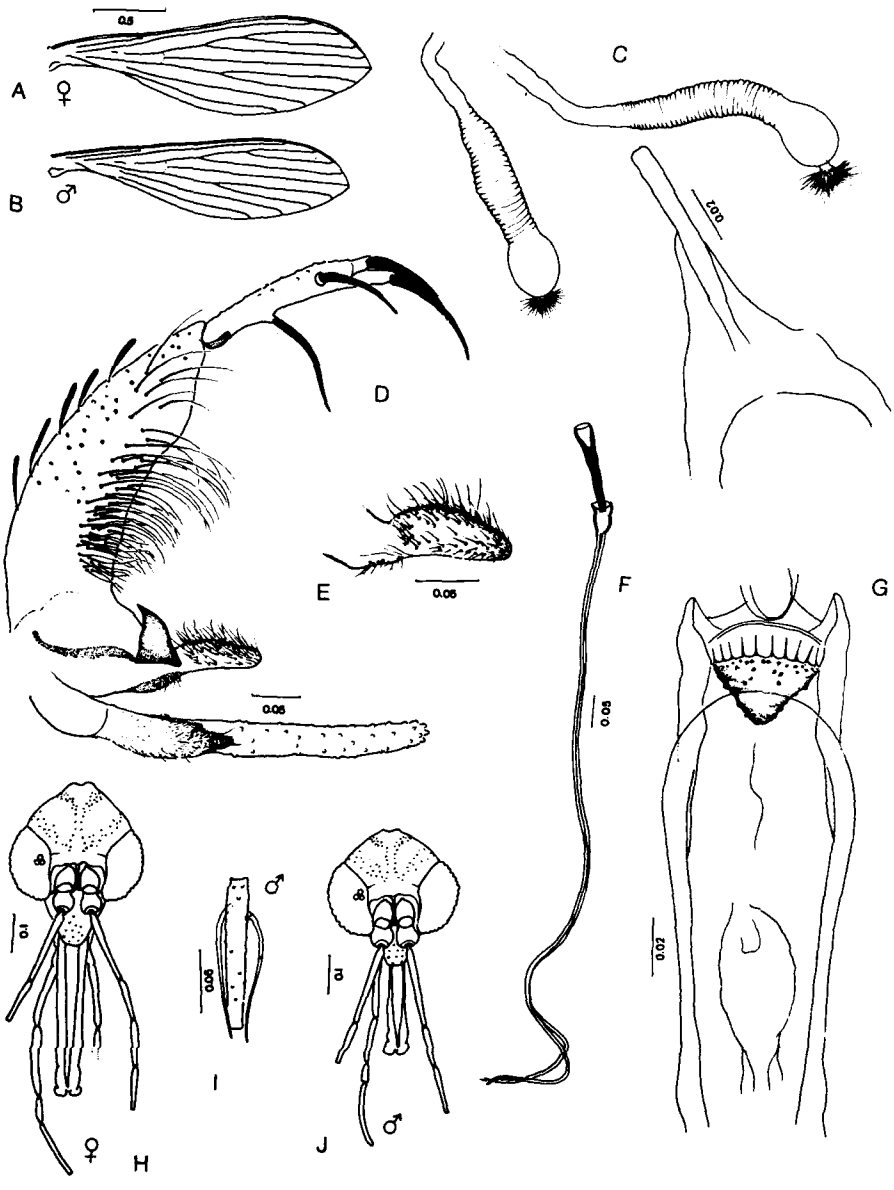
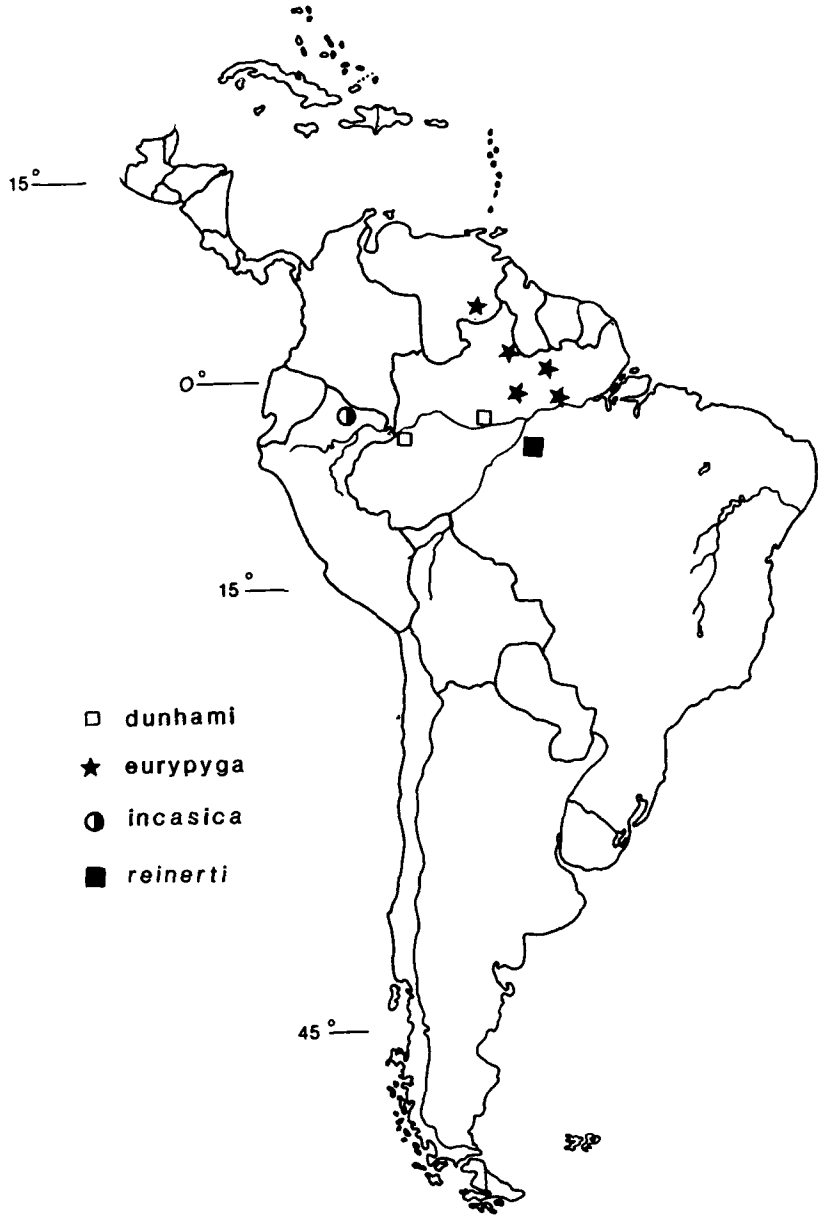
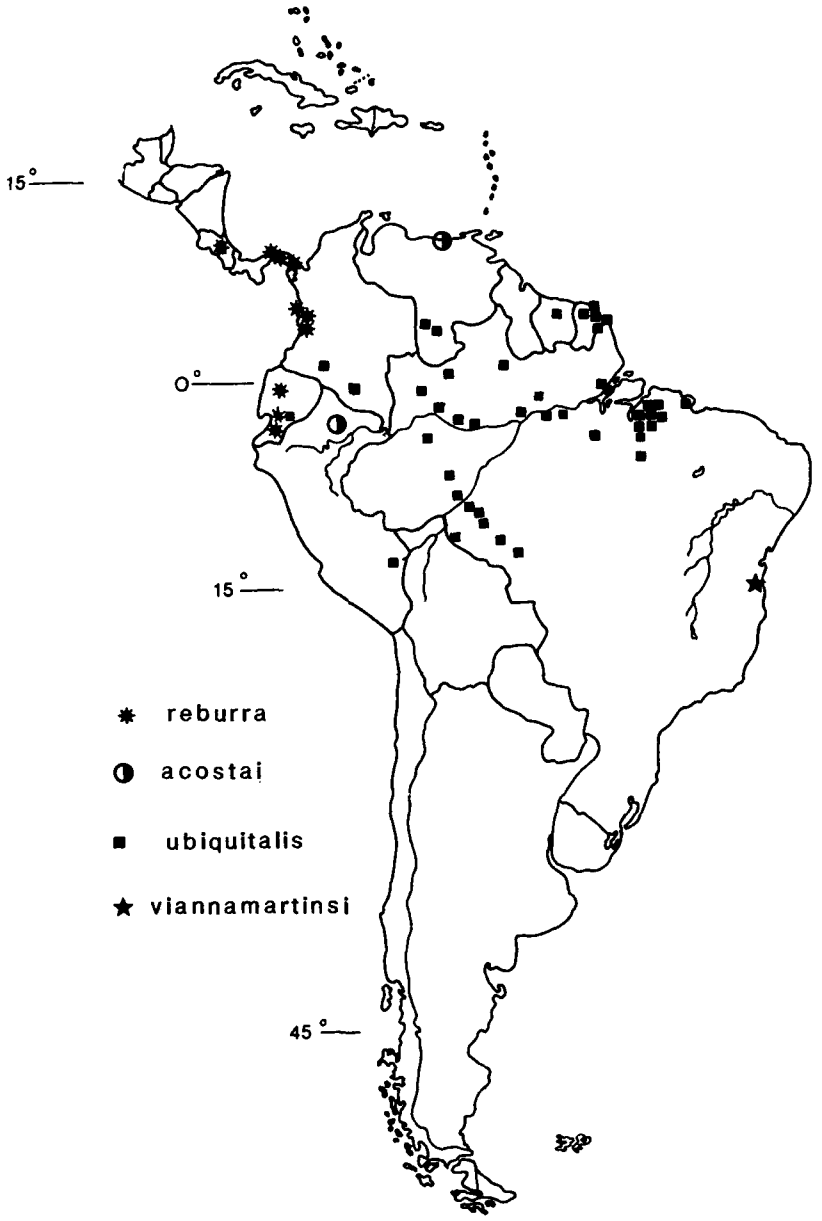


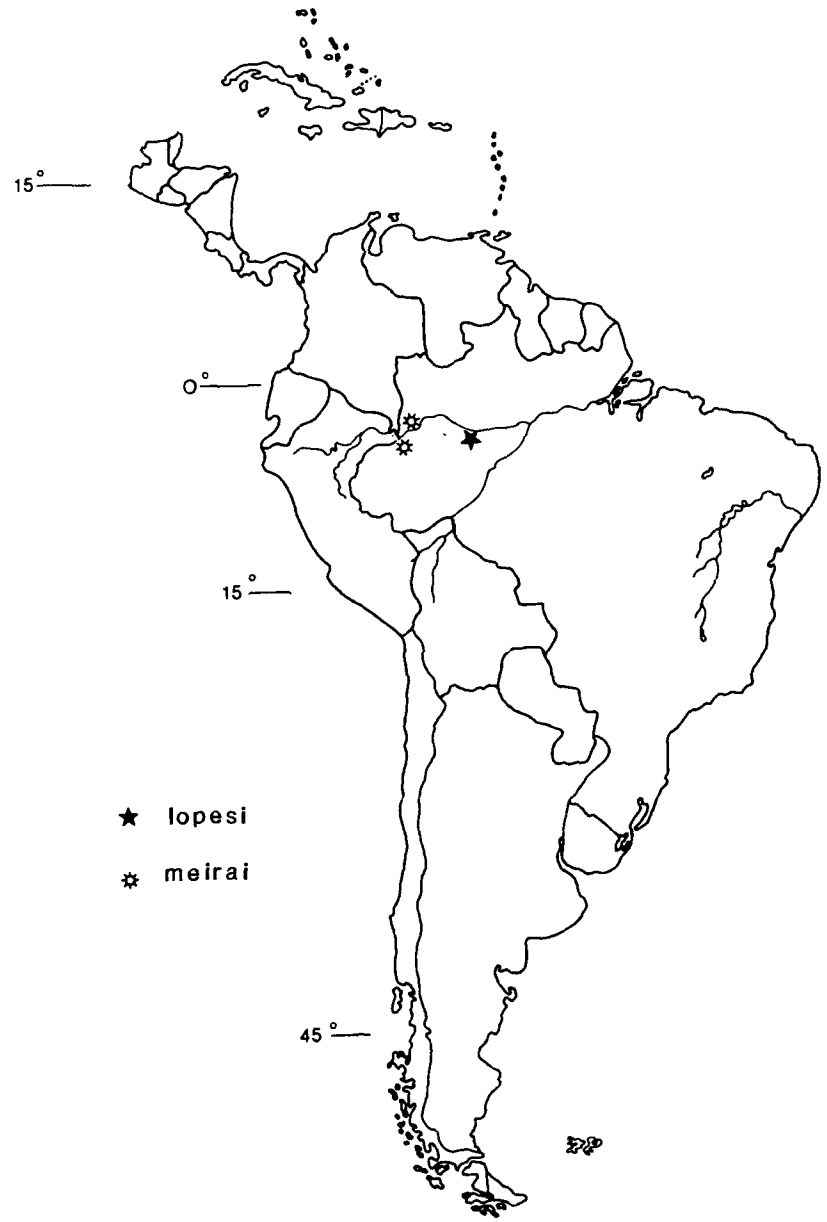
FIG. 233. ***Lutzomyia ruii.*** A. Female wing; B. Male wing; C. Spermathecae; D. Male terminalia; E. Paramere; F. Genital pump & filaments; G. Female cibarium; H. Female head; I. Male flagellomere II; J. Male head (figs. from Arias & Young 1982).



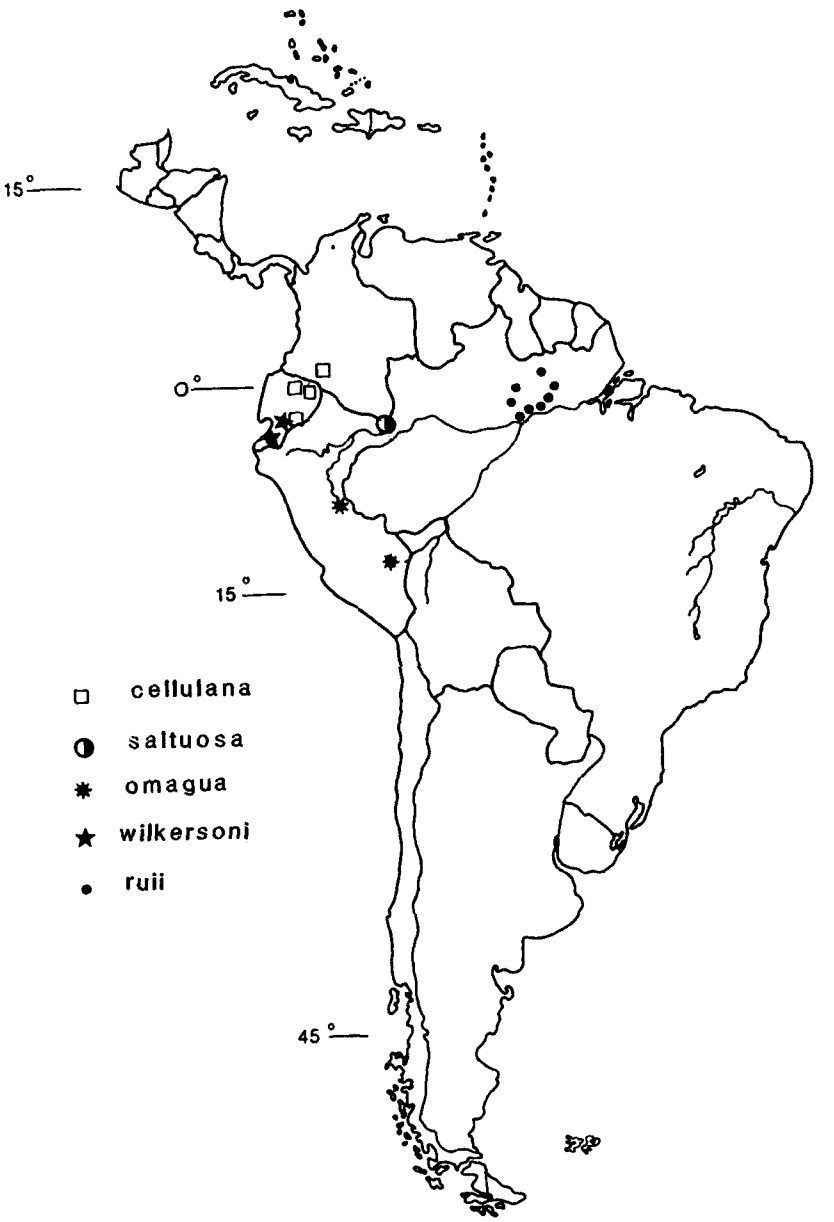
Map 105



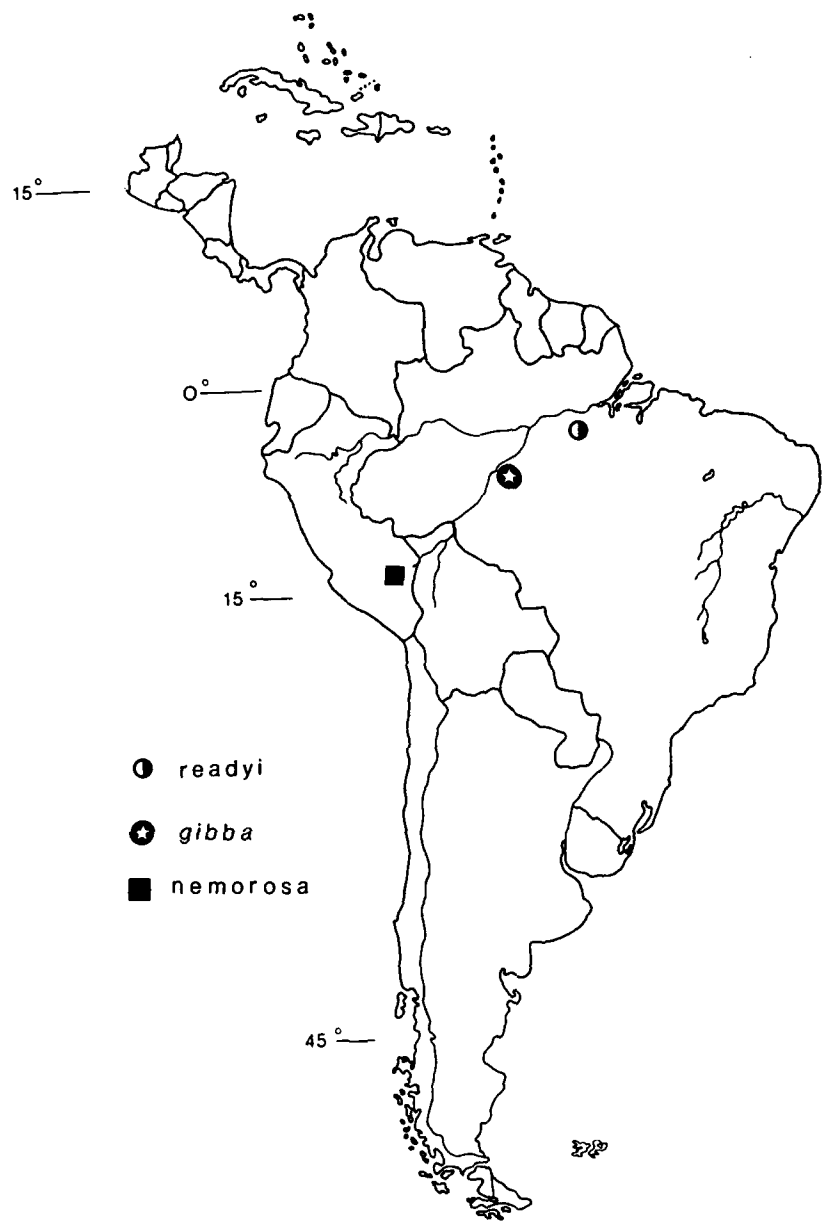
Map 106



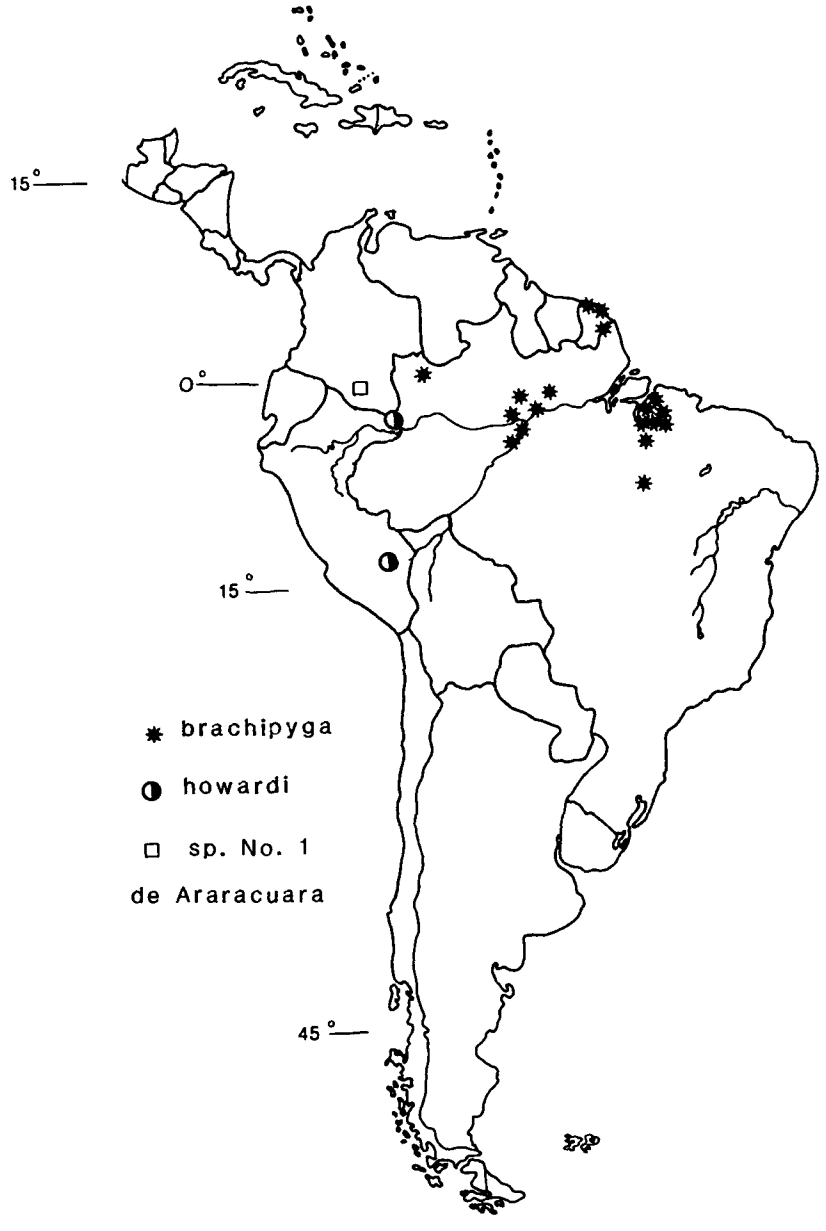
Map 107



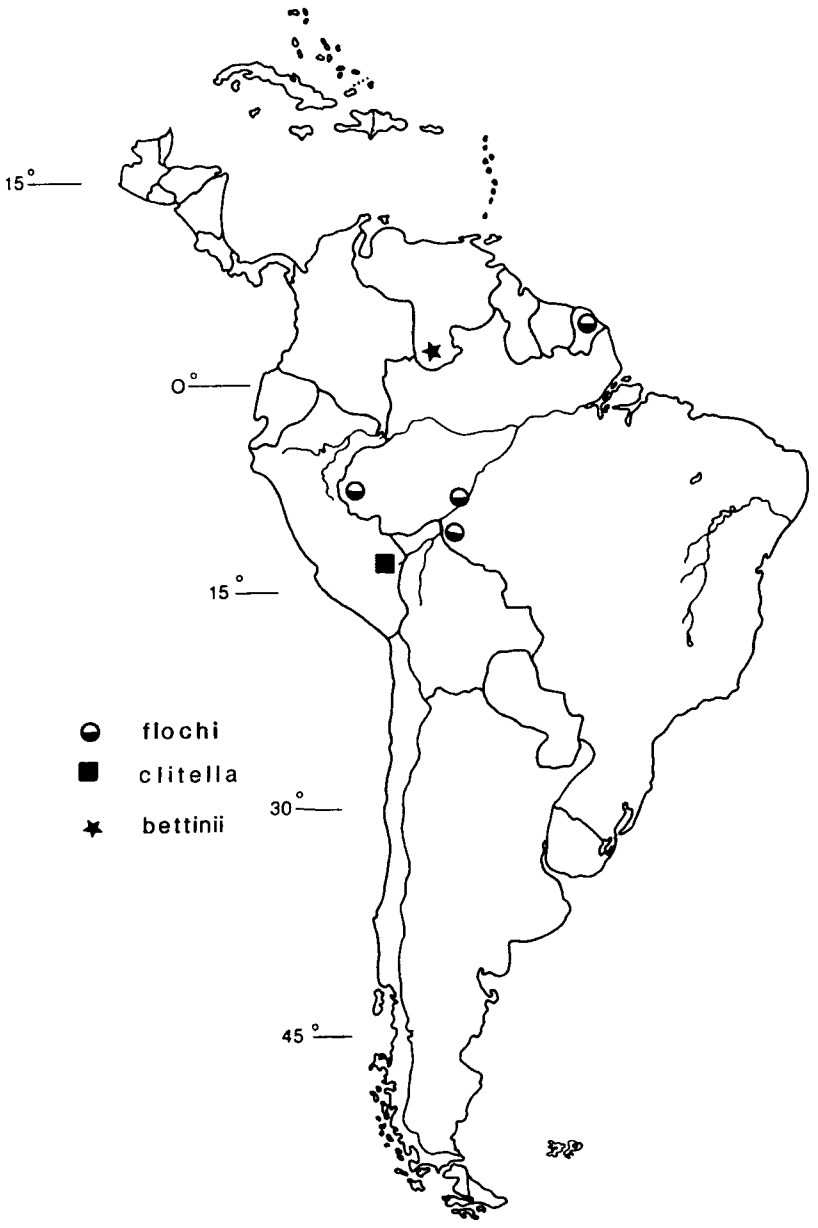
Map 108



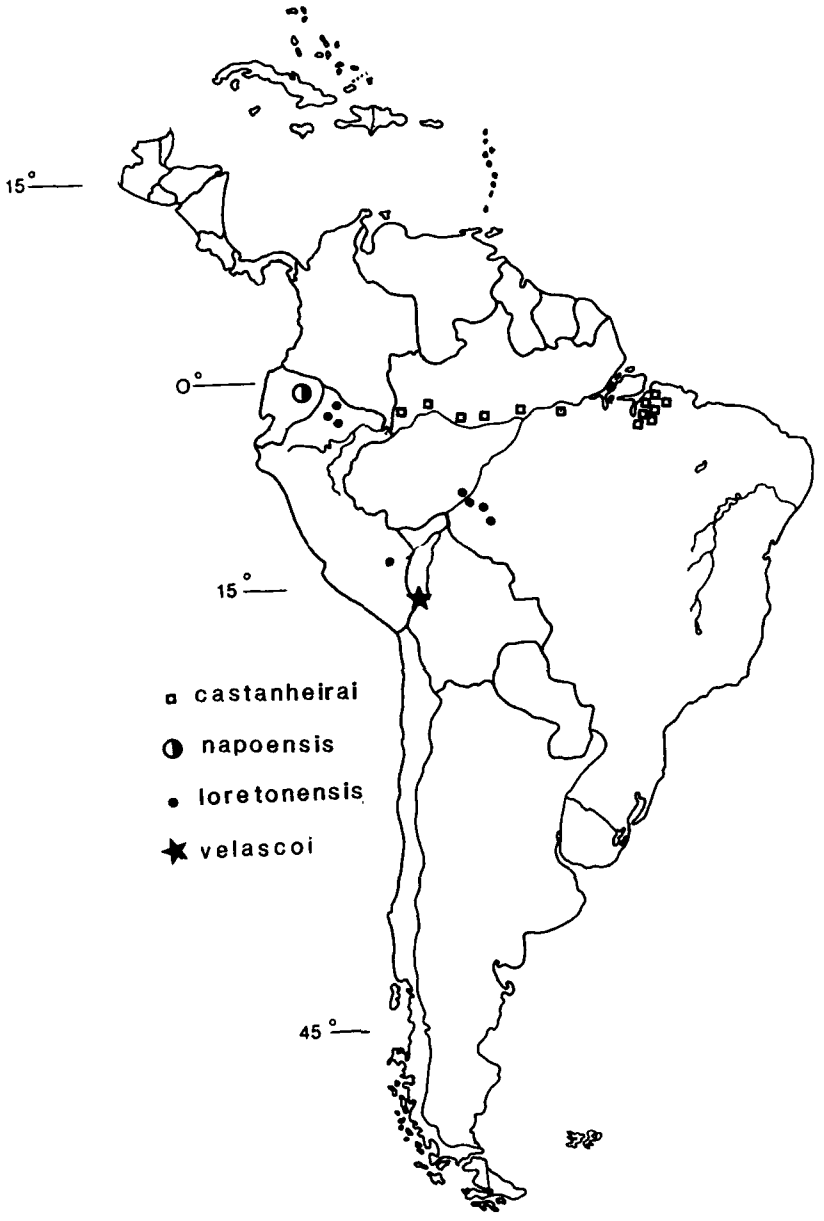
Map 109



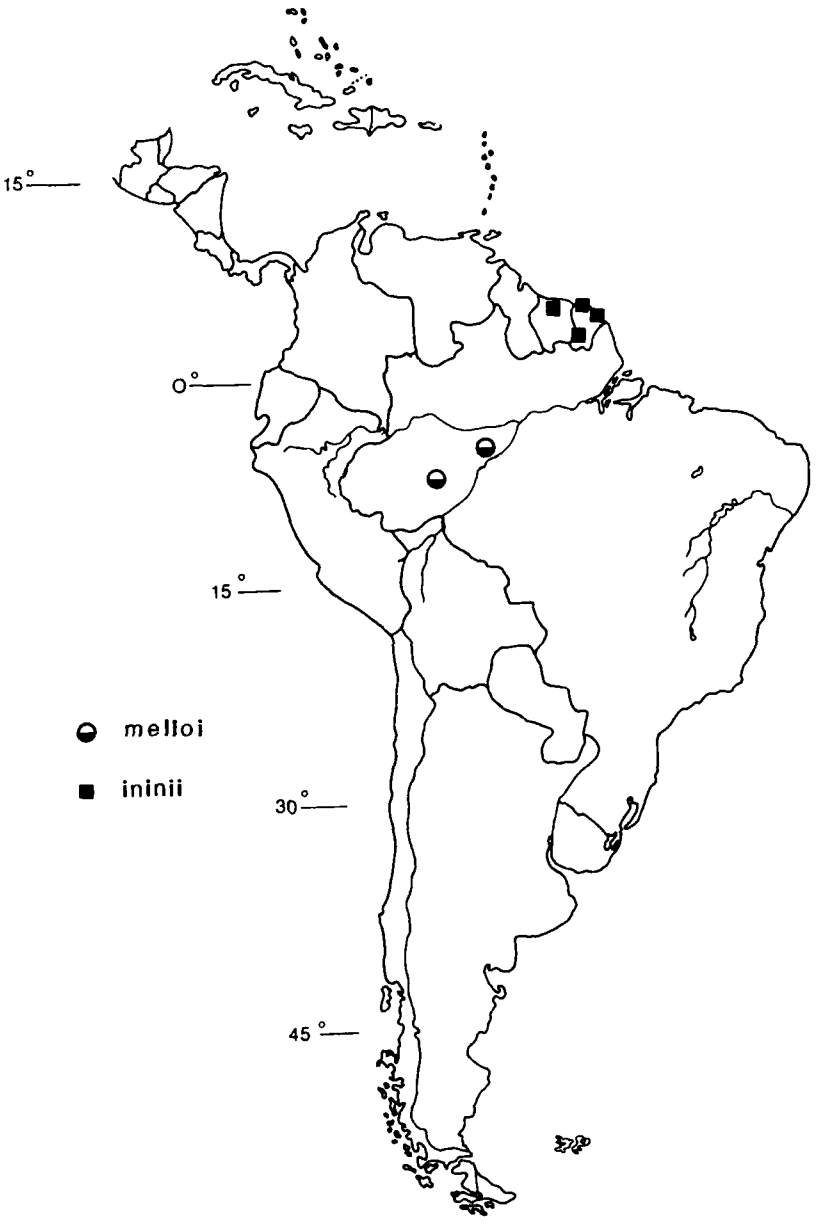
Map 110



Map 111

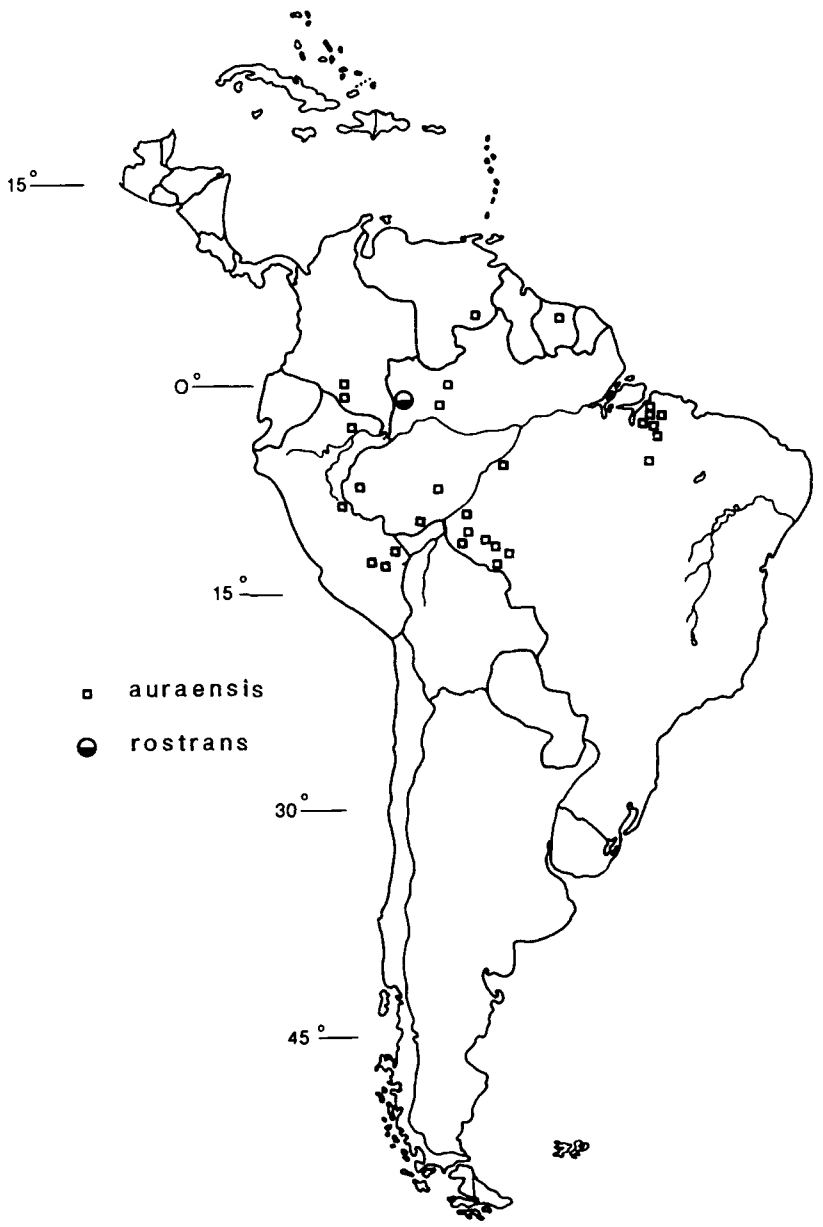


Map 112



Map 113

Map 114



Map 115

SUBGENUS *PSYCHODOPYGUS* MANGABEIRA

Phlebotomus, subgenus *Shannonomyia* (not *Shannonomyia* Alexander) Dyar 1929: 117 (type species: *Phlebotomus panamensis* Shannon by orig. designation).

Flebotomus, subgenus *Psychodopygus* Mangabeira 1941c: 237 (type species: *Flebotomus unisetosus* Mangabeira by orig. designation).

Phlebotomus, subgenus *Shannonomyina* Pratt 1947: 86 (new name for *Shannonomyia* Dyar, not *Shannonomyia* Alexander). Fairchild & Hertig 1951a: 399 (review). Fairchild 1955: 188 (defined).

Lutzomyia, subgenus *Psychodopygus*: Barretto 1962: 93 (defined). Theodor 1965: 188 (defined). Barretto 1966: 133 (spp. keyed). Lewis et al. 1977: 328. Martins et al. 1978: 34 (defined).

Psychodopygus, genus: Forattini 1971a: 104; 1973: 392 (defined). Ready et al. 1980: 75 (defined, tax.).

Phlebotomus, subgenus *Psychodopygus*: Ortiz 1972b: 221 (spp. keyed, figs.).

Psychodopygus, subgenus *Eupsychodopygus* Artemiev 1991: 73 [type species: *Psychodopygus arthuri* (Fonseca) by orig designation].

Identification. Coloration variable, completely pale to dark. Antennal ascoids simple. Palpomere 5 very short, less than length of palp. 3. Eyes large. ♀ cibarium with 4-8 horizontal teeth, few to many vertical teeth; complete or incomplete arch. Pharynx unarmed. Spermathecae imbricated, i.e., with semi-telescoped annulations; individual and at least part of common sperm ducts usually rugose or striated. ♂ *genitalia*. Coxite without persistent setae. Style with 1-6 large spines; smaller spines or setae present or not. Paramere simple to highly modified. Lateral lobe without specialized setae.

The *Psychodopygus* species are usually grouped into 3 or more informally named series or complexes based on male, and sometimes female, character states (Theodor 1965, Ortiz 1972b, Martins et al. 1978, Young 1979, Ryan 1986). Reasons for elevating this subgenus to the generic level are given by Ready et al. (1980), but we continue to follow Lewis et al. (1977) who treat *Psychodopygus* as a subgenus of *Lutzomyia*. The rank of *Psychodopygus* as a genus would necessitate elevating equally distinctive subgenera of Phlebotominae to this level, thereby increasing the number of genera in both the Old and New Worlds.

Medical Importance. Considerable; females of many species are anthropophilic and an increasing number are being incriminated as proven vectors of leishmaniasis to man (see Ryan et al. 1987c).

Key to the Males of the Subgenus *Psychodopygus**

1. Style with 1 terminal spine & 3 subapical smaller setae. Paramere with a subtransverse row of setae, directed upwards, near middle of structure at level of aedeagus. Coxite bilobed or not (series *squamiventris*) 2
   Style with 1-6 large spines; subapical setae, if present, larger & spine-like. Paramere without such a row of setae. Coxite never bilobed 11

2. Paramere with subterminal dorsal arm arising from ventral lateral side of structure 3
   Paramere without subterminal arm but small terminal projection may be present 7

3. Paramere with 10+ long wavy setae at base of dorsal arm . . . . . *L. bernalei* (Fig. 234)
   Paramere without such setae 4

4. Whole insect pale. Style arched downwards. Coxite not bilobed or with median constriction. Paramere as shown . . . . . *L. lainsoni* (Fig. 235)
   Scutum dark. Style not distinctly arched. Coxite bilobed. Paramere otherwise 5

5. Paramere with main lobe bulbous at end, without a subterminal notch on ventral margin . . . . . *L. fairtigi* (Fig. 236)
   Paramere with main lobe otherwise & with subterminal notch on ventral margin 6

6. Paramere with dorsal arm broadly subtriangular at end . . . . . *L. wellcomei* (Fig. 237)
   Paramere with dorsal arm slightly clubbed & truncated at end . . . . . *L. complexa* (Fig. 238)

7. Paramere with dorsal group of 20+ long straight setae at distal fourth of structure . . . . . *L. chagasi* (Fig. 239)
   Paramere without such a group of setae 8

8. Paramere turned downwards distally, ventral margin concave 9
   Paramere turned upwards distally, ventral margin not concave 10

9. Paramere with subterminal tooth-like projection on dorsal margin, without dorsal group of numerous setae . . . . . *L. leonidasdeanei* (Fig. 240)

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*The males of *L. guyanensis* and *Lutzomyia* sp. of Trés Esquinas are unknown.

Paramere without subterminal tooth-like projection on dorsal margin; with dorsal group of numerous setae at and near middle of structure . . . . . *L. killicki* (Fig. 241)

10. Paramere apex smoothly convex along ventral margin; dorsal seta smaller & more angular. Pronotum deeply pigmented . . . . . *L. squamiventris squamiventris* (Fig. 242C&F)
Paramere apex with acute ventral keel & enlarged, rounded dorsal seta. Pronotum nearly pale . . . *L. squamiventris maripaensis* (Fig. 242D&E)

11. Paramere simple without ventral, lateral or dorsal arms 12
Paramere with ventral, lateral or dorsal arms 18

12. Style with 2 terminal spines & no other persistent setae or spines . . . . . *L. bispinosa* (Fig. 243)
Style with 1-2 terminal spines and 2 or more other persistent setae or spines 13

13. Style with 1 large terminal spine & 3 much shorter subapical setae or spines (series *guyanensis*) 14
Style with 1-2 large terminal spines and 2 other well developed spines . 16

14. Paramere gently arched upwards, apex slightly enlarged . . . . . *L. corossoniensis* (Figs. 244 & 245G)
Paramere sharply upturned; apex not enlarged 15

15. Scutum dark. Paramere with distal upturned portion sinuous or curved, in part; end of paramere rounded . . . . . *L. geniculata* (Fig. 245I)
Scutum pale. Paramere shorter with distal upturned portion more or less straight; end of paramere subacute . . . . . *L. dorlinsis* (Fig. 245H)

16. Paramere with dorsal basal group of 10 or more long setae . . . . . *L. matosi* (Fig. 246)
Paramere without a distinct dorsal group of long setae 17

17. Style with all spines inserted at distal third of structure. Coxa 1 & katepisternum pale . . . . . *L. lloydi* (Fig. 248)
Style with proximal spine inserted before or at middle of structure. Coxa 1 & katepisternum pigmented . . . . . *L. arthuri* (Fig. 247)

18. Style with 5 spines (series *davisi*) 19
Style with 3-4 spines 21

19. Genital filaments longer than 5X genital pump length. Scutum dark; abdominal tergites 1-3 pale or but faintly pigmented . . . . . *L. davisi* (Fig. 249)
Genital filaments shorter than 4.5X genital pump length. Abdominal tergites 1-3 as dark or nearly as dark as scutum 20

20. Paramere with stout lateral arm, its length shorter than 3X its maximum width . . . . . *L. claustrei* (Fig. 250)
Paramere with more slender lateral arm, its length at least 5X its maximum width . . . . . *L. amazonensis* (Fig. 251)

21. Paramere with arched dorsal arm in addition to main lobe & ventral arm or lobe bearing setae 22
Paramere without arched dorsal arm (series *panamensis*) 23

22. All coxae as dark as scutum. Paramere with dorsal arm bearing 4-5 long apical setae; main lobe clubbed at end & bearing small simple setae; ventral lobe with about 7 long straight setae . . . . . *L. llanosmartinsi* (Fig. 252)
Coxae paler than scutum. Paramere with dorsal arm bearing 1 terminal small seta & 3 others inserted at different levels; main lobe nonclubbed & bearing 10 or more strong setae with recurved tips; ventral arm slender & bearing 2 strong setae at end . . . . . *L. recurva* (Fig. 253)

23. Paramere with main lobe bearing two tufts of blade-like setae; ventral arm with 2 large setae, one apical & one subapical . . . *L. panamensis* (Fig. 254)
Paramere with main lobe bearing one tuft of setae, blade-like or not; ventral arm with smaller more numerous setae 24

24. Paramere with main lobe bearing blade-like setae; ventral arm not situated below main lobe 25
Paramere with main lobe bearing more slender setae; ventral arm lower than main lobe 26

25. Procoxae infuscated. Paramere with a long dorsal basal seta isolated from others & borne on a distinct tubercle . . . . . *L. hirsuta nicaraguensis* (Fig. 255E)
Procoxae pale. Paramere without such a long seta . . . . . *L. hirsuta hirsuta* (Fig. 255G)

26. Coxa 1 & katepisternum strongly pigmented, as dark as scutum 27
Coxa 1 & katepisternum pale 28

27. Coxa 1-3 infuscated. Paramere larger, with most setae of main lobe clearly longer than width of lateral lobe . . . . . *L. paraensis* (Fig. 256)

Coxa 1 infuscated, coxae 2 & 3 pale. Paramere smaller with no setae of the main lobe longer than width of lateral lobe . . . . . *L. ayrozai* (Fig. 257)

28. Whole insect, including scutum, pale 29
Scutum pigmented in part or whole 30

29. Genital filament tips simple. Lateral lobe longer than coxite . . . . . *L. carrerai carrerai* (Fig. 258E)
L. carrerai thula (Fig. 259)
Genital filament tips modified as shown. Lateral lobe subequal to coxite in length . . . . . *L. fairchildi* (Fig. 260)

30. Paramere with reduced main lobe; its width subequal to width of lateral lobe . . . . . *L. nocticola* (Fig. 261)
Paramere larger, its width greater than 2X width of lateral lobe . . . . . *L. yucumensis* (Fig. 258G)

Key to the Females of the Subgenus *Psychodopygus**

1. Whole insect pale 2
Scutum pigmented in part or whole; other structures of insect may or may not be pigmented 5

2. Cibarium with transverse row of subequal vertical teeth. Individual sperm ducts nearly as long as spermatheca . . . . . *L. lainsoni* (Fig. 235)
Cibarium with 3 or more irregular rows of vertical teeth; median teeth larger than others. Individual sperm ducts clearly shorter than spermathecae 3

3. Cibarium with horizontal teeth slanted inwardly . . . *L. fairchildi* (Fig. 260)
Cibarium with horizontal teeth directed towards pharynx, not slanted inwardly 4

4. Labrum <0.30 mm or shorter than combined length of scape & flagellomere I . . . . . *L. carrerai carrerai* (Fig. 258A)
Labrum >0.30 mm or longer than combined length of scape & flagellomere I . . . . . *L. carrerai thula* (Fig. 259)

5. Cibarium with 6-8 horizontal teeth 6
Cibarium with 4 horizontal teeth 7

6. Coxa I & katepisternum moderately pigmented. Common sperm duct convoluted, in part . . . . . *L. arthuri* (Fig. 247)

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*The female of *L. dorlinsis* has not been described but is probably structurally similar to those of *L. guyanensis*, *L. corossoniensis* and *L. geniculata*.

Coxa I & katepisternum pale. Common sperm duct not convoluted . . . . . *L. lloydi* (Fig. 248)

7. Spermathecae shorter than, or subequal in length, to individual duct 8
Spermathecae clearly longer than individual duct 14

8. Common sperm duct smooth-walled, without rugosity; individual ducts, in part, with "herringbone" pattern of rugosity . . . . . *L. chagasi* (Fig. 239)
L. complexa (Fig. 238)
L. fairtigi (Fig. 236)
L. squamiventris maripaensis (Fig. 242B)
L. squamiventris squamiventris
L. killicki (Fig. 241)
Common sperm duct rugose in part and/or with transverse striations; individual ducts without "herringbone" pattern of rugosity 9

9. Coxa I & katepisternum well pigmented, nearly as dark as scutum . . . . . *L. matosi* (Fig. 246)
Coxa I with or without faint pigmentation; if present, then paler than scutum; katepisternum always pale 10

10. Common sperm duct with complete transverse striations over most or all of structure 11
Common sperm duct smooth walled below rugose portion or with incomplete transverse striations; if complete striations are present, they do not extend beyond middle of structure 12

11. Individual sperm duct with median band of numerous (>75) small suboval excrescences . . . . . *L. leonidasdeanei* (Fig. 240)
Individual sperm ducts rugose but lacking such excressences . . . . . *L. corossoniensis* (Fig. 244)
L. geniculata
L. guyanensis
? *L. dorlinsis*

12. Individual sperm ducts longer than 2X length of spermathecae. Cibarium with median longitudinal rows of markedly enlarged teeth 13
Individual sperm ducts and spermathecae subequal in length. Cibarium without median row of enlarged teeth; with only 1-2 transverse rows of vertical teeth . . . . . *L. recurva* (Fig. 253)

13. Individual sperm duct about half as long as common duct . . . . . *L.* sp. of Trés Esquinas (Fig. 245E)
Individual sperm duct longer than common duct . . . *L. bernalei* (Fig. 234)

14. Katepimeron nearly as dark as scutum 15
Katepimeron pale 17

15. Cibarium with elevated mound between inner pair of horizontal teeth, and bearing 10+ subequal vertical teeth . . . . . *L. paraensis* (Fig. 256)
Cibarium without such a structure 16

16. Cibarium with inwardly slanted horizontal teeth. Coxa 1 well pigmented; coxae 2 & 3 pale or with faint pigmentation. Labrum >0.40 mm . . . . . *L. ayrozai* (Fig. 257)
Cibarium with horizontal teeth directed towards pharynx, not inwardly slanted. All coxae well pigmented. Labrum <0.40 mm . . . . . *L. llanosmartinsi* (Fig. 252)

17. Common sperm duct with distinct striations or dot-like thickenings below rugose portion 18
Common sperm duct smooth walled below rugose portion 21

18. Common sperm duct with complete or nearly complete transverse striations. Genital fork stem broad, blade-like . . . . . *L. bispinosa* (Fig. 243)
Common sperm duct with dot-like thickenings below rugose portion. Genital fork stem more slender, subacute at tip 19

19. Individual sperm duct shorter than half the length of the spermathecae; rugose portion of common duct swollen near junction of individual ducts . . 20
Individual sperm duct larger than half the length of the spermathecae; rugose portion of common duct more or less subequal in width, not swollen . . . . . *L. davisi* (Fig. 249)

20. Coxa 1 moderately pigmented . . . . . *L. hirsuta nicaraguensis*
Coxa 1 pale . . . . . *L. hirsuta hirsuta*

21. Pronotum well pigmented . . . . . *L. claustrei*
? *L. parimaensis*
Pronotum pale 22

22. Cibarium with 1 transverse row of vertical teeth . *L. amazonensis* (Fig. 251)
Cibarium with transverse row of vertical teeth plus longitudinal median rows of markedly enlarged vertical teeth 23

23. Spermatheca with asymmetrical terminal annulation *L. panamensis* (Fig. 254)
Spermatheca with symmetrical terminal annulation 24

24. Labrum <0.30 mm long. Scutum with similar degree of pigmentation at dorsum & at sides . . . . . *L. yucumensis* (Fig. 258C)

Labrum >0.30 mm long. Scutum pale dorsally; moderately pigmented at sides . . . . . *L. nocticola* (Fig. 261)

Lutzomyia (Psychodopygus) bernalei (Osorno-Mesa, Morales & Osorno)
Fig. 234

Phlebotomus bernalei Osorno-Mesa, Morales & Osorno 1967: 30 (♂, Araracuara, Caqueta, Colombia).

Psychodopygus bernalei: Forattini 1973: 392 (♂ fig., tax.). Fraiha et al. 1987: 336 (♂ fig.).

Lutzomyia bernalei: Martins et al. 1978: 35. Young 1979: 170 (♂ fig.). Morales & Minter 1981: 105 (Caqueta, Colombia). Feliciangeli et al. 1988a: 56 (♀, Cerro La Neblina, Amazonas, Venezuela).

Distribution (Map 116). COLOMBIA (Osorno-Mesa et al. 1967; Morales & Minter 1981); VENEZUELA (Feliciangeli et al. 1988a); BRAZIL (♂♂, ♀♀, Br. 307, Km 10, Cachoeira, Amazonas, J. Arias).

Remarks. The male of *L. bernalei* is easily recognized by the dorsal group of long setae on the paramere at the base of the dorsal arm.

Lutzomyia (Psychodopygus) lainsoni (Fraiha & Ward)
Fig. 235

Psychodopygus lainsoni Fraiha & Ward 1974: 209 (♂, ♀, Transamazon Highway, Km 46. Altamira-Itaituba, Pará, Brazil). Ward & Ready 1975: 128 (egg structure). Ward 1976: 236 (larva). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ryan 1986: 126 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Fraiha et al. 1987: 338 (mention).

Lutzomyia lainsoni: Martins et al. 1978: 49 (refs., dist.). Young et al. 1985: 145 (Madre de Dios, Peru).

Distribution (Map 117). BRAZIL (Martins et al. 1978; Fraiha et al. 1978; Biancardi et al. 1982); PERU (Young et al. 1985).

Remarks. The male terminalia of *L. lainsoni* is extraordinarily modified and readily identifiable. Females are anthropophilic but, as yet, have not been found naturally infected with flagellates.

Lutzomyia (Psychodopygus) fairtigi Martins
Fig. 236

Lutzomyia fairtigi Martins 1970: 279 (♂, Villavicencio, Meta, Colombia). Martins et al. 1978: 36 (dist., refs.). Young 1979: 171 (♂, ♀ figs., refs.).

Phlebotomus squamiventris (not *squamiventris* Lutz & Neiva): Fairchild & Hertig 1951a: 414 (♂, ♀ figs., Colombia).
Psychodopygus fairtigi: Fraiha et al. 1971: 495 (cf. to *wellcomei*). Forattini 1973: 392 (figs., tax.). Fraiha et al. 1987: 336 (♂ fig., cf. to *leonideanesi*).
Phlebotomus fairtigi: Ortiz 1972b: 225 (figs., tax.).

Distribution (Map 117). COLOMBIA (Fairchild & Hertig 1951a; Young 1979).

Remarks. Forattini (1971b) reported *L. fairtigi* from Mato Grosso, Brazil -- a record considered dubious because only females were collected.

Lutzomyia* (*Psychodopygus*) *wellcomei (Fraiha, Shaw & Lainson)
Fig. 237

Psychodopygus wellcomei Fraiha, Shaw & Lainson 1971: 490 (♂, ♀, Serra dos Carajas, Pará, Brazil). Ward 1972: 15 (immatures). Ward et al. 1973b: 178 (Pará, Brazil). Ready et al. 1983b: 235 (Ceará, Brazil). Wilkes et al. 1984: 846 (parous rates & biting habits). Ready et al. 1984a: 3 (cf. to *complexa*, allozyme analysis); 1984b: 543 (as vector). Lane & Ready 1985: 469 (morphometrics). Ryan et al. 1986c: 85 (cuticular hydrocarbon analysis). Killick-Kendrick 1986: 135 (listed). Ryan 1986: 141 (♂, ♀ figs., Pará, Brazil). Fraiha et al. 1987: 336 (♂, ♀ figs., cf. to *leonideanesi*). Ryan et al. 1987a: 356 (in part, nat. *Leishmania* infections, Brazil). Queiroz et al. 1991: 159 (coll. data, Ceará, Brazil). Ready et al. 1991: 41 (DNA probes).
Lutzomyia wellcomei: Lewis 1975a: 502 (mouthpart morphol.). Martins et al. 1978: 38 (refs., dist.). Young & Lawyer 1987: 45 (Amazonas, Brazil, & refs. to role as vector of *Leishmania braziliensis*).

Distribution (Map 118). BRAZIL (Ryan 1986; Queiroz et al. 1991; Young & Lawyer 1987).

Remarks. *Lutzomyia wellcomei* is a proven vector of *Leishmania braziliensis* at the type locality in Pará, Brazil (Lainson & Shaw 1979). This species may have been misidentified as *L. squamiventris* (Lutz & Neiva) by Lucena (1953) in Ceará, Brazil (see Ready et al. 1983b). Both sexes were captured near the Rio Urubu, Amazonás, Brazil, by J. Arias and D. Young in lowland forest (Young & Lawyer 1987), but it is not known to be a *Leishmania* vector there.

Ryan et al. (1986b) reported that *Le. amazonensis* developed well in lab-infected females of *L. wellcomei*.

Lutzomyia* (*Psychodopygus*) *complexa (Mangabeira)
Fig. 238

Flebotomus complexus Mangabeira 1941a: 242 (♂, Abaeté, Pará, Brazil).

Lutzomyia complexa: Theodor 1965: 188 (listed). Martins et al. 1978: 38 (as synonym of *squamiventris*).

Psychodopygus complexus: Forattini 1973: 407 (♂ fig., tax.). Ward & Ready 1975: 128 (egg). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ready et al. 1982: 201 (as distinct species); 1984a: 3 (cf. to *wellcomei*, alloenzyme analysis). Lane & Ready 1985: 469 (morphometrics). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan et al. 1986b: 125 (as lab. host for *Le. amazonensis*); 1986c: 85 (cf. to *wellcomei*, cuticular hydrocarbons). Ryan 1986: 137 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (in part, dissecting data for flagellates). Fraiha et al. 1987: 336 (♂, ♀ figs., cf. to *leonideanesi*). Ready et al. 1991: 41 (DNA probes).

Distribution (Map 119). BRAZIL (Ready et al., 1982; Biancardi et al. 1982; Ryan 1986; Arias 1987, unpubl. data).

Remarks. The females of *L. complexa* and *L. wellcomei* are structurally similar and it is difficult to distinguish them by color or morphology. Other methods, such as cuticular hydrocarbon analysis (Ryan et al. 1986c) and DNA probes (Ready et al. 1991), have been successfully used to separate females. The males of these species, on the other hand, are easily recognized by their characteristic terminalia.

Lutzomyia (*Psychodopygus*) *chagasi* (Costa Lima)
Fig. 239

Phlebotomus chagasi Costa Lima 1941: 6 (♀, Rio Negro, Amazonas, Brazil).

Flebotomus unisetosus Mangabeira 1941a: 238 (♂, Abaeté, Pará, Brazil). Martins et al. 1968: 1 (as synonym of *chagasi*).

Lutzomyia chagasi: Theodor 1965: 188 (♂ fig.). Llanos 1973: 31 (figs., Peru). Martins et al. 1978: 35 (refs., dist.). Young 1979: 170 (♂ fig., refs., Colombia). Morales & Minter 1981: 105 (Caqueta, Colombia). Young et al. 1985: 144 (Peru).

Psychodopygus chagasi: Forattini 1973: 392 (fig., tax.). Fraiha et al. 1974: 89 (♂ figs., biting man); 1978: 136 (Pará, Brazil). Fraiha et al. 1980a: 21 (Peru). Biancardi et al. 1982: 168 (Rondônia, Brazil). Llanos 1983: 183 (Peru). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 136 (♂, ♀ figs., Pará, Brazil). Fraiha et al. 1987: 336 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 120). PERU (Llanos 1973; 1983; Fraiha et al. 1980b; Young et al. 1985; Pérez et al. 1991); BRAZIL (Martins et al. 1978; Fraiha et al. 1978: Biancardi et al. 1982; Ryan 1986); COLOMBIA (Young 1979); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. The presence of *L. chagasi* at the Tambopata Reserve, Madre de Dios, Peru (Young et al. 1985) was confirmed after discovering males from there in 1986 (Young & Peréz, unpubl. data).

Ryan et al. (1987c) found a single *L. chagasi* female naturally infected with *Leishmania* (*braziliensis* complex) in northern Brazil.

Lutzomyia* (*Psychodopygus*) *leonidasdeanei
(Fraiha, Ryan, Ward, Lainson & Shaw)
Fig. 240

Psychodopygus leonidasdeanei Fraiha, Ryan, Ward, Lainson & Shaw 1987: 333 (♂, ♀, Santarem, Pará, Brazil).
Psychodopygus sp. no. 401.63 Fraiha et al. 1978: 134 (dist., Pará, Brazil). Ryan 1986: 138 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 121). BRAZIL (refs. given above).

Lutzomyia* (*Psychodopygus*) *killicki Feliciangeli, Ramirez Pérez & Ramirez
Fig. 241

Lutzomyia killicki Feliciangeli, Ramirez Pérez & Ramirez 1988a: 49 (♂, ♀, Caño Marieta, Amazonas, Venezuela).

Distribution (Map 121). VENEZUELA (type locality).

Remarks. This species is clearly a member of the *squamiventris* series of *Psychodopygus*, and like its close relatives, is anthropophilic.

Lutzomyia* (*Psychodopygus*) *squamiventris squamiventris (Lutz & Neiva)
Fig. 242 C & F

Phlebotomus squamiventris Lutz & Neiva 1912: 89 (♀, Rio Tambobeta, Pará, Brazil).
Lutzomyia squamiventris: Theodor 1965: 188 (listed).
Psychodopygus squamiventris: Martins et al. 1968: 9 (♀, redescript.).
Lutzomyia maripaensis (not *maripaensis* Floch & Abonnenc): Arias & Freitas 1977b: 511; 1978: 387.
Psychodopygus squamiventris squamiventris: Ready et al. 1982: 201 (♂, ♀, figs., tax., dist.). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Ready 1985: 30 (mention). Ryan 1986: 140 (♂, ♀ figs., Brazil). Fraiha et al. 1987: 336 (♂, ♀ figs., cf. to *leonideanesi*).

Distribution (Map 122). BRAZIL (Ready et al. 1982; Ryan 1986).

Remarks. The literature is replete with misidentifications of this species. Ready et al. (1982), after studying samples of various populations of *L. squamiventris* and related taxa, resolved many of these taxonomic problems. They noted that there are "no valid reports of *P. squamiventris sensu stricto* being found south of the river Amazon."

The presence of *L. squamiventris* in Venezuela (either subspecies) (see Feliciangeli 1980) can be verified only when males are obtained from there.

Leishmania naiffi and unidentified *Leishmania* have been found in naturally infected females of *L. s. squamiventris* in Brazil (Naiff et al. 1991).

Lutzomyia* (*Psychodopygus*) *squamiventris maripaensis
(Floch & Abonnenc)
Fig. 242 A-B, D-E, G

Phlebotomus maripaensis Floch & Abonnenc 1946a: 1 (♂, Oyapock, Maripa, French Guiana); 1952: 61 (♂ figs.). Forattini 1973: 398 (as synonym of *squamiventris*).

Lutzomyia maripaensis: Theodor 1965: 188 (listed). Martins et al. 1978: 36 (in part, refs., dist.). Léger et al. 1980: 116 (French Guiana). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus maripaensis: Lainson et al. 1979: 241 (neg. for flagellate infections, Brazil).

Psychodopygus squamiventris maripaensis: Ready et al. 1982: 201 (as subspecies, figs., tax. dist.); 1983a: 780 (Pará, Brazil). Ryan 1986: 139 (♂, ♀ figs., Pará, Brazil). Fraiha et al. 1987: 336 (♂ fig.). Le Pont 1990: 671 (coll. data, French Guiana).

Lutzomyia squamiventris maripaensis: Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 25 (Pará, Brazil).

Distribution (Map 122). FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1980); SURINAME (Hudson & Young 1985); BRAZIL (Ready et al. 1982; Ryan 1986).

Remarks. See Ready et al. (1982) for full references and taxonomic information of this subspecies. Natural leishmanial infections have been reported in females collected in northern Brazil (Ryan et al. 1987c).

Lutzomyia* (*Psychodopygus*) *bispinosa (Fairchild & Hertig)
Fig. 243

Phlebotomus bispinosus Fairchild & Hertig 1951a: 410 (♂, ♀, La Victoria, Cerro Jefe, Panama). Lewis & Garnham 1959: 80 (♀, Belize).

Lutzomyia bispinosa: Barretto 1962: 94 (listed). Arias & Freitas 1977b: 511 (Amazonas, Brazil). Léger et al. 1977: 223 (French Guiana). Arias & Freitas 1978: 391 (neg. for flagellates, Brazil). Martins et al. 1978: 46 (refs., dist.). Young 1979: 173 (figs., refs.). Le Pont & Pajot 1980: 64 (cf. to *claustrei*). Morales & Minter 1981: 97 (Colombia). Lewis & Macfarlane 1981: 177 (mite parasite, Belize). Williams 1983: 489 (tax.). Young & Rogers 1984: 599 (listed, Ecuador). Ready et al. 1986: 26 (Pará, Brazil). Vexenat et al. 1986b: 296 (Bahia, Brazil). Porter et al. 1987: 929 (Guatemala). Herrero & Jiménez 1992: 151 (Costa Rica records).

Psychodopygus bispinosus: Forattini 1973: 170 (figs., tax.). Lainson et al. 1976a: 57 (Mato Grosso, Brazil); 1979: 241 (neg. for flagellates, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 121 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil). Le Pont 1990: 673 (coll. data, French Guiana).

Distribution (Map 123). BELIZE; HONDURAS; NICARAGUA; PANAMA (Martins et al. 1978); GUATEMALA (Porter et al. 1987); COSTA RICA (Herrero & Jiménez 1992); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales & Minter 1981); ECUADOR (Young 1979); BRAZIL (Lainson et al. 1976; Martins et al. 1978; Ryan 1986); FRENCH GUIANA (Léger et al. 1977).

Remarks. This species was reported from Bahia State, Brazil by Vexenat et al. (1986b), but females examined by us from there have slender genital fork stems, unlike typical *L. bispinosa* females found in northern Brazil and elsewhere. We have not seen males from Bahia, Brazil, and therefore consider its presence there as doubtful pending additional material.

Lutzomyia (*Psychodopygus*) *corossoniensis* Le Pont & Pajot
Figs. 244 & 245 G

Lutzomyia corossoniensis Le Pont & Pajot 1978: 224 (♂, near Corossony, French Guiana). Murillo & Zeledón 1985: 64 (♂ fig., Costa Rica). Lebbe et al. 1987: 29 (computer aided ident.).

Lutzomyia guyanensis, in part: Young 1979: 186 (♂ fig., Panama).

Psychodopygus corossoniensis: Le Pont & Desjeux 1982: 281 (♂, cf. to *dorlinsis*). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias et al. 1985: 1101 (neg. for flagellate infections, Brazil). Ryan 1986: 123 (♂, ♀, Brazil). Fraiha et al. 1987: 338 (mention).

Distribution (Map 124). COSTA RICA (Murillo Zeledón 1985); PANAMA (Young 1979, in part, ♂); FRENCH GUIANA (Le Pont & Pajot 1978); BRAZIL (Biancardi et al. 1982; Arias et al. 1985; Ryan 1986; Arias 1987, unpubl. data) SURINAME (Hudson & Young 1985).

Remarks. *Lutzomyia corossoniensis*, *L. dorlinsis*, *L. geniculata* and *L. guyanensis* form a species complex within *Psychodopygus*. The male of the latter species remains unknown, but it is probably conspecific with one of the other 3 species. Young (1979), following Forattini (1973), treated *L. geniculata* as a junor synonym of *L. guyanensis*, but the subsequent descriptions of the other species now indicate this synonym may not be correct. The male illustrated by Young (1979) represents *L. corossoniensis*, not *L. geniculata*.

Lutzomyia* (*Psychodopygus*) *geniculata (Mangabeira)
Fig. 245 I

Flebotomus geniculatus Mangabeira 1941a: 245 (♂, Aurá, Belém, Pará, Brazil). Barretto 1947a: 202 (refs.).

Phlebotomus geniculatus: Fairchild & Hertig 1951a: 412 (♂, ♀ figs., Panama). Ortiz 1972b: 230 (keyed, figs.). Forattini 1959: 160 (Amapá, Brazil).

Lutzomyia geniculata: Barretto 1962: 94 (listed). Llanos et al. 1975b: 670 (Peru). Martins et al. 1978: 48 (refs., figs.). Young 1979: 186 (in part, refs.). Morales & Minter 1981: 97 (Colombia). Williams 1983b: 489 (cf. to related spp.). Murillo & Zeledón 1985: 64 (♂, ♀ figs., Costa Rica). Feliciangeli et al. 1988a: 48 (Venezuela). Alexander et al. 1992c: 125 (Ecuador records).

Lutzomyia guyanensis (= *geniculatus* Mangabeira): Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 64 (♂, figs., Costa Rica). Young et al. 1985: 144 (Peru).

Psychodopygus geniculatus: Forattini 1973: 124 (as synonym of *guyanensis*, figs., tax.). Le Pont & Desjeux 1982: 282 (♂ fig., cf. to *dorlinsis*). Ryan 1986: 125 (♂, ♀ figs., Pará, Brazil).

Psychodopygus guyanensis (= *geniculatus* Managabeira): Forattini 1973: 124 (in part, figs.). Forattini & Galati 1977: 26 (♀). Biancardi 1982: 178 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil).

Distribution (Map 125). BELIZE (Martins et al. 1978); GUATEMALA (Porter et al. 1987); COSTA RICA (Murillo and Zeledón 1985); PANAMA (Fairchild & Hertig 1951a); Colombia (Young 1979, in part; Morales & Minter 1981); ECUADOR (Young 1979; Alexander et al. 1992c); PERU (Llanos et al. 1975b; Pérez et al. 1991); BRAZIL (Martins et al. 1978; Arias, 1987, unpubl. data); FRENCH GUIANA (♂♂, Maripasoula & Saul, E. Abonnenc); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. The presence of *L. geniculata* in a given locality must be confirmed when males are available; therefore, collecting data based on females alone are questionable. These include listings from Nicaragua (Zeledón & Murillo 1983); Panama & Colombia (Young 1979, in part); Brazil (Ward et al. 1973b; Fraiha et al. 1978; Arias & Freitas 1977b, 1978; Lainson et al. 1983); Suriname (Hudson & Young 1985). Ryan (1986) illustrated the spermathecae of *L.*

geniculata from a reared female and noted that it and *L. corossonensis* could not be distinguished with certainty.

Lutzomyia (Psychodopygus) guyanensis (Floch & Abonnenc)

Phlebotomus guyanensis Floch & Abonnenc 1941a: 18 (♀, Montagne Lucifer, French Guiana); 1952: 173 (? ♀).
Lutzomyia guyanensis: Barretto 1962: 94 (listed).
Psychodopygus guyanensis: Forattini 1971a: 105 (listed). Le Pont 1990: 671 (mammal-baited traps, coll. data, French Guiana).

Distribution (Map 126). FRENCH GUIANA (Floch & Abonnenc 1941a).

Remarks. This species was described from a single female that is now apparently lost (F. Rodhain, Inst. Pasteur Paris, pers. comm. 1987). Floch & Abonnenc (1952) redescribed the species but figured another specimen from Crique-Anguille, French Guiana. As mentioned earlier, the *guyanensis* male is probably *L. corossoniensis*, *L. geniculata*, or *L. dorlinsis* but this confusing matter can be settled only when additional topotypes are obtained and reared to properly associate the sexes.

Records of *L. guyanensis* in Suriname (Martins et al. 1978) and elsewhere are considered questionable.

Lutzomyia (Psychodopygus) dorlinsis (Le Pont & Desjeux)
Fig. 245 H

Psychodopygus dorlinsis Le Pont & Desjeux 1982: 279 (♂, near Maripasoula, French Guiana.
Lutzomyia dorlinsis: Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 120). FRENCH GUIANA (Le Pont & Desjeux 1982); BRAZIL (J. Arias, unpub. data).

Remarks. The male of *L. dorlinsis* closely resembles those of *L. geniculata* and *L. corossonensis* but can be separated from them by the shorter length of the paramere and its shape.

Lutzomyia (Psychodopygus) sp. of Trés Esquinas Young
Fig. 245 A-E

Lutzomyia sp. of Trés Esquinas Young 1979: 195 (♀, Trés Esquinas, Caqueta, Colombia). Morales & Minter 1981: 97 (Caqueta, Colombia).

Distribution (Map 126). COLOMBIA (above refs.); BRAZIL (♀, Amazonas, J. Arias).

Remarks. The female of this informally named taxon resembles those of *L. geniculata* and *L. corossoniensis* (see Ryan 1986) but the male has not been discovered.

Lutzomyia* (*Psychodopygus*) *matosi (Barretto & Zago)
Fig. 246

Sergentomyia matosi Barretto & Zago 1956: 180 (♂, Itaipaua, Petrópolis, Rio de Janeiro, Brazil).
Lutzomyia matosi: Barretto 1962: 94 (listed). Theodor 1965: 189 (listed). Barretto 1966: 135 (♀ descript.). Martins et al. 1978: 48 (refs., dist.).
Psychodopygus matosi: Forattini 1971a: 105 (listed); 1973: 413 (figs., tax.).

Distribution (Map 123). BRAZIL (Martins et al. 1978).

Remarks. The male of *L. matosi* is easily recognized by the dorsal tuft of long setae on the paramere. This species, *L. arthuri*, *L. lloydi* and *L. bispinosa* comprise the series *arthuri* of Theodor (1965) which Artemiev (1991) has formally named *Eupsychodopygus*, a subgenus.

Lutzomyia* (*Psychodopygus*) *arthuri (Fonseca)
Fig. 247

Flebotomus arthuri Fonseca 1936: 324 (♀, Serra da Cantareira, São Paulo, Brazil). Barretto 1947a: 186 (refs., in part).
Flebotomus lloydi (not *lloydi* Antunes): Coutinho 1940a: 331 (♂).
Phlebotomus arthuri (in part): Fairchild & Hertig 1951a: 401 (keyed, tax.). Floch & Abonnenc 1952: 16 (keyed, figs.). Ortiz 1972b: 225 (keyed, figs.).
Lutzomyia arthuri: Barretto 1962: 94 (listed). Barretto 1966: 144 (keyed). Martins et al. 1978: 45 (in part, dist.).
Psychodopygus arthuri: Forattini 1971a: 104 (listed); 1973: 403 (in part, figs., tax.). Galati 1981: 321 (correctly associated ♂, ♀, dist.).

Distribution (Map 120). BRAZIL (Martins et al. 1978, in part).

Remarks. The thoracic pigmentation differs markedly between both sexes of *L. arthuri* and *L. lloydi* (cf. Figs. 247 & 248). Galati (1981) was the first to point out that the male, described as the former species by Fonseca, was actually that of *L. lloydi*.

Barretto (1941) described the immature stages of *L. arthuri* from reared specimens. Only F_1 females were obtained.

Lutzomyia* (*Psychodopygus*) *lloydi (Antunes)
Fig. 248

Flebotomus lloydi Antunes 1937: 24 (♀, Perús, São Paulo, Brazil). Barretto 1947a: 207 (refs., in part).
Flebotomus arthuri (not *arthuri* Antunes): Fonseca 1939: 181 (♂).
Phlebotomus lloydi (in part): Barretto 1950a: 107 (keyed). Fairchild & Hertig 1951a: 401 (keyed). Floch & Abonnenc 1952: 36 (keyed, figs.).
Flebotomus rachoui Damasceno & Arouck 1956b: 3 (♂, Minas Gerais, Brazil). Galati 1981: 322 (as junior synonym of *L. lloydi*).
Lutzomyia lloydi: Barretto 1962: 94 (listed). Theodor 1965: 188 (listed, ♂ fig. of *arthuri* = *lloydi*). Martins et al. 1978: 46 (in part, refs., dist.).
Psychodopygus lloydi: Forattini 1971a: 105 (listed); 1973: 412 (in part, figs., tax.). Galati 1981: 322 (dist., correctly associated ♂, ♀).

Distribution (Map 126). BRAZIL (Martins et al. 1978, in part).

Remarks. Martins et al. (1978) regarded *L. rachoui* (Damasceno & Arouck) as a junior synonym of *L. arthuri*; however, it is conspecific with *L. lloydi* (Galati 1981).

Lutzomyia* (*Psychodopygus*) *davisi (Root)
Fig. 249

Phlebotomus davisi Root 1934: 242 (♂, Fordlandia, Pará, Brazil; ♀ not conspecific).
Phlebotomus rooti Mangabeira 1942a: 112 (Aurá, Belém, Pará, Brazil). Forattini 1971a: 105 (as synonym of *davisi*).
Lutzomyia davisi: Theodor 1965: 188. Llanos 1973: 30 (figs., Peru). Martins et al. 1973b: 419 (♀ descript.). Llanos et al. 1975b: 670; 1976: 480 (Peru). Arias & Freitas 1977b: 511 (Amazonas, Brazil). Martins et al. 1978: 41 (refs., dist.). Arias & Freitas 1978: 391 (neg. for flagellates, Brazil). Young 1979: 183 (figs., refs.). Abonnenc et al. 1980: 708 (♂, ♀, tax.). Le Pont & Pajot 1980: 64 (cf. to *claustrei*). Morales & Minter 1981: 97 (Colombia). Aguiar & Soucasaux 1984: 199 (seasonal biting habits). Young & Rogers 1984: 605 (figs., keyed, Ecuador). Young et al. 1985: 144 (Peru). Aguiar et al. 1985a-c (coll. data, Brazil). Vexenat et al. 1986b: 296 (Bahia, Brazil). Ready et al. 1986: 26 (Pará, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Young et al. 1987: 588 (Norte de Santander, Colombia). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Alexander et al. 1992c: 125 (Ecuador records).
Psychodopygus davisi: Forattini 1973: 163 (in part, tax.). Ward & Ready 1975: 128 (egg). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Ward 1976: 233 (larva). Fraiha et al. 1978: 136 (Pará Brazil). Lainson et al. 1979: 241 (neg. for flagellates, Brazil). Fraiha & Ward 1980b: 16 (cf. to *amazonensis*). Fraiha et al. 1980a: 21 (Peru). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias

& Freitas 1982: 401 (Acre, Brazil). Lainson et al. 1983: 326 (Marajó Island, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 132 (figs., Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan et al. 1987a: 356 (unident. flagellates, Brazil).

Lutzomyia rooti: Martins et al. 1973b: 419 (as synonym of *davisi*). Léger et al. 1977: 225 (French Guiana). Abonnenc et al. 1979: 85 (cf. to *claustrei*).

Psychodopygus rooti: Ward et al. 1973b: 178 (Pará, Brazil). Lainson et al. 1973: 190 (Pará, Brazil).

Distribution (Map 127). COLOMBIA (Young 1979; Morales & Minter 1981; Young et al. 1987); ECUADOR (Young 1979; Alexander et al. 1992a,c); PERU (Llanos 1983; Young et al. 1985, Pérez et al. 1991); BOLIVIA (Martins et al. 1978; Le Pont & Desjeux 1986); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Aguiar & Soucasaux 1984; Ryan 1986); FRENCH GUIANA (Léger et al. 1977; Abonnenc et al. 1980; Geoffroy et al. 1986). VENEZUELA (Feliciangeli et al. 1988a).

Remarks. *Lutzomyia davisi* is locally common in the Amazon Basin; populations extend northwards to Norte de Santander Dept., Colombia. Females are highly anthropophilic and have frequently been misidentified as other *L.* (*Psychodopygus*) species (see Young 1979).

Lutzomyia (*Psychodopygus*) *claustrei* Abonnenc, Léger & Fauran
Fig. 250

Lutzomyia claustrei Abonnenc, Léger & Fauran 1979: 80 (♂, Maripasoula, French Guiana). Le Pont & Pajot 1980: 62 (♀, French Guiana). Abonnenc et al. 1980: 715 (♀, French Guiana & Brazil records). Léger et al. 1980: 116 (French Guiana). Young & Rogers 1984: 605 (♂, ♀ figs., keyed). Young et al. 1985: 144 (Peru). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 29 (in Disney traps, Pará, Brazil). Young & Morales 1987: 664 (Meta, Colombia). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela). Grimaldi et al. 1991: 655 (nat. infections with new species of *Leishmania*, Brazil).

Psychodopygus claustrei: Biancardi et al. 1982: 168 (Rondônia, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 131 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (nat. infection unident. flagellates, Brazil). Naiff et al. 1989: 273 (nat. infection of *Trypanosoma freitasi* in Brazil). Le Pont 1990: 671 (coll. data, mammal-baited traps, French Guiana).

Distribution (Map 128). COLOMBIA (Young & Morales 1987); SURINAME (Hudson & Young 1985); FRENCH GUIANA (Abonnenc et al. 1980); BRAZIL

(Biancardi et al. 1982; Ryan 1986); PERU (Young et al. 1985; Pérez et al. 1991); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. Ryan et al. (1987c) isolated unidentified *Leishmania* from *L. claustrei* collected in northern Brazil. Apparently, these are the same parasites that Grimaldi et al. studied (1991) and provisionally determined to be new to science. This sand fly appears also to be a host of *Trypanosoma freitasi* (Naiff et al. 1989).

Lutzomyia (Psychodopygus) amazonensis (Root)
Fig. 251

Phlebotomus amazonensis Root 1934: 244 (♀, Iquitos, Peru). Forattini 1959: 160 (Amapá, Brazil).

Lutzomyia amazonensis: Theodor 1965: 188 (listed). Arias & Freitas 1977b: 510 (Amazonás, Brazil); 1978: 391 (neg. for flagellates, Brazil). Le Pont & Desjeux 1980: 64 (cf. to *claustrei*). Morales & Minter 1981: 105 (Caqueta, Colombia). Young & Rogers 1984: 605 (♂, ♀ figs., keyed). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli et al. 1988a: 49 (Venezuela). Alexander et al. 1992c: 125 (Ecuador records).

Psychodopygus amazonensis: Forattini 1973: 401 (♀, tax.). Fraiha et al. 1978: 136 (Brazil records); 1980a: 5 (tax.). Fraiha & Ward 1980a: 13 (cf. to *llanosmartinsi*); 1980b: 15 (♂). Biancardi et al. 1982: 178 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 128 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (dissection results, Brazil).

Lutzomyia robini Abonnenc, Arias, Léger & Young 1980: 711 (♂, ♀, Maripasoula, French Guiana). Biancardi et al. 1982: 178 (as synonym of *amazonensis*).

Distribution (Map 129). COLOMBIA (Morales & Minter 1981); VENEZUELA (Feliciangeli et al. 1988a); ECUADOR (Young & Rogers 1984; Alexander et al. 1992c); PERU (Root 1934; Fraiha et al. 1980b; Pérez et al. 1991); FRENCH GUIANA (Abonnenc et al. 1980); SURINAME (Hudson & Young 1985); BRAZIL (Forattini 1960; Arias & Freitas 1978, 1982; Biancardi et al 1982; Ryan 1986); BOLIVIA (Le Pont & Desjeux 1986).

Remarks. We have examined males and females of *L. amazonensis* from Leticia, Colombia collected by A. Morales et al. from 1986 to 1988.

Lutzomyia (Psychodopygus) parimaensis (Ortiz & Álvarez)

Phlebotomus parimaensis Ortiz & Álvarez 1972: 141 (♀, Serra Párima, Amazonas, Venezuela).

Lutzomyia parimaensis: Martins et al. 1978: 169 (as inadequately described species). Young 1979: 184 (possibly = *L. davisi*). Feliciangeli 1980: 246 (♀ figs., keyed).

Distribution (Map 130). VENEZUELA (type locality).

Remarks. No specimens referable to *L. parimaensis* can be located in Venezuelan collections (D. Feliciangeli, pers. comm.). There is a strong possibility that *L. parimaensis* is conspecific with another described species in the subgenus.

Lutzomyia* (*Psychodopygus*) *llanosmartinsi (Fraiha & Ward)
Fig. 252

Psychodopygus llanosmartinsi Fraiha & Ward 1980a: 10 (♂, ♀, Pilcopata, Cuzco, Peru). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Le Pont & Desjeux 1986: 314 (nat. *Leishmania* infection, Bolivia).

Lutzomyia amazonensis (not *amazonensis* Root): Llanos et al. 1975b: 665 (♂, ♀ figs., biting man, Peru).

Phlebotomus llanos-martinis: Desjeux et al. 1987: 744 (as probable *Leishmania* vector, Bolivia).

Distribution (Map 125). BRAZIL (Biancardi et al. 1982; ♂♂, ♀♀, Costa Marquez, Rondônia, 1987, flight trap, T. Klein); PERU (Llanos et al. 1975a,b; Pérez et al. 1991); BOLIVIA (Le Pont & Desjeux 1986).

Remarks. *Lutzomyia llanosmartinsi* and *L. recurva* are distinctive species within the subgenus and exhibit similarities in both sexes. They are not placed in a series or complex at the present time.

Lutzomyia* (*Psychodopygus*) *recurva Young
Fig. 253

Lutzomyia recurva Young 1973: 106 (♂, ♀, Curiche, Choco, Colombia). Martins et al. 1978: 45. Young 1979: 193 (♂, ♀ figs.). Christensen et al. 1983: 466 (Panama).

Distribution (Map 127). PANAMA; COLOMBIA (Young 1979).

Remarks. *Lutzomyia recurva* apparently has a limited geographic distribution; all known specimens have been taken only in Choco Dept., Colombia, and nearby Darien Prov., Panama.

Lutzomyia (Psychodopygus) panamensis (Shannon)
Fig. 254

Phlebotomus panamensis Shannon 1926: 192 (♂, Canal Zone, Panama). Fairchild & Hertig 1951a: 399 (♂, ♀, figs., tax., refs.).

Lutzomyia panamensis: Barretto 1962: 94 (listed). Theodor 1965: 188 (figs.). Zimmerman et al. 1977: 575 (egg). Léger et al. 1977: 224 (♂ fig., French Guiana). Mogollon et al. 1977: 209 (Venezuela). Martins et al. 1978: 43 (figs., dist.). Arias & Freitas 1978: 391 (neg. for flagellates, Brazil). Ramirez Peréz et al. 1978: 52 (Venezuela). Young 1979: 190 (figs., refs., dist.). Porter & De Foliart 1981: 147 (biting habits, Colombia). Christensen & Herrer 1980b: 523 (feeding habits). Feliciangeli 1980: 246 (keyed). Le Pont & Pajot 1980: 64 (cf. to *claustrei*). Lewis & Macfarlane 1981: 179 (mite parasite, Panama). Ramirez Pérez et al. 1981: 114 (pop. dynamics, age grading Venezuela). Chaniotis et al. 1982: 3 (control, Panama). Ramirez Pérez et al. 1982a: 14 (♂, ♀ figs., Venezuela); 1982b: 58 (Venezuela). Zeledón et al. 1982: 276 (Honduras). Zeledón & Murillo 1983: 280 (Nicaragua). Williams 1983b: 489 (♀ fig., tax.). Christensen et al. 1983: 465 (Panama). Young & Rogers 1984: 599 (listed, Ecuador). Hashiguchi et al. 1985a: 442 (Ecuador). Murillo & Zeledón 1985: 60 (♂, ♀ figs., Costa Rica). Porter et al. 1987: 929 (Guatemala). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela); Feliciangeli et al. 1988b: 393 (dissection results, neg. for flagellates, Venezuela). Loyola et al. 1988: 408 (mention). Añez et al. 1988: 457 (Mérida, Venezuela). Rowton et al. 1991: 503 (nat. *Leishmania* infections, Guatemala). Eshita et al. 1992: 22 (Ecuador). Alexander et al. 1992a: 37; 1992c: 124 (Ecuador).

Psychodopygus panamensis: Lewis 1965: 376 (internal morphol.). Forattini 1973: 89 (♂, ♀ figs., tax.). Ward 1976: 239 (larva keyed).

Distribution (Map 129). MEXICO; BELIZE (Martins et al. 1978); GUATEMALA (Porter et al. 1987); HONDURAS (Zeledón et al. 1982); NICARAGUA (Fairchild & Hertig 1959); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales et al. 1981); ECUADOR (Young 1979; Hashiguchi et al. 1985a; Alexander et al. 1992a,c); BRAZIL (Martins et al. 1978); FRENCH GUIANA (Léger et al. 1977); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1978; 1981; 1982a, 1982b; Feliciangeli 1987a; 1988).

Remarks. The record of *L. panamensis* from Iquitos, Peru (Root 1934), is questionable although the spermathecae figured by Root closely resemble those of this species.

Porter & De Foliart (1981) reviewed the man biting habits, behavior, seasonal abundance, etc., of *L. panamensis* based on their studies in Colombia and that of others. In Panama, *L. panamensis* is regarded as a natural vector

of *Leishmania panamensis* (see Christensen et al. 1983 for additional information and references).

One female, out of 4,525 dissected in Guatemala, had a natural *Leishmania braziliensis* infection; 5 other flies had flagellates in their guts but none grew in culture and were not identified (Rowton et al. 1991).

Lutzomyia (Psychodopygus) hirsuta hirsuta (Mangabeira)
Fig. 255 F-H

Flebotomus hirsutus Mangabeira 1942a: 116 (♂, Abaeté, Pará, Brazil).

Phlebotomus colas-belcouri Floch & Chassignet 1947a: 1 (♂, Baduel, French Guiana). Barretto 1953: 209 (as synonym of *hirsutus*).

Lutzomyia hirsuta: Barretto 1962: 94; 1966: 134 (refs.). Léger et al. 1977: 218 (French Guiana). Arias & Freitas 1977b: 511 (Amazonas, Brazil); 1978: 391 (neg. for flagellates, Brazil). Martins et al. 1978: 42 (dist.). Léger et al. 1980: 116 (French Guiana). Young & Rogers 1984: 599 (listed, Ecuador). Aguiar & Soucacaux 1984: 199 (seasonal biting habits, Brazil). Aguiar et al. 1985a-c; 1986: 477 (ecology, Brazil). Aguiar & Vilela 1987: 585 (resting sites, Brazil). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus hirsutus: Forattini 1971a: 105; 1973: 412 (♂ fig., tax.). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Lainson et al. 1979: 241 (neg. for flagellates, Pará, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan et al. 1987a: 355 (nat. *Leishmania* infections, Brazil).

Phlebotomus paraensis (not *paraensis* Costa Lima): Llanos 1973: 30 (Peru).

Lutzomyia hirsuta hirsuta: Young 1979: 188 (figs., refs.). Young & Rogers 1984: 599 (listed, Ecuador). Hudson & Young 1985: 418 (Suriname). Young et al. 1985: 145 (Madre de Dios, Peru). Alexander et al. 1992c: 125 (Ecuador records).

Psychodopygus hirsutus hirsutus: Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 133 (♂, ♀ figs., Pará, Brazil). Le Pont 1990: 673 (coll. data, French Guiana).

Distribution (Map 131). COLOMBIA (Young 1979; ♂♂, ♀♀, Leticia, Amazonas, 1986-1987, A. Morales et al.); ECUADOR (Young 1979; Alexander et al. 1992c); PERU (Llanos 1973, as *paraensis*; Young et al. 1985; Pérez et al. 1991); BOLIVIA (Le Pont & Desjeux 1986); BRAZIL (Lainson et al. 1976; Martins et al. 1978; Fraiha et al. 1978; Arias & Freitas 1977; 1978; Biancardi et al. 1982; Ryan 1986; Vexenat et al. 1986); FRENCH GUIANA (Léger et al. 1977; 1980; Martins et al. 1978); SURINAME (Hudson & Young 1985).

Remarks. This species is often confused with *L. davisi* in the Amazon basin in man biting collections. *Leishmania* (*Viannia*) sp. was identified in the guts of 3 *L. h. hirsuta* captured at Tucurui, Pará State, Brazil, by Ryan et al. (1987a), but its role as a vector to man remains to be determined.

Lutzomyia* (*Psychodopygus*) *hirsuta nicaraguensis
(Fairchild & Hertig)
Fig. 255 A-E

Phlebotomus nicaraguensis Fairchild & Hertig 1961a: 26 (♂, Villa Somoza, Nicaragua).
Lutzomyia nicaraguensis: Barretto 1962: 94 (listed). Theodor 1965: 188. Christensen et al. 1983: 466 (listed, Panama).
Psychodopygus nicaraguensis: Forattini 1971a: 105; 1973: 413 (♂ fig.).
Lutzomyia hirsuta nicaraguensis: Young 1979: 189 (tax.). Williams 1983: 489 (tax.).

Distribution (Map 131). NICARAGUA (Fairchild & Hertig 1961a); PANAMA (Young 1979).

Lutzomyia* (*Psychodopygus*) *paraensis (Costa Lima)
Fig. 256

Flebotomus paraensis Costa Lima 1941: 7 (♂, Aurá, Belém, Pará, Brazil).
Lutzomyia paraensis: Barretto 1962: 94 (listed). Theodor 1965: 188 (listed). Arias and Freitas 1977b: 511 (Amazonas, Brazil); 1978: 391 (neg. for flagellates, Brazil). Léger et al. 1977: 225 (French Guiana). Martins et al. 1978: 44 (♀ fig., list., in part). Le Pont & Pajot 1980: 64 (cf. to *claustrei*). Léger et al. 1980: 116 (French Guiana). Morales & Minter 1981: 105 (Colombia). Young & Rogers 1984: 605 (Ecuador). Young et al. 1985: 145 (Peru). Ready et al. 1986: 26 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela). Feliciangeli 1988: 106 (Venezuela). Alexander et al. 1992c: 125 (Ecuador).
Psychodopygus paraensis: Forattini 1971a: 105 (listed); 1973: 413 (in part, tax., figs.). Ward et al. 1973b: 178. Ward & Ready 1975: 128 (egg). Ward 1976: 233 (larva). Fraiha et al. 1978: 136 (Pará, Brazil records). Lainson et al. 1979: 241 (neg. for flagellates, Brazil). Fraiha et al. 1980a: 21 (Peru). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Arias et al. 1985: 1101 (nat. *Leishmania* infections, Brazil). Ryan et al. 1986b: 165 (lab. host of *Le. mexicana*). Ryan 1986: 134 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 355 (unident. flagellate infections, Brazil). Le Pont 1990: 671 (coll. data, mammal-baited traps, French Guiana). Silveira et al. 1991: 128 (nat. infected with *Leishmania naiffi*, Brazil).

Distribution (Map 130). COLOMBIA (Morales & Minter 1981; ♂♂, ♀♀ Leticia, Amazonas, 1986-1987, A. Morales, C. Ferro & D.G. Young); VENEZUELA (Feliciangeli et al. 1988a); ECUADOR (Young & Rogers 1984; Alexander et al. 1992c); PERU (Fraiha et al. 1980b; Llanos 1981; Young et al. 1985); BRAZIL (Martins et al. 1978, in part; Arias & Freitas 1977; 1982; Fraiha et al. 1978; Biancardi et al. 1982; Ryan 1986); FRENCH GUIANA (Léger et al. 1977; 1980); SURINAME (Martins et al. 1978).

Remarks. *Lutzomyia paraensis* is apparently widespread in the Amazon basin. Both sexes resemble those of *L. llanosmartinsi* in coloration but *L. paraensis* is more closely related to *L. ayrozai*, the female of which lacks a subspherical hump between the inner pair of horizontal teeth in the cibarium. Forattini (1973) mistakenly figured the spermathecae of *L. davisi* as that of *L. paraensis* and erroneously treated *L. carrerai* and *L. fairchildi* as junior synonyms of *L. paraensis*.

Lutzomyia (*Psychodopygus*) *ayrozai* (Barretto & Coutinho)
Fig. 257

Phlebotomus ayrozai Barretto & Coutinho 1940: 131 (♂, São Paulo, Brazil).

Lutzomyia ayrozai: Barretto 1962: 94 (listed). Léger et al. 1977: 223 (French Guiana). Arias & Freitas 1977b: 511 (Amazonas, Brazil); 1978: 341 (neg. for flagellates, Brazil). Young 1979: 175 (refs., figs., dist.). Le Pont & Pajot 1980: 64 (cf. to *claustrei*). Porter & De Foliart 1981: 142 (man biting habits, Colombia). Morales & Minter 1981: 97 (Colombia). Aguiar & Soucasaux 1984: 199 (seasonal biting habits, Brazil). Young et al. 1984: 599 (Ecuador). Aguiar et al. 1985a: 188; 1985b: 340; 1985c: 467; 1986: 478 (ecology, Brazil). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Aguiar & Vilela 1987: 586 (larva recovered from leaves on forest floor, Brazil). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela). Feliciangeli 1988: 106 (Venezuela). Alexander et al. 1992c: 125 (Ecuador).

Lutzomyia tintinnabula Christensen & Fairchild 1971: 301 (♂, ♀, Darien, Panama). Young 1979: 175 (as synonym of *ayrozai*).

Psychodopygus ayrozai: Forattini 1971a: 104 (listed); 1973: 392 (in part, tax.). Forattini & Galati 1977: 25 (♀). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ready et al. 1983a: 780 (Pará, Brazil). Arias et al. 1985: 1101 (nat. *Leishmania* infections, Brazil). Gomes et al. 1986: 282. Ryan 1986: 129 (figs., Pará, Brazil). Le Pont 1990: 671 (common in armadillo-baited traps, French Guiana). Silveira et al. 1991: 128 (nat. infected with *Leishmania naiffi*, Brazil).

Psychodopygus tintinnabulus: Fraiha et al. 1978: 136 (Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia).

Lutzomyia paraensis (in part): Martins et al. 1978: 44 (dist.).

Distribution (Map 132). PANAMA (Christensen & Fairchild 1971); COLOMBIA (Young 1979; Morales & Minter 1981); VENEZUELA (Feliciangeli et al.

1988a); TRINIDAD (Young 1979); FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); BRAZIL (Barretto 1947a; Arias & Freitas 1977, 1978; Fraiha et al. 1978; Young 1979; Biancardi et al. 1982; Aguiar & Soucasaux 1984; Ryan 1986); BOLIVIA (Le Pont & Desjeux 1986); ECUADOR (Young & Rogers 1984; Alexander et al. 1992c); PERU (Pérez et al. 1991).

Remarks. *Lutzomyia ayrozai* has been misidentified many times as other species (see Young 1979). It is not conspecific with *L. paraensis* as several authors, including Martins et al. (1978), have suggested. There are consistent differences in the shape and setation of the male parameres and in the distribution of thoracic pigmentation of both sexes. Adults have been found resting on the forest floor in Brazil; they are readily attracted to armadillo-baited traps and they probably transmit *Leishmania naiffi* to these animals (Table 1).

Lutzomyia (Psychodopygus) carrerai carrerai (Barretto)
Fig. 258 A-B, D-F

Phlebotomus carrerai Barretto 1946d: 286 (♂, Restrepo, Meta, Colombia).
Sergentomyia pessoanus Barretto 1955b: 247 (♂, Itatiaia, Rio de Janeiro, Brazil). Forattini 1971b: 173 (as synonym of *carrerai, paraensis & fairchildi*).
Lutzomyia carrerai: Barretto 1962: 94 (listed). Barretto 1966: 143 (keyed). Martins et al. 1973a: 411 (tax.). Llanos 1975b: 670 (Peru). Arias & Freitas 1977b: 511 (Amazonas, Brazil). Martins et al. 1978: 41 (refs., dist.). Le Pont & Pajot 1980: 64 (cf. to *claustrei*).
Lutzomyia pessoana: Barretto 1962: 94; Martins et al. 1978: 44 (dist.).
Psychodopygus carrerai: Forattini 1971a: 105 (listed). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Caillard et al. 1986: 489 (isozyme profiles). Ryan 1986: 130 (figs., Pará, Brazil). Ryan et al. 1987a: 356 (neg. for flagellates, Brazil).
Psychodopygus carrerai carrerai: Le Pont & Desjeux 1986: 314 (nat. flagellate infection, Bolivia). Le Pont et al. 1986: 79 (cf. to *yucumensis*). Le Pont et al. 1988: 279 (as *Leishmania* vector); 1989c: 307. Phillips et al. 1990: 145 (cf. to *yucumensis*, gas chromatography).
Lutzomyia carrerai carrerai: Young 1979: 178 (refs., figs.). Young & Rogers 1984: 599 (listed, Ecuador). Young et al. 1985: 144 (Peru). Feliciangeli et al. 1988a: 48 (Venezuela). Alexander et al. 1992c: 124 (Ecuador).

Distribution (Map 133). COLOMBIA; ECUADOR (Young 1979; Alexander et al. 1992c); PERU (Llanos 1975b; Young 1979; Young et al. 1985; Pérez et al. 1991); BOLIVIA (Le Pont et al. 1986); BRAZIL (Arias & Freitas 1977; Martins et al. 1978; Fraiha et al. 1978; Ryan 1986); VENEZUELA (Feliciangeli et al. 1988a).

Remarks. *Lutzomyia c. carrerai* occurs east of the Andes where it is especially common in lowland forests. We regard this subspecies as a senior synonym of *L. pessoana* (Barretto). See Young (1979) for further information.

Ryan et al. (1987c) reported successful experimental transmission of *Leishmania amazonensis* by the bite of *L. c. carrerai* to a hamster.

Lutzomyia (Psychodopygus) carrerai thula Young
Fig. 259

Phlebotomus pessoanus (not *pessoana* Barretto): Fairchild & Hertig 1951a: 406 (figs., Panama).

Lutzomyia carrerai thula Young 1979: 181 (♂, ♀, Cerro Campana, Panama). Williams 1983: 489 (♀ figs., tax.). Christensen et al. 1983: 466 (Panama, coll. data). Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 63 (♂, ♀ figs., Costa Rica). Warburg et al. 1991b: 9 (western Colombia). Alexander et al. 1992c: 125 (Ecuador).

Lutzomyia pessoana: Zimmerman et al. 1977: 578 (egg). Christensen & Herrer 1980b: 523 (feeding habits).

Distribution (Map 133). HONDURAS (Fairchild & Hertig 1959); COSTA RICA (Murillo & Zeledón 1985); PANAMA; COLOMBIA; ECUADOR (Young 1979; Alexander et al. 1992c).

Remarks. Fairchild & Hertig (1951a) originally treated this subspecies as *L. paraensis* (not *paraensis* Costa Lima). They and other authors who studied sand flies in Panama and elsewhere within the geographic range of *L. c. thula*, also used the name, *pessoana* Barretto, for this taxon (see Young 1979 for refs.). Strangways-Dixon and Lainson (1966) reported the first experimental transmission of *Leishmania* in the Americas by the bite of "*Phlebotomus pessoanus*" in Belize, but the sand fly was probably conspecific with *L. panamensis* (Williams 1983).

Lutzomyia (Psychodopygus) fairchildi Barretto
Fig. 260

Lutzomyia fairchildi Barretto 1966: 136 (♂, ♀, Itatiaia, Rio de Janeiro, Brazil). Martins et al. 1973: 415; 1978 (refs., dist.).

Distribution (Map 116). BRAZIL (Martins et al. 1978).

Remarks. We examined 1 ♂, 1 ♀ topotypes of *L. fairchildi*, a pale species. The tips of the genital filaments of the male are hidden within the aedeagus so it was impossible to view their modifications. The lateral lobes are shorter than those of *L. c. carrerai*, a closely related species.

Forattini (1973) regards *L. fairchildi* and *L. paraensis* as conspecific but structural and color differences between these species are readily apparent.

Lutzomyia (Psychodopygus) yucumensis
(Le Pont, Caillard, Tibayrenc & Desjeux)
Fig. 258 C & G

Psychodopygus yucumensis Le Pont, Caillard, Tibayrenc & Desjeux 1986: 79 (♂, ♀, Serrania del Pilon, Beni, Bolivia). Caillard et al. 1986: 489 (cf. with *carrerai carrerai*, isozymes). Le Pont & Desjeux 1986: 314 (Bolivia). Phillips et al. 1990: 145 (cf. to *L. c. carrerai* using gas chromatography analysis).
Psychodopygus sp. no. 2 Biancardi et al. 1982: 177 (Rondônia, Brazil).
Lutzomyia carrerai carrerai (dark form): Young et al. 1985: 144 (Madre de Dios, Peru).
Phlebotomus yucumensis: Desjeux et al. 1987: 744 (as likely vector of *Leishmania*, Bolivia).
Lutzomyia yucumensis: Young et al. 1987: 588 (mention).

Distribution (Map 118). BRAZIL (Biancardi et al. 1982); PERU (Young et al. 1985; Pérez et al. 1991); BOLIVIA (Le Pont et al. 1986; ♂♂, ♀♀, Rio Yapancani, Santa Cruz, 1985-1987, H. Bermudez).

Remarks. Females of *L. yucumensis* have been found naturally infected with *Leishmania braziliensis* in Bolivia (Le Pont et al. 1986; Le Pont & Desjeux 1986). The species is common in other parts of Bolivia (Rio Yapancani, Santa Cruz, H. Bermudez, pers. comm.), Peru, and Brazil in lowland forests.

Lutzomyia (Psychodopygus) nocticola Young
Fig. 261

Lutzomyia nocticola Young 1973: 109 (♂, ♀, Rio Anori, Antioquia, Colombia). Martins et al. 1978: 43 (refs., dist.). Young 1979: 190 (figs., refs., dist.). Porter & De Foliart 1981: 157 (listed). Le Pont & Pajot 1980: 64 (cf. to *claustrei*). Williams 1983: 489 (tax.). Young & Rogers 1984: 599 (listed, Ecuador). Lebbe et al. 1987: 29 (computer aided ident.). Alexander et al. 1992c: 125 (listed).
Psychodopygus nocticola: Le Pont & Desjeux 1986: 314 (Bolivia).

Distribution (Map 132). PANAMA; COLOMBIA; ECUADOR (Young 1979); FRENCH GUIANA (Lebbe et al. 1987); BOLIVIA (Le Pont & Desjeux 1986); PERU (Pérez et al. 1991).

Remarks. This species is mostly pale except for the scutum which has a lateral band of faint to moderate pigmentation. Dorsum of the scutum is nearly pale.

Lebbe et al. (1987) include *L. nocticola* in the sand fly fauna of French Guiana. We studied a female from Säul, kindly loaned to us by F. Le Pont, that appears to be conspecific with *L. nocticola*, but males from there are needed to confirm its presence in this area.

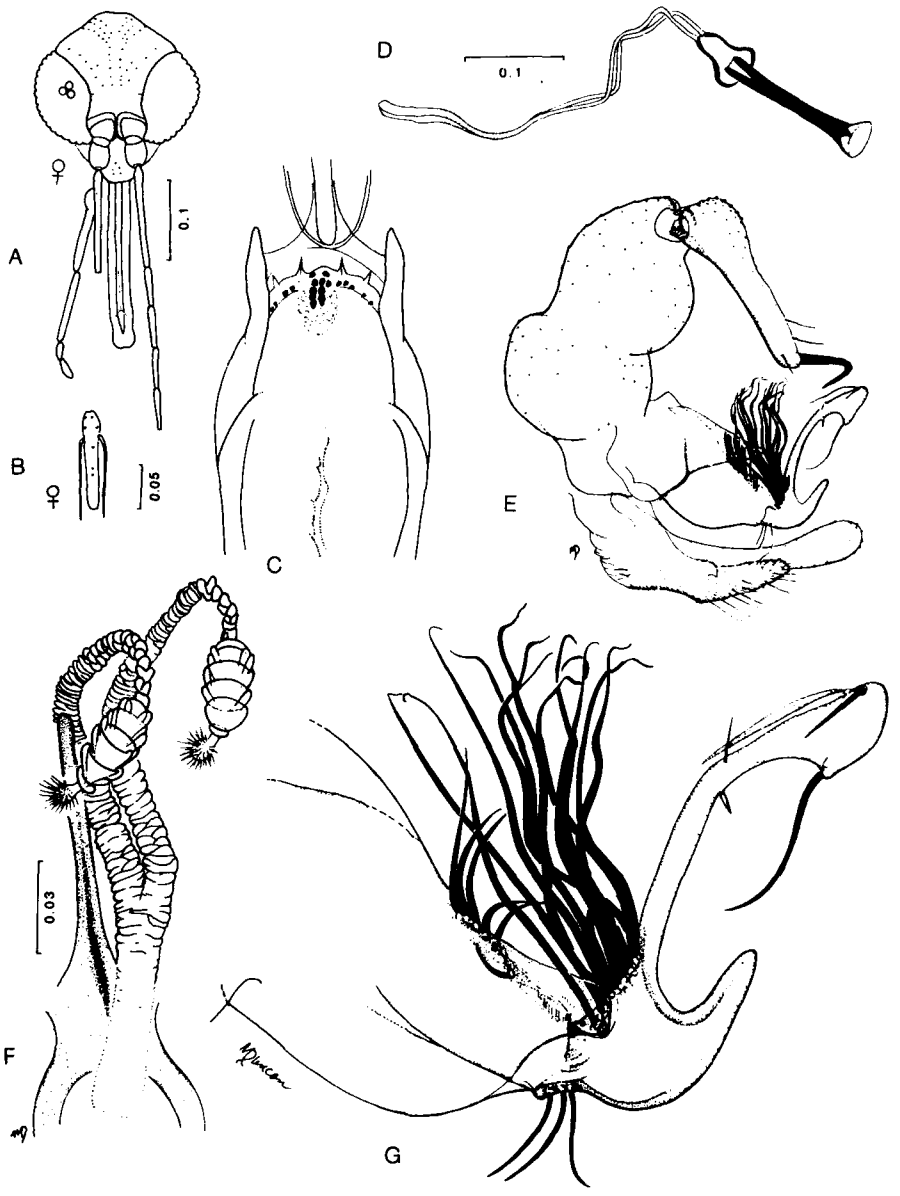


FIG. 234. ***Lutzomyia bernalei.*** A. Female head; B. Female flagellomere II; C. Female cibarium; D. Genital pump & filaments; E. Male terminalia; F. Spermathecae; G. Paramere. (female figures from Feliciangeli et al. 1988a).

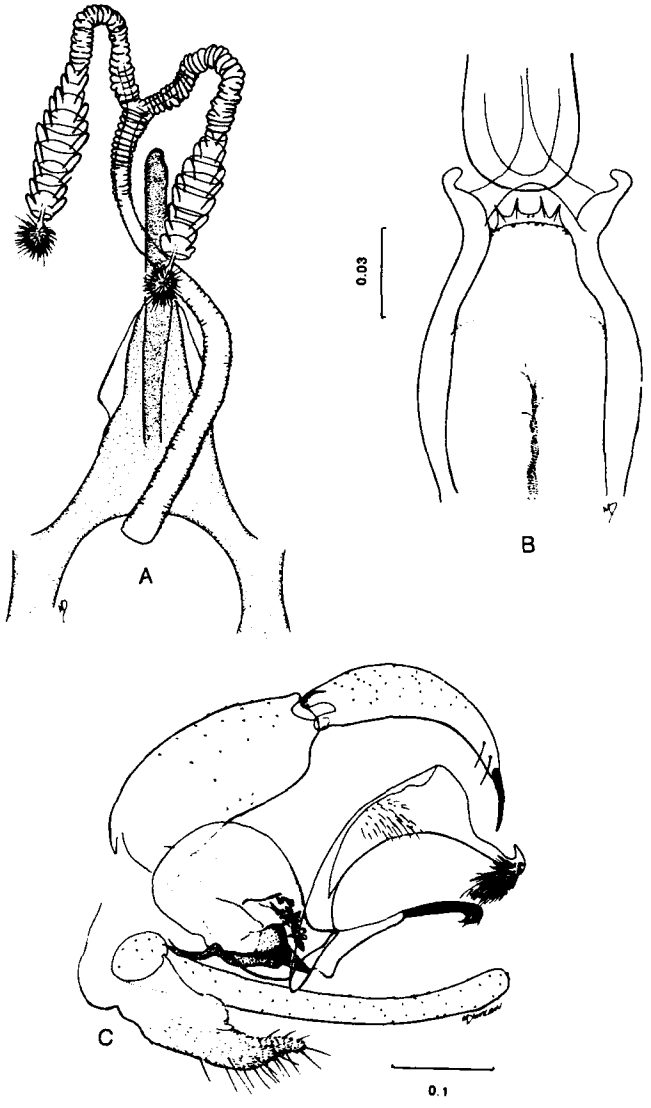


FIG. 235. ***Lutzomyia lainsoni.*** A. Spermathecae; B. Female cibarium; C. Male terminalia.

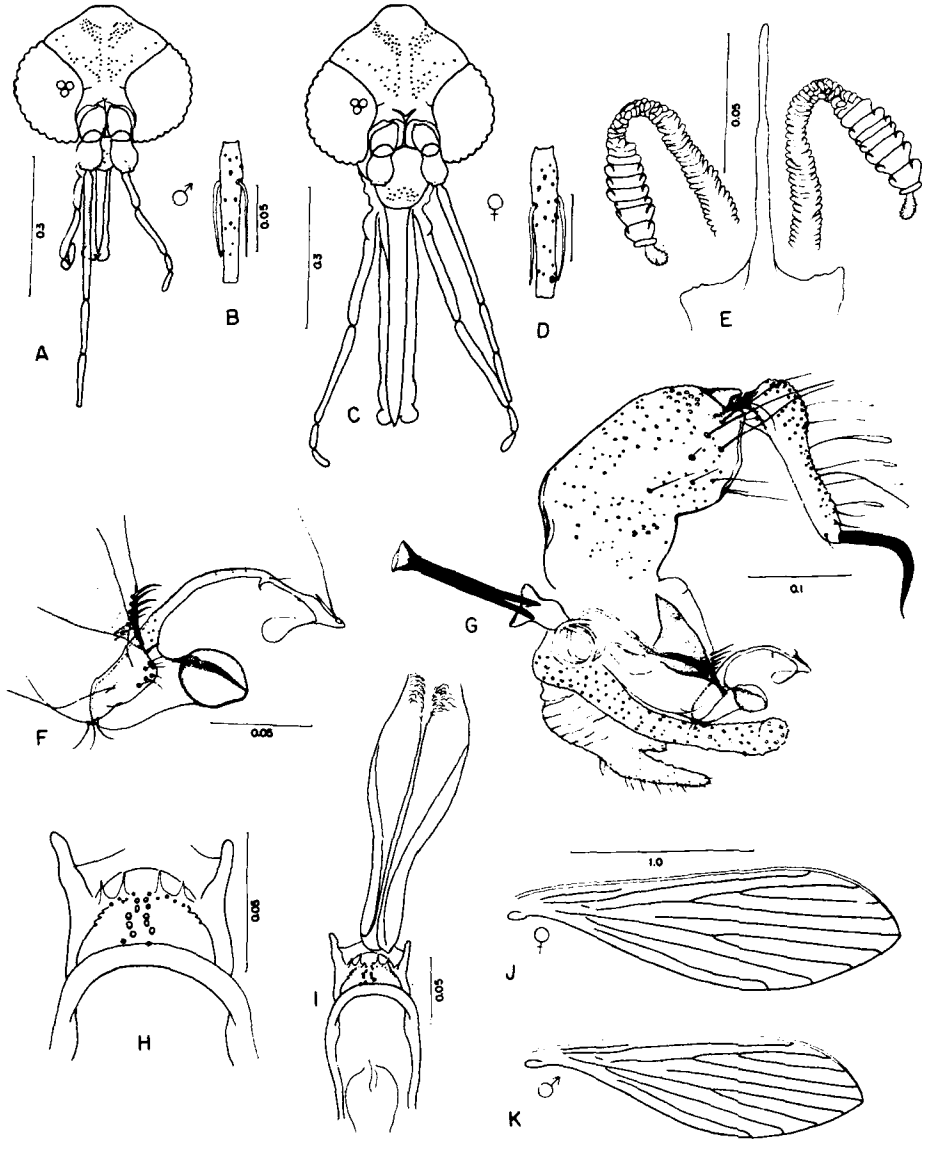


FIG. 236. ***Lutzomyia fairtigi.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Spermathecae; F. Paramere; G. Male terminalia; H. Female cibarium; I. Female cibarium & pharynx; J. Female wing; K. Male wing (figs. from Young 1979).

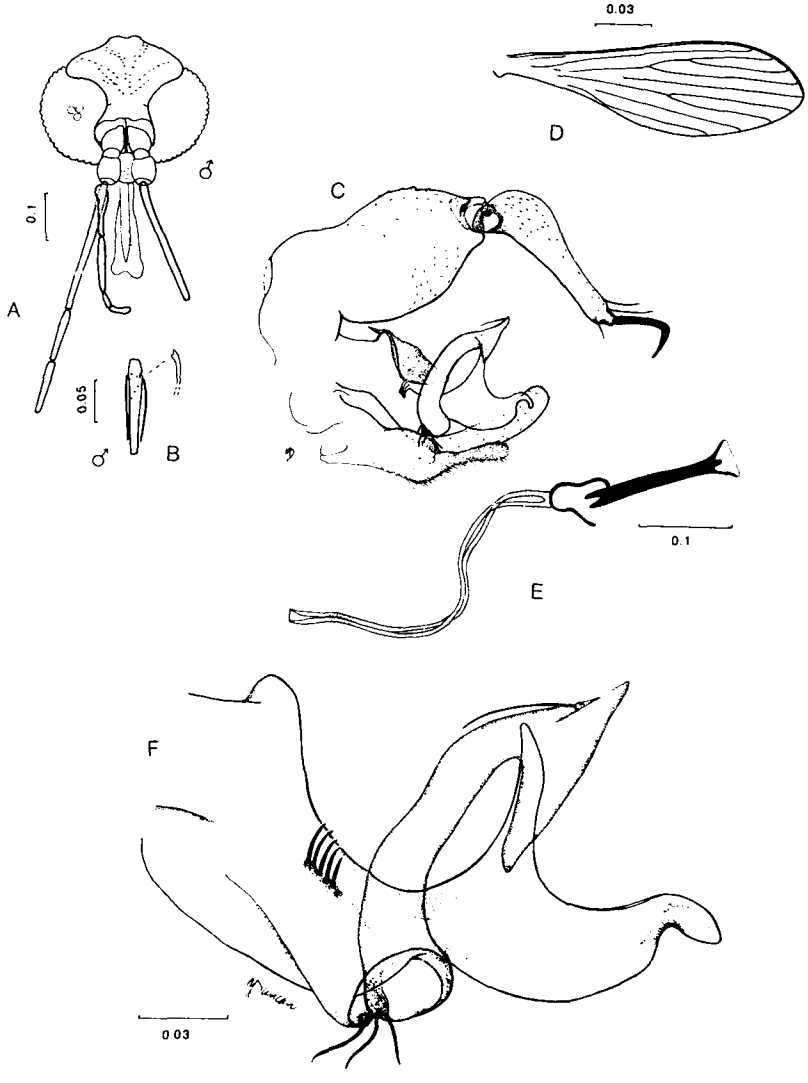


FIG. 237. ***Lutzomyia wellcomei.*** A. Male head; B. Male flagellomere II; C. Male terminalia; D. Male wing; E. Genital pump & filaments; F. Paramere.

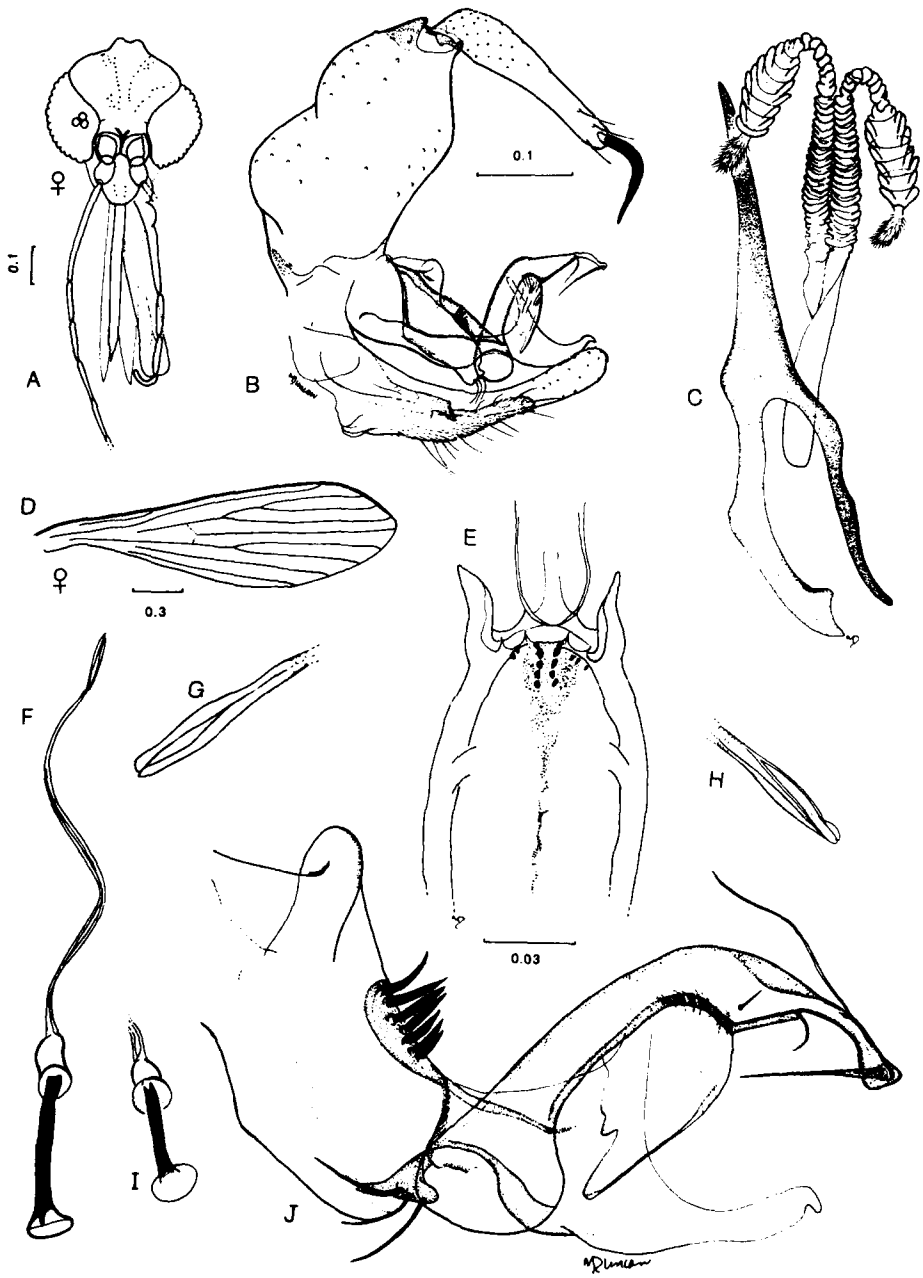


FIG. 238. ***Lutzomyia complexa.*** A. Female head; B. Male terminalia; C. Spermathecae; D. Female wing; E. Female cibarium; F. Genital pump & filaments; G. & H. Tips of genital filaments; I. Genital pump; J. Paramere.

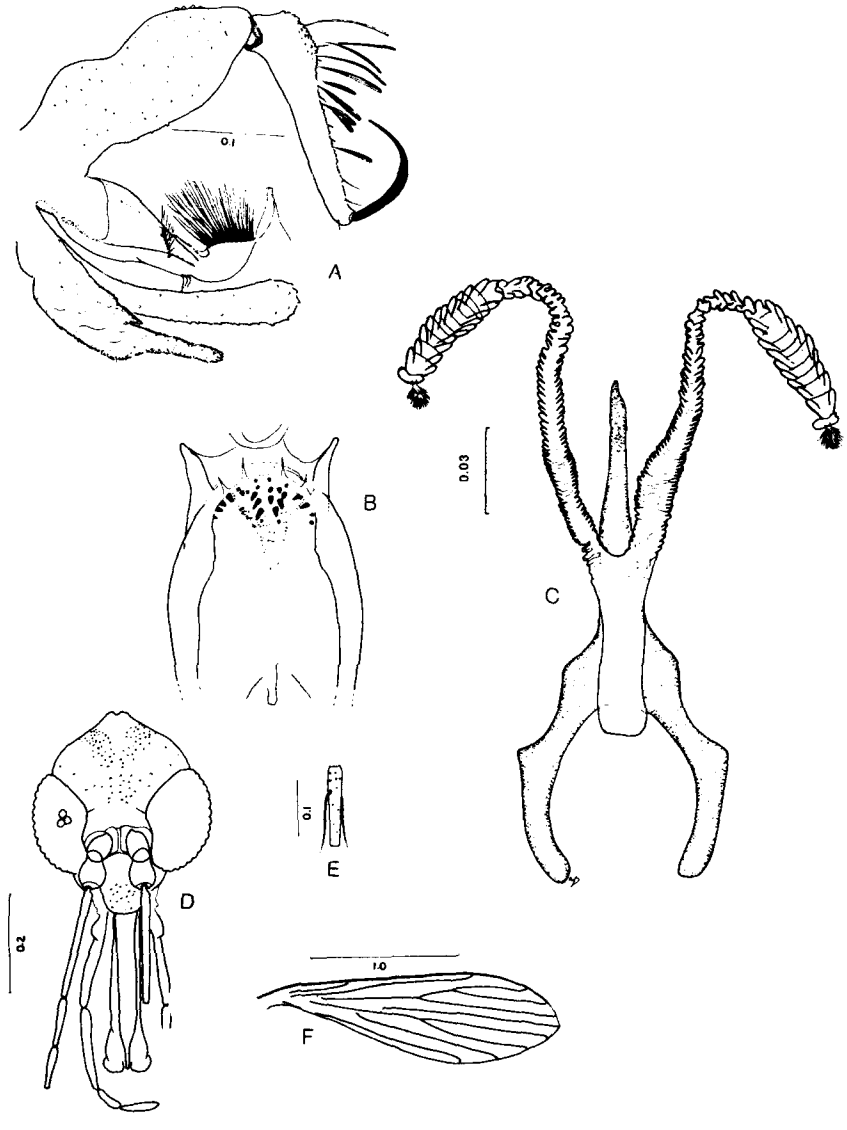


FIG. 239 ***Lutzomyia chagasi***. A. Male terminalia; B. Cibarium; C. Spermathecae (Fig. A from Young 1979); D. Male head; E. Male flagellomere II; F. Male wing.

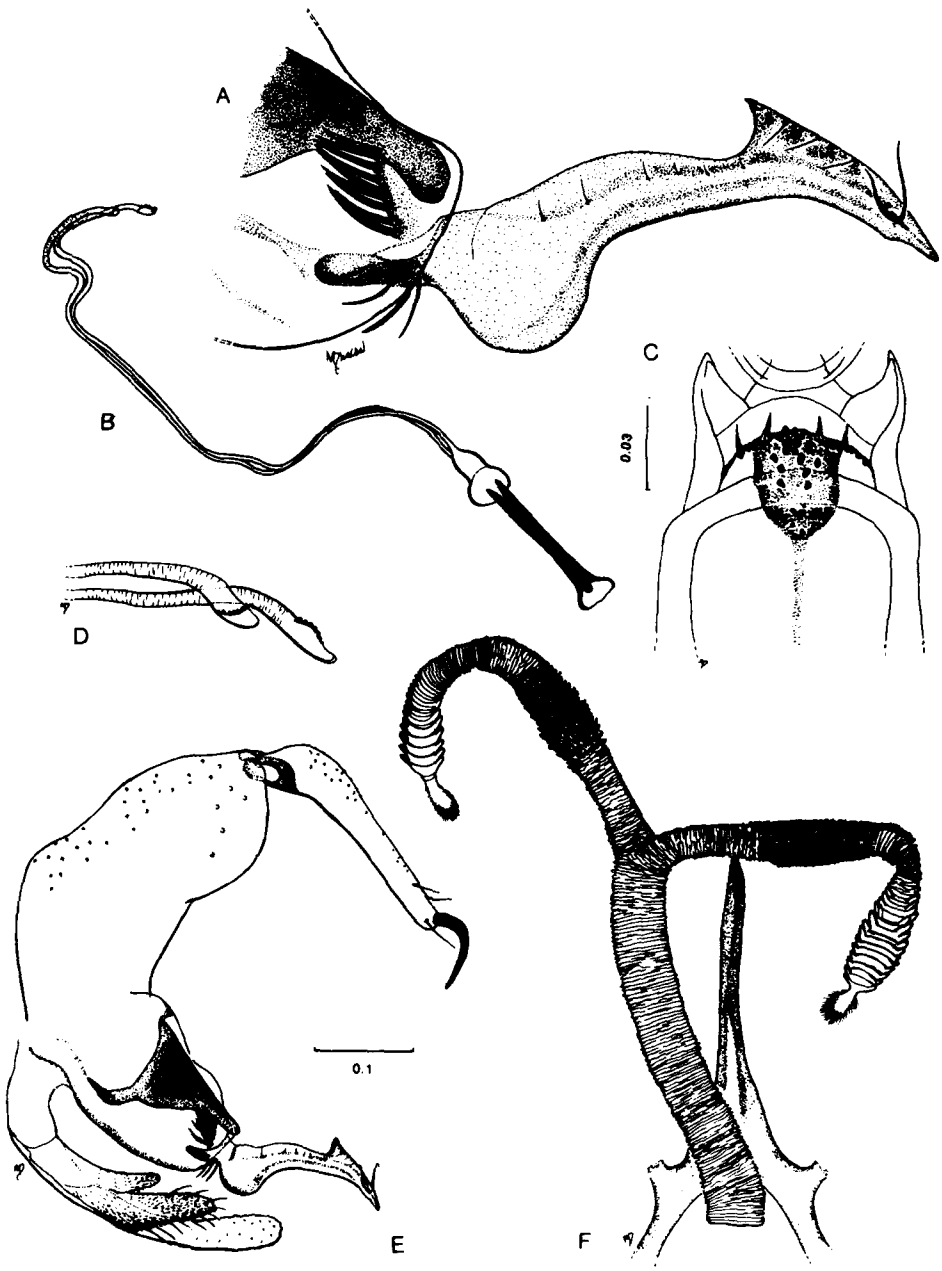


FIG. 240. ***Lutzomyia leonidasdeanei.*** A. Paramere & aedeagus; B. Genital pump & filaments; C. Female cibarium; D. Tips of genital filaments; E. Male terminalia; F. Spermathecae.

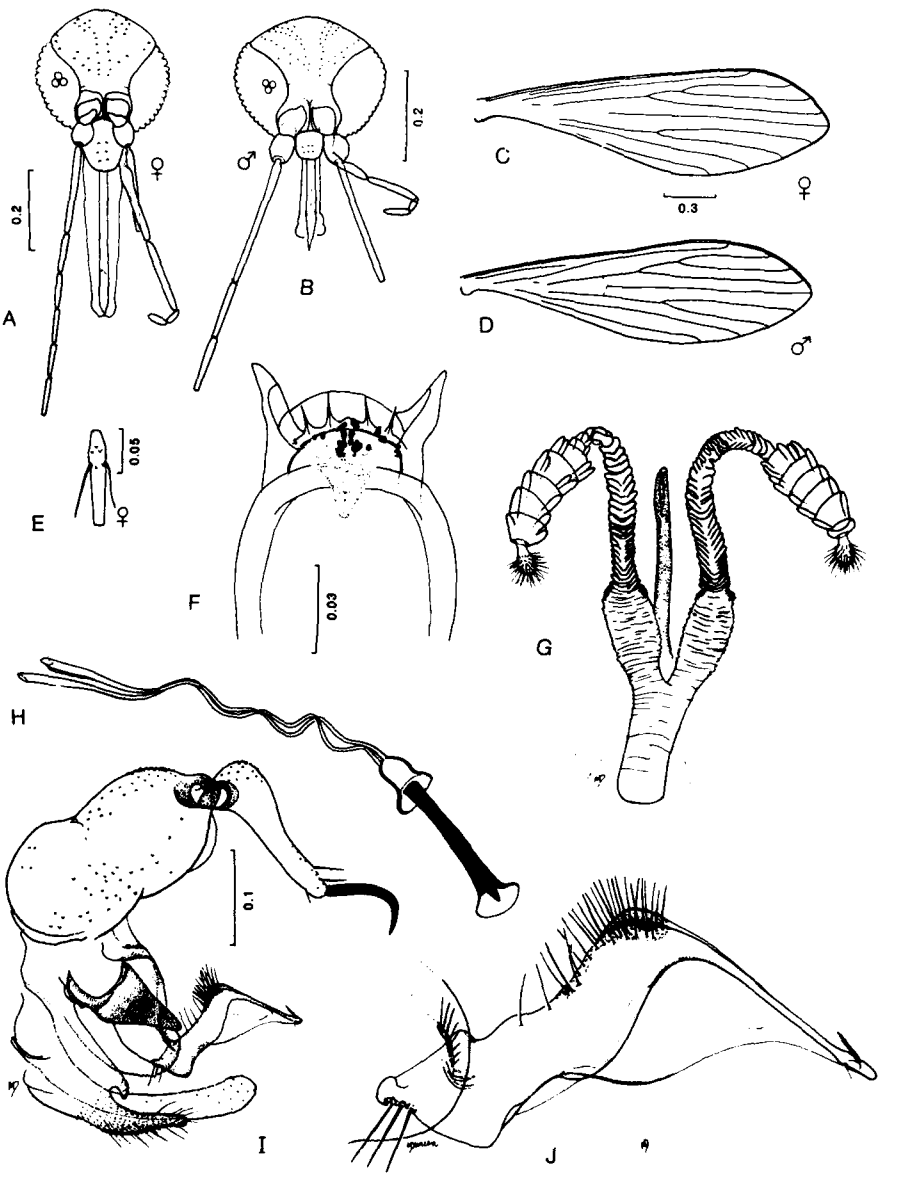


FIG. 241. ***Lutzomyia killicki.*** A. Female head; B. Male head; C. Female wing; D. Male wing; E. Female flagellomere II; F. Female cibarium; G. Spermathecae; H. Genital pump & filaments; I. Male terminalia; J. Paramere. (all figs. from Feliciangeli et al. 1988a).

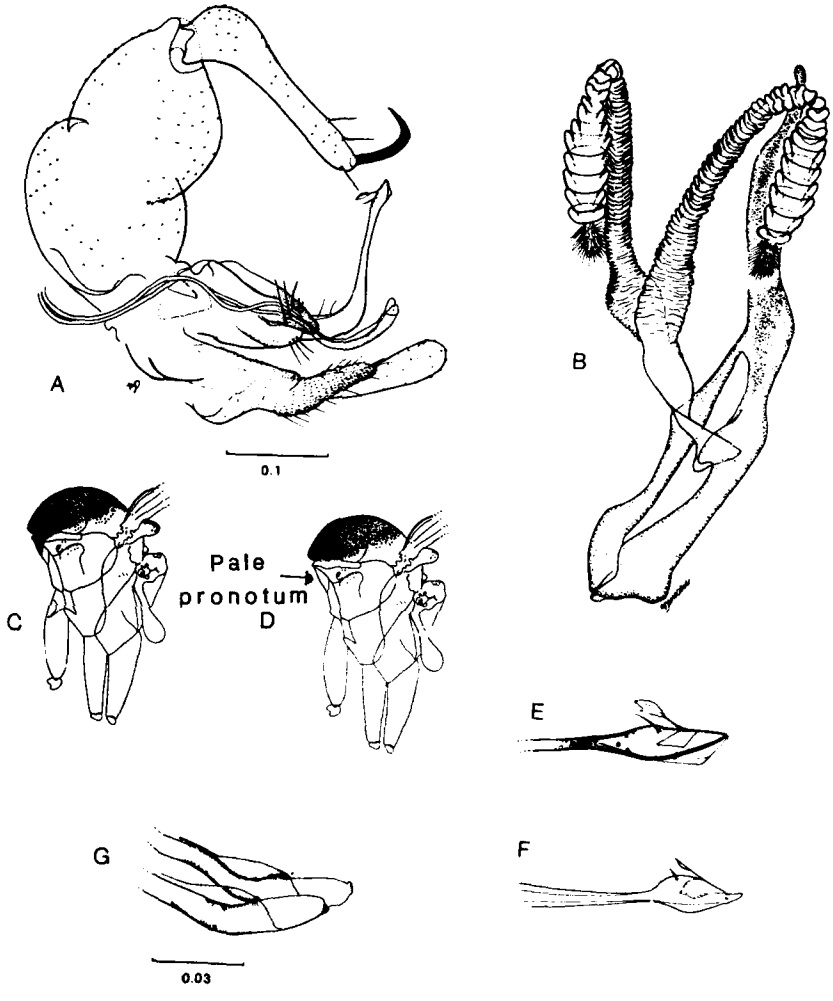


FIG. 242. ***Lutzomyia squamiventris maripaensis.*** A. Male terminalia; B. Spermathecae; D. Thorax; E. Paramere apex; G. Tips of genital filaments.
Lutzomyia squamiventris squamiventris. C. Thorax; F. Paramere apex (fig. F from Ready et al. 1982).

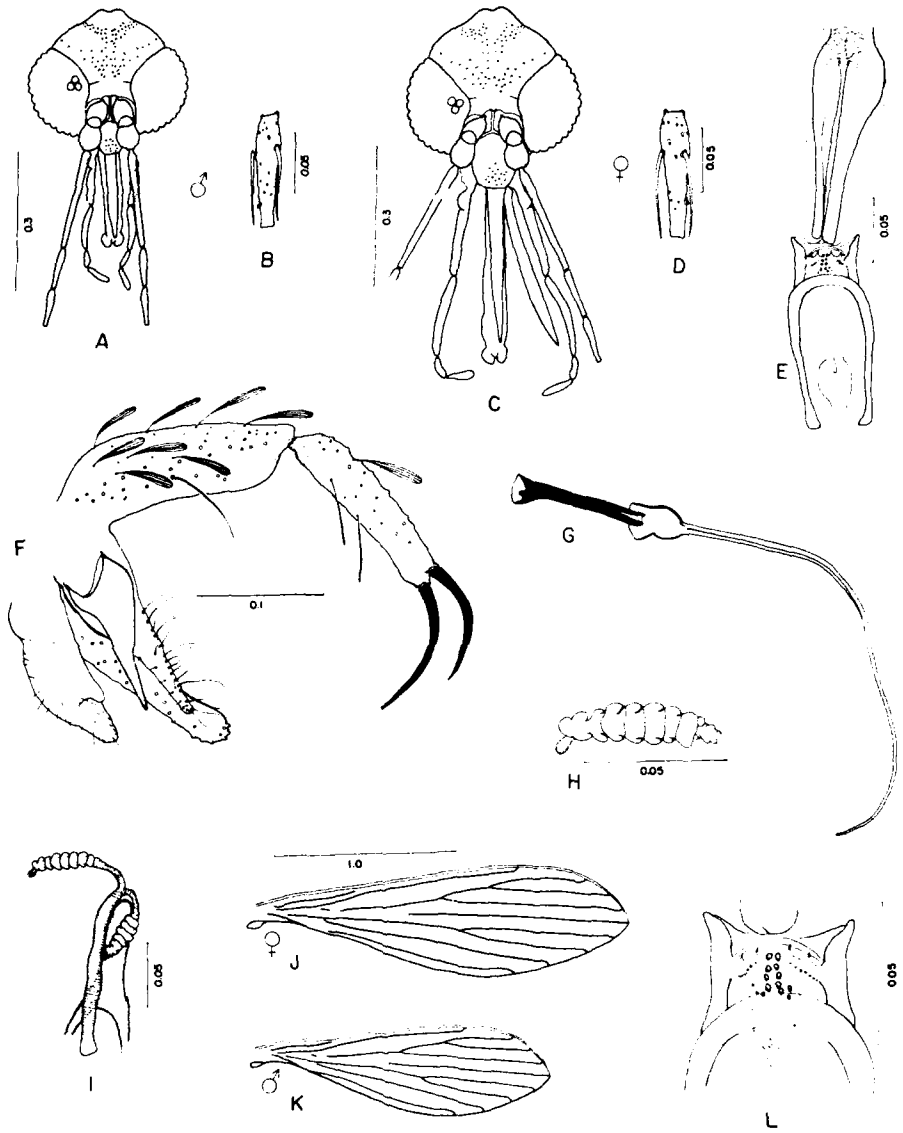


FIG. 243 ***Lutzomyia bispinosa.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Body of spermatheca; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

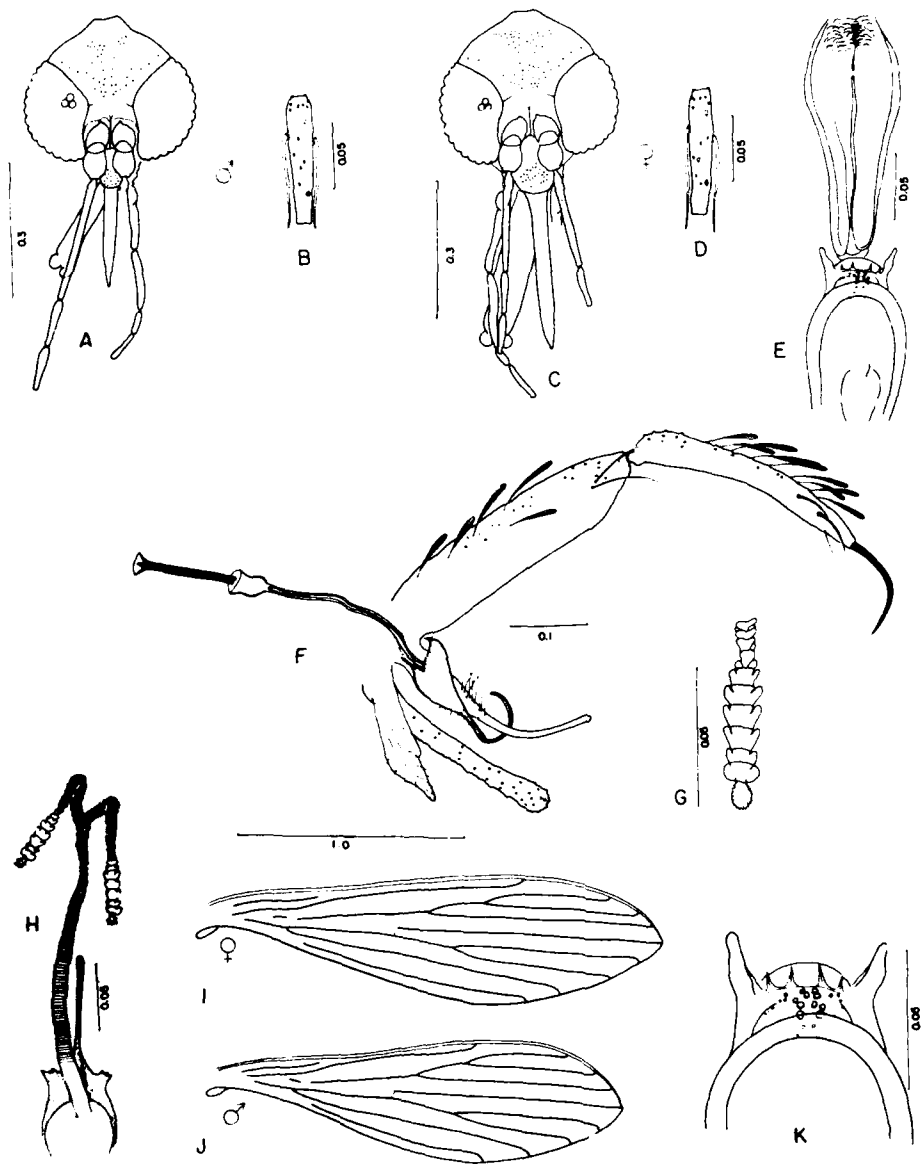


FIG. 244. ***Lutzomyia corossoniensis.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Spermatheca; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

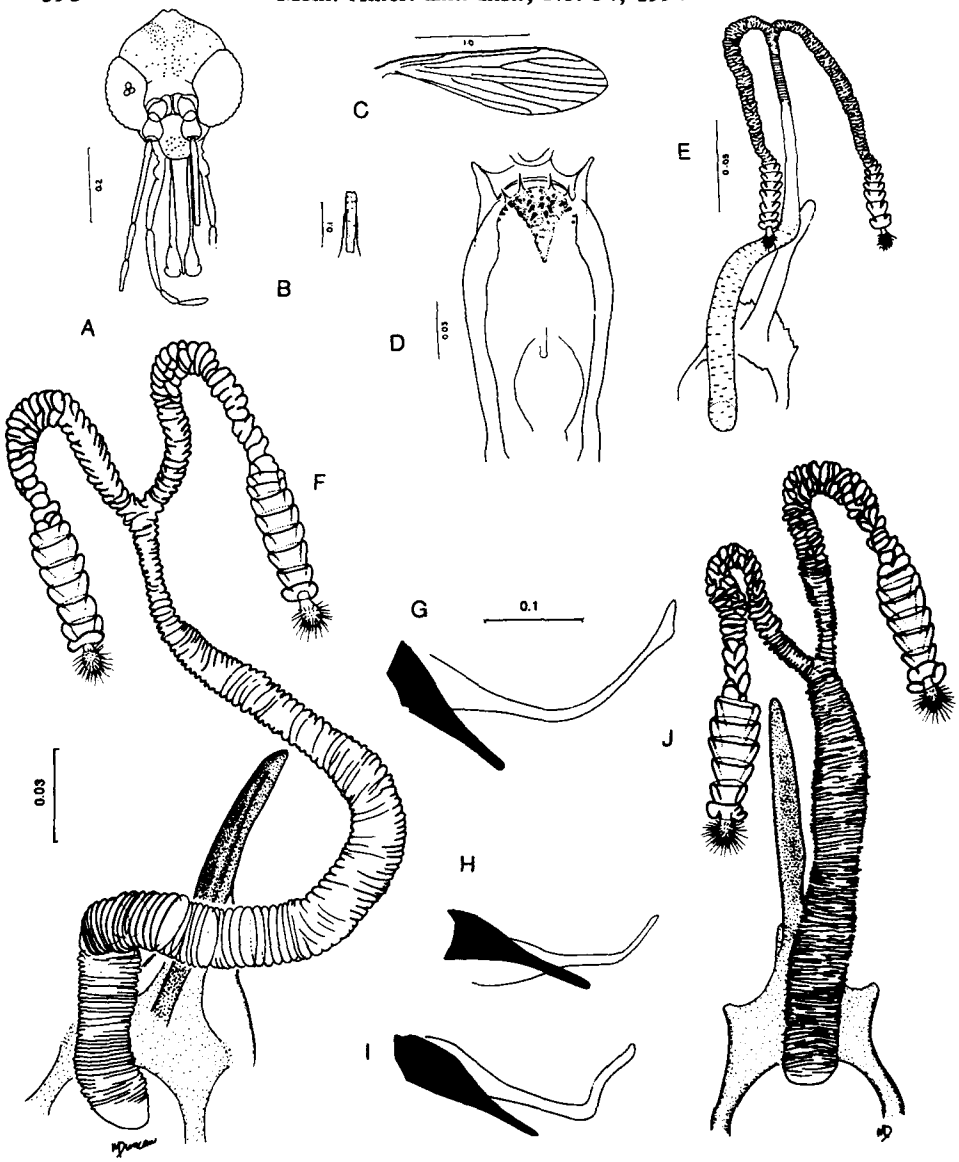


FIG. 245 ***Lutzomyia*** **sp. of Tres Esquinas.** A. Female head; B. Female flagellomere II; C. Female wing; D. Female cibarium; E. Spermathecae (from Young 1979). ***Lutzomyia corossoniensis.*** G. Paramere & aedeagus (after Le Pont & Desjeux 1982). ***Lutzomyia dorlinsis.*** H. Paramere & aedeagus (after Le Pont & Desjeux 1982). ***Lutzomyia geniculata.*** I. Paramere & aedeagus (after Le Pont & Desjeux 1982). ***Lutzomyia*** **sp.** F.& J. Spermathecae, females from Venezuela. (from Feliciangeli et al. 1988a).

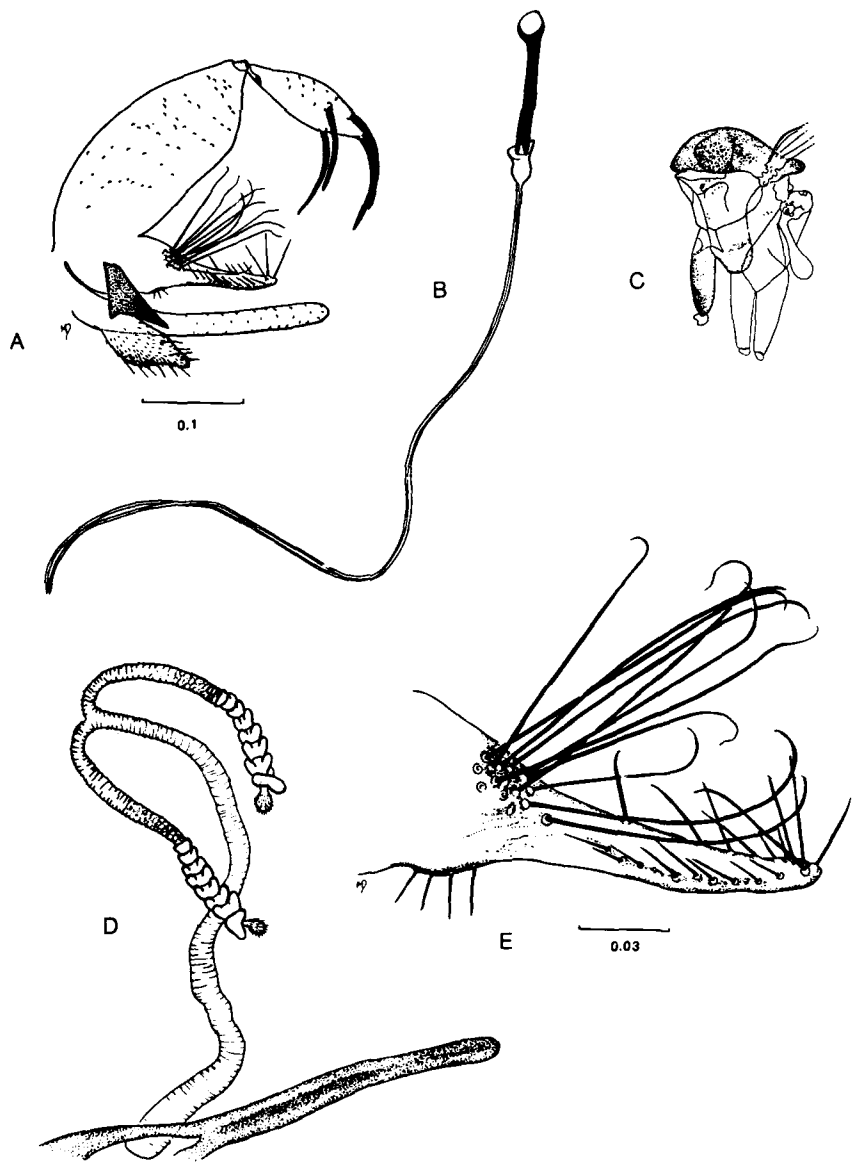


FIG. 246. ***Lutzomyia matosi.*** A. Male terminalia; B. Genital pump & filaments; C. Thorax; D. Spermathecae; E. Paramere.

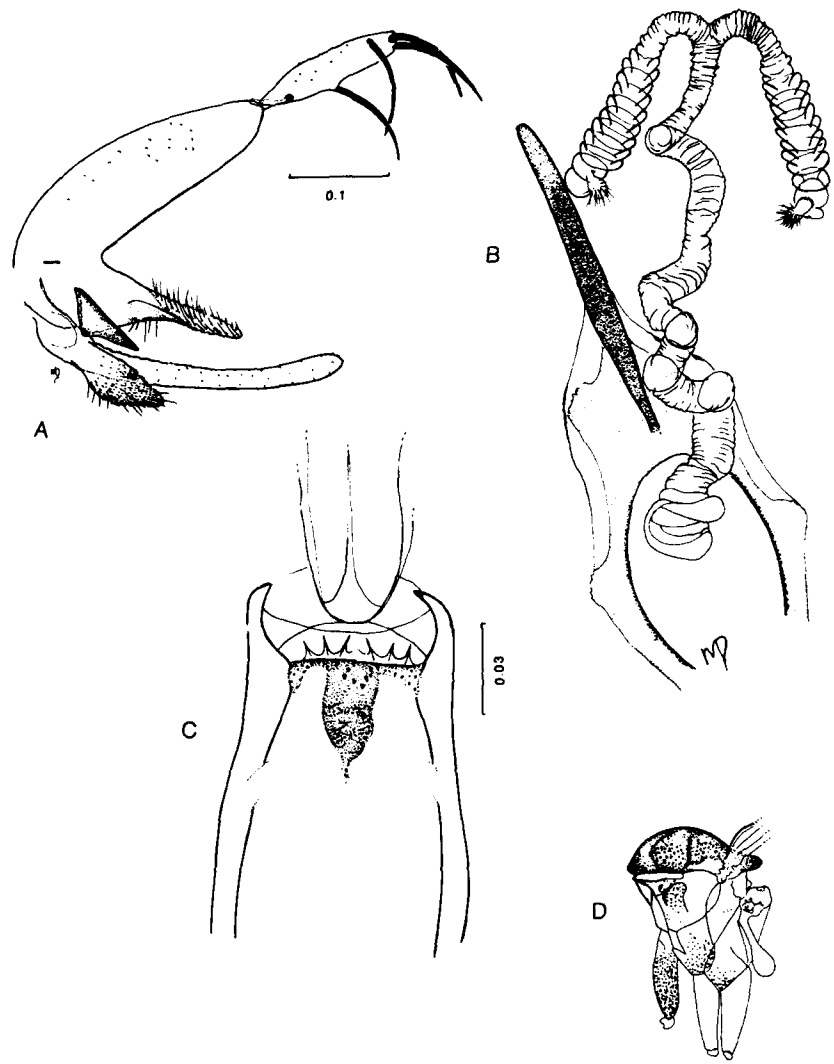


FIG. 247. ***Lutzomyia arthuri.*** A. Male terminalia; B. Spermathecae; C. Female cibarium; D. Thorax.

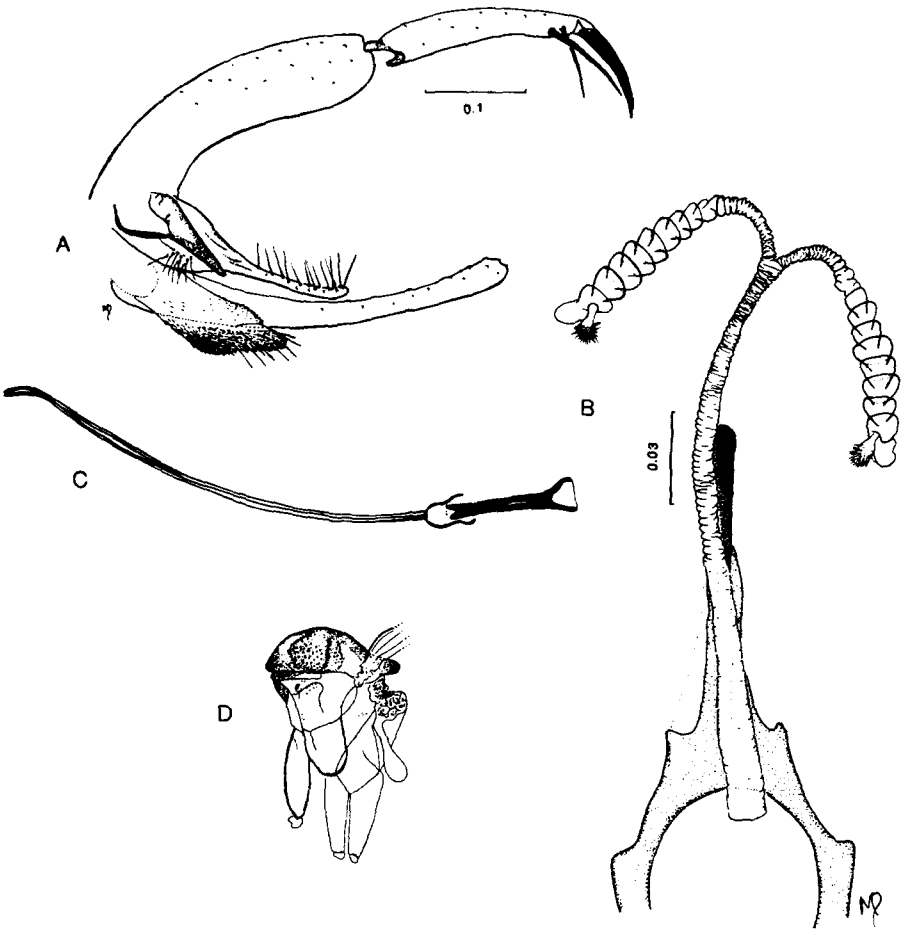


FIG. 248 ***Lutzomyia lloydi.*** A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Thorax.

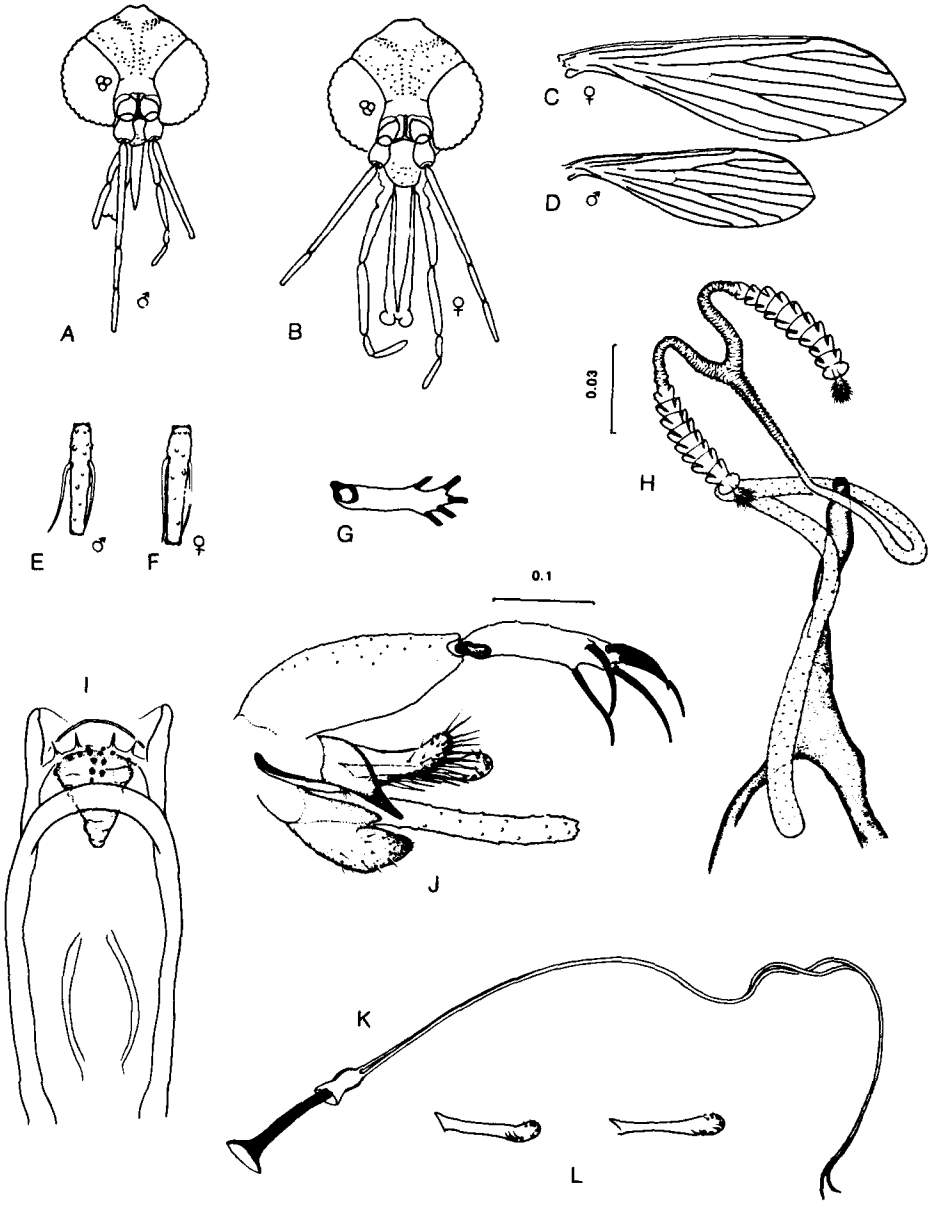


FIG. 249 ***Lutzomyia davisi.*** A. Male head; B. Female head; C. Female wing; D. Male wing; E. Male flagellomere II; F. Female flagellomere II; G. Style; H. Spermathecae; I. Female cibarium; J. Male terminalia; K. Genital pump & filaments; L. Paramere (figs. from Young & Rogers 1984, same scale as those in Fig. 251).

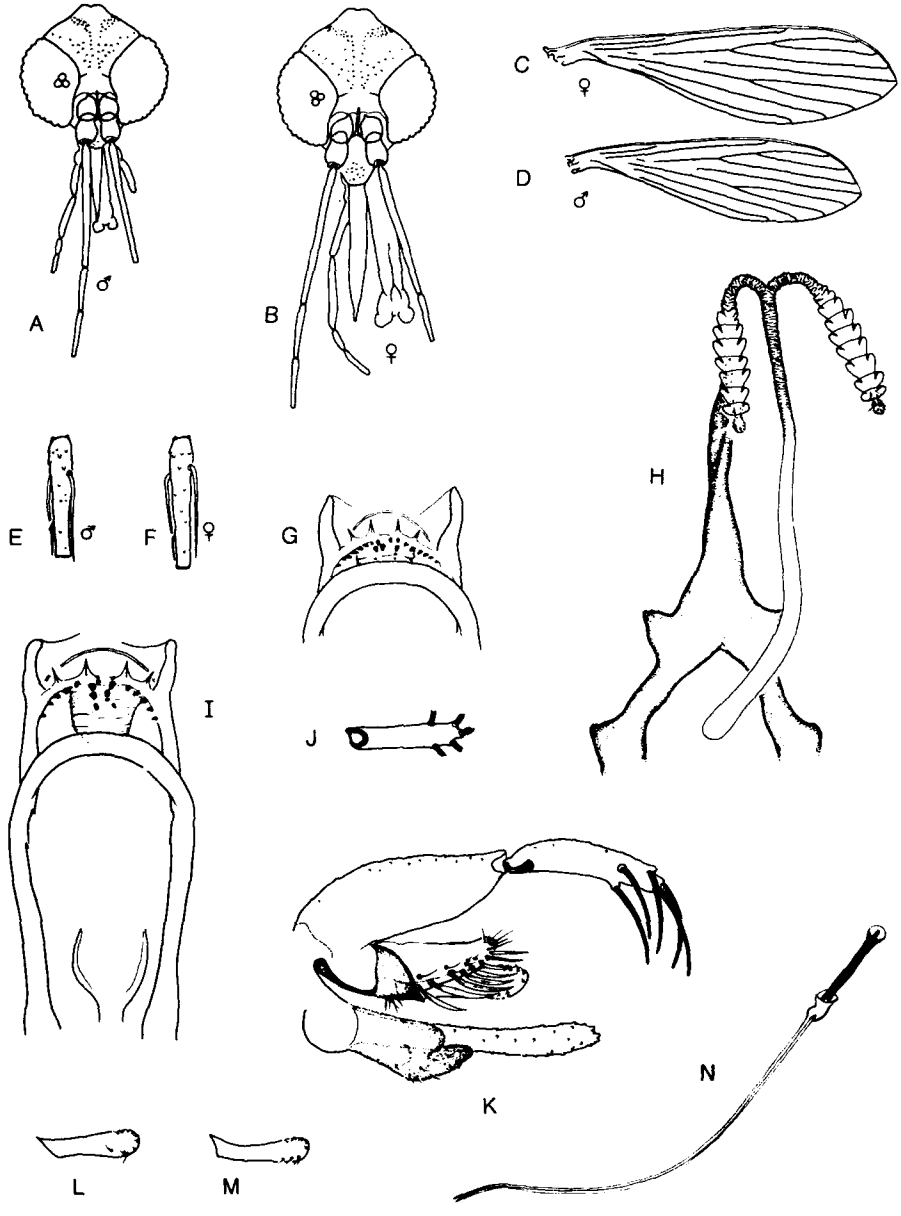


FIG. 250. ***Lutzomyia claustrei***. A. Male head; B. Female head; C. Female wing; D. Male wing; E. Male flagellomere; F. Female flagellomere II; G. Female cibarium; H. Spermathecae; I. Female cibarium; J. Style; K. Male terminalia; L. Paramere; M. Paramere; N. Genital pump & filaments (figs. from Young & Rogers 1984, same scale as those in Fig. 251).

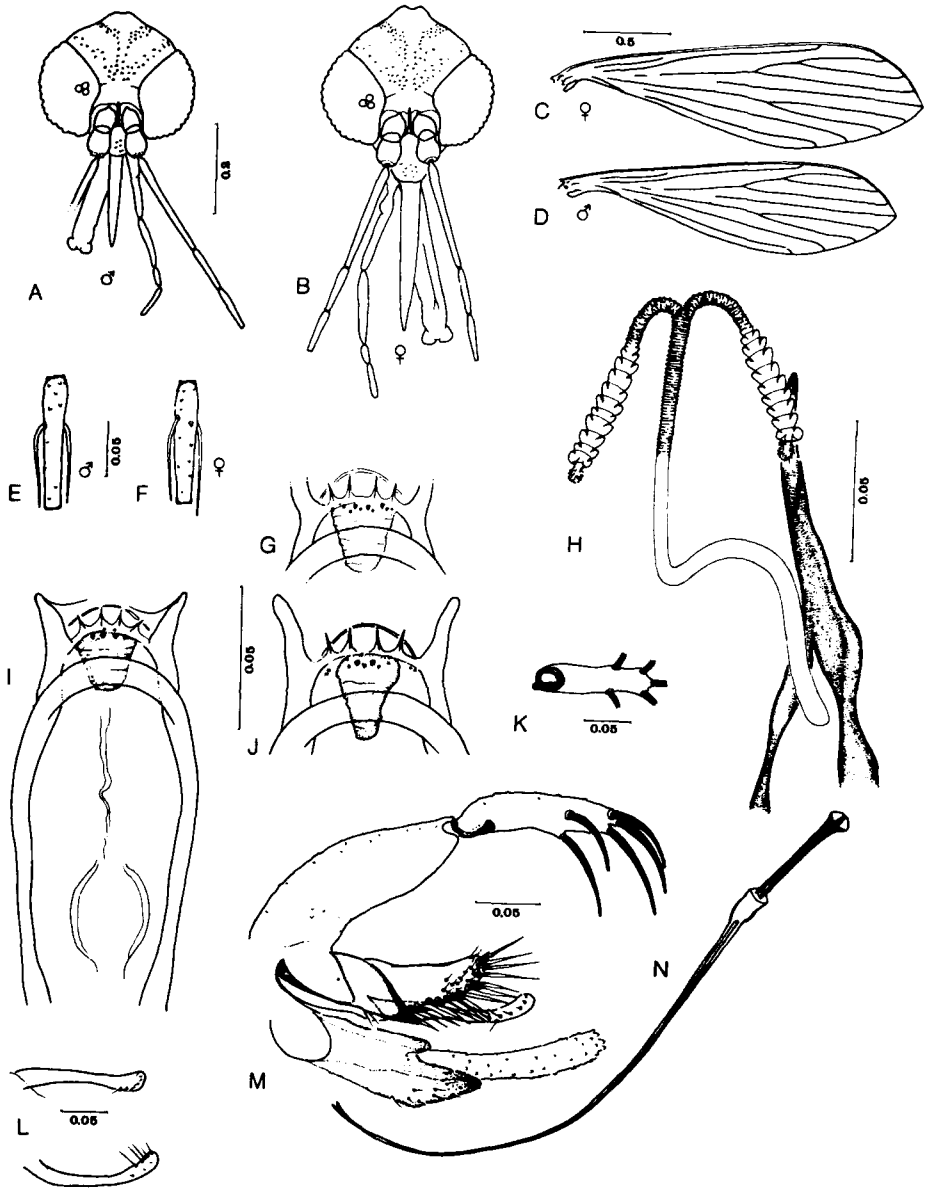


FIG. 251. ***Lutzomyia amazonensis.*** A. Male head; B.Female head; C. Female wing; D. Male wing; E. Male flagellomere II; F. Female flagellomere II; G. Female cibarium; H. Spermathecae; I. Female cibarium; J. Female cibarium of another female showing variation; K. Male style; L. Paramere shown at different angles of view; M. Male terminalia; N. Genital pump & filaments (from Young & Rogers 1984).

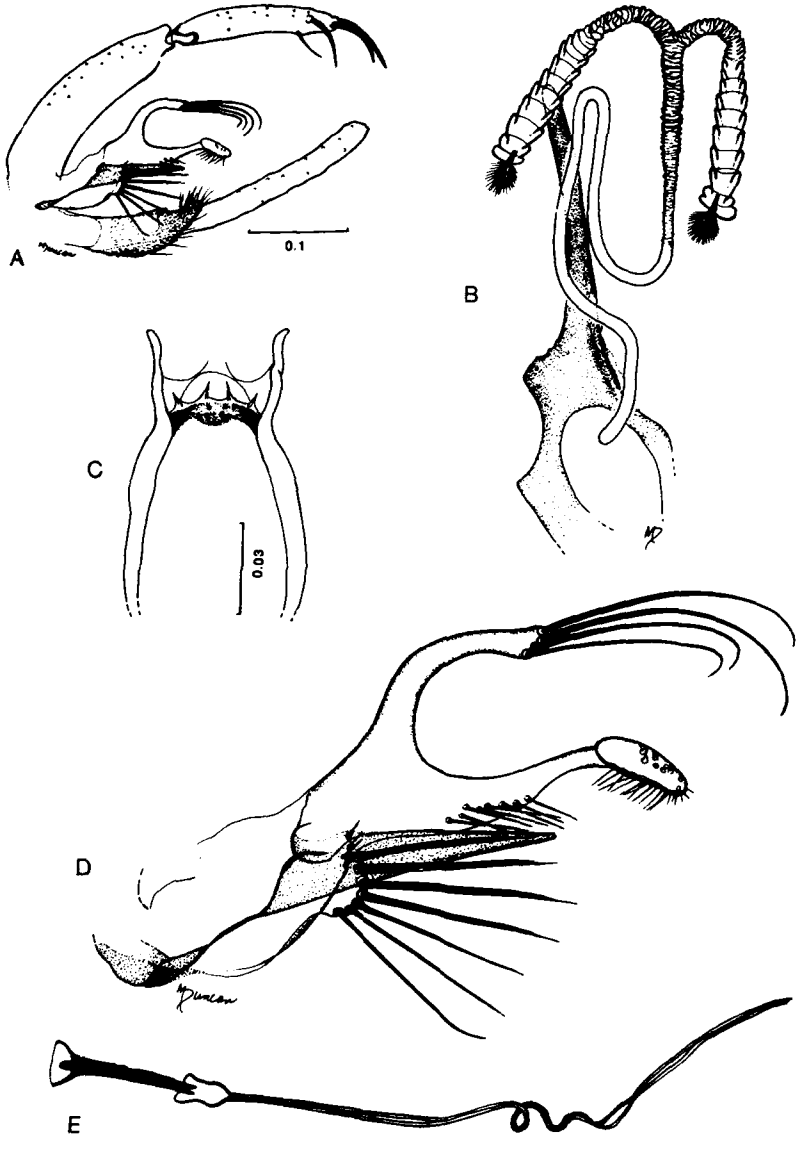


FIG. 252. ***Lutzomyia llanosmartinsi.*** A. Male terminalia; B. Spermathecae; C. Female cibarium; D. Paramere & aedeagus; E. Genital pump & filaments.

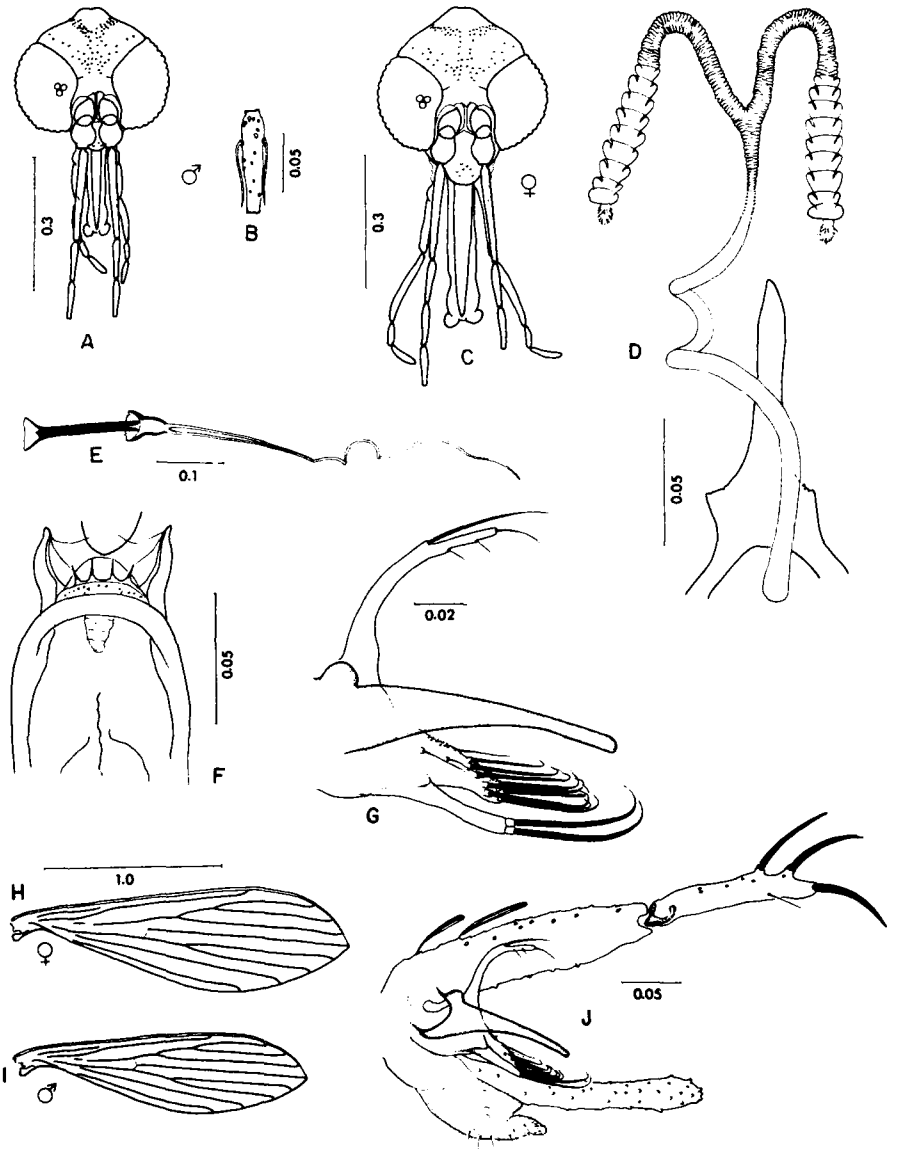


FIG. 253. ***Lutzomyia recurva.*** A. Male head; B. Male flagellomere II; C. Female head; D. Spermathecae; E. Genital pump & filaments; F. Female cibarium; G. Aedeagus & paramere; H. Female wing; I. Male wing; J. Male terminalia (from Young 1973).

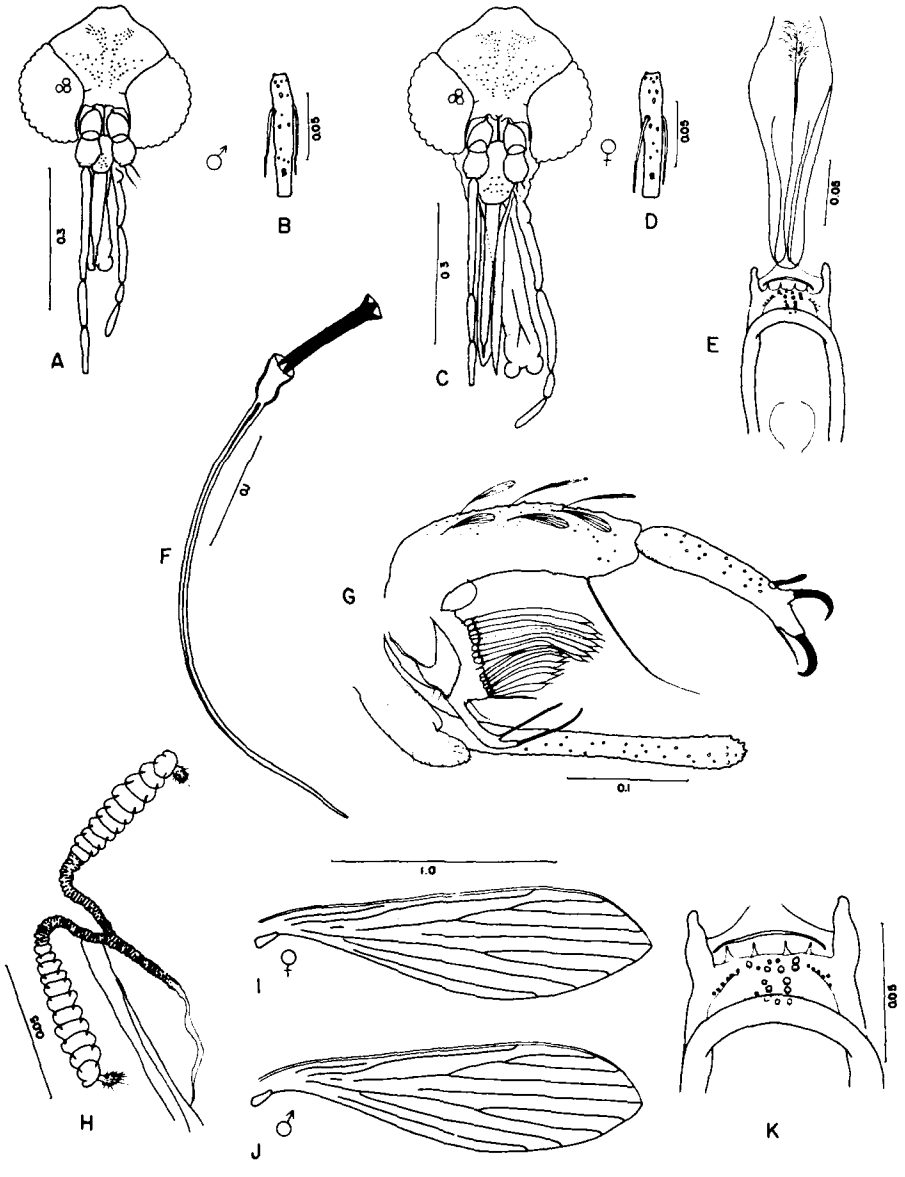


FIG. 254. ***Lutzomyia panamensis.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

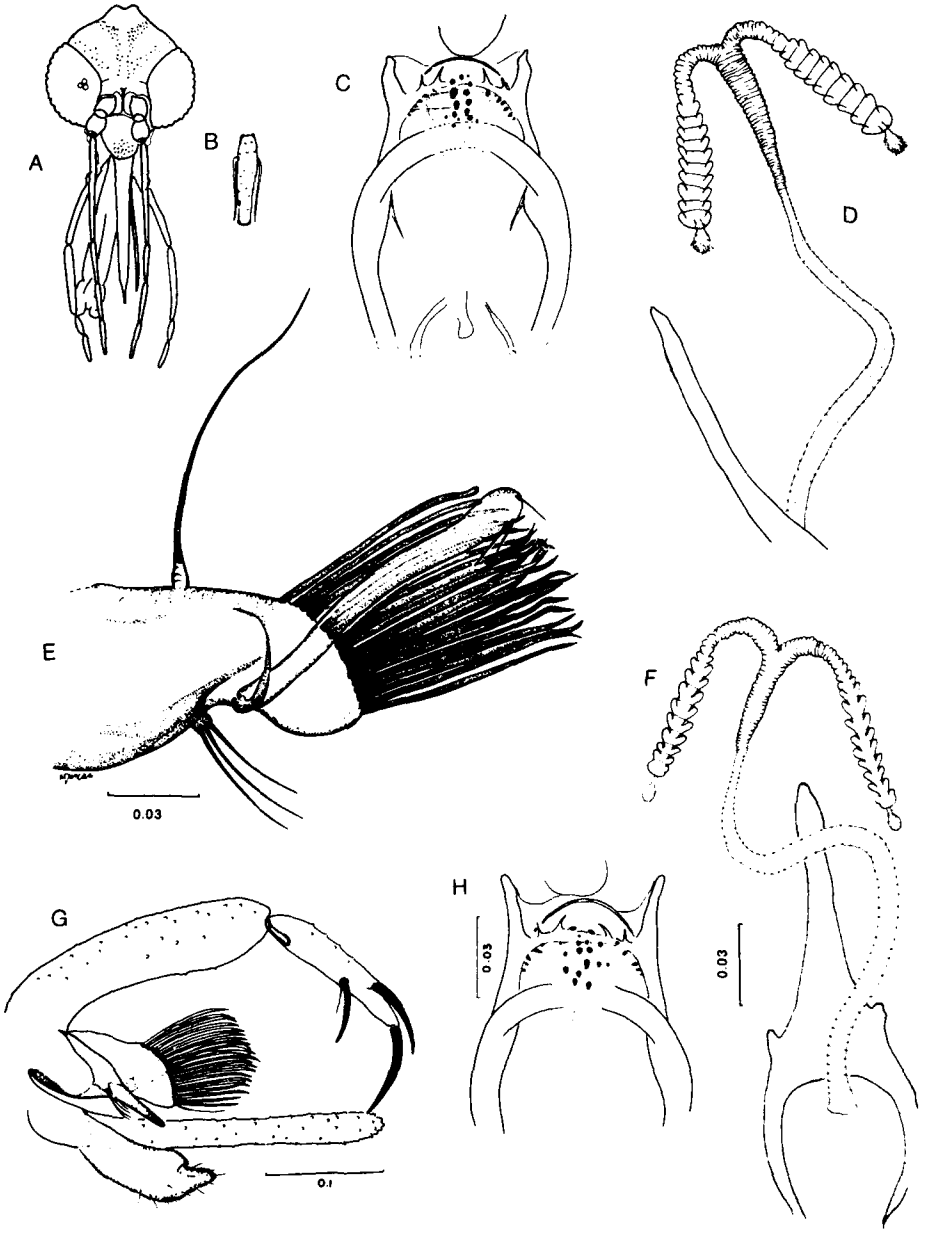


FIG. 255. ***Lutzomyia hirsuta nicaraguensis.*** A. Female head; B. Female flagellomere II; C. Female cibarium; D. Spermathecae; E. Paramere (female figs. from Young 1979).
Lutzomyia hirsuta hirsuta. F. Spermathecae; G. Male terminalia; H. Female cibarium (from Young 1979).

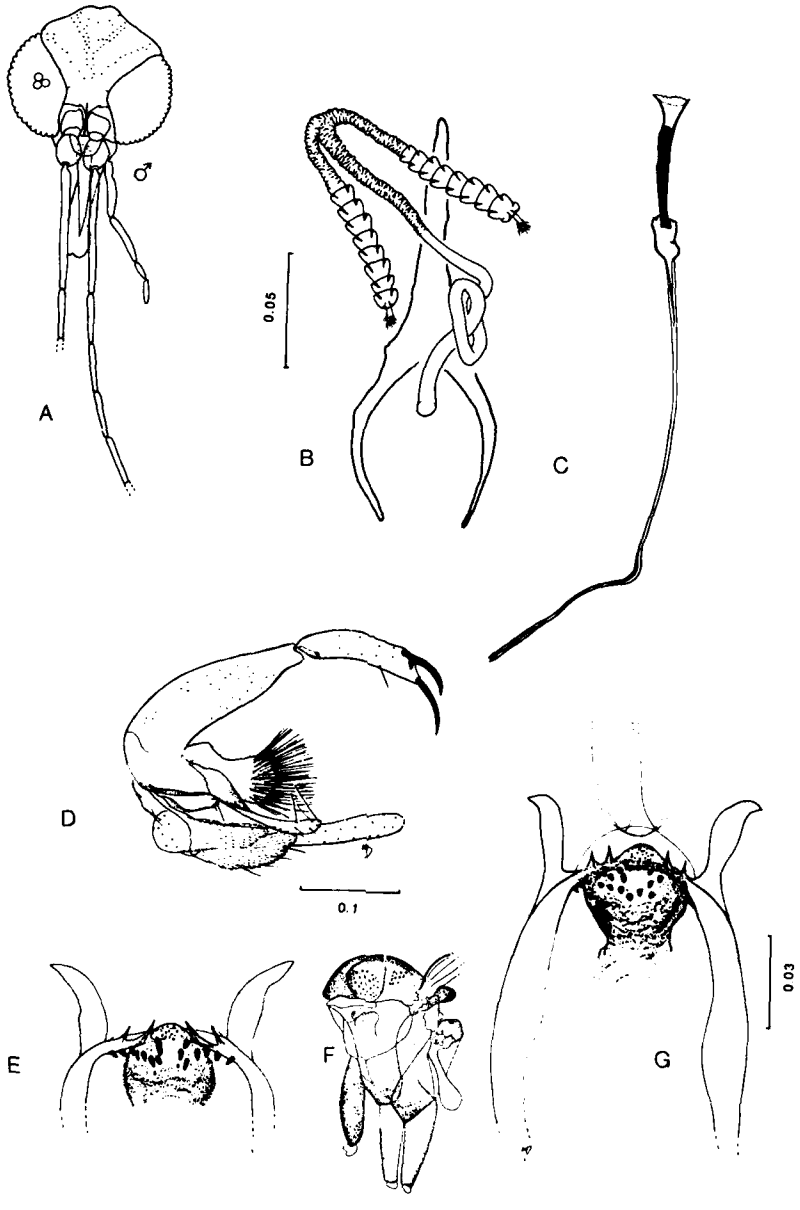


FIG. 256. ***Lutzomyia paraensis***. A. Male head; B. Spermathecae; C. Genital pump & filaments; D. Male terminalia; E. Female cibarium showing inwardly slanted teeth; F. Thorax; G. Female cibarium with straight horizontal teeth (less common).

FIG. 257. ***Lutzomyia ayrozai.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Female cibarium; I. Spermathecae; J. Thorax; K. Male terminalia (from Young 1979, except Fig. 257J).

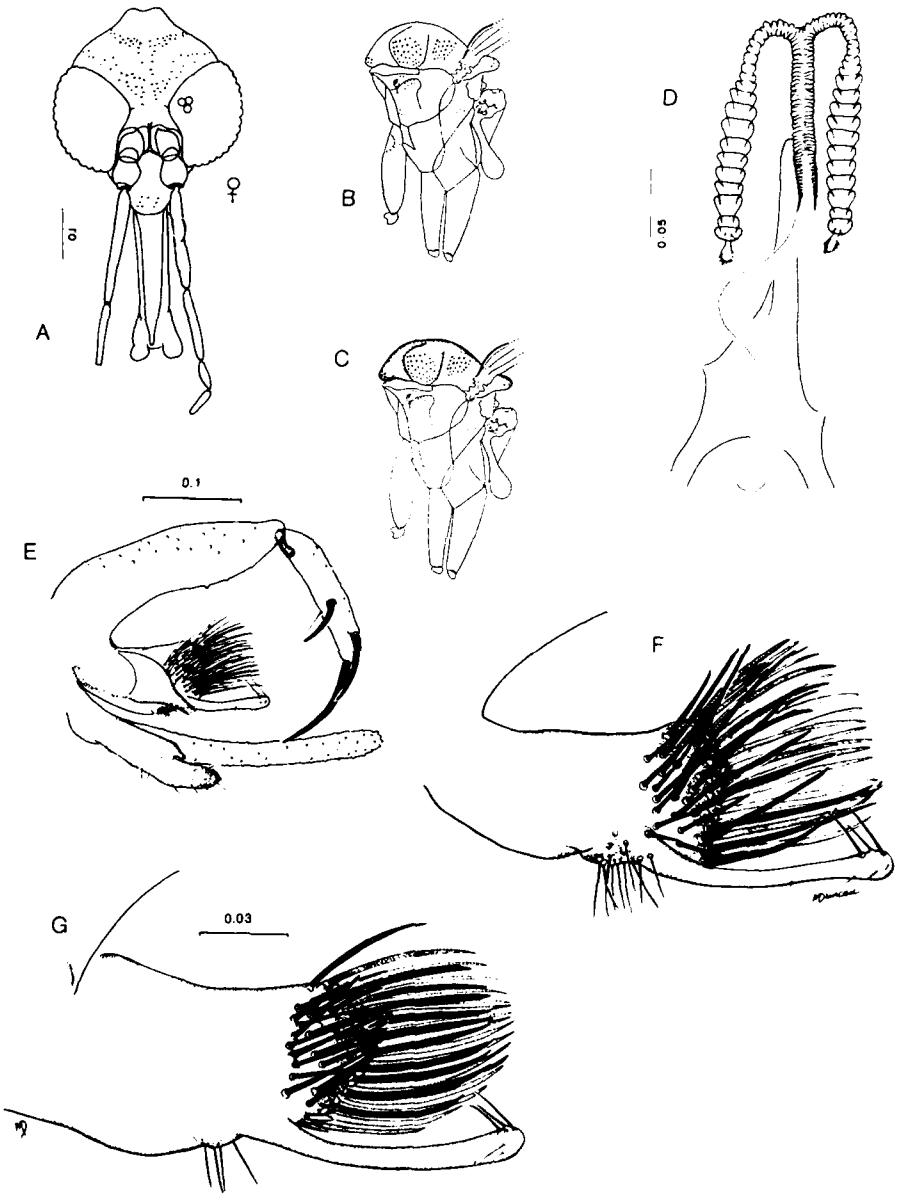


FIG. 258. ***Lutzomyia carrerai carrerai.*** A. Female head; B. Thorax; D. Spermathecae; E. Male terminalia; F. Paramere (all figs. except B & F from Young 1979).
Lutzomyia yucumensis. C. Thorax G. Paramere.

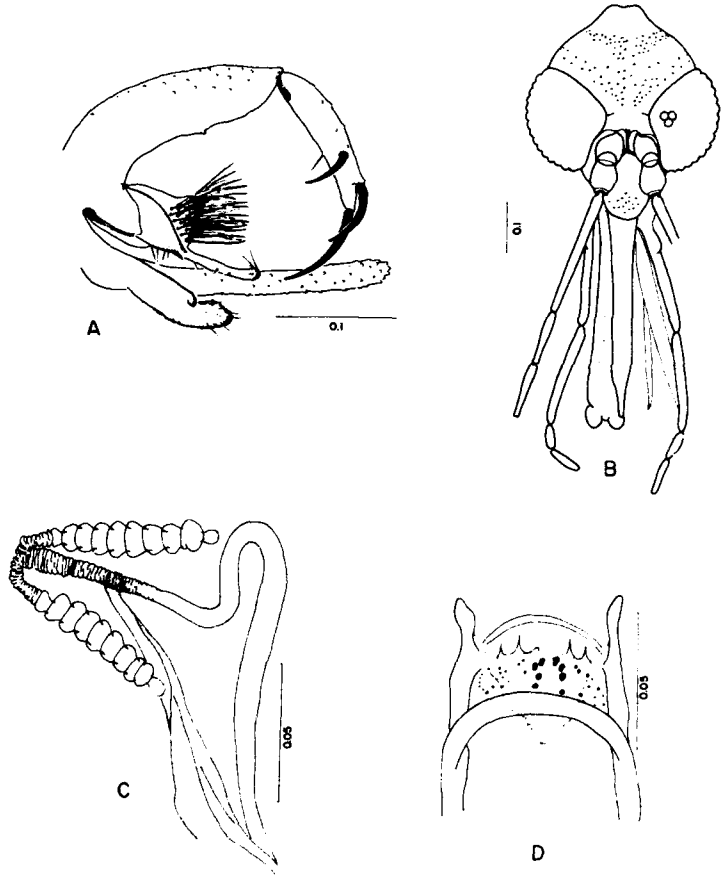


FIG. 259. ***Lutzomyia carrerai thula.*** A. Male terminalia; B. Female head; C. Spermathecae; D. Female cibarium (from Young 1979).

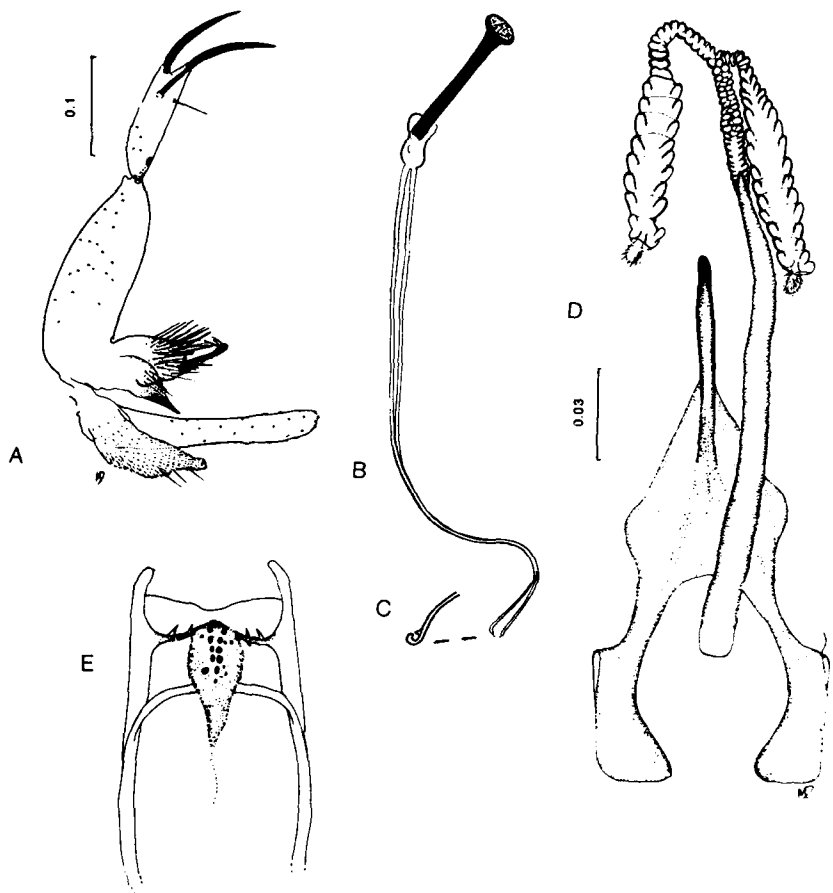


FIG. 260. ***Lutzomyia fairchildi.*** A. Male terminalia; B. Genital pump & filaments; C. Tip of genital filament; D. Spermathecae; E. Female cibarium (fig. C from Barretto, 1966).

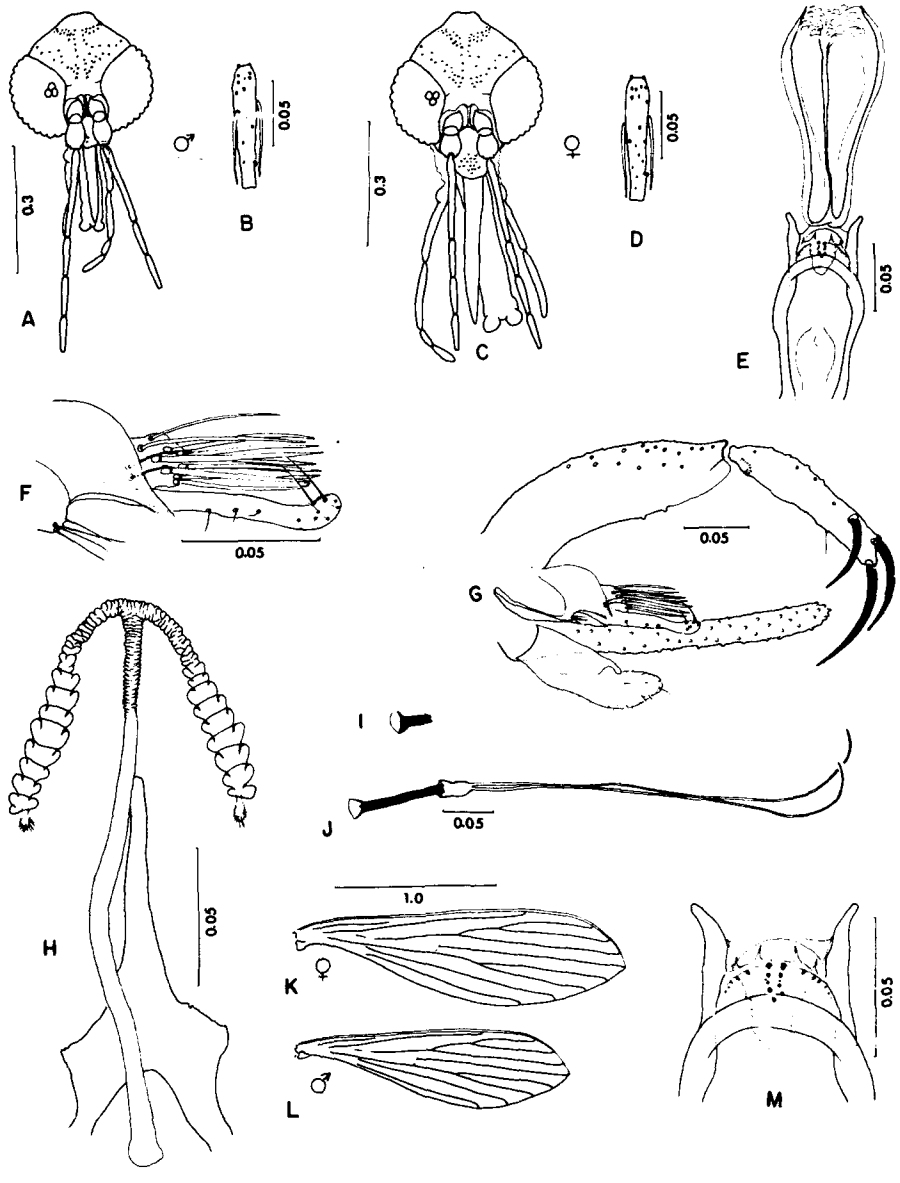
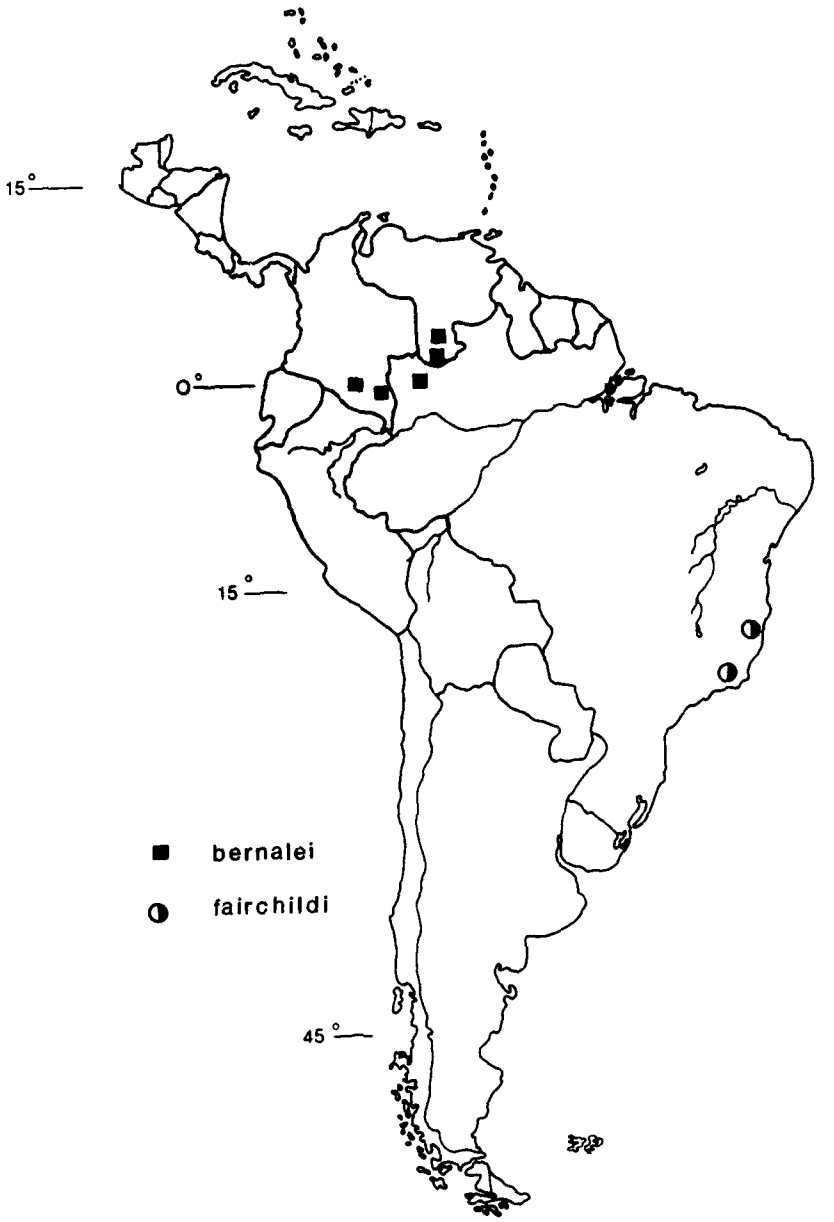
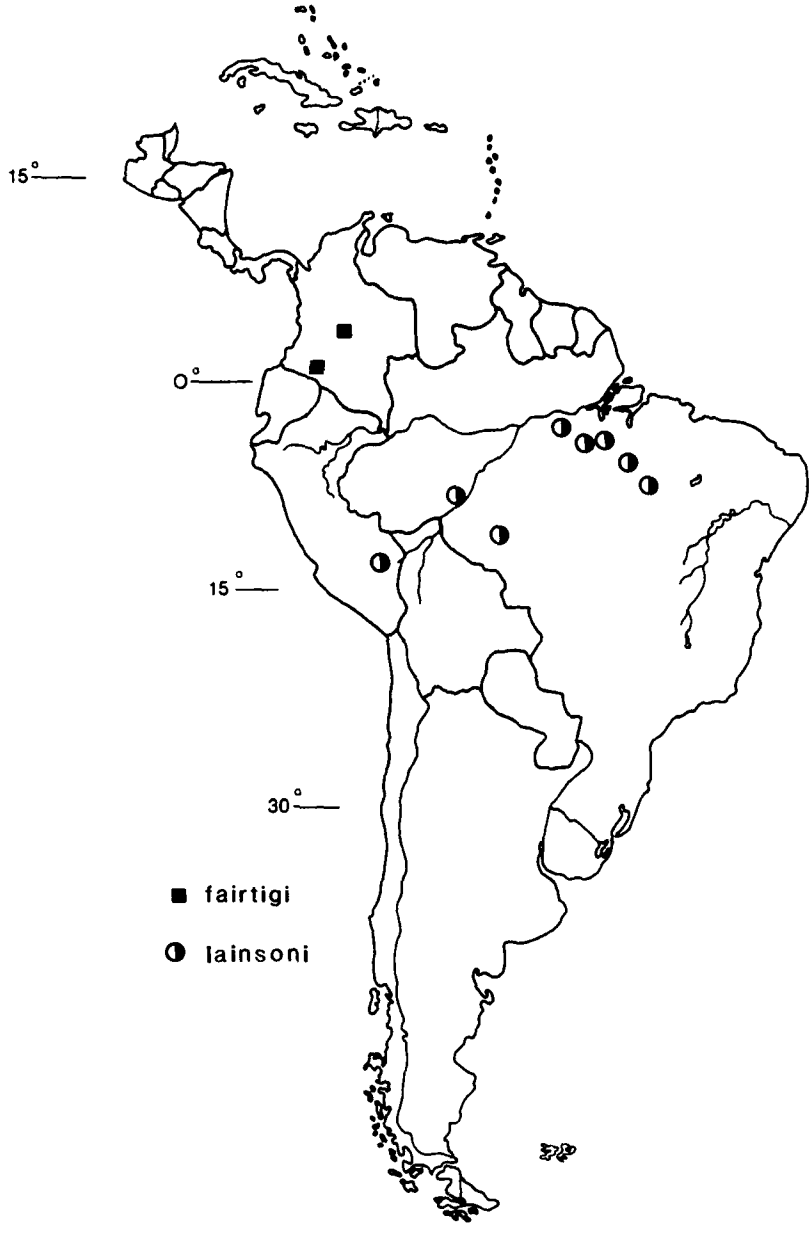


FIG. 261 ***Lutzomyia nocticola.*** A. Male head; B. Male flagellomere; C. Female head; D. Female flagellomere II; E. Female cibarium & pharnyx; F. Paramere; G. Male terminalia; H. Spermathecae; I. Base of genital pump; J. Genital pump & filaments; K. Female wing; L. Male wing; M. Female cibarium (figs. from Young 1973).

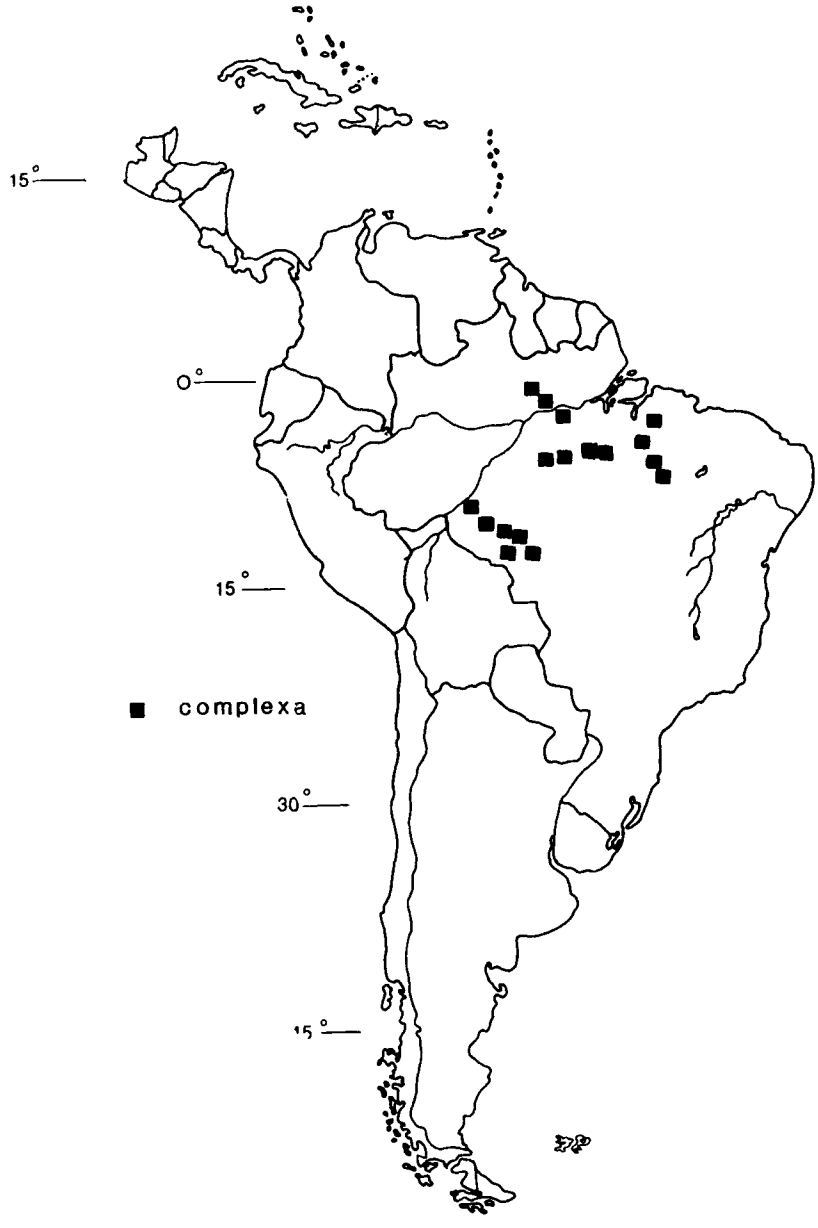


Map 116

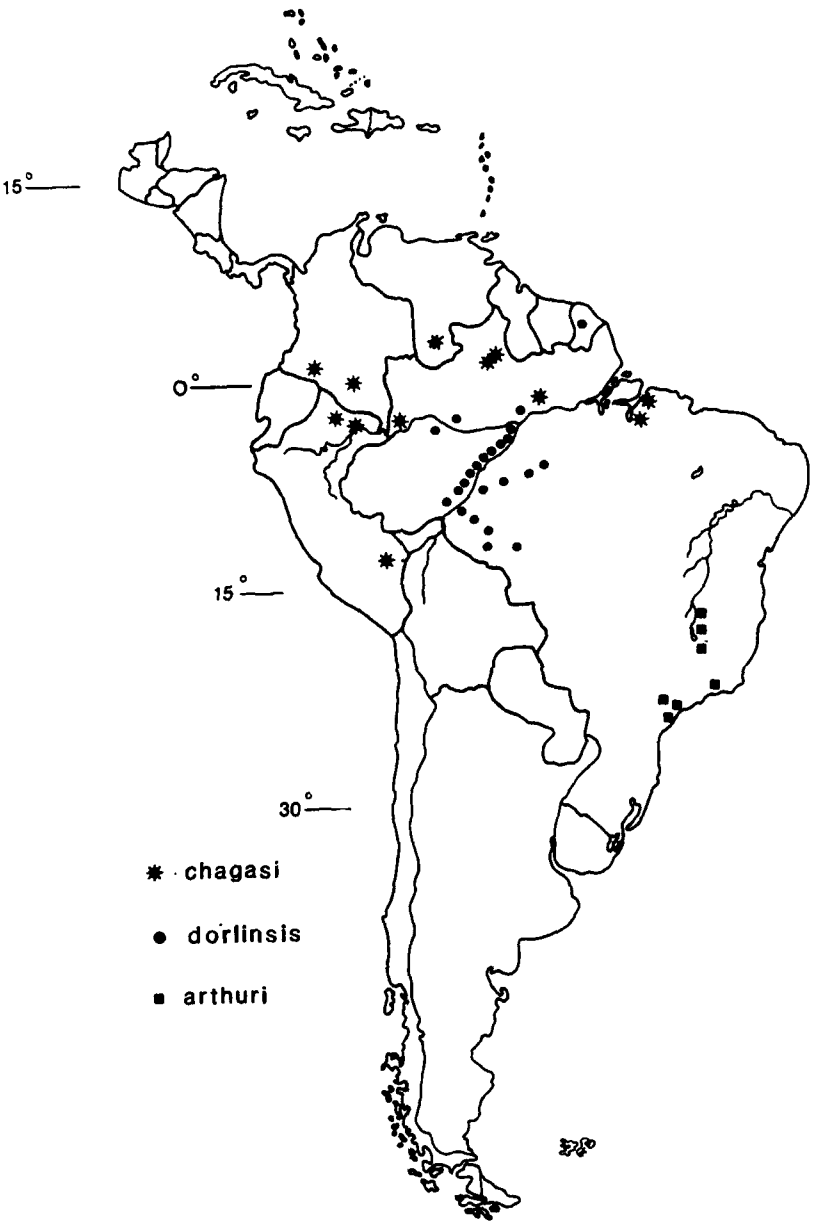


Map 117

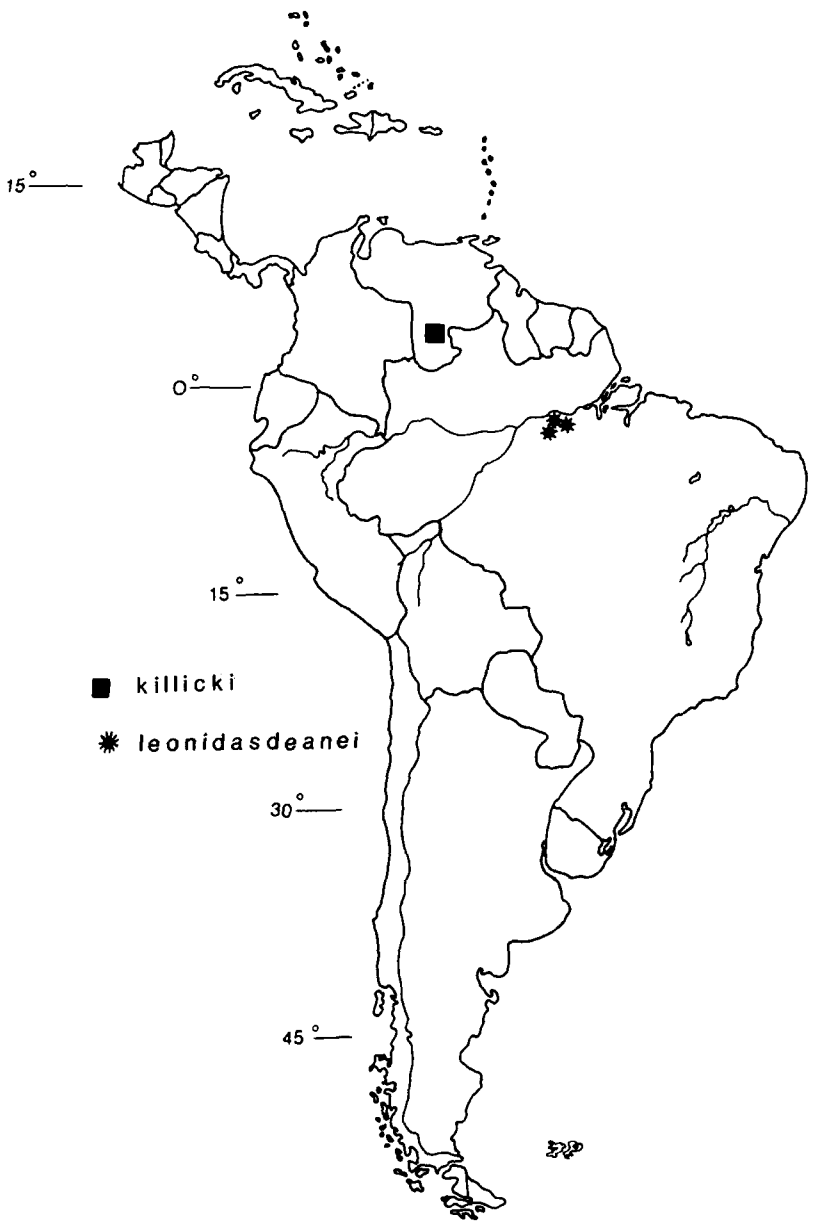
Map 118



Map 119



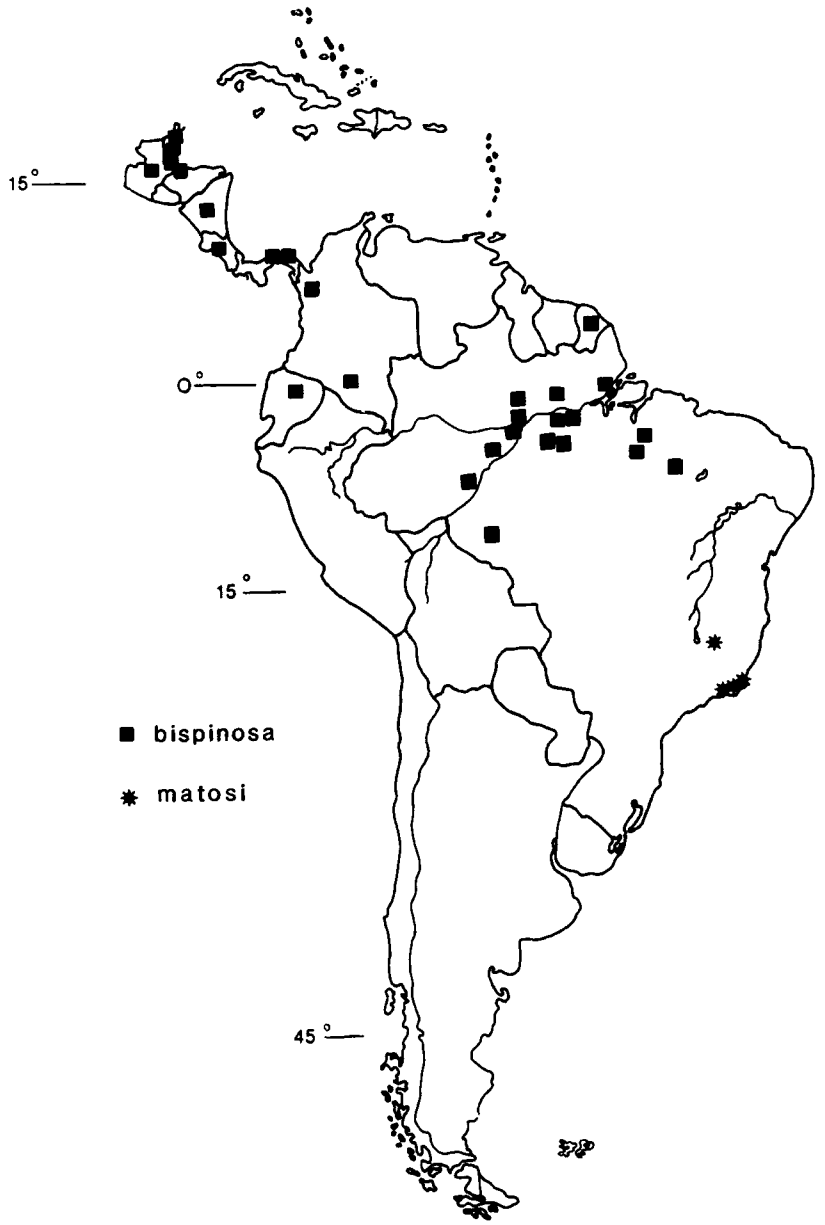
Map 120



Map 121

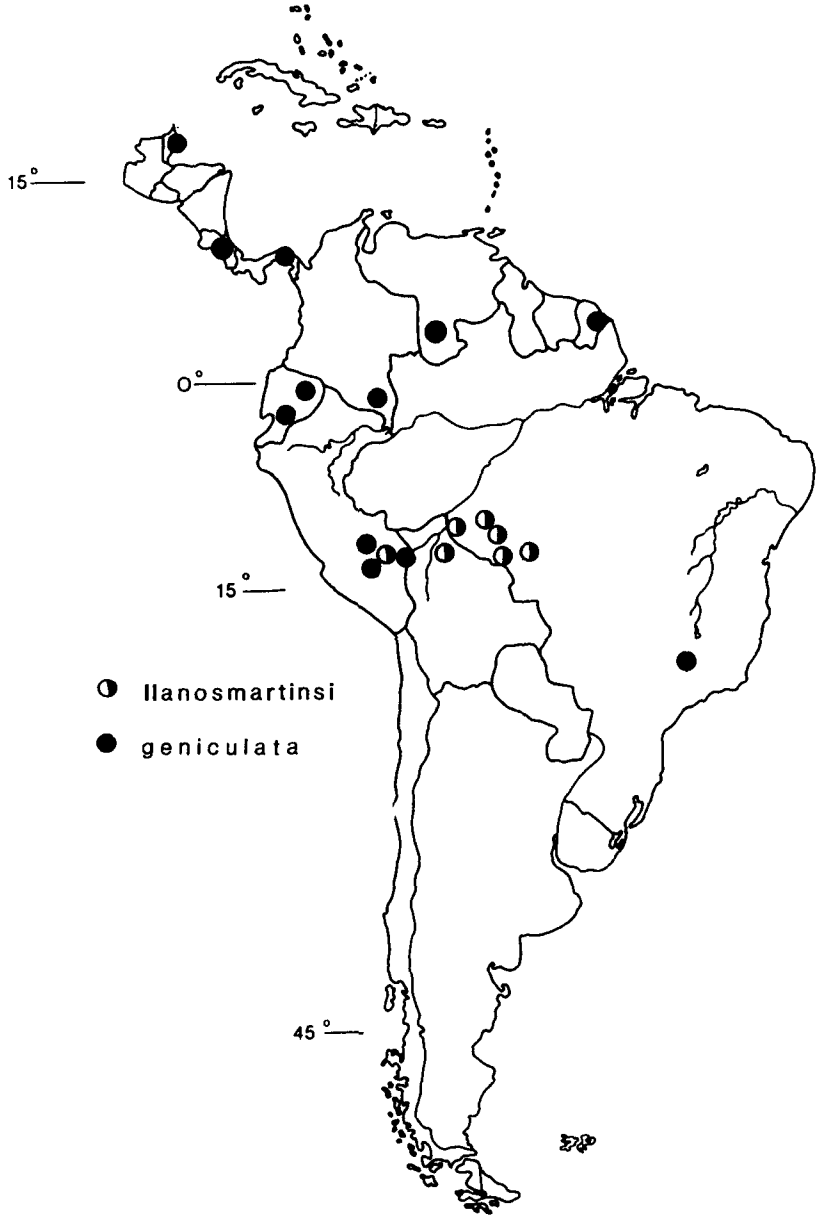

15°
0°
15°
30°
45°
?
★ squamiventris maripaensis
● squamiventris squamiventris

Map 122

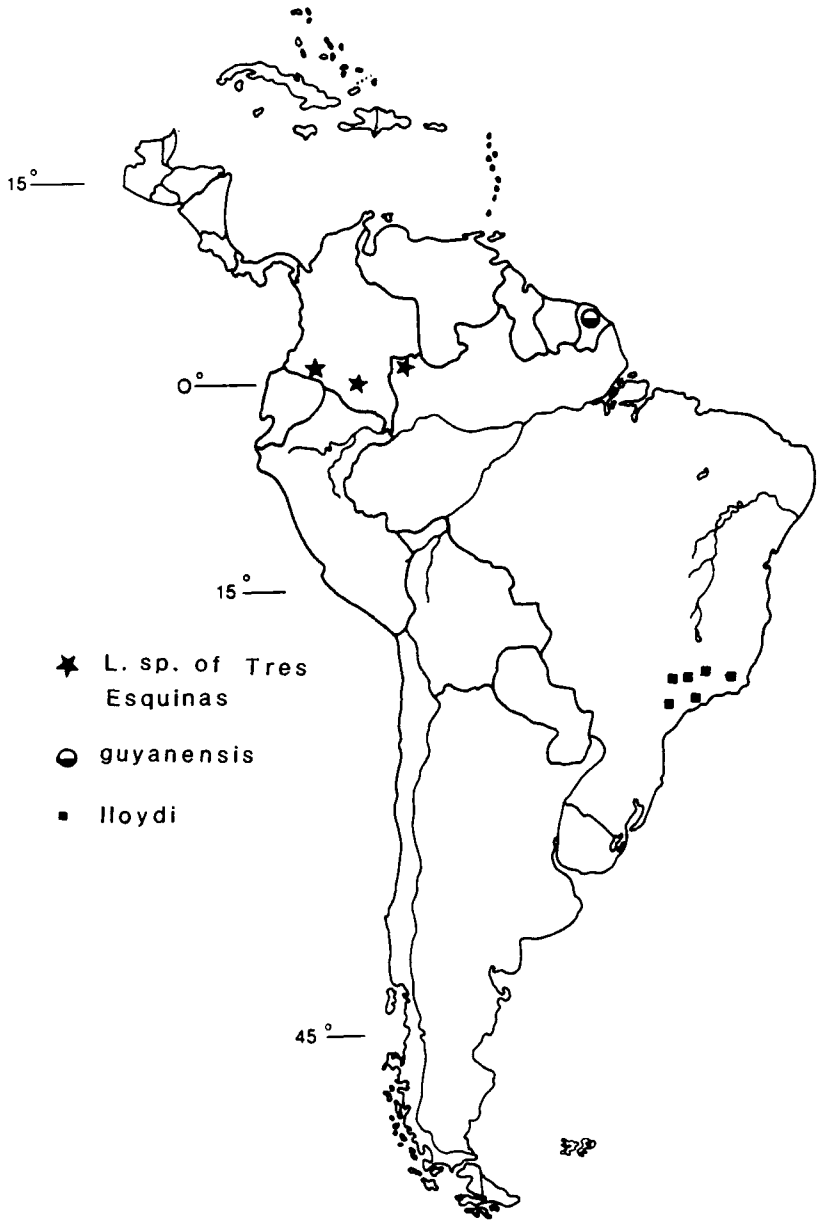


Map 123

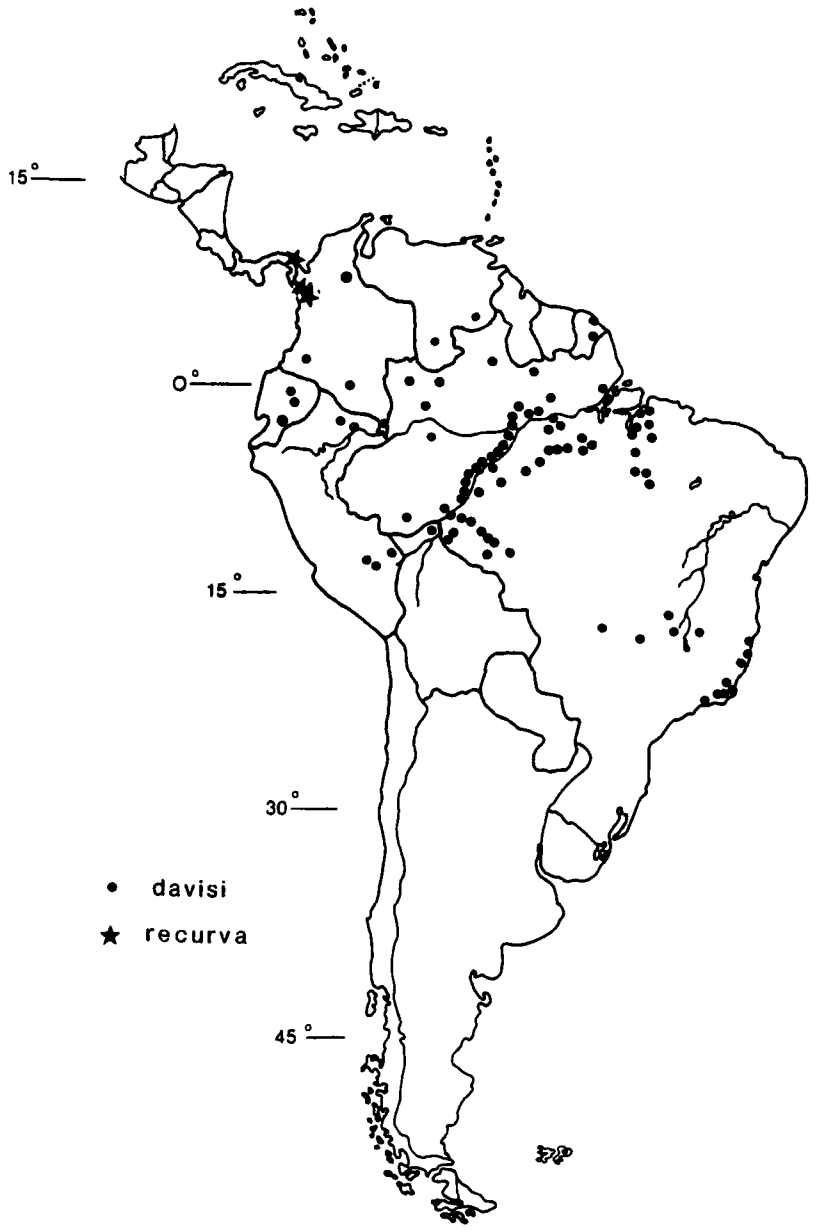
Map 124



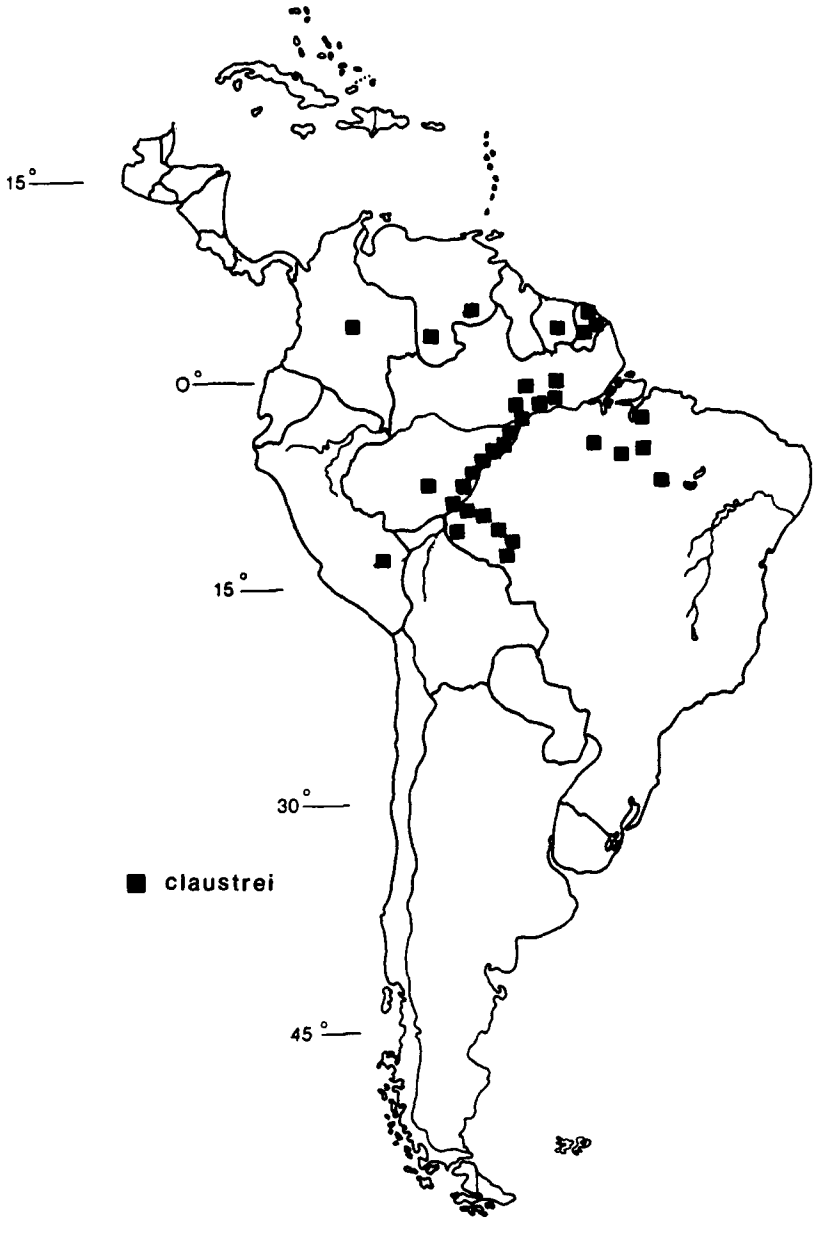
Map 125



Map 126

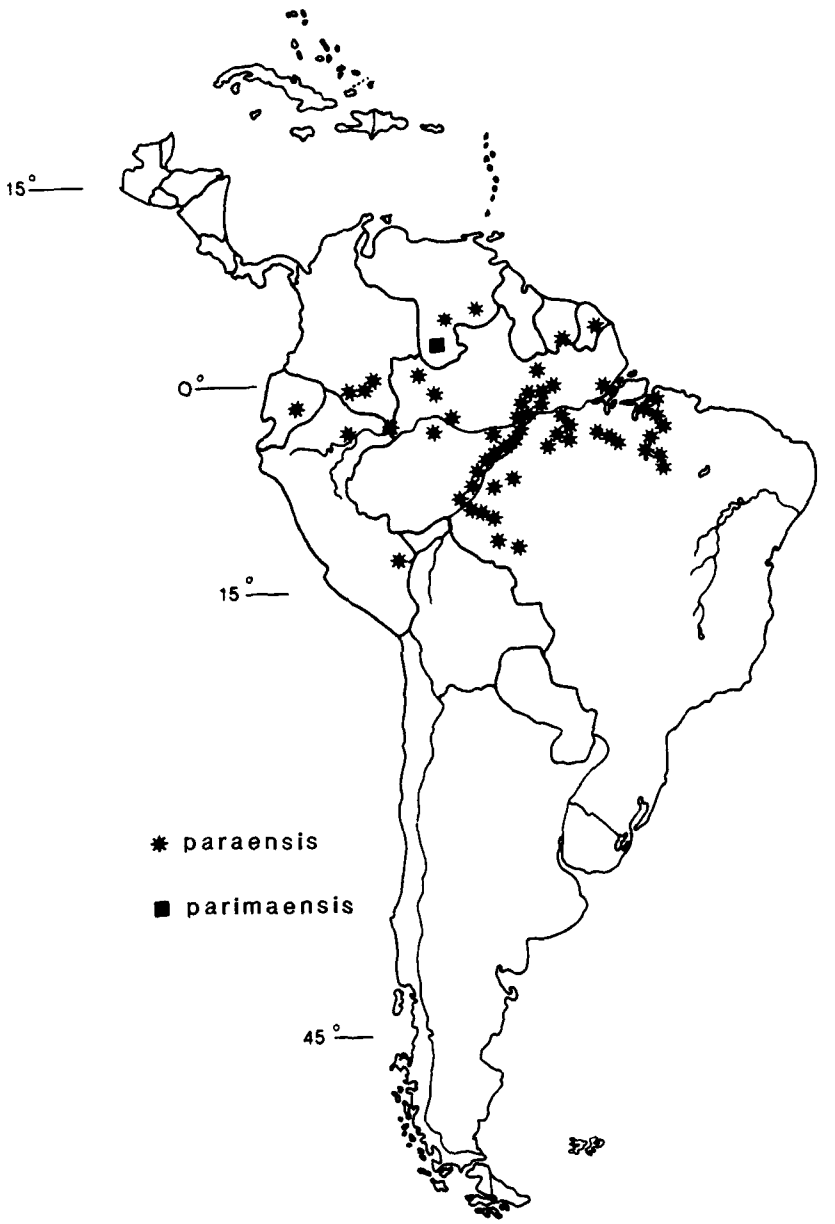


Map 127

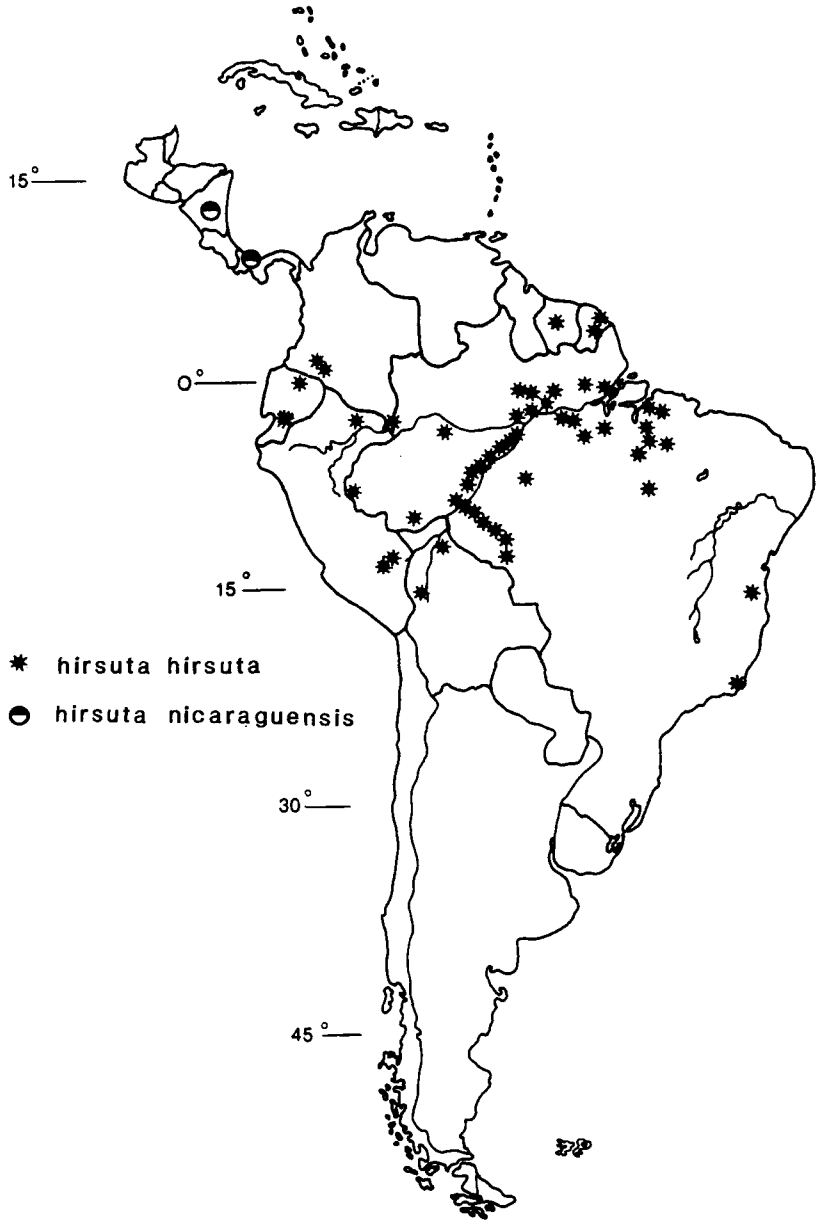


Map 128

Map 129

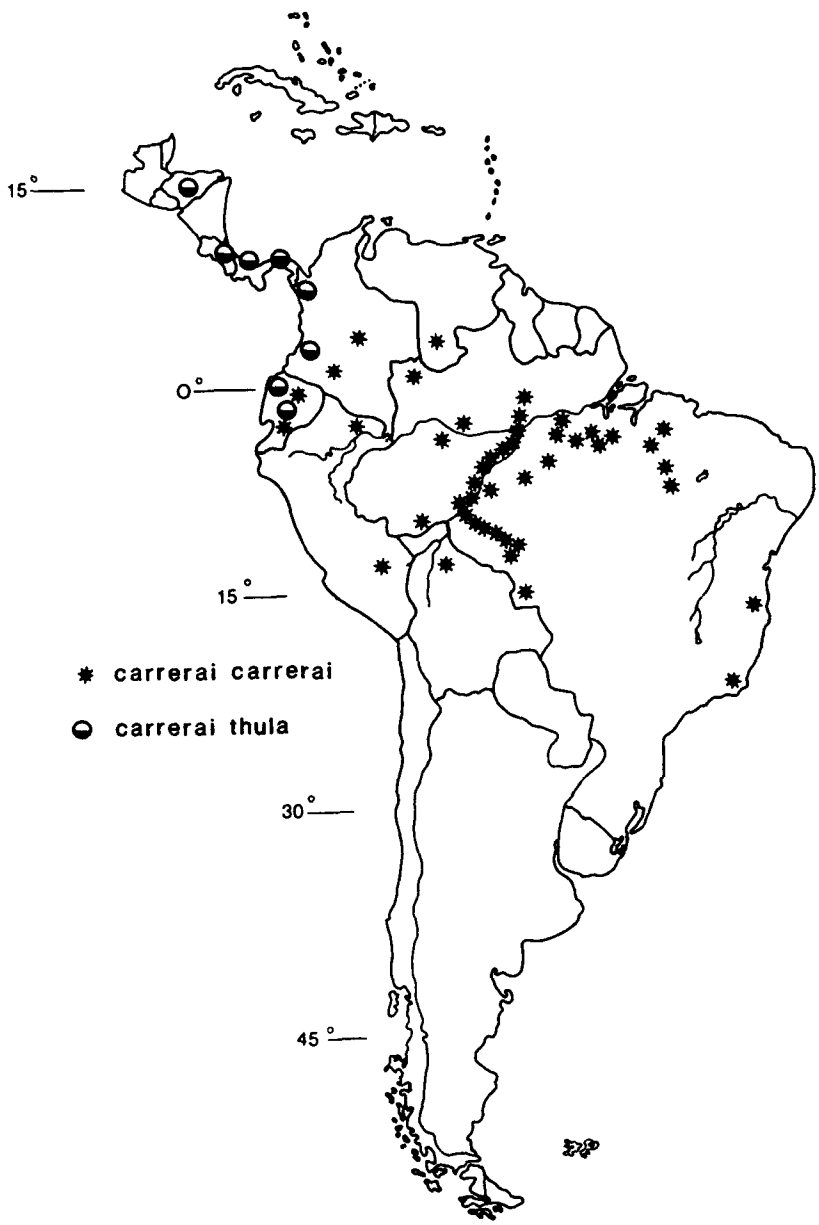


Map 130



Map 131

Map 132



Map 133

SUBGENUS *MICROPYGOMYIA* BARRETTO

Lutzomyia subgenus *Micropygomyia* Barretto 1962: 95 (type species: *Phlebotomus cayennensis* Floch & Abonnenc by orig. designation). Forattini 1971a: 100; 1973: 335 (in part). Martins et al. 1978: 60 (in part).
Lutzomyia species group *cayennensis* Theodor 1965: 186. Lewis et al. 1977: 325.
Lutzomyia subgenus *Coromyia*: Forattini 1971a: 101; 1973: 273 (in part).
Lutzomyia subgenus *Trichopygomyia*: Forattini 1971a: 101; 1973: 292 (in part).
Lutzomyia species group *atroclavata*: Martins et al. 1978: 129 (in part).
Micropygomyia, genus: Artemiev 1991: 74 (in part).
Lutzomyia, subgenus *Helcocyrtomyia*: Williams 1991: 535 (in part).

Identification. Coloration pale to dark. Antennal ascoids simple, those on flagellomere II not reaching end of segment. Palpomere 5 longer than palp. 3. ♀ cibarium with 4 to 30 horizontal teeth; arch usually conspicuous only at sides; pigment patch visible. Pharynx armed with spines or unarmed. Spermathecae variable; common duct always shorter than individual ducts. ♂ *genitalia.* Coxite with or without persistent setae. Style with 4-5 spines; no subterminal seta. Paramere simple. Genital filament tips simple or expanded.

Several species in this subgenus are known only from single specimens; others have not been adequately described and therefore the keys must be used with caution.

Artemiev (1991) elevates *Micropygomyia* to the genus level and includes 3 subgenera and 10 species groups, none of which is defined. His new subgenus, *Sauromyia* Artemiev, contains members of the *oswaldi* group as treated in the present paper.

Medical Importance. Unknown; the females are not anthropophilic; some species feed on lizards.

Key to the Males of the Subgenus *Micropygomyia**

1. Style with 5 spines 2
   Style with 4 spines 3

2. Genital filament tips inflated. Coxite with few (< 5) or no persistent setae near middle of structure. Paramere as shown . . . . . *L. durani* (Fig. 262)
   Genital filament tips not inflated. Coxite with basal group of 5-7 setae & median group of 10+ setae. Paramere otherwise . . . . . *L. chiapanensis* (Fig. 263)

*The males of *L. ctenidophora*, *L. wirthi* & *L. farilli* are unknown.

3. Coxite with group of persistent setae 4
   Coxite without persistent setae 5

4. Coxite with 4-5 persistent setae, one or more modified (foliceaous) . . . . . *L. atroclavata* (Fig. 264F)
   Coxite with 7-11 simple persistent setae . . . . *L. venezuelensis* (Fig. 264H)

5. Paramere as shown, with 2 long dorsal setae, much longer than others, near apex. Antennal ascoids nearly reaching ends of their respective flagellomeres . . . . . *L. quadrispinosa* (Fig. 265)
   Paramere otherwise, without 2 long dorsal setae as above. Antennal flagellomeres much shorter 6

6. Genital filaments longer than 3X genital pump length 7
   Genital filaments 3X length of genital pump or shorter 8

7. Thorax with scutum, proepimeron & katepisternum heavily pigmented, nearly black. Labrum & flagellomere I subequal in length. Aedeagus with acute tip . . . . . *L. yencanensis* (Fig. 266)
   Thorax with pale scutum, proepimeron & katepisternum. Labrum shorter than flagellomere I. Aedeagus with rounded, blunt tip . . . . . *L. lewisi* (Fig. 267)

8. Labrum longer than 0.22 mm, subequal in length to palpomere 5 (series *minasensis*) 9
   Labrum shorter than 0.20 mm, much shorter than palpomere 5 10

9. Paramere upturned. Style with proximal spine inserted at middle of structure . . . . . *L. oliveirai* (Fig. 268A)
   Paramere not upturned. Style with proximal spine inserted beyond middle of structure . . . . . *L. minasensis* (Fig. 268G)

10. Flagellomere I subequal to, or longer than, combined length of labrum & clypeus. Forefemur longer than hindfemur . . . . . *L. duppyorum*
    Flagellomere I shorter than combined length of labrum & clypeus. Forefemur shorter than hindfemur 11

11. Genital filament tips expanded as shown . . . . . *L. schreiberi* (Fig. 269E)
    Genital filament tips not expanded 12

12. Forefemur longer than foretibia. Thorax with heavily pigmented pleura, as dark as scutum . . . . . *L. micropyga* (Fig. 270)

Forefemur shorter than foretibia. Thorax with pale pleura or, if pigmented, not as dark as scutum . . . . . *L. cayennensis* subspecies (Fig. 273)
L. cubensis (Fig. 275)
? *L. hardisoni*

Key to the Females of the Subgenus *Micropygomyia**

1. Pharynx armed with conspicuous spines at posterior end 2
   Pharynx without conspicuous spines 16

2. Cibarium with 4-5 horizontal teeth 3
   Cibarium with 6 or more horizontal teeth 6

3. Spermathecae smooth walled & elongate, its length about 4X maximum width . . . . . *L. lewisi* (Fig. 267)
   Spermathecae pear-shaped or subspherical, not elongate; incipient or complete annuli may be apparent 4

4. Cibarium with 4 conspicuous horizontal teeth plus a small median horizontal tooth. Pharynx lacking heavily sclerotized transverse bands . . . . . *L. cubensis* (Fig. 275)
   Cibarium with 4 horizontal teeth. Pharynx with heavily sclerotized transverse bands 5

5. Cibarium with very short horizontal teeth; pigment patch broad & with numerous vertical teeth. Spermathecae slightly constricted in middle . . . . . *L. atroclavata* (Fig. 264D&E)
   Cibarium with well developed horizontal teeth; pigment patch more slender with few or no vertical teeth. Spermathecae subspherical, lacking median constriction . . . . . *L. venezuelensis* (Fig. 264G&I)

6. Cibarium with 30+ horizontal teeth in a comb-like row . . . . . *L. ctenidophora* (Fig. 274A)
   Cibarium with fewer horizontal teeth in a comb-like row or not 7

7. Cibarium with 6-9 horizontal teeth . . . . . *L. duppyorum* (Fig. 269C)
   Cibarium with 10 or more horizontal teeth 8

8. Spermathecae with terminal knob inserted into a prominent depression . . . . . *L. wirthi*
   Spermathecae with terminal knob inserted otherwise 9

*The female of *L. quadrispinosa* remains undescribed.

9. Wing venation with *delta* less than half length of *alpha* 10
Wing venation with *delta* longer than half length of *alpha* 11

10. Spermathecae with relatively wide individual ducts, at least 4X maximum width of terminal knob. Scutum and pleura light brown . . . . . *L. durani* (Fig. 262)
Spermathecae with very slender individual ducts, more or less equal to maximum width of terminal knob. Scutum, proepimeron & katepisternum dark, pleura pale . . . . . *L. yencanensis* (Fig. 266)

11. Cibarium with 4 vertical teeth; pale species* 12
Cibarium with 6 or more vertical teeth; dark species (except possibly for *L. c. puertoriciensis*) 14

12. Cibarium with median horizontal teeth shorter than 1/2 internal width of cibarium . . . . . *L. c. viequesensis* (Fig. 271A)
L. c. cruzi
Cibarium with median horizontal teeth as long as, or longer than, 1/2 internal width of cibarium 13

13. Cibarium with median horizontal teeth subequal to 1/2 internal width of cibarium . . . . . *L. c. jamaicensis* (Fig. 274B)
Cibarium with longer median horizontal teeth, greater than 1/2 internal width of cibarium . . . . . *L. c. braci* (Fig. 272)

14. Cibarium with median horizontal teeth shorter than 1/2 internal width of cibarium . . . . . *L. c. cayennensis* (Fig. 273)
? *L. farilli*
Cibarium with median horizontal teeth as long as, or longer than, 1/2 internal width of cibarium 15

15. Cibarium with prominent vertical teeth, those in middle larger than others . . . . . *L. c. maciasi* (Fig. 271B)
Cibarium without prominent vertical teeth, those in middle not markedly larger than others . . . . . *L. c. hispaniolae* (Fig. 271C)
L. c. puertoriciensis (Fig. 271D)

16. Cibarium with each pair of horizontal teeth inserted on common base; numerous & prominent lateral teeth present. Spermathecae annulated & elongate, length about 4X maximum width; individual sperm ducts become wider towards common duct . . . . . *L. minasensis*
L. oliveirai (Fig. 268C&D)

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*Adapted from Lewis (1967b).

Cibarium with horizontal teeth inserted individually; no lateral teeth. Spermathecae annulated basally but subspherical, individual ducts not tapered, subequal in width throughout 17

17. Cibarium with 4 horizontal teeth not in a comb-like row 18
Cibarium with 16-28 horizontal teeth in comb-like row . . . . . *L. chiapanensis* (Fig. 263)

18. Pleura dark. Profemur shorter than protibia . . . . *L. micropyga* (Fig. 270)
Pleura pale. Profemur longer than protibia . . . . *L. schreiberi* (Fig. 269F)

Lutzomyia (*Micropygomyia*) *durani* (Vargas & Nájera)
Fig. 262

Phlebotomus durani Vargas & Nájera 1952: 68 (♂, Nocupetaro, Michoacán, Mexico; ♀, Iguala, Guerrero, Mexico); 1953b: 310 (listed). Rosabal & Trejos 1964: 167; 1965: 222 (El Salvador).

Lutzomyia durani: Barretto 1962: 96 (listed). Theodor 1965: 187 (listed). Forattini 1973: 342 (♂, ♀ figs., tax.). Martins et al. 1978: 68 (listed). Navin et al. 1985: 1074 (Honduras). Williams 1991: 537 (dist.).

Distribution (Map 134). MEXICO (Vargas & Nájera 1952 & ♂♂, ♀♀, Miacatlán, Morelos, 1980, M. Camino); HONDURAS (Navin et al. 1985); EL SALVADOR (Rosabal & Trejos 1964; 1965).

Remarks. The provisional record of *L. durani* in northern El Salvador (Rosabal & Trejos 1964, 1965) is probably correct in view of its recent discovery in southern Honduras (Navin et al. 1985).

Lutzomyia (*Micropygomyia*) *chiapanensis* (Dampf)
Fig. 263

Phlebotomus chiapanensis Dampf 1947b: 180 (♀, Chiapa de Corzo, Chiapas, Mexico). Fairchild & Hertig 1948b: 456 (♂, ♀). Vargas & Nájera 1953b: 310 (dist., Mexico). Fairchild & Hertig 1959: 122 (dist., Mexico & Central America). Rosabal & Trejos 1964: 167; 1965: 222 (El Salvador).

Lutzomyia chiapanensis: Barretto 1962: 95 (listed). Theodor 1965: 187 (listed). Forattini 1973: 339 (♂, ♀ figs., tax.). Lewis 1975a: 502 (mouthpart morphol.). Martins et al. 1978: 67 (♂, ♀ figs., dist.). Navin et al. 1985: 1074 (Honduras). Murillo & Zeledón 1985: 114 (♂, ♀ figs., Costa Rica). Williams 1991: 537 (dist.).

Distribution (Map 135). MEXICO (Vargas & Nájera 1953B); EL SALVADOR (Martins et al. 1978); HONDURAS (Intermill & Muller 1976; Navin et al.

1985); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978).

Remarks. There is a strong possibility that *L. chiapanensis* and *L. californica* are conspecific (see Young & Perkins 1984). They and *L. durani* form a species complex, series *chiapanensis* of Theodor (1965) or species group *chiapanensis* of Artemiev (1991).

Lutzomyia* (*Micropygomyia*) *atroclavata (Knab)
Fig. 264 A-F

Phlebotomus atroclavatus Knab 1913: 135 (♂, ♀, Gasparee Island, Trinidad). Dampf 1947a: 296 (figs., refs.). Fairchild & Hertig 1948b: 455 (♂, ♀, tax., refs.).

Flebotomus atroclavatus: Barretto 1947a: 186 (full refs.).

Phlebotomus tejerae Larrousse 1922: 41 (♂, ♀, Zulia, Venezuela). Dyar 1929: 120 (as synonym of *atroclavatus*).

Phlebotomus guadeloupensis Floch & Abonnenc 1945a: 1 (♂, ♀, Guadeloupe, W.I.). Fairchild & Hertig 1948b: 456 (as synonym of *atroclavatus*).

Lutzomyia atroclavata: Theodor 1965: 195 (♀ figs.). Forattini 1973: 211 (♂, ♀, figs., tax.). Martins et al. 1978: 129 (♂, ♀ figs., dist.). Ramirez Pérez et al. 1978: 49 (♂, ♀ figs., Aragua, Venezuela). Young 1979: 218 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Pérez et al. 1982a: 14 (♂, ♀ figs., Sucre, Venezuela); 1982b: 57 (figs., Tachira, Venezuela). Murillo & Zeledón 1985: 109 (figs., Costa Rica). Feliciangeli 1987a: 122; 1987b: 127; 1988: 101 (coll. data, Venezuela). Young et al. 1987: 588 (Norte de Santander, Colombia). Añez et al. 1988: 457 (Mérida, Venezuela). Bonfante-Garrido et al. 1991: 99 (dissection results, Lara, Venezuela).

Distribution (Map 134). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Martins et al. 1978; Young 1979; Young et al. 1987); VENEZUELA (Martins et al. 1978; Ramirez Pérez et al. 1978; 1982a,b; Feliciangeli 1987a,b; 1988); WEST INDIES (Martins et al. 1978).

Remarks. Courmes et al. (1966) suggested that *L. atroclavata* (as *guadeloupensis*) was a possible vector of *Leishmania chagasi* on the island of Guadeloupe because it was the only sand fly collected by them from there. However, there is no other evidence to support this hypothesis. Females are not anthropophilic. Bonfante-Garrido et al. (1991) dissected 15 females from Lara State, Venezuela but none was infected with flagellates.

Lutzomyia (Micropygomyia) venezuelensis (Floch & Abonnenc)
Fig. 264 G-I

Phlebotomus venezuelensis Floch & Abonnenc 1948b: 1 (♂, Selva de Tamanaco, Zulia, Venezuela). Pifano et al. 1962c: 403 (♂, ♀). Forattini 1973: 312 (incorrectly as synonym of *oswaldoi*).

Phlebotomus zuliaensis Floch & Abonnenc 1948b: 5 (♀, Zulia, Venezuela). Scorza & Ortiz 1960: 434 (as probable synonym of *venezuelensis*). Forattini 1971a: 101; 1973: 281 (incorrectly as synonym of *atroclavatus*).

Lutzomyia venezuelensis: Barretto 1962: 96 (listed). Lewis 1975a: 502 (mouthpart morphol.). Ramirez Pérez 1978: 52 (Aragua, Venezuela). Martins et al. 1978: 132 (refs., dist.). Young 1979: 220 (figs., refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Pérez et al. 1982a: 14 (♂, ♀ figs., Sucre, Venezuela); 1982b: 58 (♂, ♀ figs., Tachira, Venezuela). Morales et al. 1987: 93 (Colombian record). Añez et al. 1988: 457 (Mérida, Venezuela). Feliciangeli 1988: 102. Feliciangeli et al. 1993: 652 (egg morphol.).

Lutzomyia zuliaensis: Theodor 1965: 195 (cf. to *atroclavata*).

Distribution (Map 135). COLOMBIA (Martins et al. 1978; Young 1979); VENEZUELA (Feliciangeli 1988).

Remarks. We observed 15+ *venezuelensis* females collected near Durania, Norte de Santander, Colombia, in 1986 & 1987, naturally infected with trypanosomes in their hind guts (Young, Morales, Ferro et al., unpub. data). We suspect that the vertebrate hosts of these parasites are lizards.

Males and females are commonly found resting in rock crevices and on tree trunks at this site. Numerous human bait collections were carried out for more than a year at Durania; no females were captured.

Ramirez Pérez et al. (1978) illustrated the male and female of *L. venezuelensis* and other species, including the female of *L. micropyga* which, however, more closely resembles that of *L. venezuelensis* and may be a misidentification. *Lutzomyia venezuelensis* and *L. atroclavata* are closely related based on structural characters.

Lutzomyia (Micropygomyia) quadrispinosa (Floch & Chassignet)
Fig. 265

Phlebotomus quadrispinosus Floch & Chassignet 1947b: 2 (♂, Baduel, French Guiana). Floch & Abonnenc 1952: 142 (♂ fig., redescript.). Forattini 1973: 310 (as synonym of *micropygus* & *minasensis*).

Lutzomyia quadrispinosa: Barretto 1962: 96 (as member of subgenus *Scoipemyia*). Theodor 1965: 187 (listed). Léger et al. 1977: 221 (as distinct species). Martins et al. 1978: 64 (refs.). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 136). FRENCH GUIANA (type locality).

Remarks. *Lutzomyia quadrispinosa* is known only from the holotype male in the collection of the Institute Pasteur, Paris. We studied and illustrated this specimen in 1987 through the courtesy of F. Rodhain, and noted the following:

Whole insect, including the scutum, pale possibly because of intense maceration. Wing length 1.70 mm; width 0.46 (slightly shorter than 1.95 mm length given in original description). Antennal ascoid nearly reaching end of flagellomere II & simple. Palpomere length (1, 0.04; 2, 0.153; 3, 0.189; 4, 0.106; 5, 0.28 but shrunken). Aedeagus not seen due to the dissected terminalia; genital pump & filaments not discernible as noted by Floch & Abonnenc (1952). The legs are detached from the thorax & are mounted under a separate coverslip. Measurements of the hindleg given by Floch & Chassignet (1947b) and repeated by Floch & Abonnenc (1952) were actually those of the midleg. Length of the femora, tibiae & basitarsi: foreleg, 0.54, 0.79-0.84, 0.56-0.58; midleg, 0.49-0.53, 1.07-1.09, 0.66-0.68; hindleg, 0.51-0.53, 1.22, 0.68. Six legs were measured. Other measurements closely agree with those given in the original description.

This species is clearly distinct from *L. micropyga* and *L. minasensis*, as noted by Léger et al. (1977) who disagree with Forattini's (1973) proposed synonym.

Lutzomyia (*Micropygomyia*) *yencanensis* (Ortiz)
Fig. 266

Phlebotomus yencanensis Ortiz 1965a: 208 (♂, ♀, Rancho Grande, Aragua, Venezuela). Scorza et al. 1968c: 90 (measurements). Forattini 1971.

Phlebotomus cayennensis (not *cayennensis* Floch & Abonnenc): Scorza & Ortiz 1960: 433.

Lutzomyia yencanensis: Forattini 1971a: 101 (listed); 1973: 336 (as synonym of *cayennensis*). Martins et al. 1978: 65 (listed). Ramirez Pérez et al. 1978: 61 (as synonym of *cayennensis*). Cazorla et al. 1988a: 481 (♀ redescript., ♂, ♀, figs.). Feliciangeli 1988: 102 (Venezuela).

Distribution (Map 137). VENEZUELA (Feliciangeli 1988); COLOMBIA (♂♂, ♀♀, Durania, Norte de Santander, Colombia, 900 m a.s.l., 1986-1987, D. Young, A. Morales & C. Ferro).

Remarks. We examined topotypes, graciously provided by D. Feliciangeli, and observed that they and the specimens from Durania, Colombia, were identical in structure and coloration. Further studies may show that *L. yencanensis* is a subspecies of *L. cayennensis*.

At Durania, Colombia, we collected females naturally infected with trypanosomes similar to those found in *L. venezuelensis* that occurs at the same site (Young, Morales & Ferro, unpub. data). We also collected females of *L. yencanensis* as they were feeding on small lizards.

Lutzomyia (Micropygomyia) lewisi Feliciangeli, Ordonez & Fernandez
Fig. 267

Lutzomyia lewisi Feliciangeli, Ordonez & Fernandez 1984a: 359 (♀, La Vaquira, Cojedes, Venezuela).

Distribution (Map 138). VENEZUELA (type locality).

Remarks. The spermathecae of *L. lewis* are markedly different from those of other species in this subgenus. The male, partially illustrated here, will be fully described by D. Feliciangeli in a forthcoming publication.

Lutzomyia (Micropygomyia) oliveirai Martins, Silva & Falcão
Fig. 268 A-E

Lutzomyia oliveirai Martins, Silva & Falcão 1970b: 550 (♂, ♀, Serra do Cipó, Minas Gerais, Brazil). Forattini 1973: 312 (♂, ♀ figs., tax.). Martins et al. 1978: 64 (refs., dist.). Galati et al. 1985: 261 (Mato Grosso do Sul, Brazil).

Distribution (Map 135). BRAZIL (Martins et al. 1978).

Remarks. Specimens of *L. oliveirai* have been captured in rock crevices and small caves in Brazil.

Lutzomyia (Micropygomyia) minasensis (Mangabeira)
Fig. 268 F-I

Flebotomus minasensis Mangabeira 1942a: 136 (♂, Januária, Minas Gerais, Brazil).
Lutzomyia minasensis: Barretto 1962: 96 (in subgenus *Sciopemyia*). Theodor 1965: 187 (listed). Martins et al. 1970b: 551 (♂ figs., tax. ♀). Forattini 1973: 310 (as synonym of *micropyga*). Martins et al. 1978: 64 (dist., refs.).

Distribution (Map 139). BRAZIL (Martins et al. 1978).

Remarks. The female of *L. minasensis* cannot be distinguished from that of *L. oliverai* (see Martins et al. 1970b). It and the male, however, are markedly different in structure and coloration from that of *L. micropyga* which Forattini (1973) erroneously treats as a senior synonym of *L. minasensis*.

Lutzomyia* (*Micropygomyia*) *duppyorum (Fairchild & Trapido)
Fig. 269 A-C

Phlebotomus duppyorum Fairchild & Trapido 1950: 412 (♂, ♀, near Ferry River, Kingston, Jamaica). Ortiz 1965a: 209 (♀ keyed).
Lutzomyia duppyorum: Barretto 1962: 95 (listed). Theodor 1965: 187 (listed). Forattini 1973: 341 (figs., tax.). Lewis 1975a: 502 (mouthpart morphol.). Martins et al. 1978: 63 (dist.).

Distribution (Map 137). JAMAICA (Martins et al. 1978).

Remarks. The diurnal resting sites of this species in Jamaica include tree trunks, especially Ceiba trees. One of us (D.Y.) captured both sexes within holes in a concrete wall near Montego Bay in 1969.

Lutzomyia* (*Micropygomyia*) *schreiberi Martins, Falcão & Silva
Fig. 269 D-F

Lutzomyia schreiberi Martins, Falcão & Silva 1975a: 769 (♂, ♀, Vitória, Espirito Santo, Brazil). Martins et al. 1978: 65 (♀ figs., dist.). Young 1979: 217 (cf. to *micropygus*). Mayrink et al. 1979: 131 (Minas Gerais, Brazil).
Phlebotomus micropygus (not *micropygus* Mangabeira): Sherlock & Carneiro 1962: 430 (♀); 1964: 207 (♂). Sherlock & Pessoa 1966: 47 (nat. flagellate infections).
Lutzomyia micropyga (in part): Forattini 1973: 312.

Distribution (Map 137). BRAZIL (Martins et al. 1978).

Remarks: Sherlock & Pessoa (1966) in Bahia, Brazil, found 12 of 368 females of *L. schreiberi* (as *micropyga*) infected with flagellates believed to be parasites of geckoes.

Lutzomyia* (*Micropygomyia*) *micropyga (Mangabeira)
Fig. 270

Flebotomus micropygus Mangabeira 1942a: 132 (♂, Aurá, Belém, Pará, Brazil).
Lutzomyia micropyga: Barretto 1962: 96 (listed). Lainson et al. 1976a: 57. Léger et al. 1977: 221 (French Guiana). Ramirez Pérez et al. 1978: 49 (♂, ? ♀, figs., Aragua, Venezuela). Martins et al. 1978: 63 (refs., dist.). Young 1979: 215 (♂, ♀, refs.). Feliciangeli 1980: 246 (figs., keyed). Ramirez Pérez et al.

1981: 124; 1982a: 14; 1982b: 58 (Venezuela records). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Freitas 1982: 404 (Acre, Brazil). Young & Rogers 1984: 599 (listed, Ecuador). Young et al. 1985: 145 (Peru). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Murillo & Zeledón 1985: 114 (figs., Costa Rica). Ryan 1986: 26 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.). Añez et al. 1988:457 (Mérida, Venezuela). Feliciangeli 1988: 101 (Venezuela). Alexander et al. 1992a: 37 (Ecuador records); 1992c: 125 (Ecuador).

Distribution (Map 136). COSTA RICA (Murillo & Zeledón 1985); PANAMA; COLOMBIA; ECUADOR (Young 1979; Alexander et al. 1992a,c); PERU; BOLIVIA; TRINIDAD (Martins et al. 1978); BRAZIL (Martins et al. 1978; Young 1979; Biancardi et al. 1982; Arias & Frietas 1982; Ryan 1986); VENEZUELA (Feliciangeli 1988); FRENCH GUIANA (Léger et al. 1977).

Remarks. *Lutzomyia micropyga* is a small dark sand fly often found resting in crevices of tree trunks. Tesh et al. (1971b) identified blood meals from 4 *micropyga* females; two were of reptile/amphibian origin, one was mammalian, and one did not react with antisera.

Llanos et al. (1976) described and illustrated the female of *L. micropyga* from Peru but there were 7-8 horizontal teeth in the cibarium, not 4 as observed in females from Colombia (Young 1979). We suspect now that these specimens are not conspecific.

Lutzomyia (Micropygomyia) cayennensis cayennensis (Floch & Abonnenc)
Fig. 273

Phlebotomus cayennensis Floch & Abonnenc 1941a: 13 (♂, Montjoly, Cayenne, French Guiana). Fairchild & Hertig 1948b: 460 (♂, ♀, refs., tax.).

Lutzomyia cayennensis: Barretto 1962: 95 (listed). Léger et al. 1977: 220 (French Guiana). Ramirez Pérez et al. 1978: 49 (Aragua, Venezuela). Deane et al. 1978: 236 (infected with trypanosomes, Venezuela, as *cayennense*). Young 1979: 213 (♂, ♀, refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramírez Pérez et al. 1981: 124; 1982a: 14; 1982b: 58 (Venezuela records, figs.). Zeledón et al. 1982: 276 (Honduras). Young & Rogers 1984: 599 (listed, Ecuador). Feliciangeli et al. 1984: 360 (Venezuela). Murillo & Zeledón 1985: 112 (♂, ♀ figs., Costa Rica). Morales et al. 1987: 93 (Colombia record). Lebbe et al. 1987: 28 (computer aided ident.) Feliciangeli 1987a: 122; 1987b: 127; 1988: 101 (coll. data, Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Alexander et al. 1992a: 37 (Ecuador records); 1992c: 125 (Ecuador).

Lutzomyia cayennensis cayennensis: Martins et al. 1978: 61 (♀ figs., refs., dist.).

Distribution (Map 140). MEXICO; BELIZE; EL SALVADOR (Martins et al. 1978); HONDURAS (Zeledón et al. 1982); COSTA RICA (Murillo & Zeledón

1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979); ECUADOR (Young & Rogers 1984; Alexander et al. 1992a,c); PERU (Llanos 1981); VENEZUELA (Feliciangeli 1988); TRINIDAD (Young 1979); FRENCH GUIANA (Martins et al. 1978).

Remarks. Additional studies of the nominate subspecies from countries listed above may show more variation than is now recorded. Females of *L. c. cayennensis* have been found infected with trypanosomes in Venezuela (Deane et al. 1978) and in Colombia (Ryan et al. 1987c).

Lutzomyia (Micropygomyia) cayennensis viequesensis (Fairchild & Hertig)
Fig. 271 A

Phlebotomus cayennensis viequesensis Fairchild & Hertig 1948b: 464 (♂, ♀, Laguna Yanuel, Vieques Island, Puerto Rico). Fairchild & Trapido 1950: 417 (St. Thomas, Virgin Islands).
Lutzomyia cayennensis viequesensis: Lewis 1967b: 80 (♀ keyed). Martins et al. 1978: 62 (dist.).

Distribution (Map 140). PUERTO RICO; VIRGIN ISLANDS (refs. given above).

Lutzomyia (Micropygomyia) cayennensis cruzi Gonzalez & Garcia

Lutzomyia cayennensis cruzi Gonzalez & Garcia 1981 (not *cruzi* Mangabeira 1938): 16 (♂, ♀, Cuba). **(NEW HOMONOMY)**

Distribution (Map 140). CUBA (Gonzalez & Garcia Avila 1981: 1 ♀, Guantanamo Bay U.S. Naval base, Jan. 1970, J.E. Tisdale).

Remarks. The subspecies name, *cruzi* Gonzalez & Garcia, will have to be replaced with another name because it is preoccupied [*L. cruzi* (Mangabeira 1938) in the subgenus *Lutzomyia*].

We examined one female of *L. cayennensis* from Cuba (Guantanamo Bay). The specimen is in poor condition but the cibarial armature is clearly visible and shows 4 vertical teeth and 16 horizontal teeth, very similar to that of *L. c. viequesensis*.

Lutzomyia (Micropygomyia) cayennensis jamaicensis (Fairchild & Trapido)
Fig. 274 B

Phlebotomus cayennensis jamaicensis Fairchild & Trapido 1950: 414 (♂, ♀, Rockfort, near Kingston, St. Andrew, Jamaica). Lewis & Garnham 1959: 85.
Lutzomyia cayennensis jamaicensis: Lewis 1967b: 79 (tax., keyed).

Distribution (Map 140). JAMAICA (refs. given above).

Lutzomyia (Micropygomyia) cayennensis braci Lewis
Fig. 272

Lutzomyia cayennensis braci Lewis 1967b: 77 (♂, ♀, Bamboo Bay, Cayman Brac Island).

Distribution (Map 138). CAYMAN BRAC ISLAND (type locality).

Lutzomyia (Micropygomyia) cayennensis maciasi (Fairchild & Hertig)
Fig. 271 B

Phlebotomus cayennensis maciasi (Fairchild & Hertig 1948b: 466 (♀, Zumpango, Guerrero, Mexico; ♂, Esquintla, Guatemala).
Lutzomyia cayennensis maciasi: Lewis 1967b: 79 (refs., ♀ keyed). Williams 1970b: 333 (coll. data, Belize). Martins et al. 1978: 62 (dist.).

Distribution (Map 138). MEXICO; GUATEMALA; BELIZE (Martins et al. 1978).

Remarks. Williams (1970b) reported that nearly all of the females of *L. cayennensis* from Belize resembled *L. c. maciasi*. One female, however, resembled *L. c. cayennensis*. Lewis (1967b) noted that both these forms were found in the same locality in Mexico and suggested that "they should be regarded either as species or as minor variants."

Lutzomyia (Micropygomyia) cayennensis hispaniolae
(Fairchild & Trapido)
Fig. 271 C

Phlebotomus cayennensis hispaniolae Fairchild & Trapido 1950: 415 (♂, ♀, Seibo Prov., Dominican Republic).
Lutzomyia cayennensis hispaniolae: Lewis 1967a: 79 (listed). Martins et al. 1978: 62 (dist.).

Distribution (Map 140). DOMINICAN REPUBLIC (Johnson et al. 1992); HAITI (Martins et al. 1978).

Remarks. Johnson et al. (1992) observed that during the dry season in the Dominican Republic, from January to May, few adults of *L. c. hispaniolae* were captured on tree trunks. Many females, however, were commonly seen feeding on the backs of lizards in full sunlight. Johnson (unpublished data) reared 5 larvae to adults that he collected from soil between the buttressed roots of a large tree in a coffee plantation at Monte Claro.

Lutzomyia (Micropygomyia) cayennensis puertoricensis
(Fairchild & Hertig)
Fig. 271 D

Phlebotomus cayennensis puertoricensis Fairchild & Hertig 1948b: 462 (♂, ♀, Lares, Puerto Rico). Fairchild & Trapido 1950: 416 (locality records, Puerto Rico, keyed).
Lutzomyia cayennensis puertoricensis: Lewis 1967b: 80 (♀ keyed).

Distribution (Map 138). PUERTO RICO (Martins et al. 1978).

Lutzomyia (Micropygomyia) farilli (Vargas & Nájera)

Phlebotomus farilli Vargas & Nájera 1959: 141 (♀, Acacoyahua, Chiapas, Mexico). Ortiz 1965a: 209 (keyed).
Lutzomyia farilli: Barretto 1962: 96 (listed). Lewis 1967b: 80 (mention). Forattini 1973: 336 (as synonym of *cayennensis*). Martins et al. 1978: 63 (refs., dist.).

Distribution (Map 139). MEXICO (type locality).

Remarks. As other authors have suggested (Theodor 1965; Forattini 1973), *L. farilli* is probably conspecific with *L. cayennensis* but this can be determined only when additional material becomes available, or after careful study of the holotype.

Lutzomyia (Micropygomyia) wirthi (Vargas & Nájera)

Phlebotomus wirthi Vargas & Nájera 1951b: 103 (♀, Carrizal, Verracruz, Mexico); 1953b: 313 (listed). Ortiz 1965a: 209 (keyed). Forattini 1973: 336 (as synonym of *cayennensis*).
Lutzomyia wirthi: Barretto 1962: 96 (listed). Lewis 1967b: 79 (mention). Martins et al. 1978: 65 (refs., dist.).

Distribution (Map 136). MEXICO (type locality).

Remarks. The holotype female of *L. wirthi* should be re-examined and redescribed owing to its close resemblance to some other species in this subgenus.

Lutzomyia (Micropygomyia) ctenidophora (Fairchild & Hertig)
Fig. 274 A

Phlebotomus ctenidophorus Fairchild & Hertig 1948b: 466 (♀, Tamazunchale, San Luis Potosi, Mexico).

Lutzomyia ctenidophora: Barretto 1962: 95 (listed). Theodor 1965: 187 (listed). Forattini 1971a: 101; 1973: 341 (♀ figs.). Martins et al. 1978: 62 (listed). Williams 1991: 537 (dist.).

Distribution (Map 139). MEXICO (type locality).

Remarks. The male of this species has been collected in Mexico but remains undescribed (W. Hanson, pers. comm.).

Lutzomyia* (*Micropygomyia*) *cubensis (Fairchild & Trapido)
Fig. 275

Phlebotomus cubensis Fairchild & Trapido 1950: 414 (♂, ♀, near Camaguey, Cuba). Ortiz 1965a: 290 (keyed).

Lutzomyia cubensis: Barretto 1962: 95. Young 1972b: 63 (Florida, U.S.A.). Forattini 1973: 335 (figs., tax.). Lewis 1975a: 502 (mouthpart morphol.). Martins 1978: 62 (dist.). Gonzalez & Garcia Avila 1981: 23 (tax., figs., ecology). Young & Perkins 1984: 281 (refs., figs.).

Distribution (Map 135). USA (Young & Perkins 1984); CUBA (Fairchild & Trapido 1950; Gonzalez & Garcia Avila 1981).

Lutzomyia* (*Micropygomyia*) *hardisoni (Vargas & Nájera)

Phlebotomus hardisoni (Vargas & Nájera 1952: 63 (♂, ♀, Iguala, Guerrero, Mexico). Ortiz 1965a: 205 (keyed). Forattini 1973: 336 (as synonym of *cayennensis*).

Lutzomyia hardisoni: Barretto 1962: 96 (listed). Forattini 1971a: 101 (listed). Martins et al. 1978: 63 (refs., dist.).

Distribution (Map 139). MEXICO (type locality).

Remarks. This species may be conspecific with *L. cayennensis* as Forattini (1973) suggests.

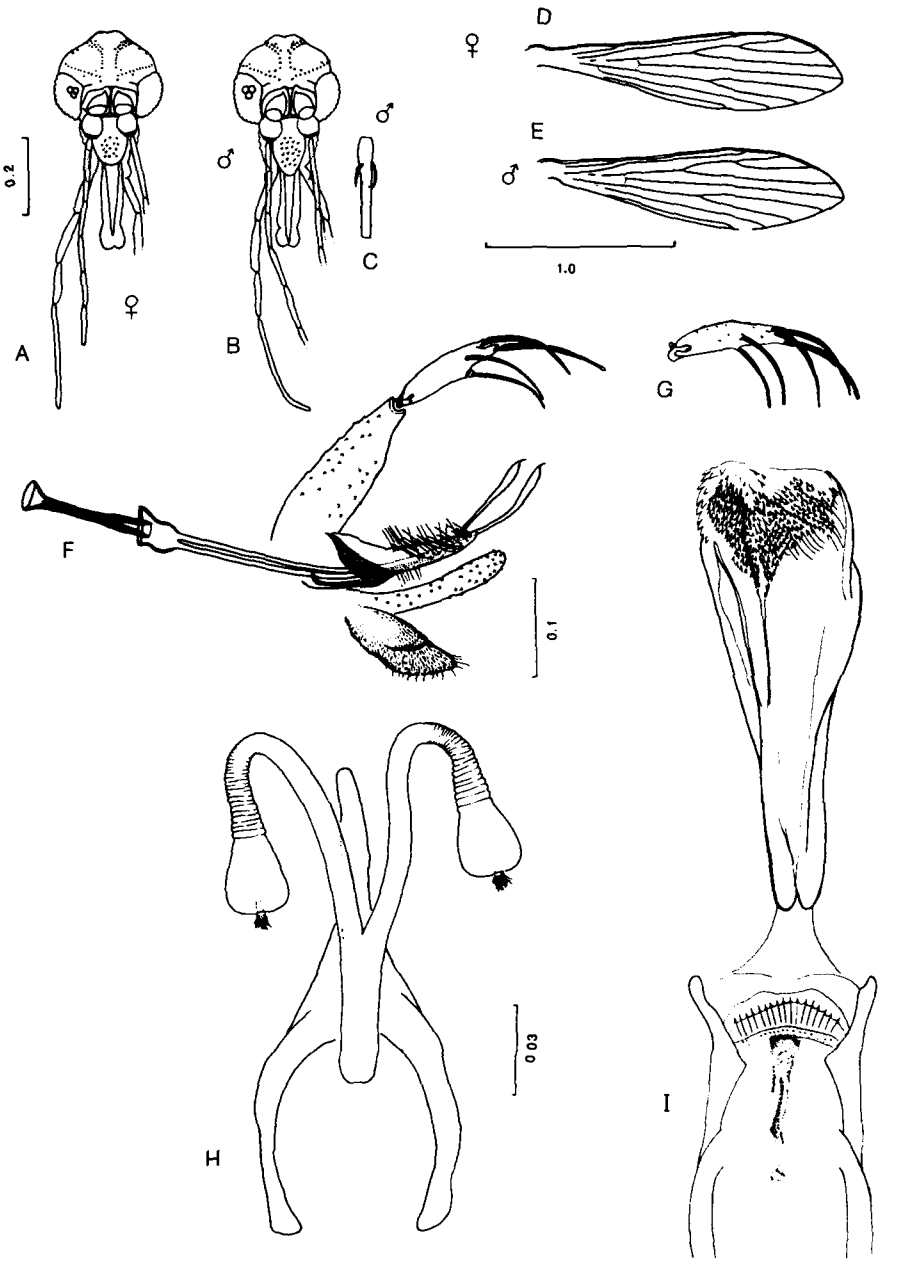


FIG. 262. ***Lutzomyia durani.*** A. Female head; B. Male head; C. Male flagellomere II; D. Female wing; E. Male wing; F. Male terminalia; G. Style with 5 spines; H. Spermathecae; I. Female cibarium & pharynx.

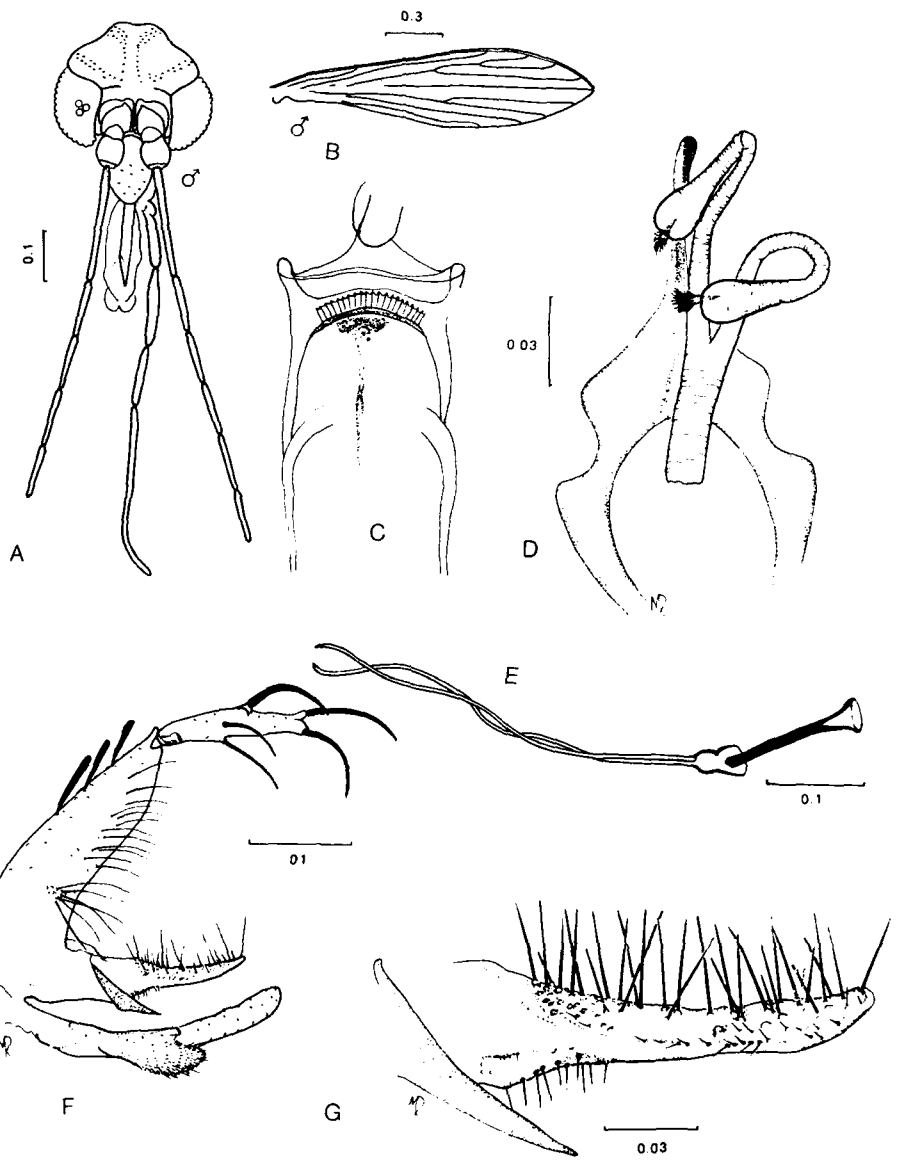


FIG. 263. ***Lutzomyia chiapanensis***. A. Male head; B. Male wing; C. Cibarium; D. Spermathecae; E. Genital pump & filaments. F. Male terminalia; G. Paramere.

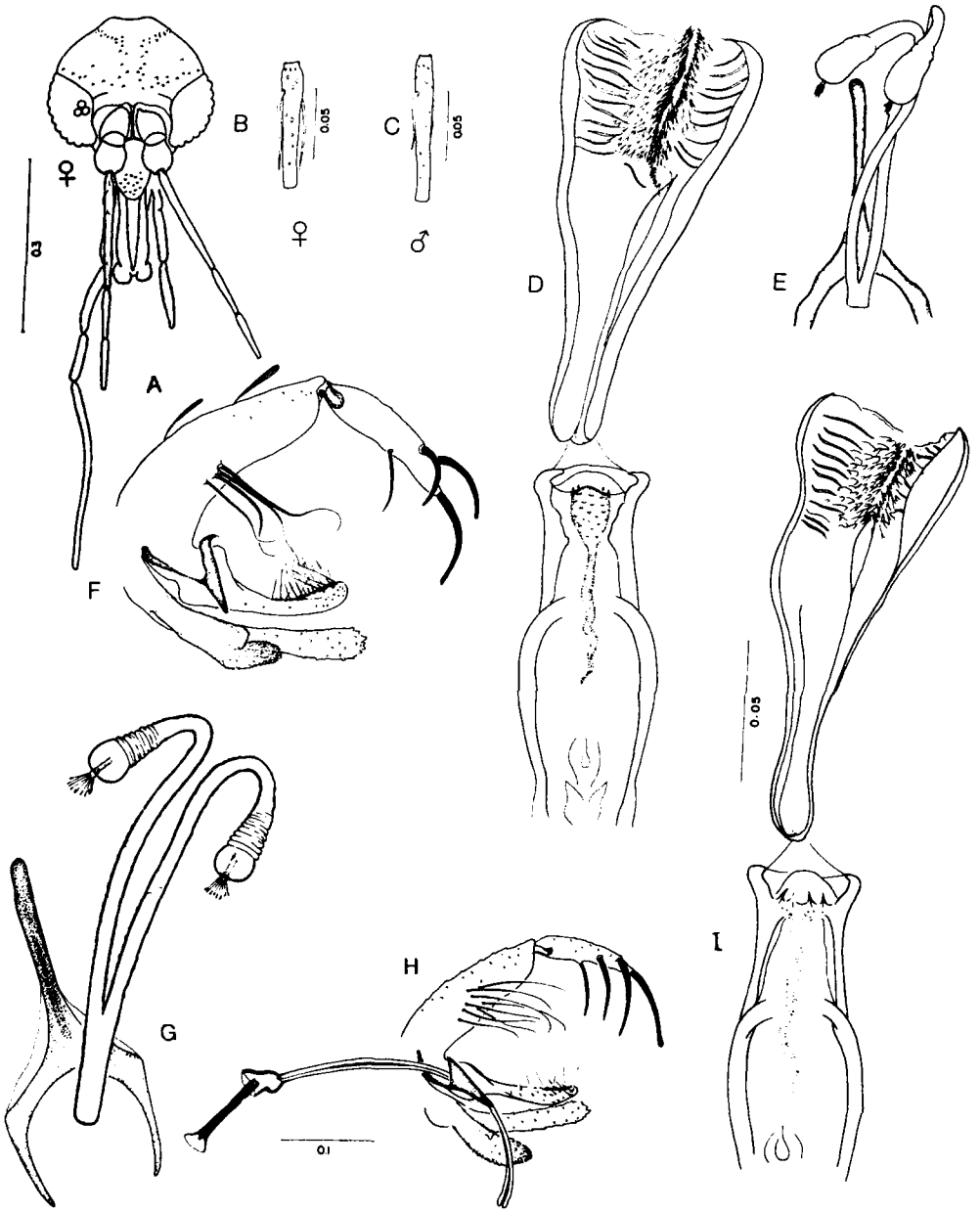


FIG. 264. ***Lutzomyia atroclavata.*** A. Female head; B. Female flagellomere II; C. Male flagellomere II; D. Female cibarium & pharynx; E. Female spermathecae; F. Male terminalia (figs. A-C from Young 1979). ***Lutzomyia venezuelensis.*** G. Female spermathecae; H. Male terminalia; I. Female cibarium & pharynx (figs. H & I from Young 1979).

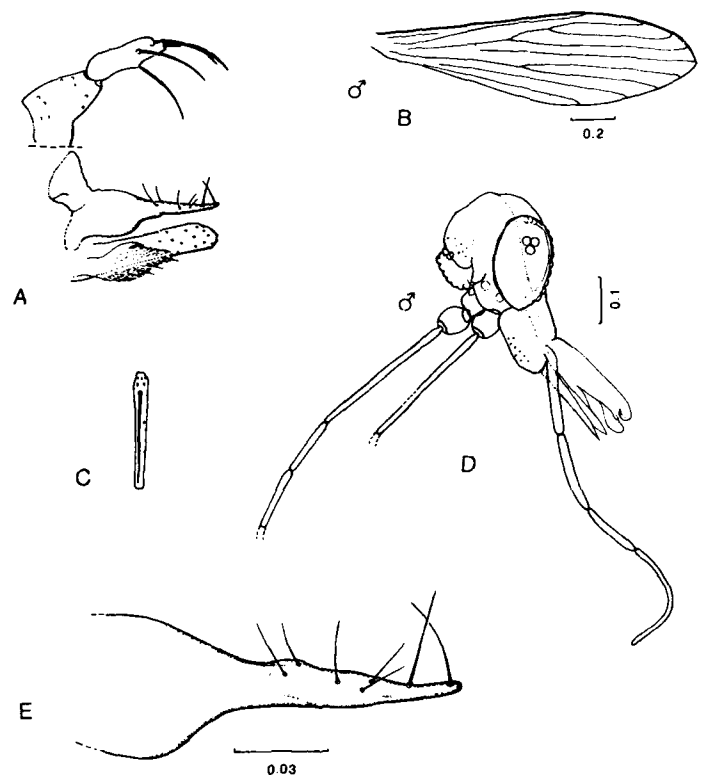


FIG. 265 ***Lutzomyia quadrispinosa***. A. Male terminalia; B. Male wing; C. Male flagellomere; D. Male head; E. Paramere.

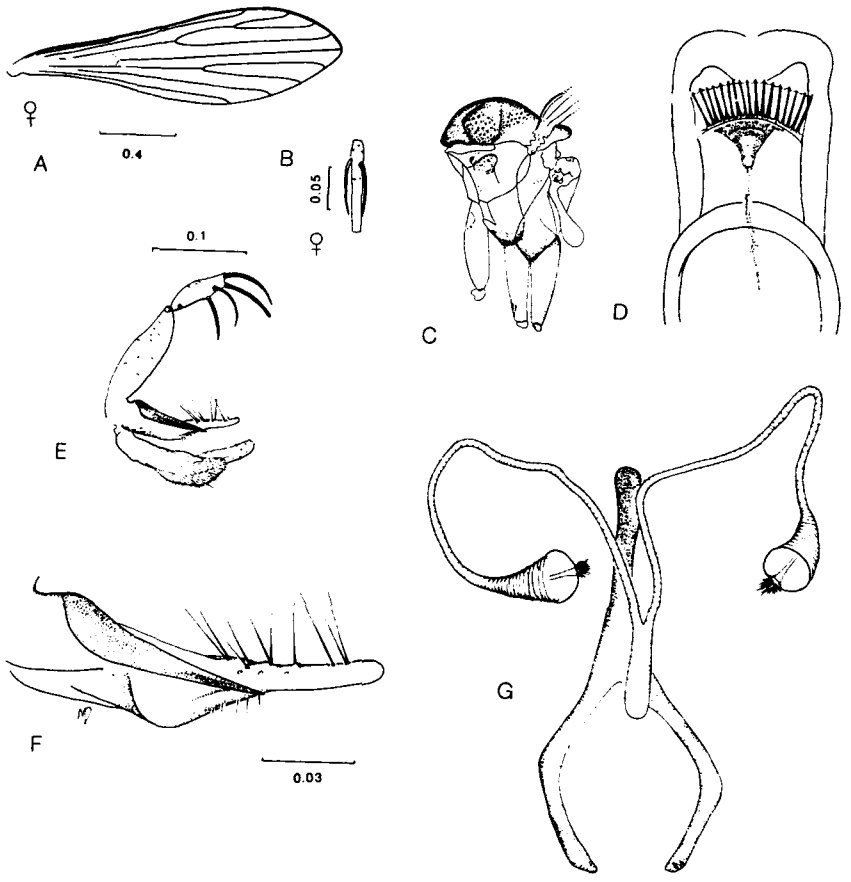


FIG. 266. ***Lutzomyia yencanensis***. A. Female wing; B. Female flagellomere II; C. Thorax; D. Female cibarium; E. Male terminalia; F. Paramere; G. Spermathecae.

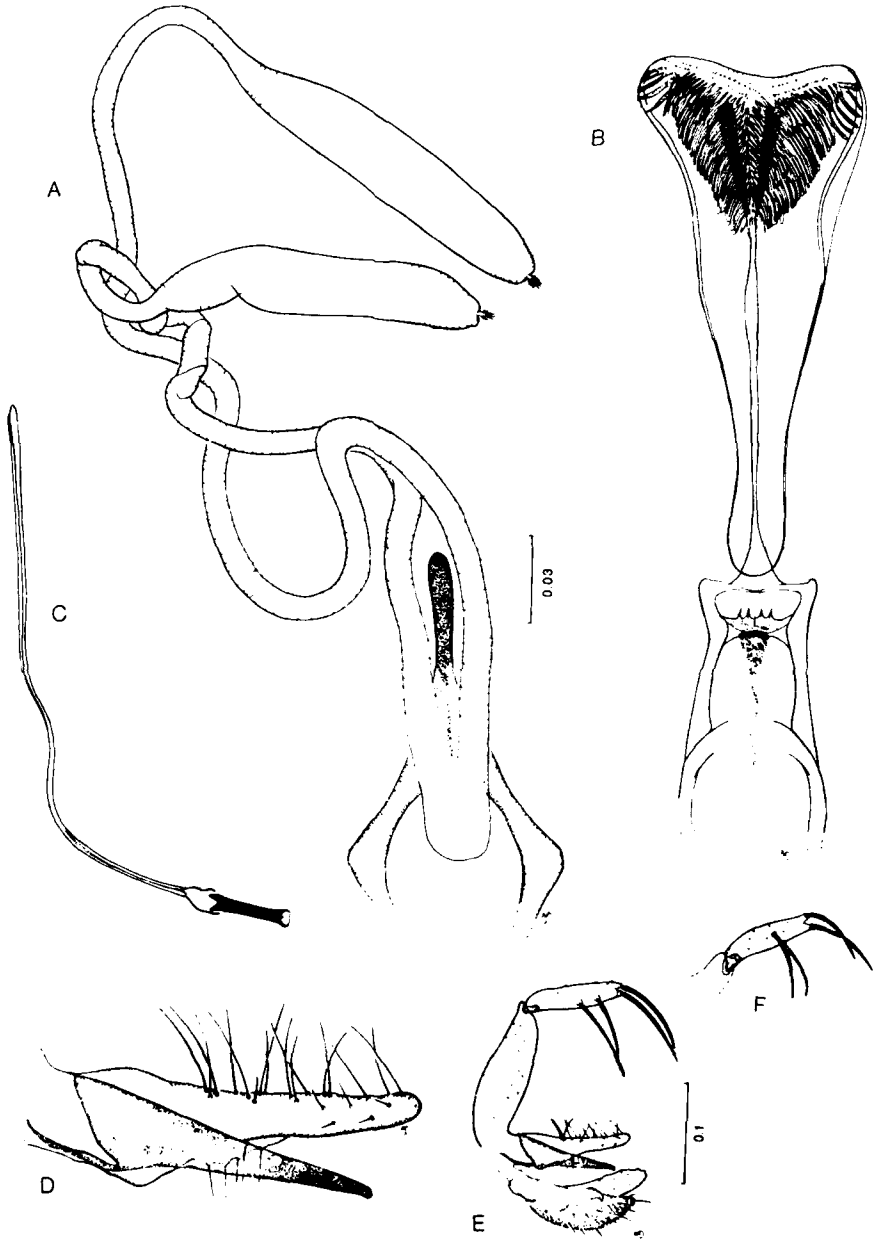


FIG. 267. ***Lutzomyia lewisi***. A. Spermatheacae; B. Female cibarium & pharynx; C. Genital pump & filaments; D. Paramere; E. Male terminalia; F. Style.

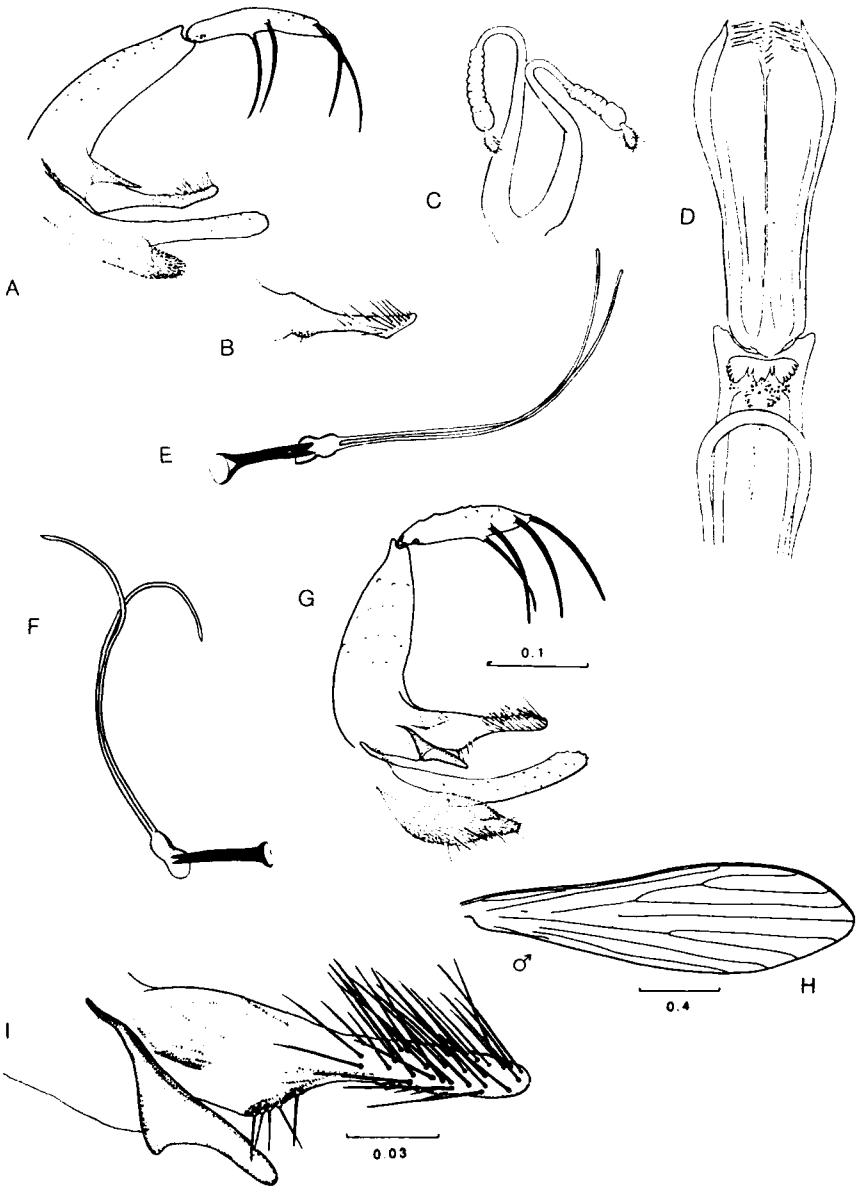


FIG. 268. ***Lutzomyia oliveirai.*** A. Male terminalia; B. Paramere; C. Spermathecae; D. Female cibarium & pharynx; E. Genital pump & filaments (figs. C & D from Martins et al. 1970b).
Lutzomyia minasensis. F. Genital pump & filaments; G. Male terminalia; H. Male wing; I. Paramere.

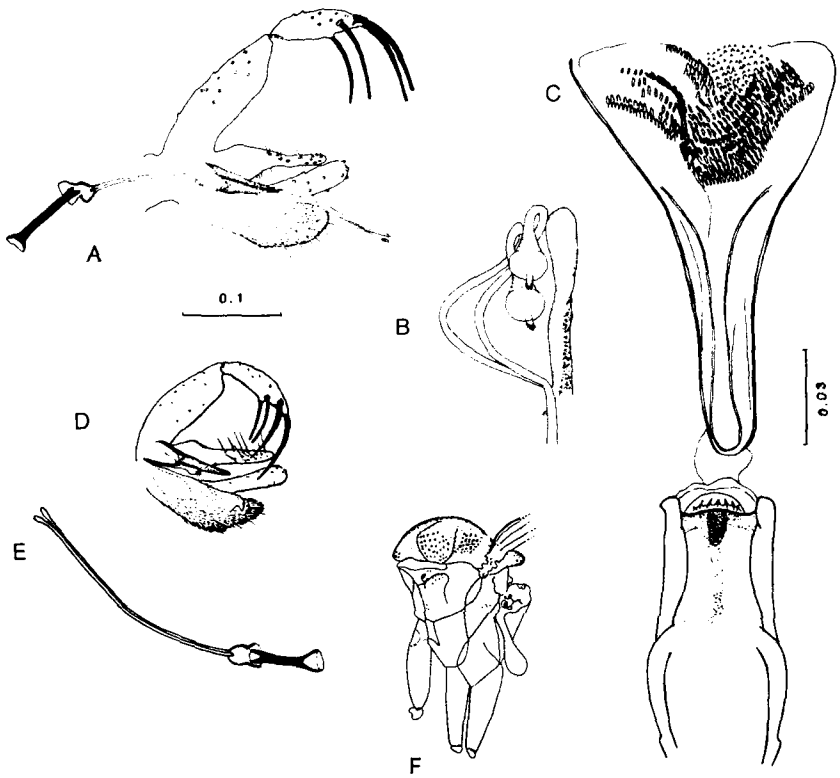


FIG. 269. ***Lutzomyia duppyorum.*** A. Male terminalia; B. Spermathecae; C. Female cibarium & pharynx.
Lutzomyia schreiberi. D. Male terminalia; E. Genital pump & filaments; F. Thorax.

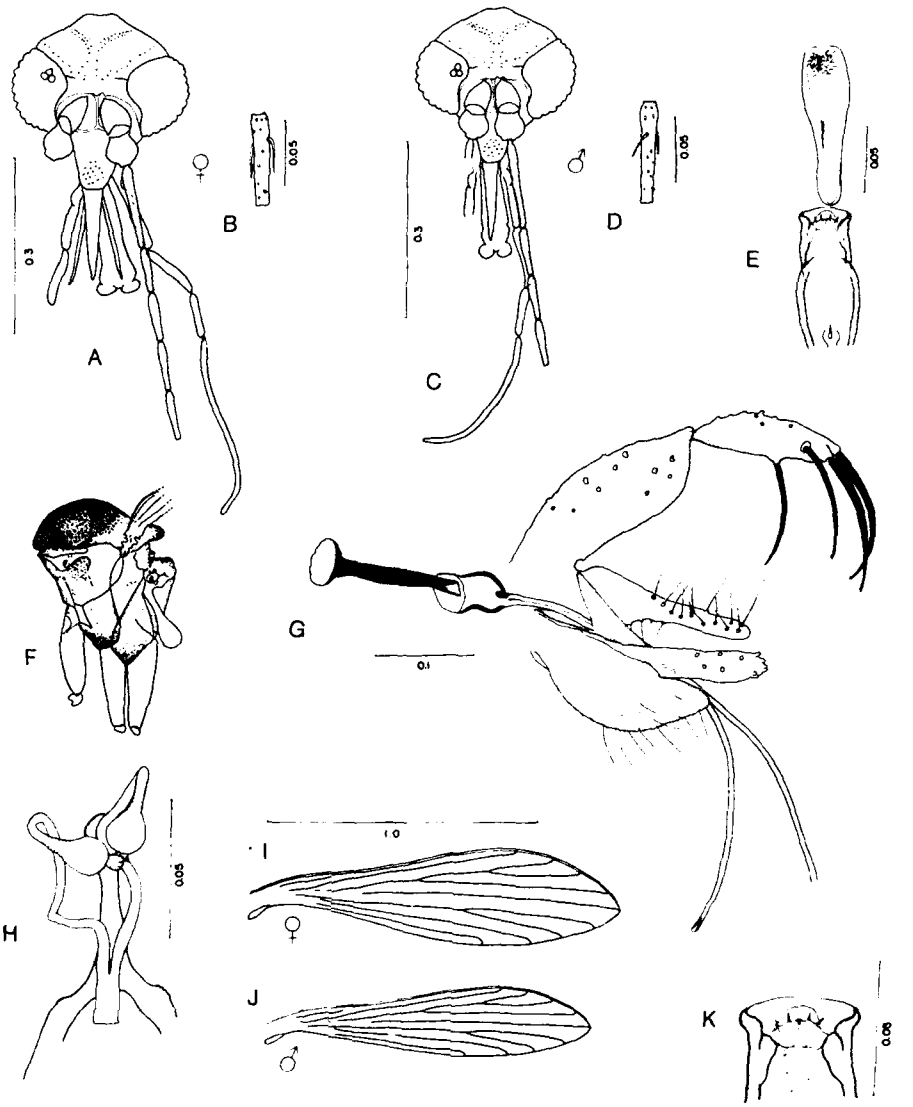


FIG. 270. ***Lutzomyia micropyga.*** A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female cibarium & pharynx; F. Thorax; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing. K. Female cibarium (all figs. except F from Young 1979).

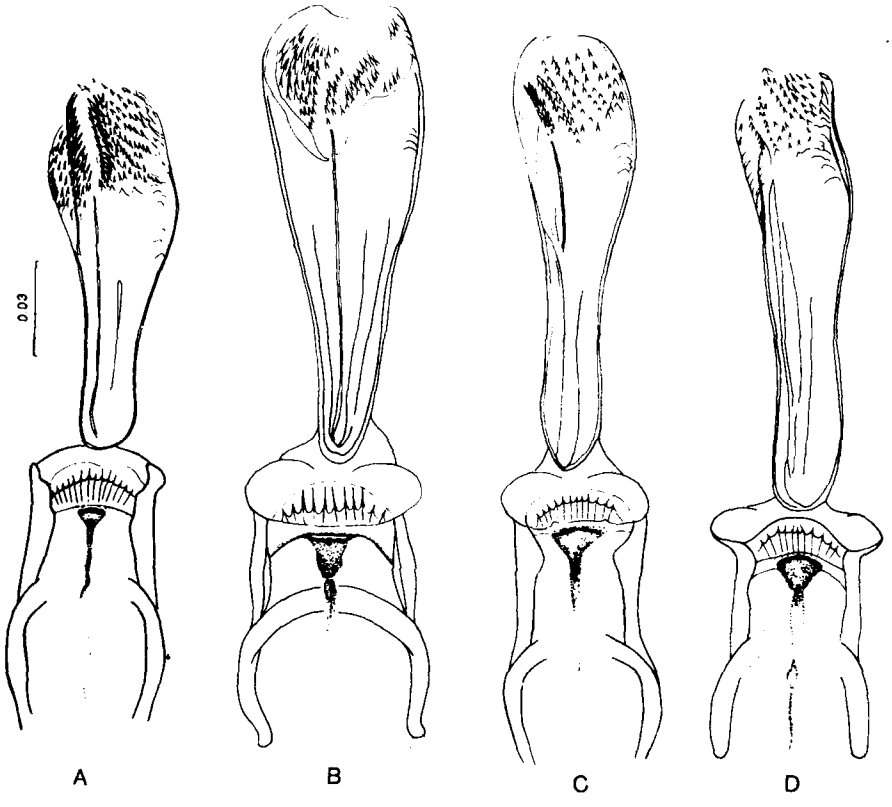


FIG. 271. ***Lutzomyia cayennensis viequesensis***. A. Female cibarium & pharynx.
Lutzomyia cayennensis maciasi. B. Female cibarium & pharynx.
Lutzomyia cayennensis hispaniolae. C. Female cibarium & pharynx.
Lutzomyia cayennensis puertoricensis. D. Female cibarium & pharynx.

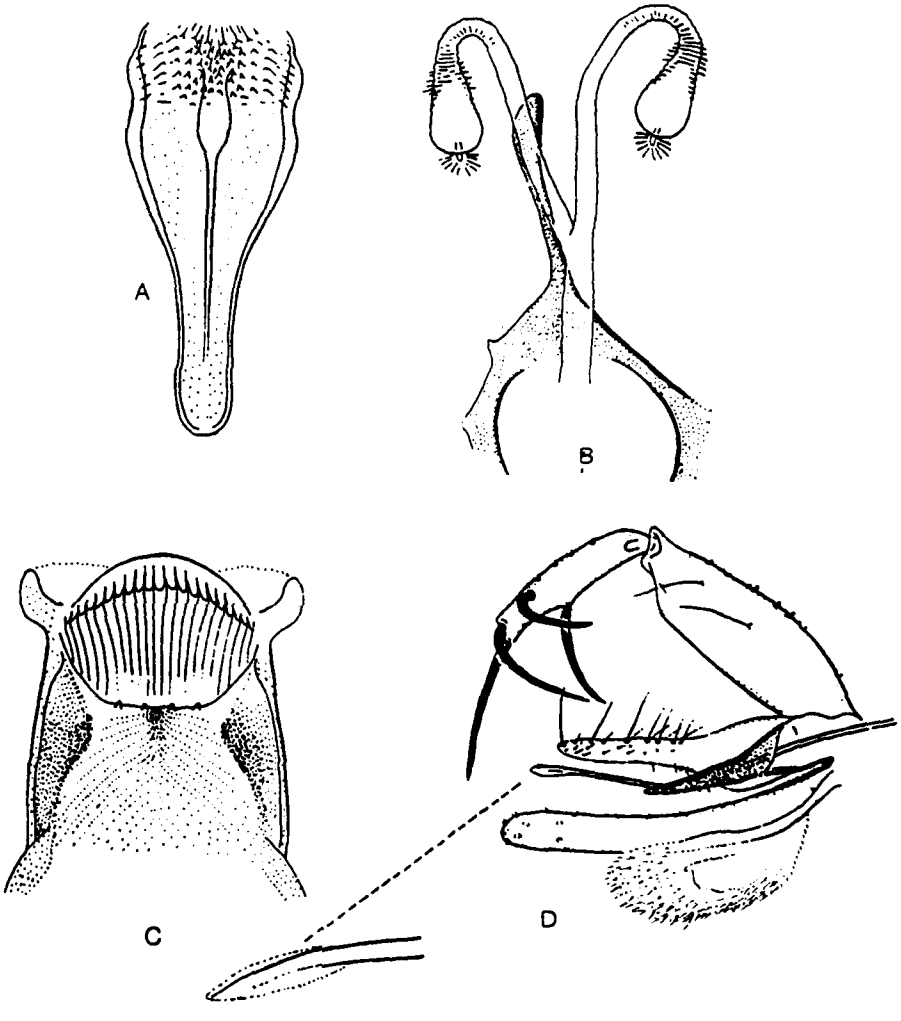


FIG. 272. ***Lutzomyia cayennensis braci.*** A. Female pharynx; B. Spermathecae; C. Female cibarium; D. Male terminalia (figs. from Lewis 1967a).

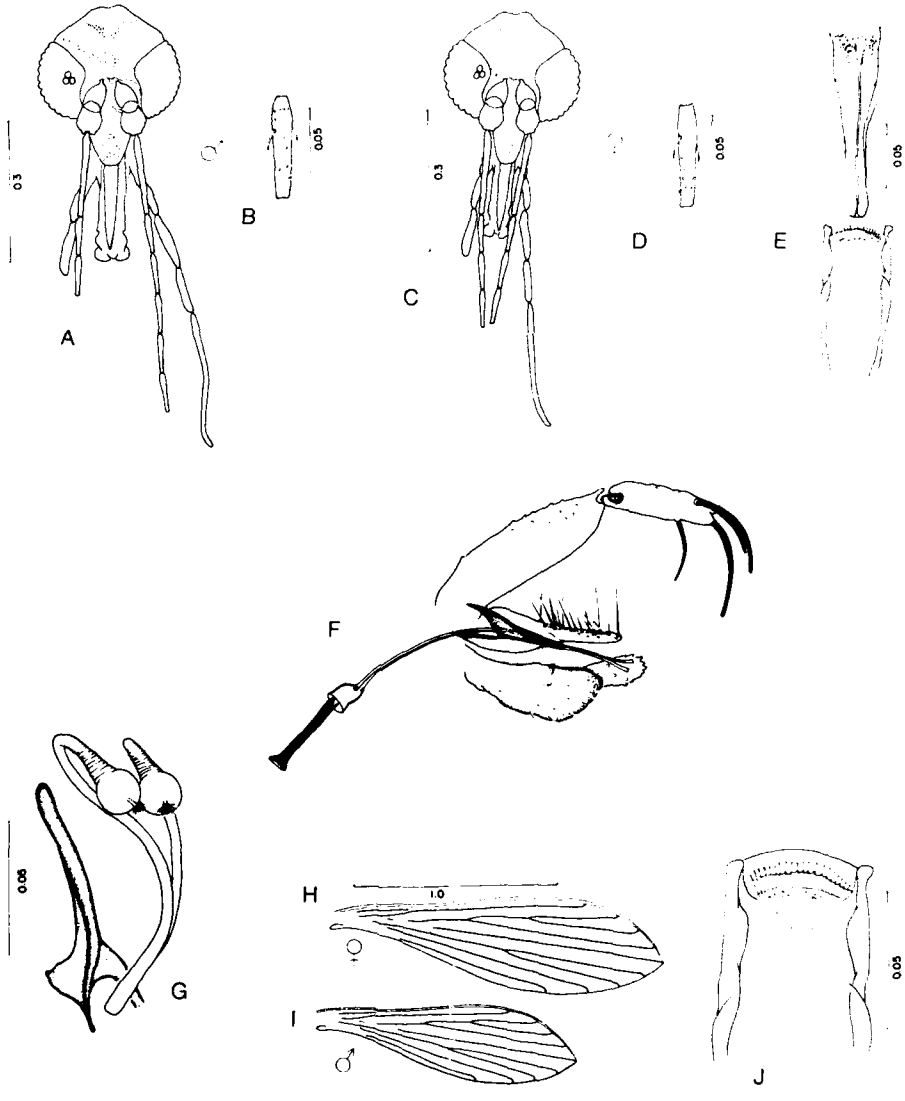


FIG. 273. ***Lutzomyia cayennensis cayennensis.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Spermathecae; H. Female wing; I. Male wing; J. Female cibarium (from Young 1979).

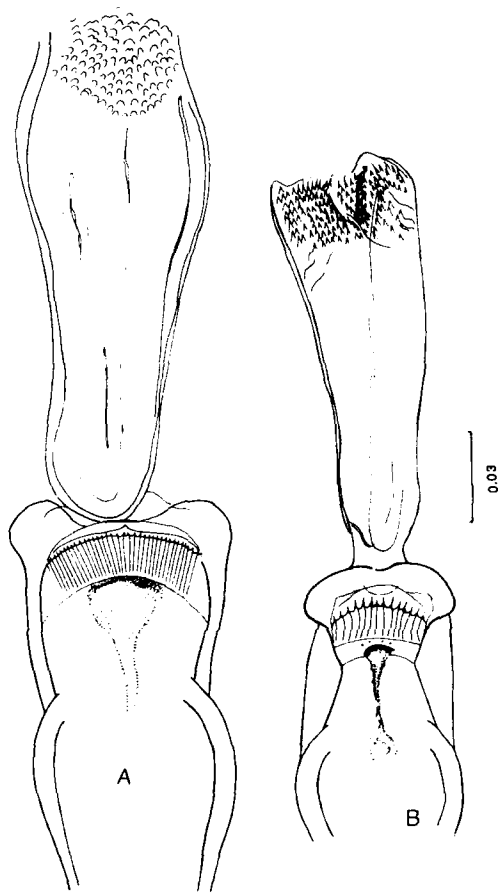


FIG. 274. ***Lutzomyia ctenidophora.*** A. Female cibarium & pharynx.
Lutzomyia cayennensis jamaicensis. B. Female cibarium & pharynx.

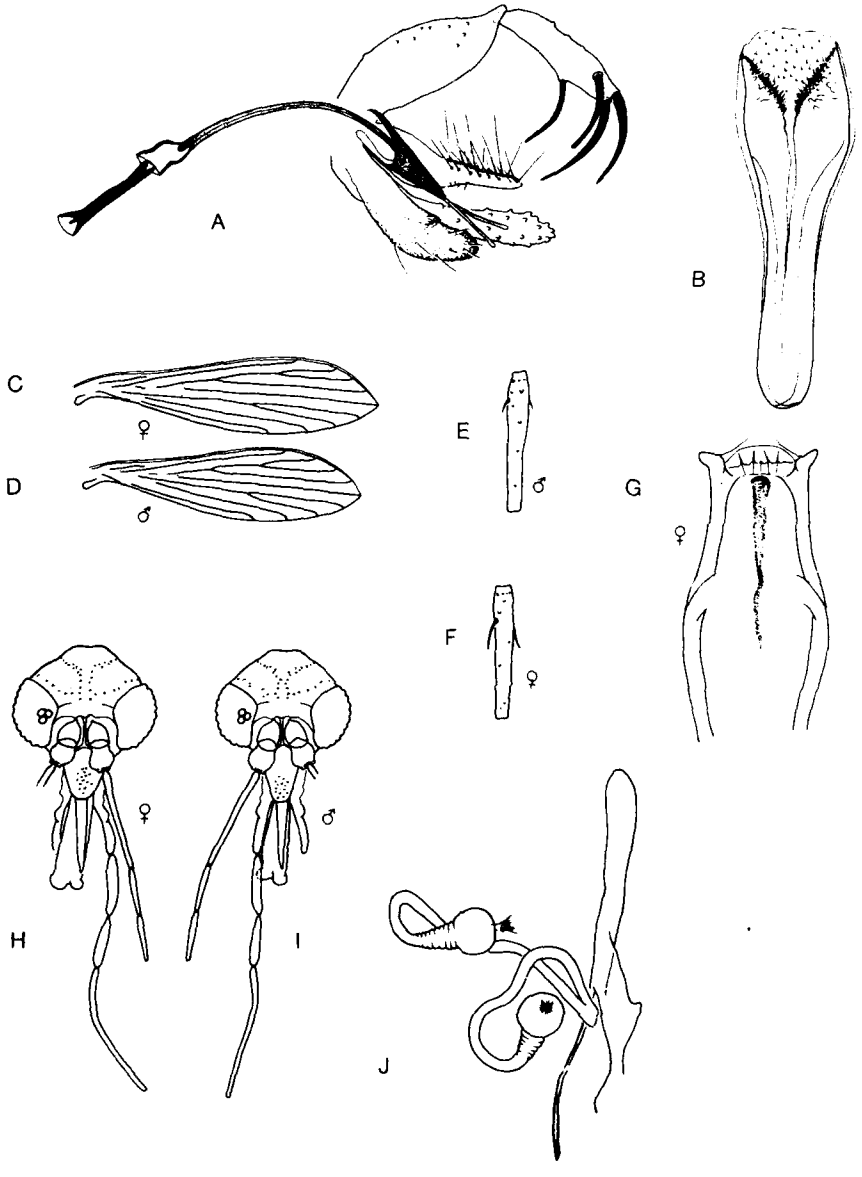
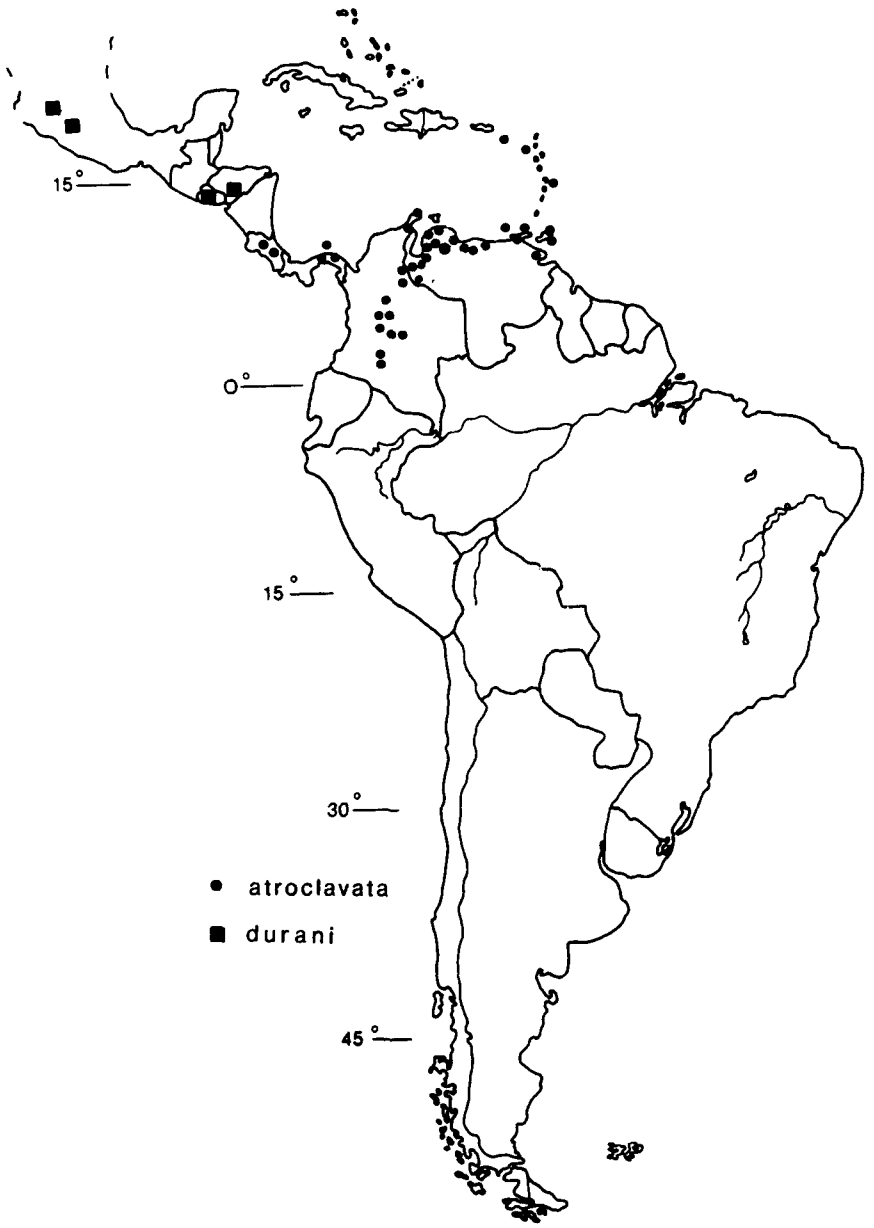
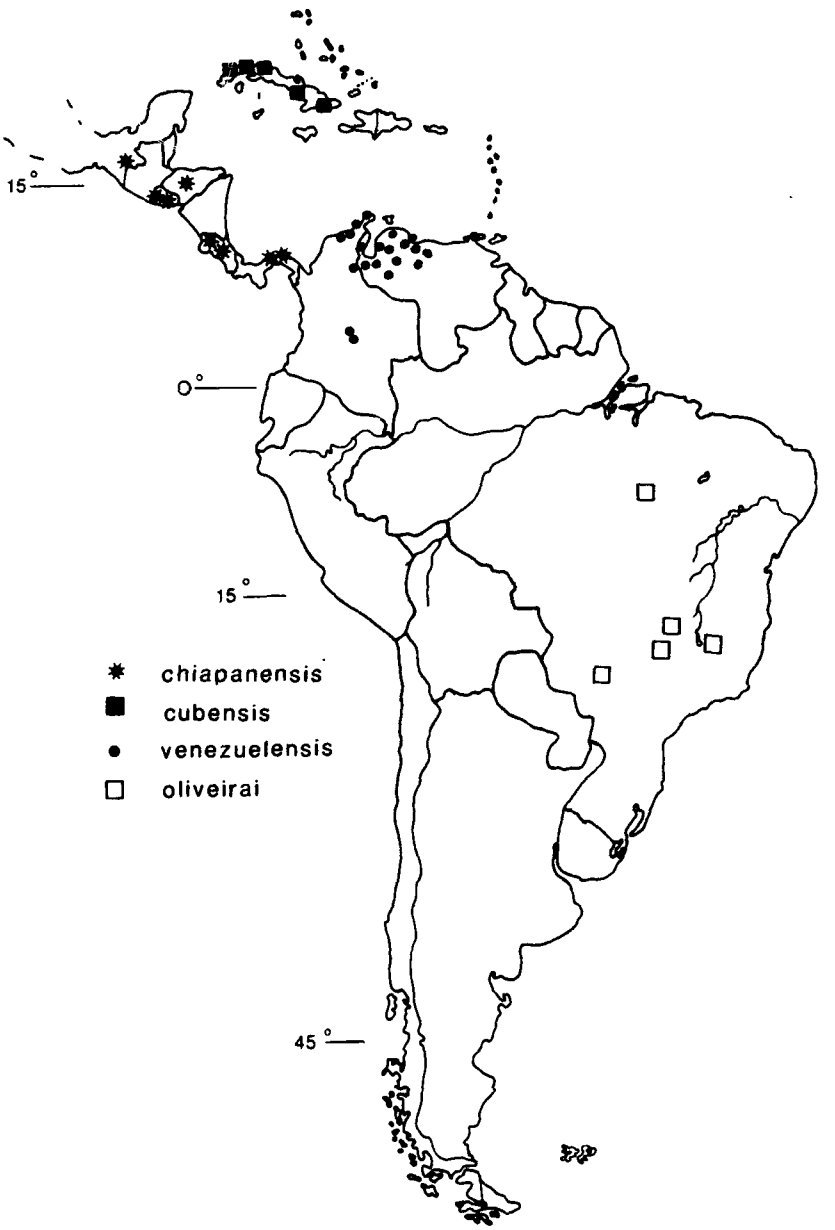


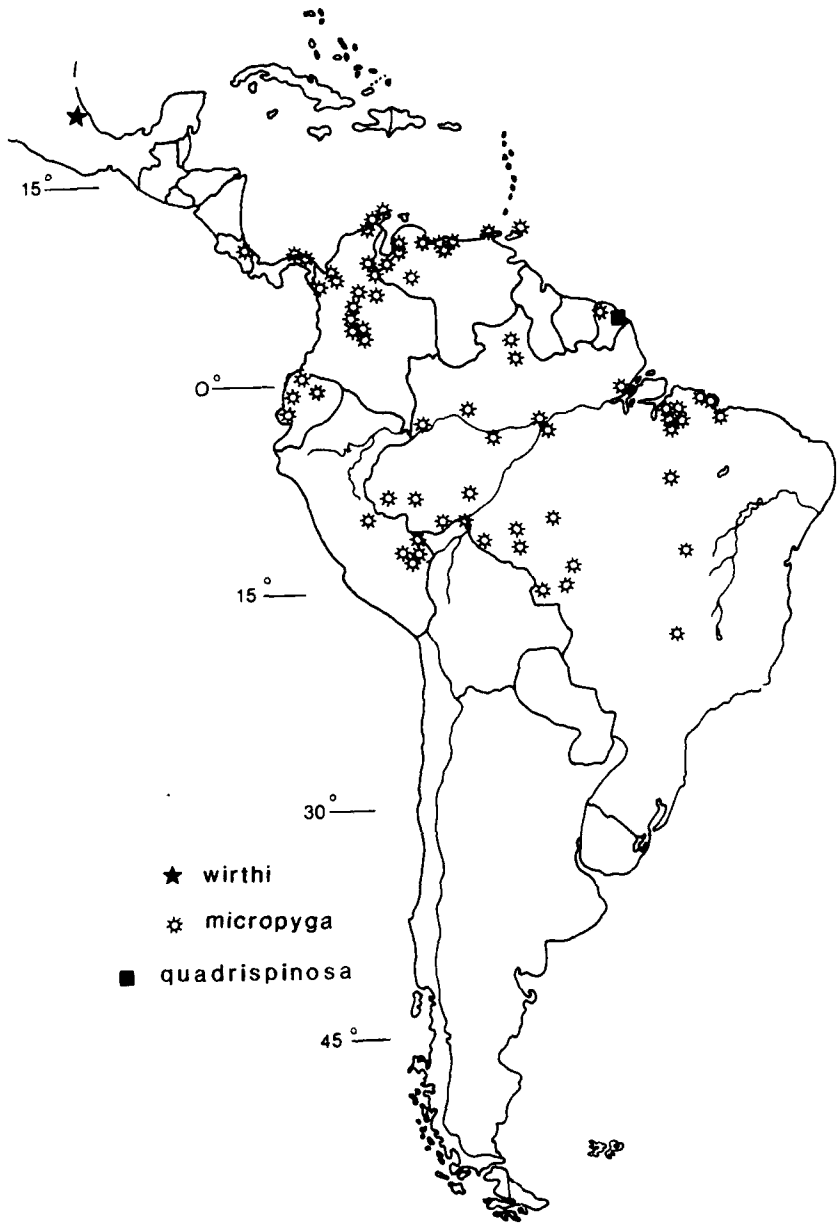
FIG. 275. ***Lutzomyia cubensis.*** A. Male terminalia; B. Female pharynx; C. Female wing; D. Male wing; E. Male flagellomere II; F. Female flagellomere II; G. Female cibarium; H. Female head; I. Male head; J. Spermathecae (from Young & Perkins 1984).



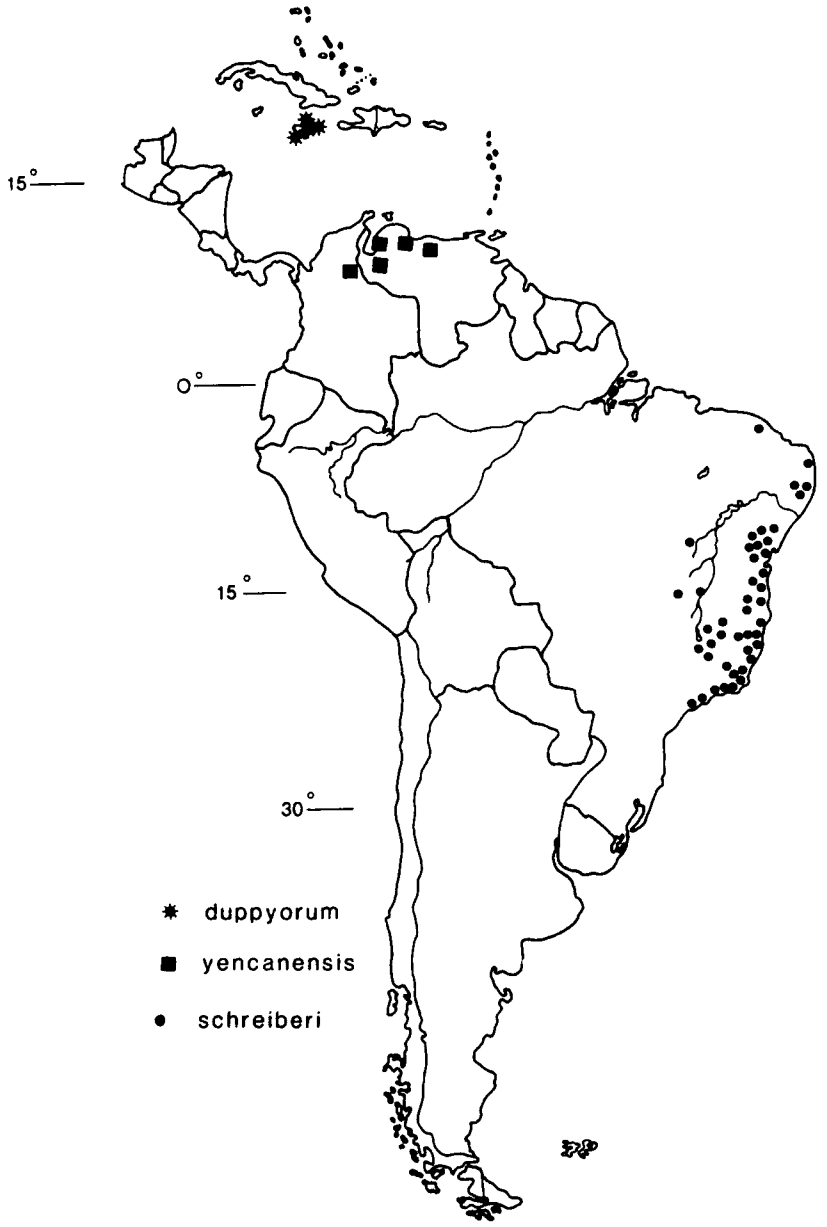
Map 134



Map 135



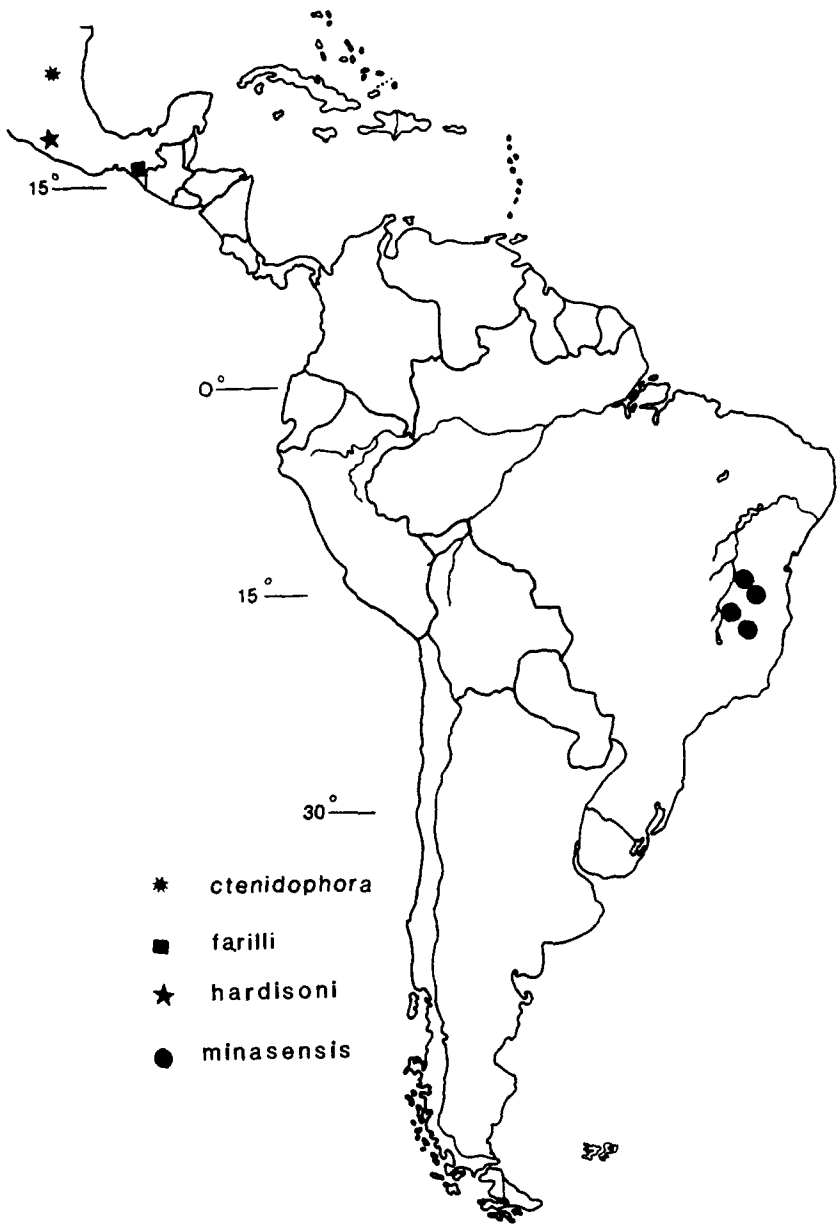
Map 136



Map 137


15°
0°
15°
45°
• cayennensis maciasi
▫ cayennensis puertoricensis
cayennensis braci
lewisi

Map 138



Map 139


15°
0°
15°
45°
cayennensis cayennensis
cayennensis hispaniolae
cayennensis jamaicensis
cayennensis viequesensis
cayennensis cruzi

Map 140

SPECIES GROUP *PILOSA*

Lutzomyia species group *pilosa* Theodor 1965: 194 (defined). Lewis et al. 1977: 325.
Lutzomyia, subgenus *Micropygomyia* Barretto 1962: 95. Forattini 1971a: 101; 1973: 335 (in part).
Lutzomyia species group *chassigneti* Martins et al. 1978: 151 (defined).
Micropygomyia, subgenus *Sciopemyia*: Artemiev 1991: 74.

Identification. Coloration dusky, scutum moderately pigmented. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with 4-5 horizontal teeth in comb-like row; arch conspicuous only at sides. ♀ pharynx unarmed. Spermathecae with incomplete or complete annuli, it & associated ducts tubular; common duct short or absent. ♂ *genitalia*. Coxite with or without median-distal group of persistent setae. Style with 3 strong spines & small median or distal small seta; subterminal seta absent. Paramere simple. Lateral lobe extending to tip of paramere or slightly beyond.

The females in this species group appear to be indistinguishable.

Medical Importance. Unknown; the species are not anthropophilic.

Key to Males of the Species group *pilosa*

1. Coxite with group of 15 or more persistent setae 2
   Coxite without persistent setae . . . . . *L. chassigneti* (Fig. 276A)

2. Coxite with basal-median group of 15-20 rigid setae; 3-4 shorter setae present at base of group . . . . . *L. mangabeirana* (Fig. 276D)
   Coxite with median-distal group of thinner setae & without shorter setae at base of group . . . . . *L. pilosa* (Fig. 277)

Lutzomyia chassigneti (Floch & Abonnenc)
Fig. 276 A-C

Phlebotomus chassigneti Floch & Abonnenc 1944a: 3 (♂, ♀, Baduel, Cayenne, French Guiana). Fairchild & Trapido 1950: 410 (mention). Floch & Abonnenc 1952: 69 (♂, ♀ figs., tax.).
Lutzomyia chassigneti: Theodor 1965: 194 (♀ figs.). Forattini 1971a: 101 (listed); 1973: 339 (figs., tax.). Lewis 1975a: 503 (mouthpart morphol.). Léger et al. 1977: 218 (French Guiana). Martins et al. 1978: 152 (refs., dist.). Ramirez Pérez et al. 1979: 264 (cf. to *pilosa*). Ryan 1986: 78 (mention). Lebbe et al. 1987: 29 (computer aided ident).

Distribution (Map 141). FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); BRAZIL (♂♂, ♀♀, Labrea, Amazonas, D. Young).

Remarks. This species has not been previously reported in Brazil.

Lutzomyia pilosa (Damasceno & Causey)
Fig. 277

Flebotomus pilosus Damasceno & Causey 1944: 342 (♂, Belém, Pará, Brazil). Barretto 1947a: 219. Floch & Abonnenc 1952: 30 (♂ keyed).

Lutzomyia pilosa: Theodor 1965: 194 (♂ figs.). Forattini 1973: 343 (figs., tax.). Martins et al. 1978: 152 (refs., dist.). Young 1979: 231 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 97 (♀, probably *pilosa*, Colombia). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ramirez Pérez et al. 1982b: 58 (Tachira, Venezuela, ♂, ♀ figs.). Christensen et al. 1983: 466 (listed). Murillo & Zeledón 1985: 121 (figs., Costa Rica). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan 1986: 78 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Añez et al. 1988: 457 (Mérida, Venezuela). Feliciangeli et al. 1988a: 49 (Amazonas, Venezuela).

Distribution (Map 142). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Young 1979); COLOMBIA (Young 1979; Morales & Minter 1981); FRENCH GUIANA (Geoffroy et al. 1986); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); TRINIDAD (Aitken et al. 1968). VENEZUELA (Añez et al. 1988; Feliciangeli 1988).

Lutzomyia mangabeirana Martins, Falcão & Silva
Fig. 276 D & E

Lutzomyia mangabeirana Martins, Falcão & Silva 1963: 342 (♂, ♀, Terreno do Padres, Roraima, Brazil). Theodor 1965: 194 (listed). Forattini 1971a: 101 (listed); 1973: 343 (♂, ♀ figs., tax.). Martins et al. 1978: 151 (♂, ♀ figs.). Ramirez Pérez et al. 1979: 264 (mention).

Distribution (Map 141). BRAZIL (type locality).

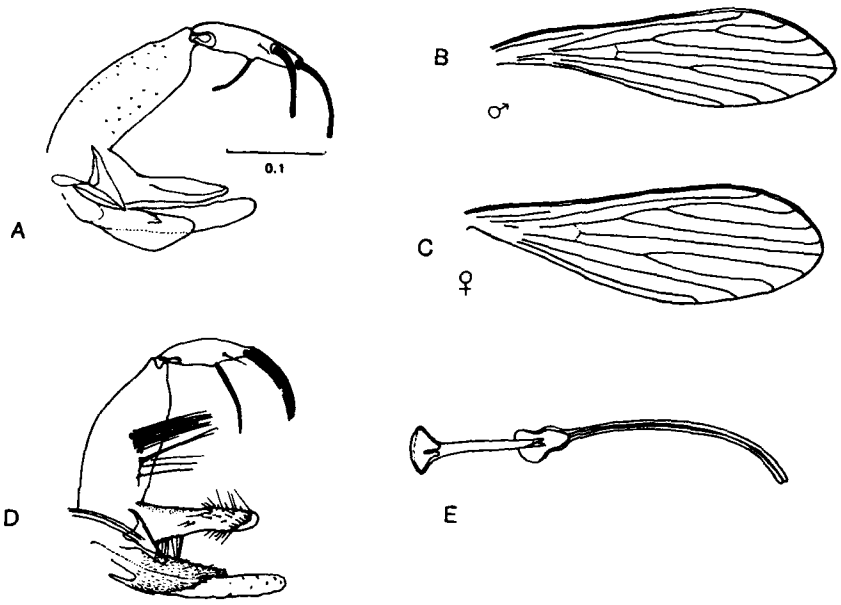


FIG. 276. ***Lutzomyia chassigneti.*** A. Male terminalia, setae on paramere not shown; B. Male wing; C. Female wing. ***Lutzomyia mangabeirana.*** D. Male terminalia; E. Genital pump & filaments (after Martins et al. 1963).

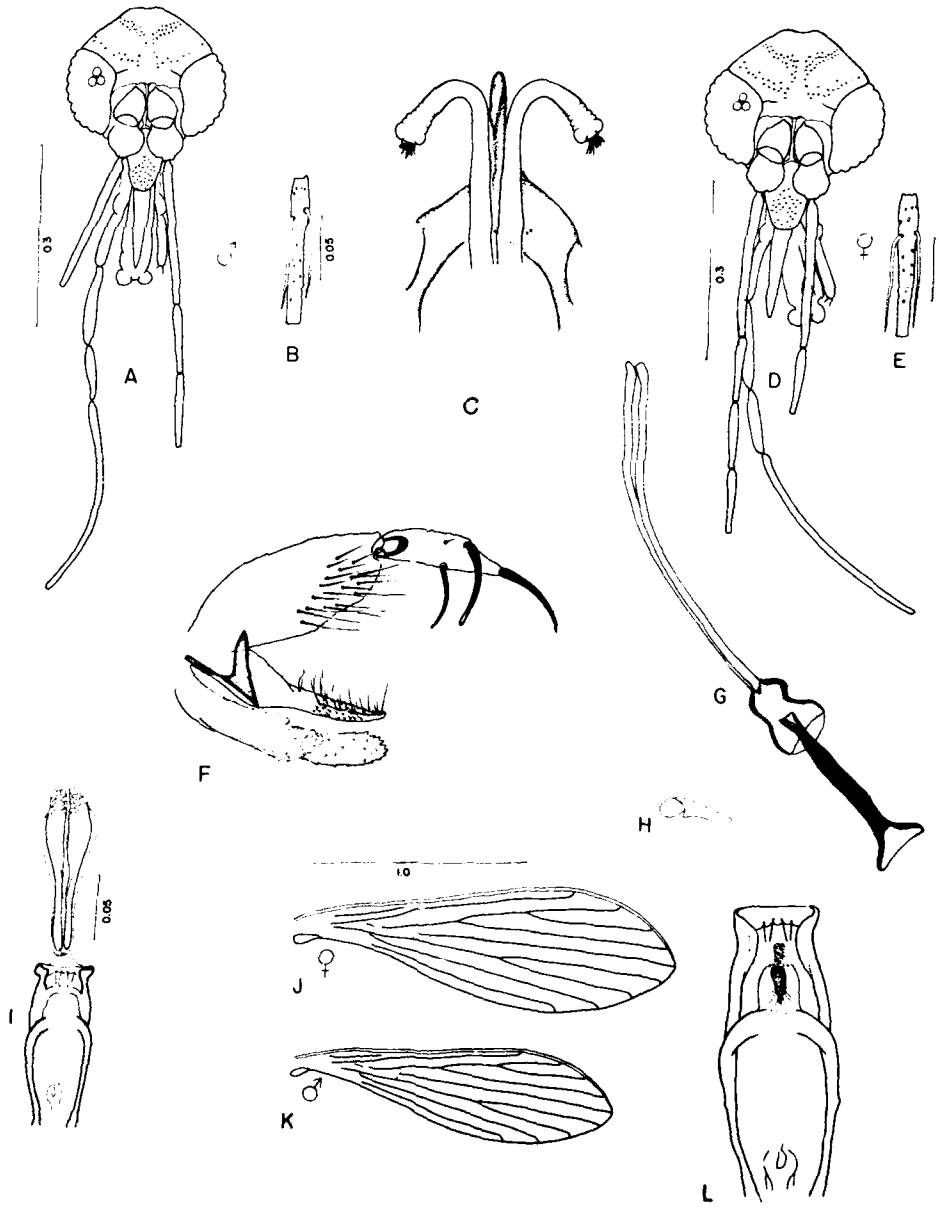
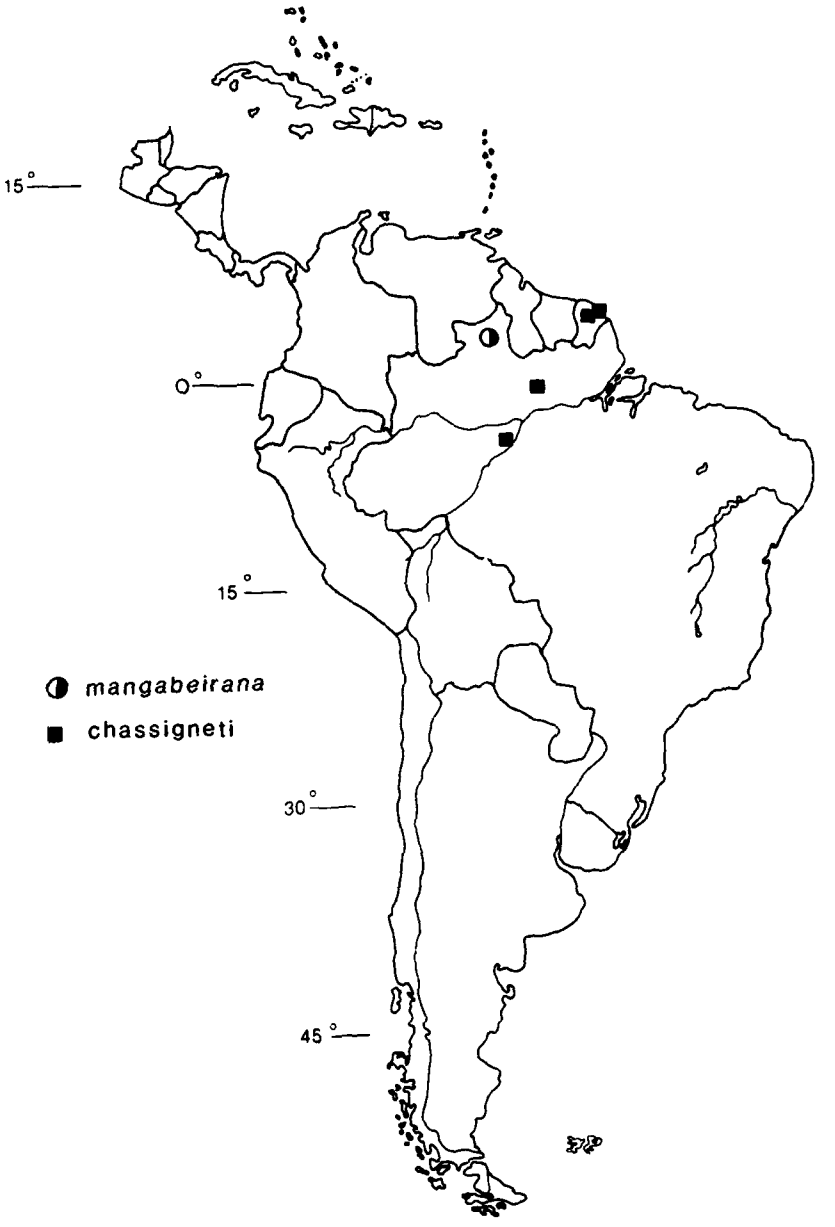
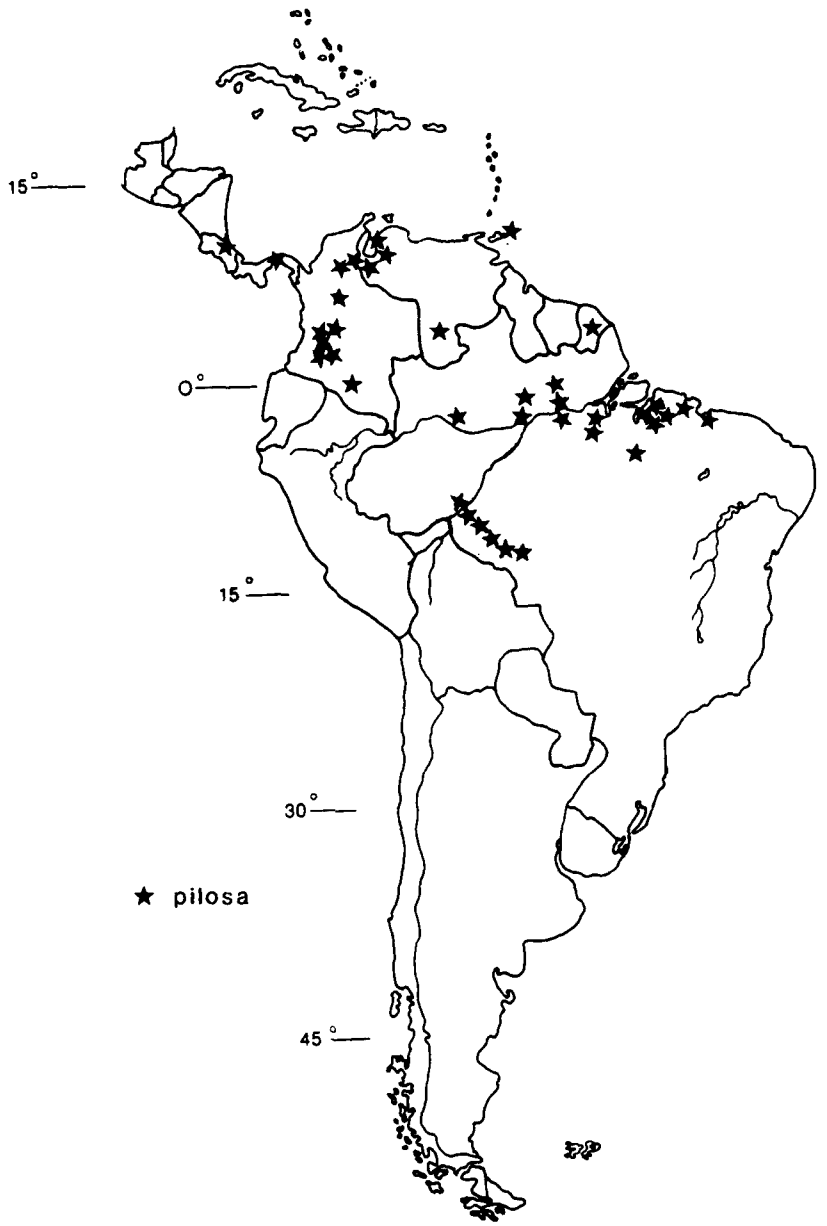


FIG. 277. ***Lutzomyia pilosa***. A. Male head; B. Male flagellomere II; C. Spermathecae; D. Female head; E. Female flagellomere II; F. Male terminalia; G. Genital pump & filaments; H. Tip of genital filament; I. Female cibarium & pharynx; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).



Map 141



Map 142

SPECIES GROUP *OSWALDOI*

Lutzomyia, subgenus *Helcocyrtomyia* Barretto 1962: 96. Martins et al. 1978: 68 (defined).
Lutzomyia species group *oswaldoi*: Theodor 1965: 187. Lewis et al. 1977: 325.
Lutzomyia, subgenus *Trichopygomyia* (in part): Forattini 1971a: 101; 1973: 292 (in part).
Micropygomyia, subgenus *Sauromyia* Artemiev 1991: 74 [type species: *Micropygomyia oswaldoi* (Mang.) by orig. designation].

Identification. Coloration dusky to dark, no completely pale species known. Antennal ascoids simple & often very short, barely reaching distal fourth of flagellomeres. Palpomere 5 longer than palp. 3. ♀ cibarium with 4 horizontal teeth, inwardly directed or not; arch complete or not pigment patch usually conspicuous. Pharynx with or without posterior spines. Spermathecae smooth walled & elongate or shorter with 1 or more complete or incipient annulations. ♂ *genitalia.* Coxite with or without persistent setae. Style with 5-6 spines (*L. rorotaensis* populations in parts of western Colombia have 4 spines); subterminal seta absent. Paramere simple, bifurcate or with median dorsal arm.

The species in this group correspond to those in the series *oswaldoi* of Martins et al. (1978) except that we include *L. quinquefer* and *L. fonsecai*. The latter, little-known species is provisionally placed in this group pending more information. Dias et al. (1991) reviewed this group (series *oswaldoi* in the subgenus *Helcocyrtomyia*) and provided illustrations of the individual species. Williams (1991) also reviewed the classification, geographic distribution and biology of these species.

The status of some species, such as *L. pratti*, remains uncertain. We have examined large numbers of *L. trinidadensis* and *L. rorotaensis* but few or no specimens of the other taxa. *Lutzomyia paterna*, a fossil species from Mexican amber (Quate 1963) may belong in this group (Dias et al. 1991).

Medical Importance. Unknown; the females in this group are not highly anthropophilic. Some species feed on reptiles.

Key to the Males of the Species Group *Oswaldoi**

1. Paramere bifurcate or with dorsal arm 2
   Paramere simple 3

2. Paramere with relatively large dorsal arm bearing 20+ setae. Genital filaments shorter than 3X length of pump . . . . . *L. ramirezi* (Fig. 278B)

*The male of *L. fonsecai* remains unknown.

Paramere with smaller, less clubbed dorsal arm bearing fewer than 10 setae. Genital filaments at least 3X length of pump . . . . . *L. appendiculata* (Fig. 278I,J&L)

3. Genital filament tips bifurcate. Style with median group of 3 spines inserted close together plus a subapical & apical spine . . . . . *L. breviducta* (Fig. 278M&N)
Genital filament tips simple. Style with spines distributed otherwise 4

4. Paramere with subterminal acute projection on ventral margin . . . . . *L. zikani* (Fig. 279A)
Paramere without such a projection 5

5. Coxite with 4 or more spatulate or enlarged setae at or near middle of structure 6
Coxite without such setae 8

6. Coxite with fewer than 6 setae near middle, all spatulate . . . . . *L. borgmeirei* (Fig. 279D)
Coxite with simple setae near middle 7

7. Genital filaments 3X length of pump or longer. Style with 2 terminal spines . . . . . *L. quinquefer* (Fig. 280)
Genital filaments shorter than 3X length of pump. Style with 1 terminal spine . . . . . *L. valderramai* (Fig. 281)

8. Coxite with inner median group of 10 or more persistent setae 9
Coxite with median group of fewer setae or else lacking them entirely . . 12

9. Wing venation with *beta* longer than *alpha* 10
Wing venation with *beta* shorter than or equal to *alpha* 11

10. Coxite with compact tuft of setae. Genital filaments longer than 4X length of genital pump . . . . . *Lutzomyia* sp. #2 of Araracuara (Fig. 282A)
Coxite with diffuse group of setae. Genital filaments shorter than 4X length of pump . . . . . *L. longipennis* (Fig. 282B&C)

11. Coxite with inner group of 20+ setae occupying nearly all of middle third of structure . . . . . *L. quechua* (Fig. 283)
L. rorotaensis (Fig. 284)*

*Some males in western Colombia have but 4 spines on their styles (Young 1979).

Coxite with fewer persistent setae . . . . . *L. trinidadensis* (Fig. 286)
L. goiana (Fig. 287A)

12. Genital filaments 3X length of pump or longer 13
Genital filaments shorter than 3X length of pump 15

13. Wing venation with *beta* longer than *alpha*. Genital filaments 4X or more length of pump . . . . . *L. machupicchu* (Fig. 287E&G)
Wing venation with *beta* shorter than *alpha*. Genital filaments shorter than 4X length of pump 14

14. Lateral lobe shorter than 0.20 mm . . . . . *L. peresi* (Fig. 288)
Lateral lobe longer than 0.20 mm . . . . . *L. capixaba* (Fig. 289F)

15. Coxite with fewer than 8 persistent setae 16
Coxite without persistent setae 17

16. Wing venation with *delta* nil . . . . . *L. pratti* (Fig. 290C)
Wing venation with *delta* positive . . . . . *L. ferreirana* (Fig. 290B)
L. oswaldoi

17. Paramere more slender, gradually narrowing towards its tip. Lateral lobe extending slightly beyond tip of paramere . . . . *L. pusilla* (Fig. 291D)
Paramere broader, slightly clubbed apically. Lateral lobe extending well beyond tip of paramere . . . . . *L. alphabetica* (Fig. 291H)

Key to the Females of the Species Group *oswaldoi**

1. Spermatheca smooth-walled & tubular, its length greater than 4X maximum width; without annulations 2
Spermatheca otherwise 3

2. Pharynx relatively slender throughout & with about 8 transverse rows of small spines at posterior end . . . . . *L. goiana* (Fig. 287C)
Pharynx indented on each side near middle of structure, much wider posteriorally & with numerous strong spines . *L. trinidadensis* (Fig. 286)

3. Cibarium with 4 horizontal teeth & 2 large vertical teeth . . . . . *L. ferreirana*
Cibarium with 4 horizontal teeth & 0 or 4+ vertical teeth 4

*The females of *L. appendiculata*, *L. breviducta*, *L. machupicchu* and *L. pratti* are undescribed.

4. Spermathecae subspherical but constricted basally (light bulb shape), sometimes with a single collar-like annulation at base . . . *L. fonsecai* (Fig. 289H)
L. capixaba (Fig. 289D)
Spermathecae subspherical or tubular, with 2 or more annulations 5

5. Spermatheca tubular, its length about 4X maximum width; terminal annulation longer than wide, apical half narrowing to terminal knob . . . . . *L. pusilla* (Fig. 291F)
Spermathecae otherwise 6

6. Spermathecae with basal & terminal annulations subequal in width; 2-3 annulations between these subequal in width but smaller . . . . . *L. alphabetica* (Fig. 291I)
Spermathecae with all annulations subequal in width or else terminal annulation larger than others 7

7. Cibarium with sclerotized slender "hump" between inner pair of horizontal teeth 8
Cibarium without such a structure 9

8. Spermathecae with 9 or more incomplete or complete annulations; slender throughout . . . . . *L. peresi* (Fig. 288)
Spermathecae with 6 or fewer annulations; terminal annulation much larger than others . . . . . *L. oswaldoi* (Fig. 290H)

9. Spermathecae subequal in width, terminal annulation not enlarged or suboval; individual ducts very thin & about 10X length of spermathecae . . . . . *L. ramirezi* (Fig. 278H)
Spermathecae with enlarged, suboval terminal annulation; individual sperm ducts wider & shorter than 10X length of spermathecae 10

10. Spermathecae with 3-4 annulations. Pharynx with numerous posterior spines . . . . . *L. borgmeirai* (Fig. 279E)
Spermathecae with 6 or more incomplete or complete annulations. Pharynx unarmed or with only a few barely discernible spines 11

11. Cibarium with horizontal teeth pointing to pharynx, not inwardly directed . . . . . *L. zikani* (Fig. 279B)
L. longipennis (Fig. 282E)
Cibarium with inner and/or outer pair of horizontal teeth slanted inwards . . . . . *Lutzomyia* sp. #2 of Araracuara
L. quechua (Fig. 283)
L. quinquefer (Fig. 280)
L. rorotaensis (Fig. 284)

Lutzomyia ramirezi Martins, Falcão, Silva & Miranda
Fig. 278 A-H

Lutzomyia ramirezi Martins, Falcão, Silva & Miranda 1982: 417 (♂, ♀, Morro do Chapeú, Minas Gerais, Brazil).

Distribution (Map 143). BRAZIL (type locality).

Remarks. The placement of this species in the *oswaldoi* species group is provisional. The female has an armed pharynx, like some others in the group, but the spermathecae and thin individual ducts resemble those of several species in the subgenus *Lutzomyia* (Martins et al. 1982).

Lutzomyia appendiculata Martins, Falcão & Silva
Fig. 278 I-L

Lutzomyia appendiculata Martins, Falcão & Silva 1961b: 297 (♂, Jepuitinhonha, Minas Gerais, Brazil). Theodor 1965: 187 (listed). Forattini 1971a: 102 (listed); 1973: 302 (♂ fig.). Martins et al. 1978: 70 (refs., dist.). Dias et al. 1991: 324 (tax.).

Distribution (Map 144). BRAZIL (type locality).

Remarks. This species remains known only from the male holotype.

Lutzomyia breviducta (Barretto)
Fig. 278 M & N

Phlebotomus breviductus Barretto 1950b: 146 (♂, Alegre, Espirito Santo, Brazil). Fairchild & Hertig 1961b: 250 (mention).

Lutzomyia breviducta (or *breviductus*): Martins et al. 1961b: 299 (cf. to *appendiculata*). Theodor 1965: 187 (listed). Forattini 1973: 302 (♂ fig.). Martins et al. 1978: 70 (refs., dist.). Dias et al. 1991: 338 (subgeneric status uncertain). Williams 1991: 536 (removed from *oswaldoi* group).

Distribution (Map 144). BRAZIL (type locality).

Remarks. As pointed out by Dias et al. (1991), the male of *L. breviducta* differs from others in this group by the single terminal spine on the style.

Lutzomyia zikani (Barretto)
Fig. 279 A-C

Phlebotomus zikani Barretto 1950b: 143 (♂, ♀, Alegre, Espirito Santo, Brazil). Sherlock & Alencar 1959: 122 (cf. to *pelloni*). Ortiz & Álvarez 1963b: 312 (listed).

Lutzomyia zikani: Martins et al. 1962d: 85 (listed). Barretto 1962: 96. Theodor 1965: 187. Forattini 1973: 325 (♂, ♀ figs., tax.). Martins et al. 1978: 75 (refs., dist.). Dias et al. 1991: 338 (tax., figs.). Williams 1991: 537 (dist.).

Distribution (Map 145). BRAZIL (type locality).

Remarks. Dias et al. (1991) noted that the females of *L. zikani* and *L. longipennis* may be conspecific. The males, however, are quite distinct.

Lutzomyia borgmeieri Martins, Falcão & Silva
Fig. 279 D-G

Lutzomyia borgmeirei Martins, Falcão & Silva 1972: 497 (♂, ♀, Mata do Barreiro de Cima, Belo Horizonte, Minas Gerais, Brazil). Martins et al. 1978:70 (refs., dist.). Dias et al. 1991: 325 (figs., dist.). Williams 1991: 537 (dist.).

Distribution (Map 143). BRAZIL (Martins et al. 1978; Dias et al. 1991).

Lutzomyia quinquefer (Dyar)
Fig. 280

Phlebotomus quinquefer Dyar 1929: 114 (♂, Iguazu Falls, Missiones, Argentina). Fairchild & Hertig 1957: 326 (♂ fig., keyed, refs.). Lucena & Almeida 1965: 295 (♂, ♀).

Flebotomus quinquefer: Barretto 1947a: 220 (full refs.).

Flebotomus rickardi: Costa Lima 1936: 288 (♂, Crato, Ceará, Brazil). Fairchild & Hertig 1957: 332 (as synonym of *quinquefer*).

Lutzomyia quinquefer: Martins et al. 1961b: 297 (mention). Forattini 1973: 266 (♂, ♀ figs., tax.). Lewis 1975a: 501 (mouthpart morphol.). Martins et al. 1978: 80 (refs., dist., ♀ figs.). Mayrink et al. 1979: 131 (coll. data, Brazil). Williams 1991: 537 (dist.).

Distribution (Map 146). BRAZIL; ARGENTINA (Martins et al. 1978); BOLIVIA (♂♂, ♀♀, Rurrenbaque, Beni, rock tunnel, 1978, J. Velasco).

Remarks. *Lutzomyia quinquefer* clearly belongs in the *oswaldoi* species group. The female cibarium, male terminalia, ascoids and palpomeres are diagnostic. Its inclusion with members of the subgenus *Helcocyrtomyia*, series *peruensis*

(Martins et al. 1978) cannot be justified when all character states are considered. Deane & Deane (1957) believe that females feed on lizards.

Lutzomyia quinquefer has not been reported previously from Bolivia.

Lutzomyia valderramai Cazorla
Fig. 281

Lutzomyia valderramai Cazorla 1988: 607 (♂, Los Curos, Mérida, Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela).

Distribution (Map 146). VENEZUELA (type locality).

Remarks. The holotype of *L. valderramai* was collected in a Shannon trap at 1440 m a.s.l. in Mérida State, Venezuela. A combination of character states (e.g., short antennal ascoids, relative lengths of palpomeres and male genitalic characters) indicates that this species is more closely allied with the *oswaldoi* group species than to some members of the subgenus *Helcocyrtomyia* as suggested by Cazorla in the original description. We have not seen specimens referable to this species.

Lutzomyia species no. 2 of Araracuara
Fig. 282 A

Lutzomyia sp. no. 2 of Araracuara Morales & Minter 1981: 106 (♂, ♀, Araracuara, Caqueta, Colombia).

Distribution (Map 147). COLOMBIA (Morales & Minter 1981).

Remarks. This informally named taxon appears to be distinct from others in the *oswaldoi* species group but we have not closely examined males or females.

Lutzomyia longipennis (Barretto)
Fig. 282 B-E

Flebotomus longipennis Barretto 1946c: 427 (♂, Corumbá, Goias, Brazil).
Lutzomyia longipennis: Martins et al. 1962c: 390 (♂, ♀ figs.). Forattini 1973: 307 (figs., tax.). Martins et al. 1978: 71 (figs., refs., dist.). Arias & Freitas 1982: 404 (Acre, Brazil). Ryan 1986: 73 (♂, ♀ figs., Pará, Brazil). Dias et al. 1991: 329 (tax.). Williams 1991: 537 (dist.).

Distribution (Map 148). BRAZIL (Martins et al. 1978; Arias & Freitas 1982; Ryan 1986; Dias et al. 1991); PERU (Dias et al. 1991).

Remarks. The male resembles that of *L. trinidadensis* but has "curved (comma-shaped) genital filaments and the longest wings among the species" in the *oswaldoi* group (Dias et al. 1991).

Lutzomyia quechua Martins, Llanos & Silva
Fig. 283

Lutzomyia quechua Martins, Llanos & Silva 1975e: 646 (♂, ♀, Rio Chuillape, Quillabamba, Cuzco, Peru). Llanos et al. 1975b: 671 (Peru). Martins et al. 1978: 80 (dist.). Williams 1991: 537 (dist.).

Distribution (Map 149). PERU (Martins et al. 1978).

Remarks. Dias et al. (1991), unlike Williams (1991), do not include *L. quechua* in the *oswaldoi* series (= group) but male and female characters of this species indicate that it is closely allied with these species.

Lutzomyia rorotaensis (Floch & Abonnenc)
Fig. 284

Phlebotomus rorotaensis Floch & Abonnenc 1944e: 4 (♂, ♀, Rorota, French Guiana).

Lutzomyia rorotaensis: Martins et al. 1961b: 300 (mention). Léger et al. 1977: 222 (French Guiana). Martins et al. 1978: 73 (refs., dist.). Young 1979: 225 (full refs., figs.). Lainson et al. 1979: 240 (neg. for flagellates, Pará, Brazil). Biancardi et al. 1982: 168 (Rondônia, Brazil). Ready et al. 1983a: 780 (Brazil). Geoffroy 1984: 257 (gyandromorph, fig., French Guiana). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Young et al. 1985: 145 (Peru). Ready et al. 1986: 27 (Brazil). Dias et al. 1986a: 218 (cf. to *peresi*). Geoffroy et al. 1986: 486 (tree preference study, French Guiana). Ryan 1986: 76 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli et al. 1988a: 48 (Amazonas, Venezuela). Feliciangeli 1989a: 336 (figs., dist., Venezuela). Dias et al. 1991: 335 (figs., tax, dist.). Williams 1991: 537 (dist.).

Lutzomyia oswaldoi: Léger et al. 1977: 218 (? misident., French Guiana).

Distribution (Map 143). PANAMA; COLOMBIA (Young 1979); FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977; Geoffroy et al. 1986); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); PERU (Young et al. 1985); VENEZUELA (Feliciangeli 1988).

Remarks. Forattini (1973) considers *L. rorotaensis* to be conspecific with *L. venezuelensis* and *L. oswaldoi* but this treatment is not supported by structural differences (Young 1979; Martins et al. 1978).

Females of *L. rorotaensis* feed on cold blooded vertebrates in Panama (Tesh et al. 1971a) and breeding sites include the open forest floor in that country (Rutledge & Ellenwood 1975a).

Léger et al. (1977) list *L. oswaldoi* from French Guiana but the specimens are probably conspecific with *L. rorotaensis*.

In Pará, Brazil, trypanosomes were observed in dissected *L. rorotaensis* captured while feeding on the gecko, *Thecadactylus rapicaudus* (Lainson & Shaw 1979).

Lutzomyia saccai Feliciangeli
Fig. 285

Lutzomyia saccai Feliciangeli 1989a: 336 (♂, La Gran Sabana, Waramaisen, Bolivar, Venezuela; ♀, same data but La Escalera).

Distribution (Map 150). VENEZUELA (Feliciangeli 1989a).

Lutzomyia trinidadensis (Newstead)
Fig. 286

Phlebotomus trinidadensis Newstead 1922: 47 (♂, ♀, Trinidad). Fairchild & Hertig 1948a: 253 (refs., figs., tax.).

Phlebotomus yucatanensis Galliard 1934a: 1 (♂, ♀, near Chichen Itza, Yucatan, Mexico). Fairchild & Hertig 1948a: 255 (as synonym of *trinidadensis*).

Phlebotomus yucatanensis var. *baduelensis* Floch & Abonnenc 1941a: 4 (♂, Baduel, French Guiana). Fairchild & Hertig 1948a: 255 (as synonym of *trinidadensis*).

Phlebotomus villelai Mangabeira 1942a: 196 (♂, Ceará & Pará, Brazil). Barretto 1946b: 527 (as synonym of *baduelensis*). Fairchild & Hertig 1948a: 255 (as synonym of *trinidadensis*).

Phlebotomus baduelensis Floch & Abonnenc 1944e: 1 (♂, ♀, French Guiana). Fairchild & Hertig 1948a: 255 (as synonym of *trinidadensis*. Floch & Abonnenc 1952: 163 (♂, ♀).

Lutzomyia trinidadensis: Martins et al. 1961b: 300 (mention). Léger et al. 1977: 218 (French Guiana). Ramirez Pérez et al. 1978: 52 (figs., Venezuela). Martins et al. 1978: 73 (refs.,dist.). Young 1979: 227 (refs., dist., figs.). Scorza et al. 1979a: 35 (biting habits). Feliciangeli 1980: 246 (keyed). Ramirez Pérez et al. 1981: 124 (Venezuela); 1982a: 14 (♂, ♀ figs., Venezuela); 1982b: 58 (♂, ♀ figs., Venezuela). Biancardi et al. 1982: 168 (Rondônia, Brazil). Arias & Frietas 1982: 401 (Acre, Brazil). Young & Rogers 1984: 610 (Ecuador). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Murillo & Zeledón 1985: 117 (♂, ♀ figs., Costa Rica). Ryan 1986: 77 (figs., Brazil). Dias et al. 1986a: 218 (cf. to *peresi*). Feliciangeli 1987a: 122; 1987b: 127; 1988: 105 (coll. data, Venezuela). Morales et al. 1987: 93 (Colombia record).

Lebbe et al. 1987:29 (computer aided ident.). Ryan et al. 1987a: 356 (nat. infection flagellates, Pará, Brazil). Cazorla et al. 1988b: 93 (anomalies). Feliciangeli et al. 1988a: 48 (Venezuela). Añez et al. 1988: 457 (Venezuela). Williams 1988: 375 (tax.). Feliciangeli 1988: 105 (Venezuela); 1989a: 333 (figs., dist., Venezuela). Bonfante-Garrido 1990: 477 (nat. *Leishmania* infections, Venezuela). Williams 1991: 537 (dist.). Dias et al. 1991: 334 (tax., figs.). Bonfante-Garrido et al. 1991: 99 (neg. for flagellates). Rowton et al. 1991: 501 (Guatemala). Alexander et al. 1992a: 37 (Ecuador). Feliciangeli et al. 1993: 652 (egg morphol).

Lutzomyia cruciata (not *cruciatus* Coq.): Zeledón et al. 1982: 276 (Honduras).

Distribution (Map 145). MEXICO; BELIZE (Martins et al. 1978); GUATEMALA (Rowton et al. 1991); HONDURAS (Fairchild & Hertig 1959; Zeledón et al. 1982); NICARAGUA (Fairchild & Hertig 1959); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales et al. 1987); ECUADOR (Young & Rogers 1984; Alexander et al. 1992a,c); PERU (Martins et al. 1978; Dias et al. 1991); VENEZUELA (Feliciangeli 1988); FRENCH GUIANA (Léger et al. 1977; Martins et al. 1978); TRINIDAD (Aitken et al. 1968); BRAZIL (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986; Dias et al. 1991); BOLIVIA (Martins et al. 1978).

Remarks. *Lutzomyia trinidadensis* has the widest geographic distribution of the *oswaldoi* group species (Dias et al. 1991). Females feed on cold blooded vertebrates (Tesh et al. 1971a) and have been found naturally infected with flagellates, mostly trypanosomes, and filarial worms (Williams 1976a & Ryan et al. 1987c). Bonfante-Garrido et al. (1990) reported natural leishmanial infections in this species in Venezuela but the identify of the positive sand flies requires confirmation, according to Feliciangeli (1991). There are several reports of *L. trinidadensis* biting man (e.g. Scorza et al. 1979a), but this species is not regarded as anthropophilic.

Williams (1991) provisionally treats *L. baduelensis* (Floch & Abonnenc) and *L. villelai* (Mangabeira) as valid species, distinct from *L. trinidadensis*.

Hanson (unpublished data) collected larvae of *L. trinidadensis* in Panama from soil samples between buttressed roots of trees. The adults commonly rest on tree trunks and also have been found resting inside houses where, presumably, they feed on geckoes and other lizards.

Lutzomyia goiana Martins, Falcão & Silva
Fig. 287 A-D

Lutzomyia goiana Martins, Falcão & Silva 1962c: 383 (♂, ♀, Sitio d'Abadia, Goias, Brazil). Forattini 1971a: 102 (listed). Lewis 1975a: 502 (mouthpart morphol.).

Martins et al. 1978: 71 (refs., dist.). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Galati et al. 1985: 261 (Mato Grosso do Sul, Brazil). Dias et al 1986a: 218 (cf. to *peresi*); 1991: 328 (tax., figs.). Williams 1991: 537 (dist.).

Lutzomyia trinidadensis: Forattini 1973: 321 (in part).

Distribution (Map 144). BRAZIL (Martins et al. 1978; Galati et al. 1985; Dias et al. 1991).

Remarks. Forattini (1973) treats *L. goiana* as a junior synonym of *L. trinidadensis*, but the female pharynx of *L. goiana* consists of fewer, barely visible spines and is more slender than that of *L. trinidadensis*. The males are structurally similar but that of *L. goiana*, like the female, has a larger clypeus (Dias et al. 1991).

Lutzomyia machupicchu Martins, Llanos & Silva
Fig. 287 E-G

Lutzomyia machupicchu Martins, Llanos & Silva 1975e: 652 (♂, Machupicchu, Cuzco, Peru). Llanos et al. 1975b: 670 (Peru). Martins et al. 1978: 71. Llanos 1983: 183 (listed).

Distribution (Map 151). PERU (type locality).

Remarks. One of us (D.G.Y.) was unable to locate the male holotype of *L. machupicchu* in the collection of the National Institute or Health, Lima, in 1988. We have not seen specimens referable to this species.

Lutzomyia peresi (Mangabeira)
Fig. 288

Flebotomus peresi Mangabeira 1942a: 190 (♂, Januária, Minas Gerais, Brazil). Barretto 1947a: 217 (refs.); 1950a: 112 (♂ keyed).

Lutzomyia peresi: Barretto 1962: 96 (listed). Forattini 1973: 314 (♂ fig.). Martins et al. 1978: 72 (in part, dist.). Dias et al. 1986a: 215 (♂, ♀, tax., dist., figs.); 1986b: 395 (cf. to *pusilla*); 1991: 330 (tax., figs.). Williams 1991: 537 (dist.).

Distribution (Map 150). BRAZIL (Dias et al. 1986a, 1991); BOLIVIA (2 ♀♀, Rurrenabaque, Beni, 1978, J. Velasco).

Remarks. Records of *L. peresi* from Brazilian localities, other than in the states of Goias, Minas Gerais, Mato Grosso do Sul and Mato Grosso, Brazil, are erroneous and represent *L. pusilla* (Dias et al. 1986a,b). The presence of this species in Ceará State, Brazil, and in Pernambuco, Brazil (Lucena & Almeida 1965), is questionable (Dias et al. 1986b). *Lutzomyia peresi* has not previously

been reported in Bolivia. Two females from there have tiny, almost indiscernible, spines in the pharynx.

Lutzomyia capixaba Dias, Falcão, Silva & Martins
Fig. 289 A-G

Lutzomyia capixaba Dias, Falcão, Silva & Martins 1987: 193 (♂, ♀, Conquista, Espirito Santo, Brazil). Dias et al. 1991: 326 (tax.). Williams 1991: 537 (dist.).

Distribution (Map 152). BRAZIL (Dias et al. 1987).

Lutzomyia fonsecai (Costa Lima)
Fig. 289 H

Phlebotomus fonsecai Costa Lima 1932: 49 (♀, Gruta de Inscripciones, Carmen, Santa Cruz, Bolivia).
Lutzomyia fonsecai: Theodor 1965: 196 (listed). Forattini 1973: 352 (♀ fig.). Martins et al. 1978: 168 (listed).

Distribution (Map 150). BOLIVIA (type locality).

Remarks. This species was inadequately described and illustrated from the female. No additional specimens have been taken at, or near, the type locality. Seven females represent the type material which we have not examined.

From the wing, spermathecae illustrations, and palpal measurements (Costa Lima 1932), it is likely that this species belongs in the *oswaldoi* species group. The spermathecae resemble those of *L. capixaba* in shape but the sperm ducts of *L. fonsecai* appear to be shorter and broader.

Lutzomyia ferreirana (Barretto, Martins & Pellegrino)
Fig. 290 A & B

Sergentomyia ferreirana Barretto, Martins & Pellegrino 1956: 52 (♂, Itambacuri, Minas Gerais, Brazil). Barretto et al. 1958: 187 (repeat of original descript.).
Lutzomyia ferreirana: Barretto 1962: 96 (listed). Forattini 1973: 306 (♂ fig., tax.). Martins et al. 1978: 70 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Dias et al. 1989: 245 (♀); 1991: 326 (tax.). Williams 1991: 537 (dist.).

Distribution (Map 151). BRAZIL (Martins et al. 1978; Dias et al. 1989, 1991).

Remarks. The female of *L. ferreirana* was recently described by Dias et al. (1989). It differs from others in the *oswaldoi* group by the presence of one pair of vertical teeth in the cibarium.

Lutzomyia pratti (Vargas & Nájera)
Fig. 290 C-E

Phlebotomus pratti Vargas & Nájera 1951a: 19 (♂, Iguala, Guerrero, Mexico).
Lutzomyia pratti: Barretto 1962: 96 (listed). Forattini 1973: 317 (♂ fig.). Martins et al. 1978: 72 (dist.). Dias et al. 1991: 338 (tax.). Williams 1991: 537 (dist.).

Distribution (Map 144). MEXICO (Martins et al. 1978).

Remarks. This species has been mentioned several times in the literature (e.g., Vargas 1981), but it remains poorly known from the male only. We have not examined material of *L. pratti*. Dias et al. (1991) are uncertain of its placement in this group.

Lutzomyia oswaldoi (Mangabeira)
Fig. 290 F-I

Flebotomus oswaldoi Mangabeira 1942a: 190 (♂, Timbaúbas, Russas, Ceará, Brazil); 1942e: 288 (♀ & immatures). Barretto 1947a: 216 (refs., synonomy).
Phlebotomus oswaldoi: Barretto 1950b: 145 (cf. to *zikani*). Floch & Abonnenc 1950b: 8 (tax.). Deane & Deane 1957: 226 (coll. data, Ceará, Brazil). Forattini 1959: 160 (Amapá, Brazil). Carneiro & Sherlock 1964: 315 (pupa keyed). Sherlock & Pessoa 1964: 332 (habits, Brazil). Mangabeira 1969: 18 (habits, figs., Brazil).
Lutzomyia oswaldoi: Martins et al. 1961b: 299 (cf. to *appendiculata*). Theodor 1965: 187 (♂, ♀ figs.). Forattini 1973: 312 (in part, figs., tax.). Martins et al. 1978: 71 (refs., dist.). Lainson et al. 1983: 329 (lizard feeding, Pará, Brazil). Ryan et al. 1984: 547 (Pará, Brazil). Dias et al. 1986a: 218; 1986b: 196 (cf. to *oswaldoi* group spp.). Ryan 1986: 74 (♂, ♀ figs., Pará, Brazil). Dias et al. 1991: 330 (tax., figs.). Williams 1991: 537 (dist.).

Distribution (Map 147). BRAZIL (Martins et al. 1978; Ryan 1986; Dias et al. 1991).

Remarks. Deane & Deane (1957) and others reported that females of *L. oswaldoi* feed on lizards. The record of this species from Amapá, Brazil (Forattini 1959) is questionable; Dias et al. (1991) apparently consider it to be based on a misidentification of another species.

Lutzomyia pusilla Dias, Martins, Falcão & Silva
Fig. 291 A-G

Lutzomyia pusilla Dias, Martins, Falcão & Silva 1986b: 395 (♂, ♀, Serra do Navio, Amapá, Brazil). Dias et al. 1991:334 (tax., figs.). Williams 1991: 537 (dist.).
Phlebotomus peresi (not *peresi* Mangabeira): Floch & Abonnenc 1944e: 7 (♂, French Guiana). Damasceno et al. 1949: 830 (Pará, Brazil). Barretto 1950c: 222 (Amazonás & Pará, Brazil). Floch & Abonnenc 1952: 170 (♂ figs., tax., French Guiana). Lucena & Almeida 1965: 257 (Pernambuco, Brazil).
Phlebotomus sp. de Saül Floch & Abonnenc 1944e: 8 (♀, French Guiana); 1952: 186 (♀ figs.). Léger et al. 1977: 218 (French Guiana).
Lutzomyia peresi (not *peresi* Mangabeira). Léger et al. 1977: 222 (French Guiana). Martins et al. 1978: 72 (in part, dist., refs.). Ryan 1986: 75 (♂ fig., Pará Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 153). FRENCH GUIANA (Floch & Abonnenc 1952; Léger et al. 1977); BRAZIL (Dias et al. 1986b, 1991; Ryan 1986).

Remarks. Dias et al. (1986a,b) discussed previous misidentifications of this species as *L. peresi*; not *peresi* Mangabeira.

Lutzomyia alphabetica (Fonseca)
Fig. 291 H-J

Flebotomus alphabeticus Fonseca 1936: 327 (♀, Horto Florestal, Serra da Cantareira, São Paulo, Brazil). Barretto 1943: 703 (variation; 1947a: 183 (refs.).
Phlebotomus alphabeticus Coutinho & Barretto 1940b: 193 (♂, ♀). Barretto 1941: 398 (immatures).
Lutzomyia alphabetica: Martins et al. 1961b: 299 (cf. to *appendiculata*). Forattini 1973: 300 (figs., tax.). Martins et al. 1978: 161 (refs., dist.). Dias et al. 1991: 324 (tax., ♂ figs.).

Distribution (Map 149). BRAZIL; ARGENTINA (Martins et al. 1978).

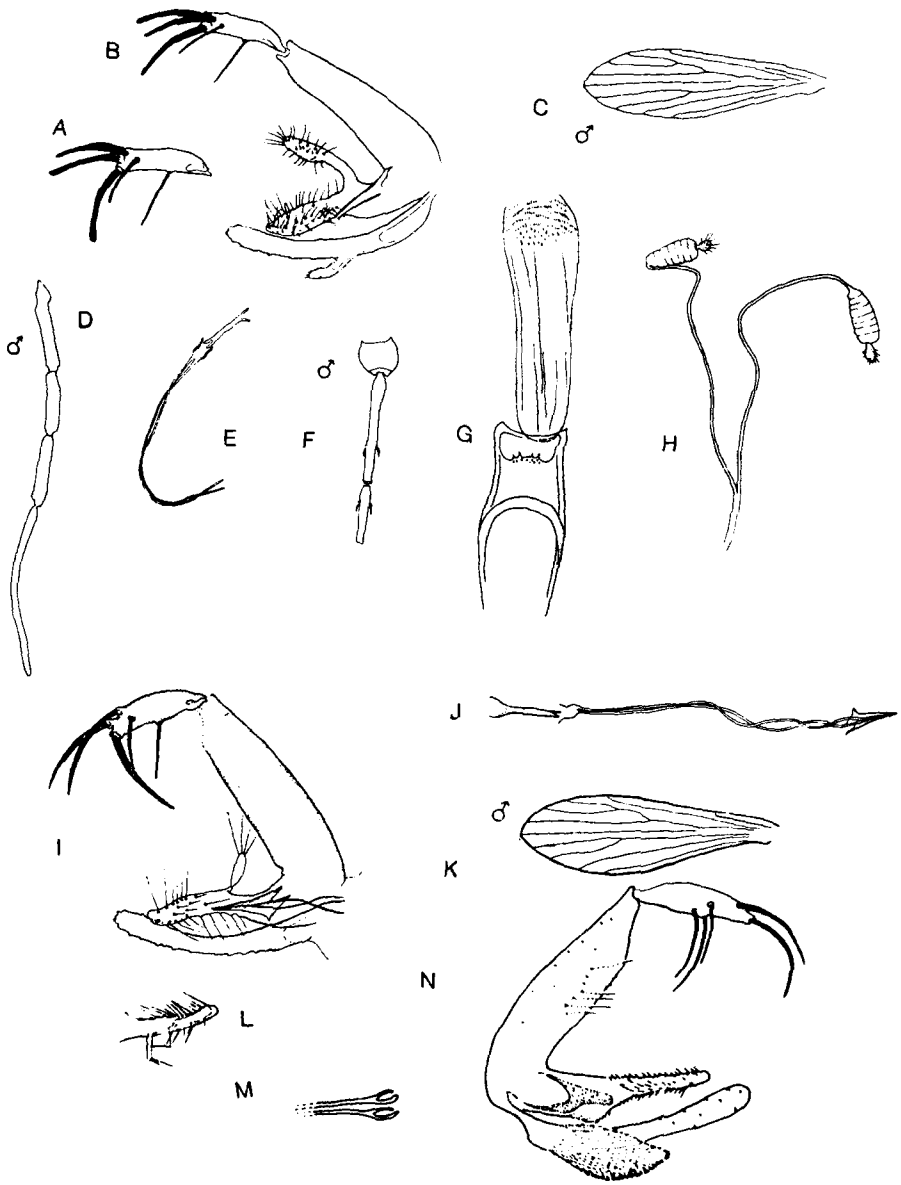


FIG. 278. ***Lutzomyia ramirezi.*** A. Male style; B. Male terminalia; C. Male wing; D. Male palpus; E. Genital pump & filaments; F. Male antenna, scape & basal flagellomeres; G. Female cibarium & pharynx; H. Spermathecae (figs. from Martins et al. 1982). ***Lutzomyia appendiculata.*** I. Male terminalia; J. Genital pump & filaments; K. Male wing; L. Paramere (figs. from Martins et al. 1961b). ***Lutzomyia breviducta.*** M. Tips of genital filaments; N. Male terminalia (figs. from Barretto 1951b).

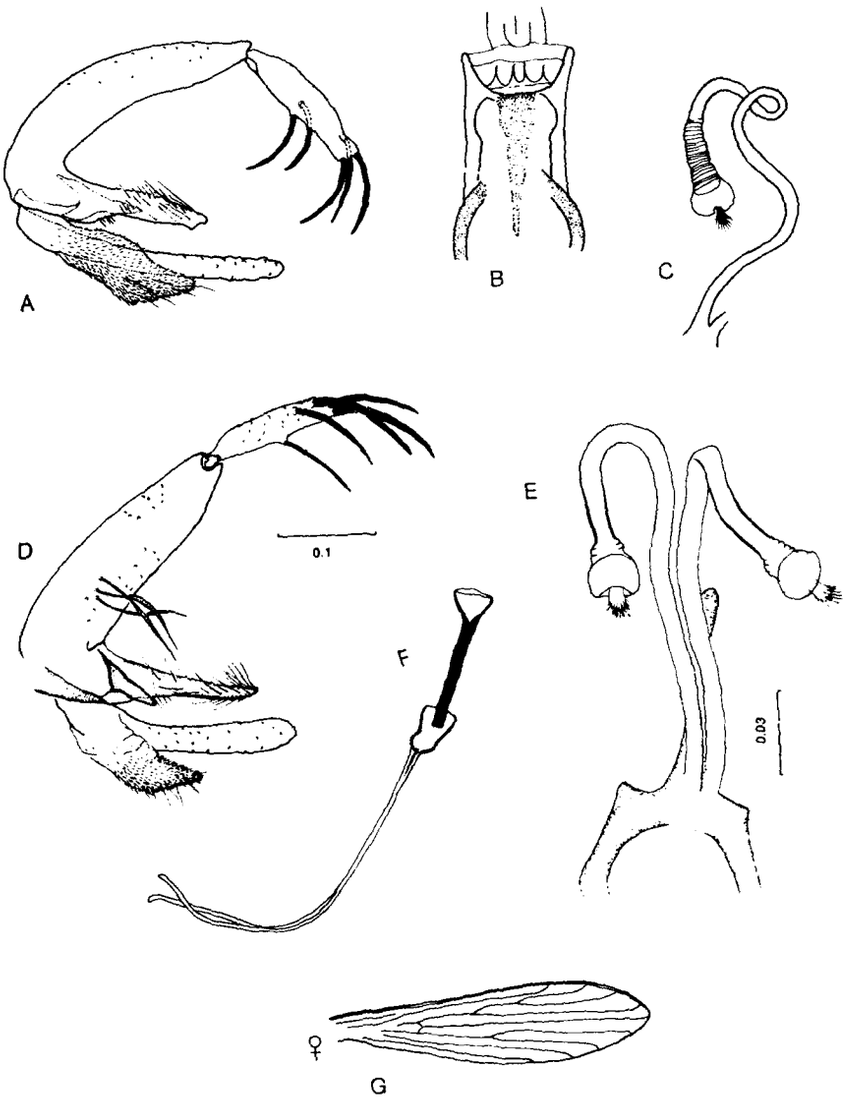


FIG. 279. ***Lutzomyia zikani.*** A. Male terminalia; B. Female cibarium; C. Spermatheca (figs. from Barretto 1950b). ***Lutzomyia borgmeirai.*** D. Male terminalia; E. Spermathecae; F. Genital pump & filaments; G. Female wing.

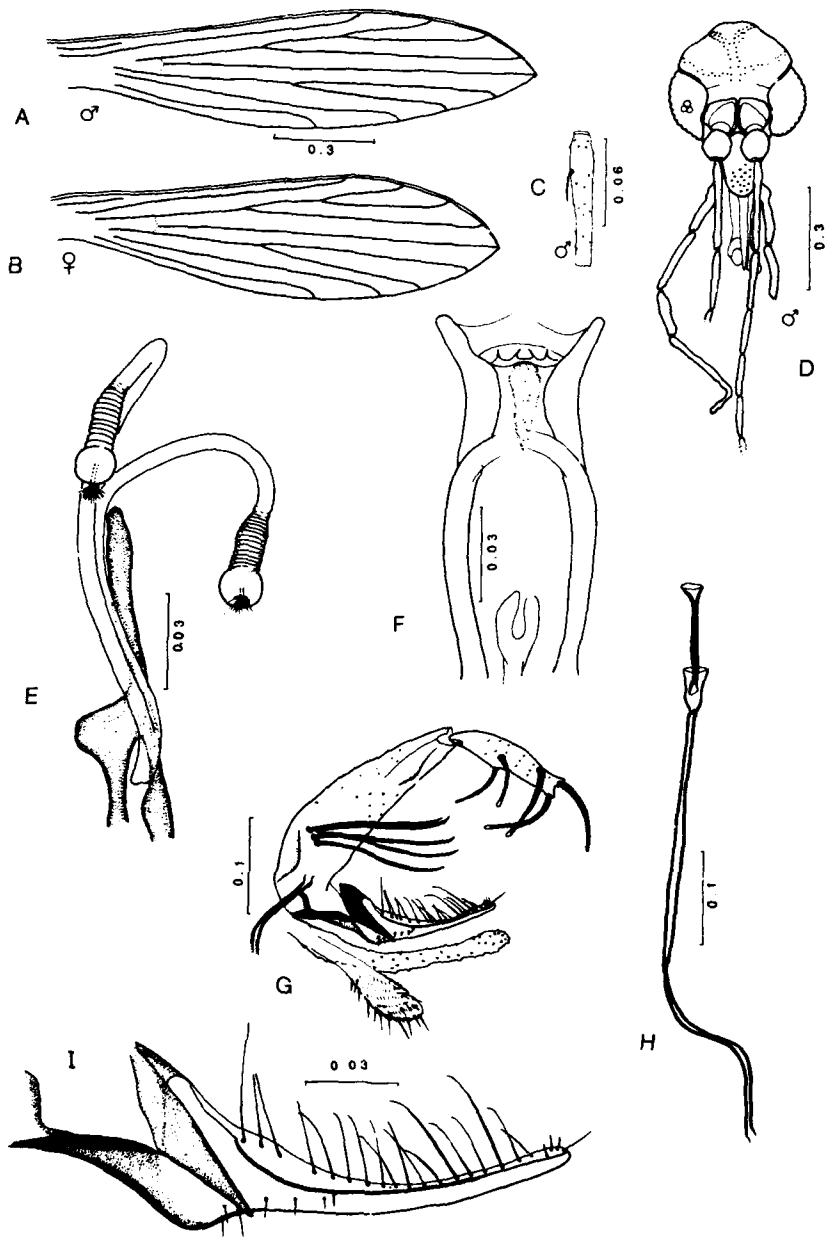


FIG. 280. ***Lutzomyia quinquefer.*** A. Male wing; B. Female wing; C. Male flagellomere II; D. Male head; E. Spermathecae; F. Female cibarium; G. Male terminalia; H. Genital pump & filaments; I. Paramere & aedeagus.

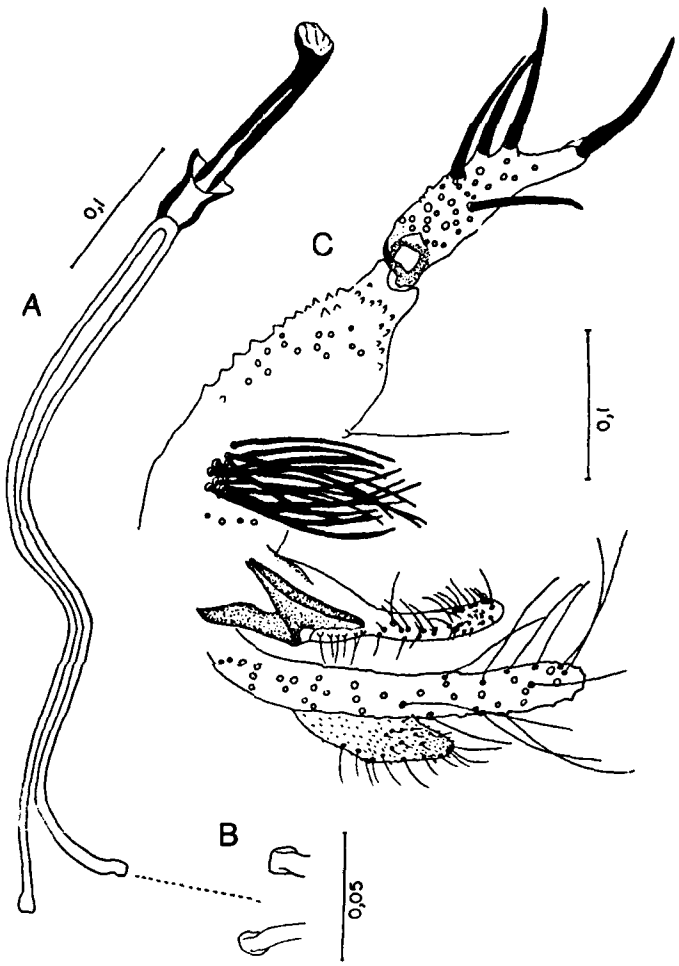


FIG. 281. ***Lutzomyia valderramai.*** A. Genital pump & filaments; B. Filament tips; C. Male terminalia (Figs. from Cazorla 1988).

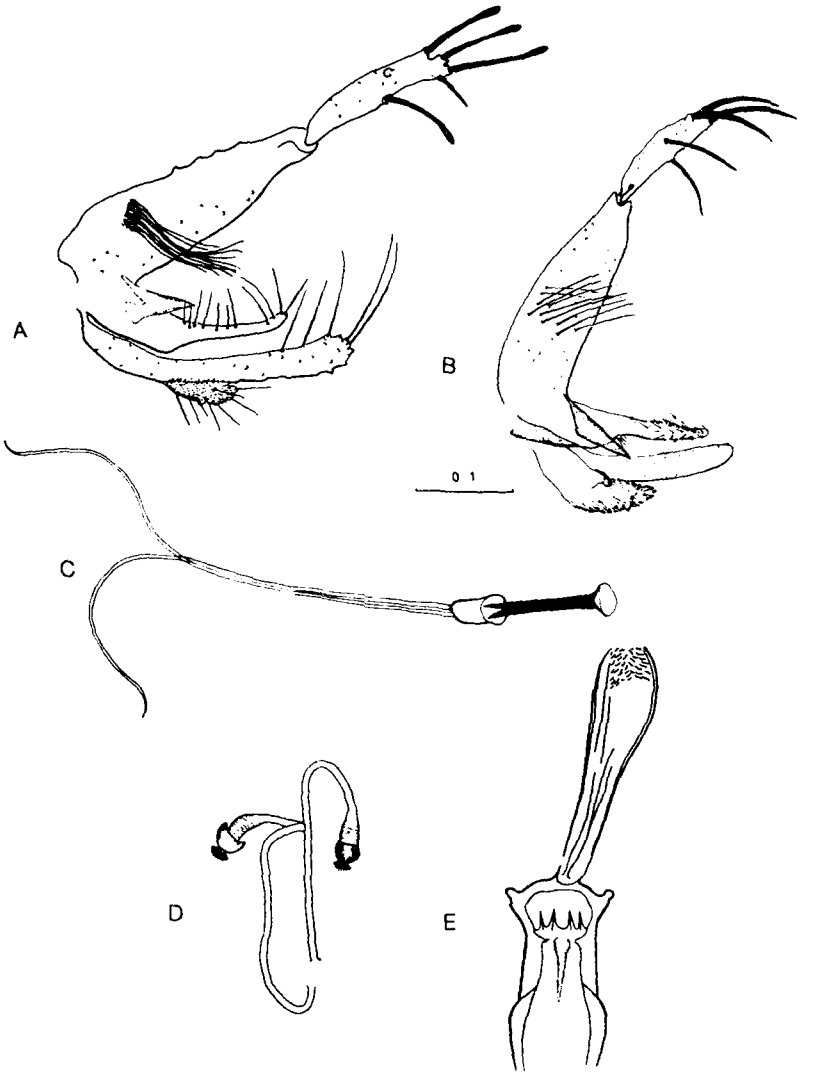


FIG. 282. ***Lutzomyia*** **sp. #2 of Araracuara.** A. Male terminalia (after Morales & Minter 1981).
Lutzomyia longipennis. B. Male terminalia. C. Genital pump & filaments; D. Spermathecae; E. Female cibarium (figs. D & E after Martins et al. 1962c).

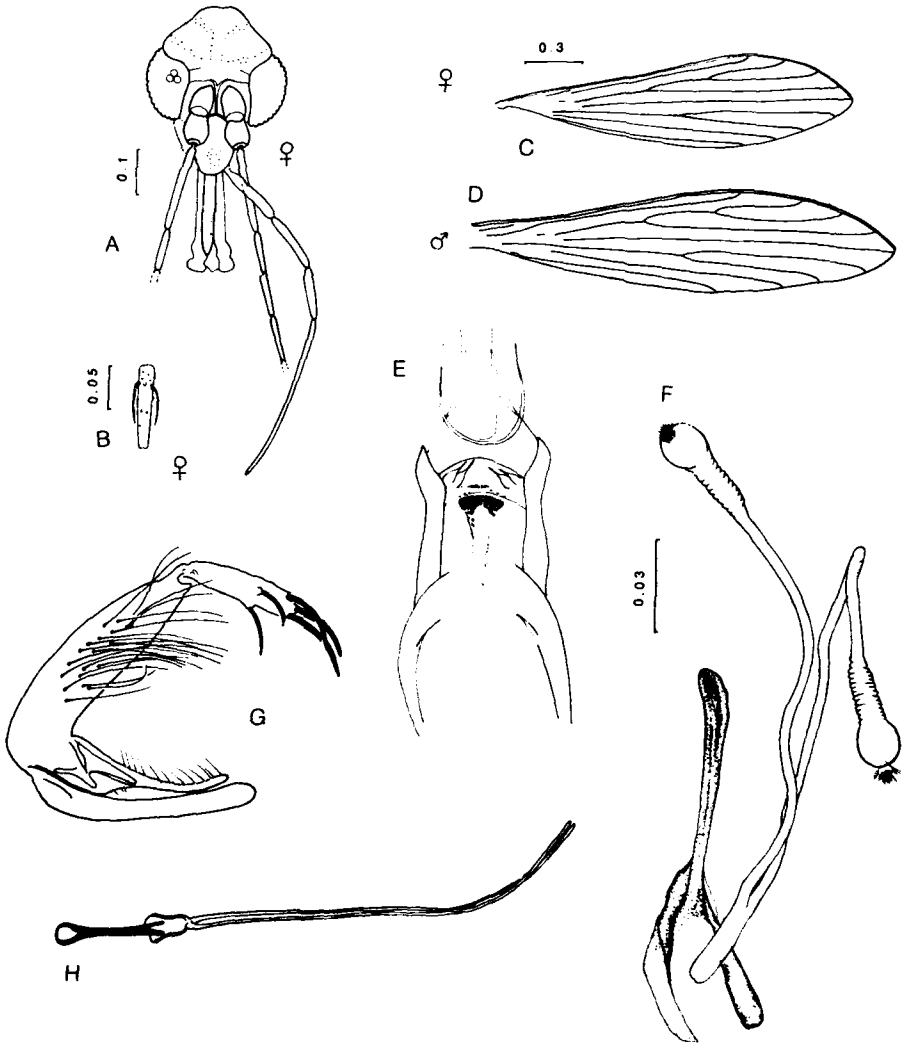


FIG. 283. ***Lutzomyia quechua.*** A. Female head; B. Female flagellomere II; C. Female wing; D. Male wing; E. Female cibarium; F. Spermathecae; G. Male terminalia; H. Genital pump & filaments (male figs. after Martins et al. 1975e).

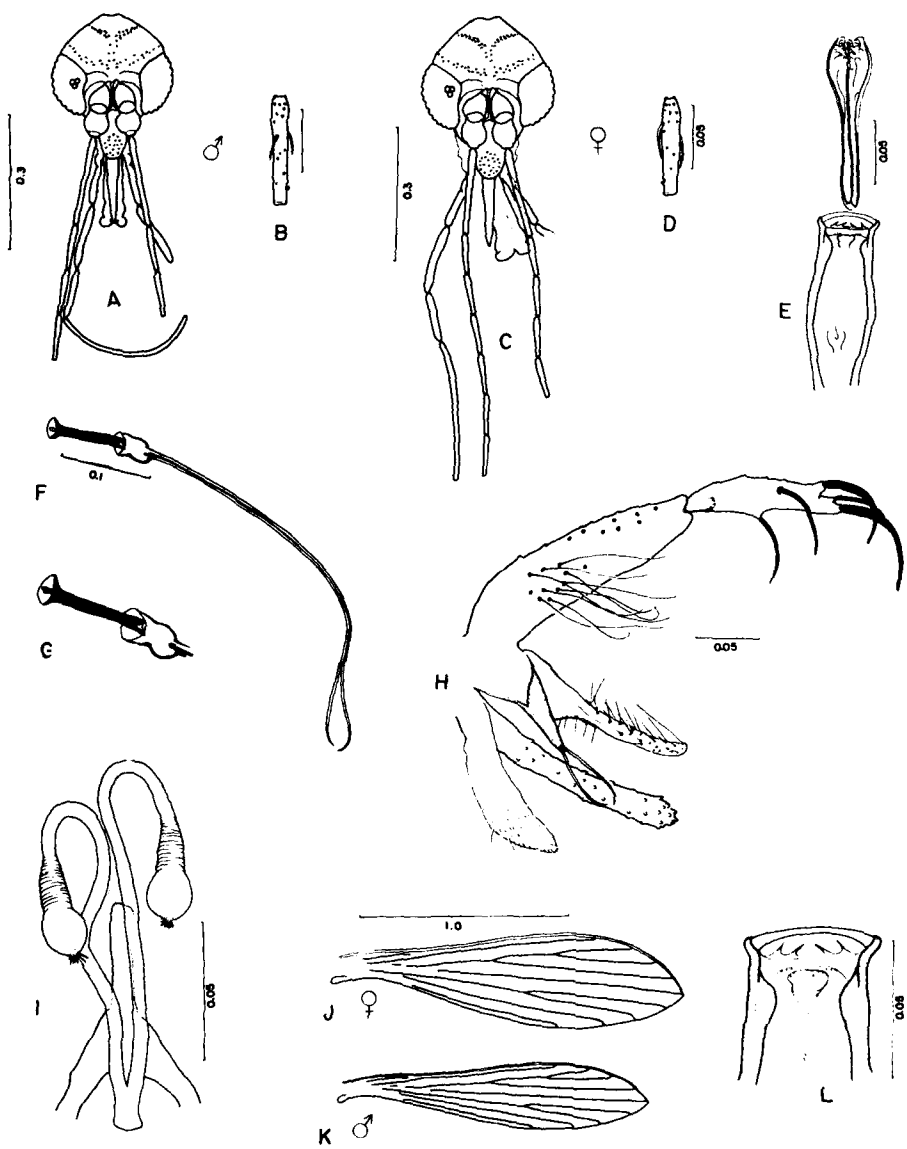


FIG. 284. ***Lutzomyia rorotaensis.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Genital pump; H. Male terminalia; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (figs. from Young 1979).

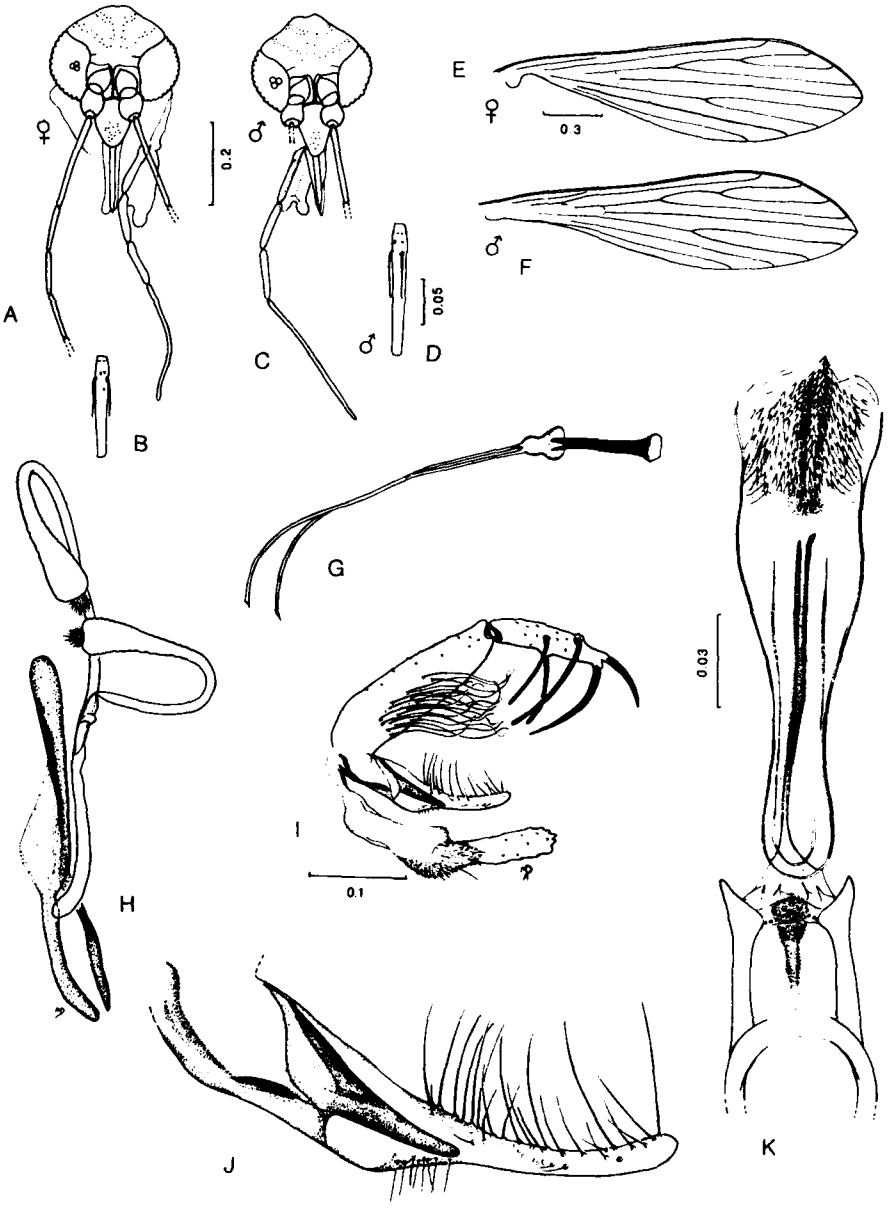


FIG. 285. ***Lutzomyia saccai.*** A. Female head. B. Female flagellomere; C. Male head; D. Male flagellomere; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Spermathecae; I. Male terminalia; J. Paramere & aedeagus; K. Female cibarium & pharnyx (figs. from Feliciangeli 1989a).

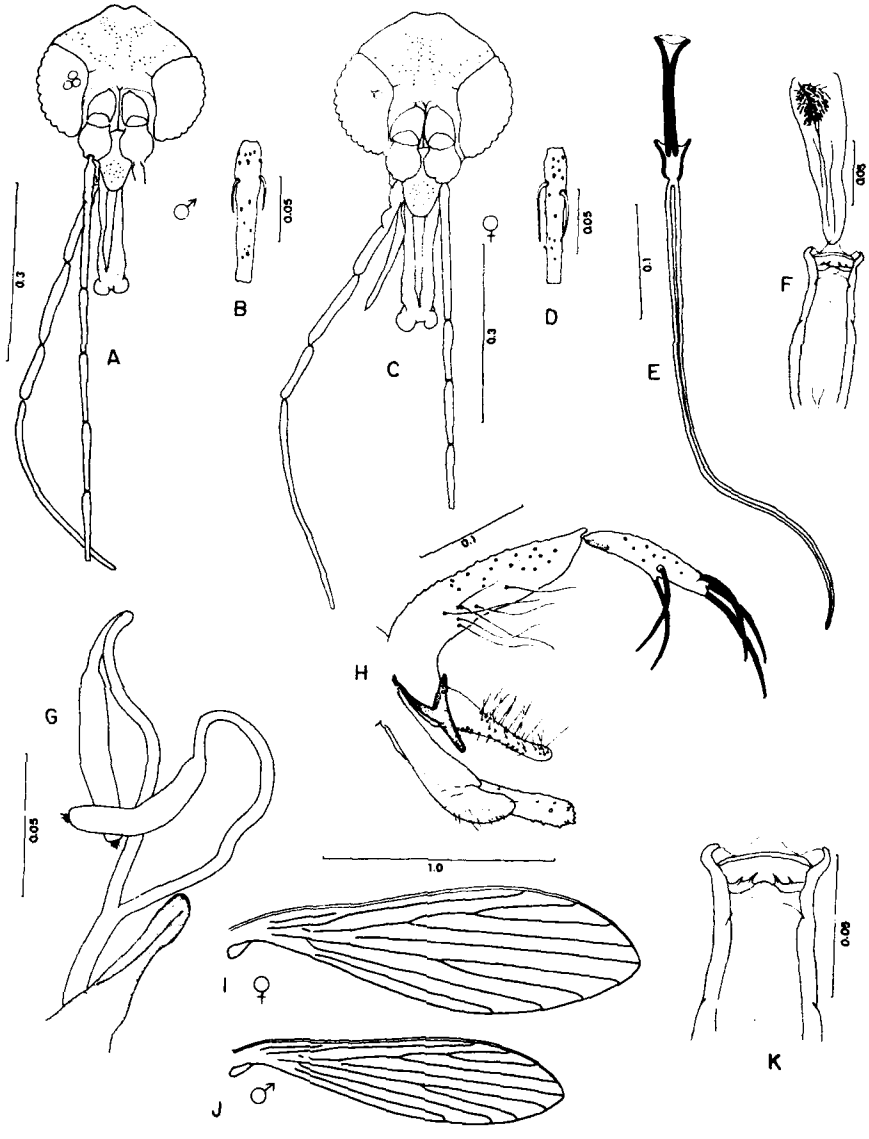


FIG. 286. ***Lutzomyia trinidadensis.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Genital pump & filaments; F. Female cibarium & pharynx; G. Spermathecae; H. Male terminalia; I. Female wing; J. Male wing; K. Female cibarium (figs. from Young 1979).

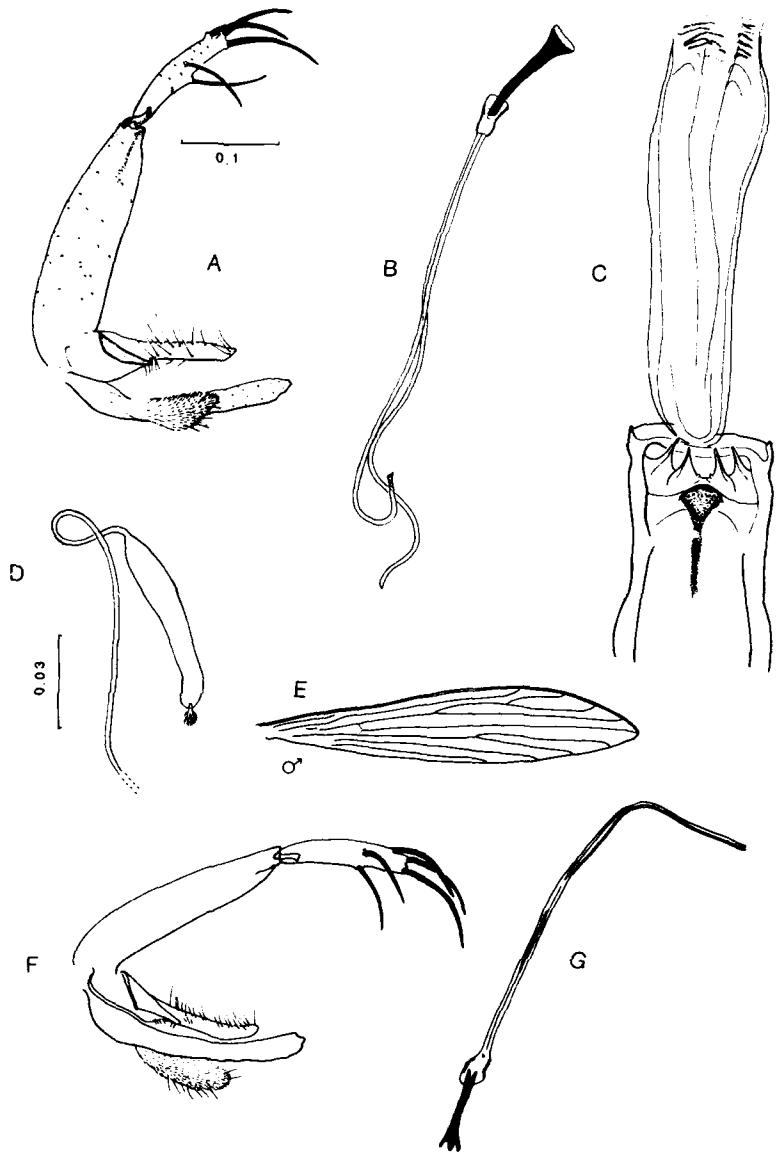


FIG. 287. ***Lutzomyia goiana***. A. Male terminalia; B. Genital pump & filaments; C. Female cibarium & pharynx; D. Spermatheca (fig. D after Martins et al. 1962c).
Lutzomyia machupicchu. E. Male wing; F. Male terminalia; G. Genital pump & filaments (figs. from Martins et al. 1975e).

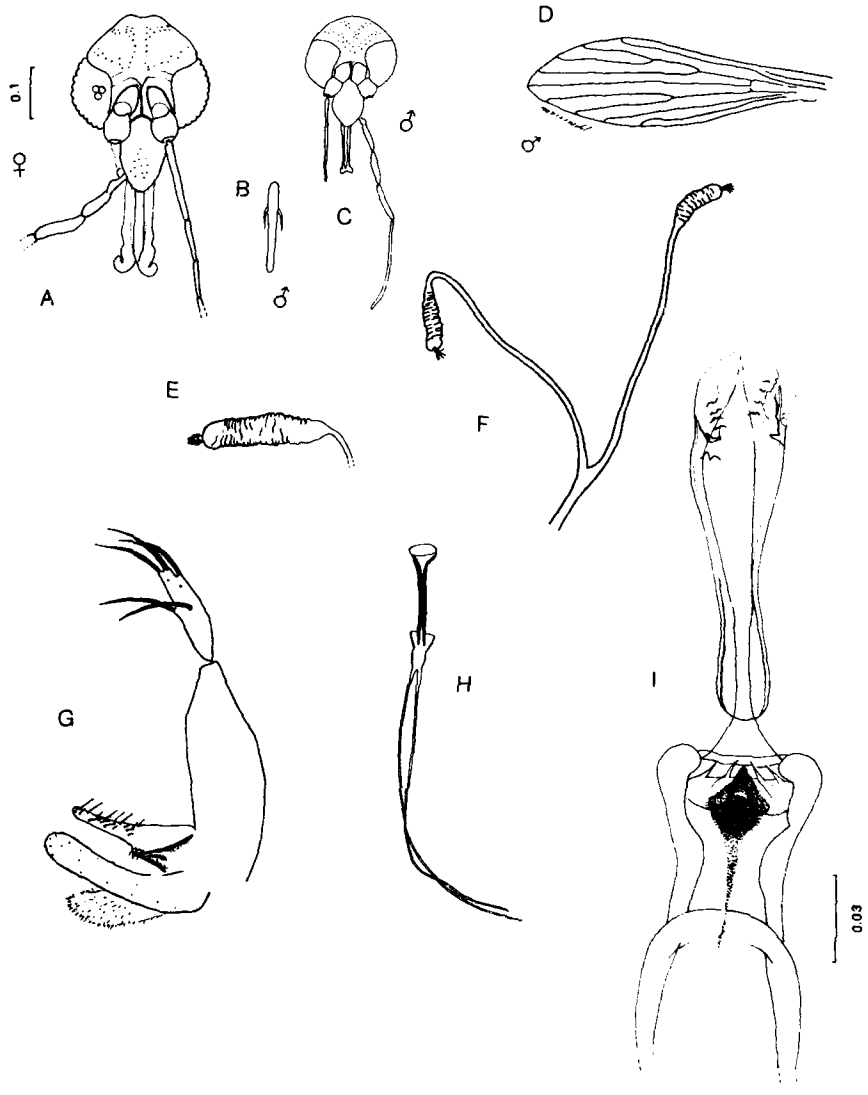


FIG. 288. ***Lutzomyia peresi***. A. Female head; B. Male flagellomere II; C. Male head; D. Male wing; E. Spermatheca; F. Spermathecae; G. Male terminalia; H. Genital pump & filaments; I. Female cibarium & pharynx (all figs. except F & I from Dias et al. 1986a).

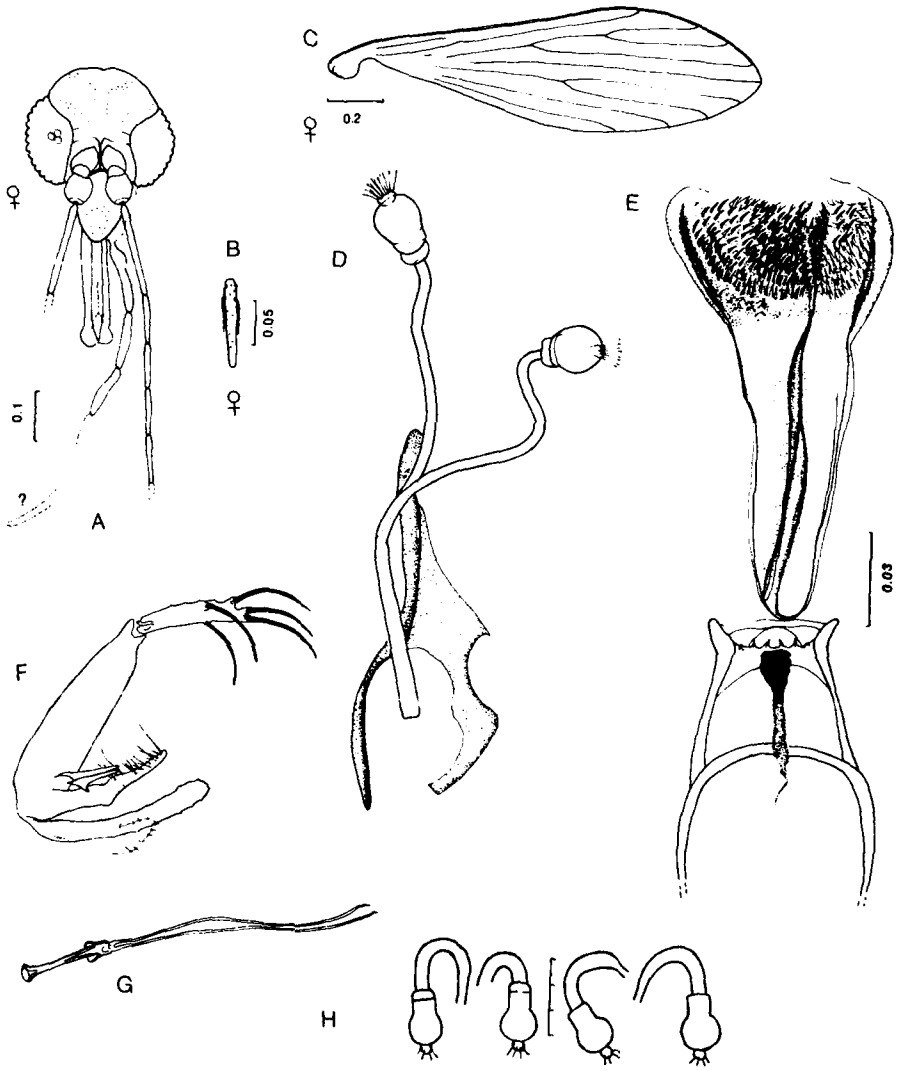


FIG. 289. ***Lutzomyia capixaba.*** A. Female head; B. Female flagellomere II; C. Female wing; D. Spermathecae; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments (male figs. from Dias et al. 1987).
Lutzomyia fonsecai. H. Spermathecae (after Costa Lima 1932).

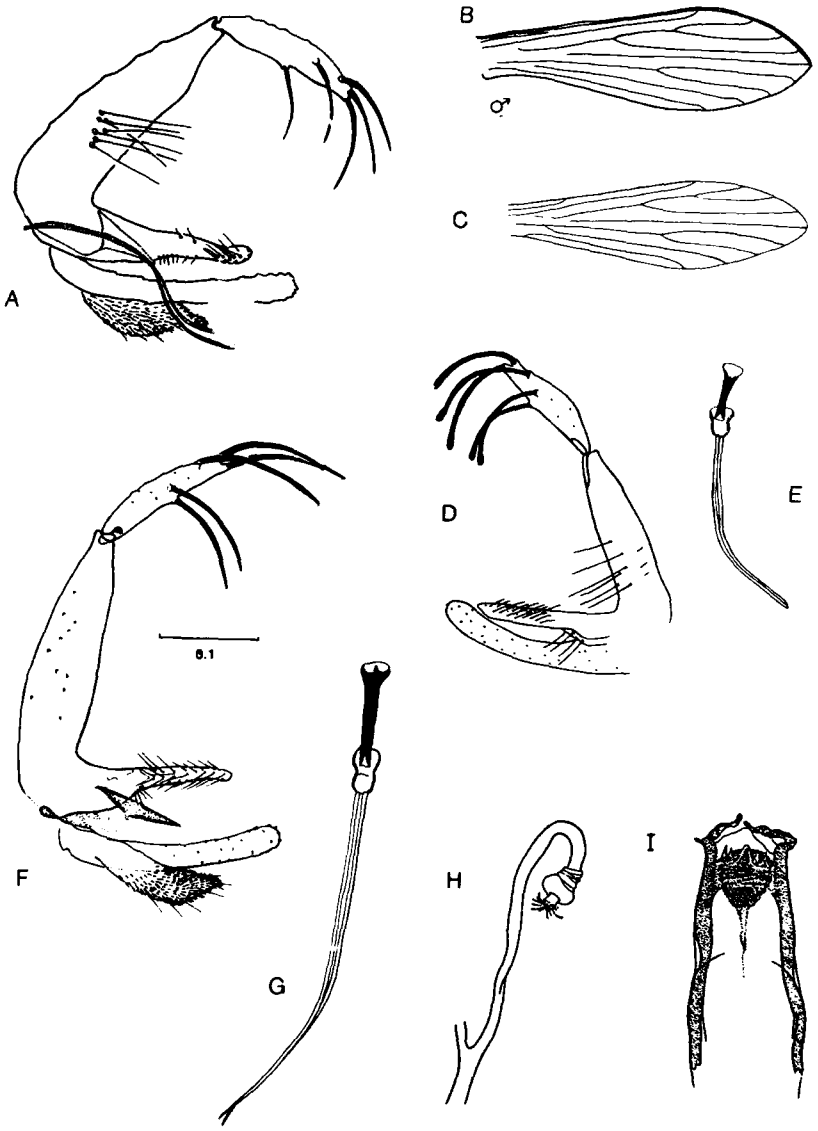


FIG. 290. ***Lutzomyia ferreirana.*** A. Male terminalia; B. Male wing (figs, after Barretto et al. 1958).
Lutzomyia pratti. C. Male wing; D. Male terminalia; E. Genital pump & filaments (figs. after Vargas & Nájera 1951a).
Lutzomyia oswaldoi. F. Male terminalia; G. Genital pump & filaments; H. Spermatheca; I. Female cibarium (figs. H & I after Mangabeira 1942e).

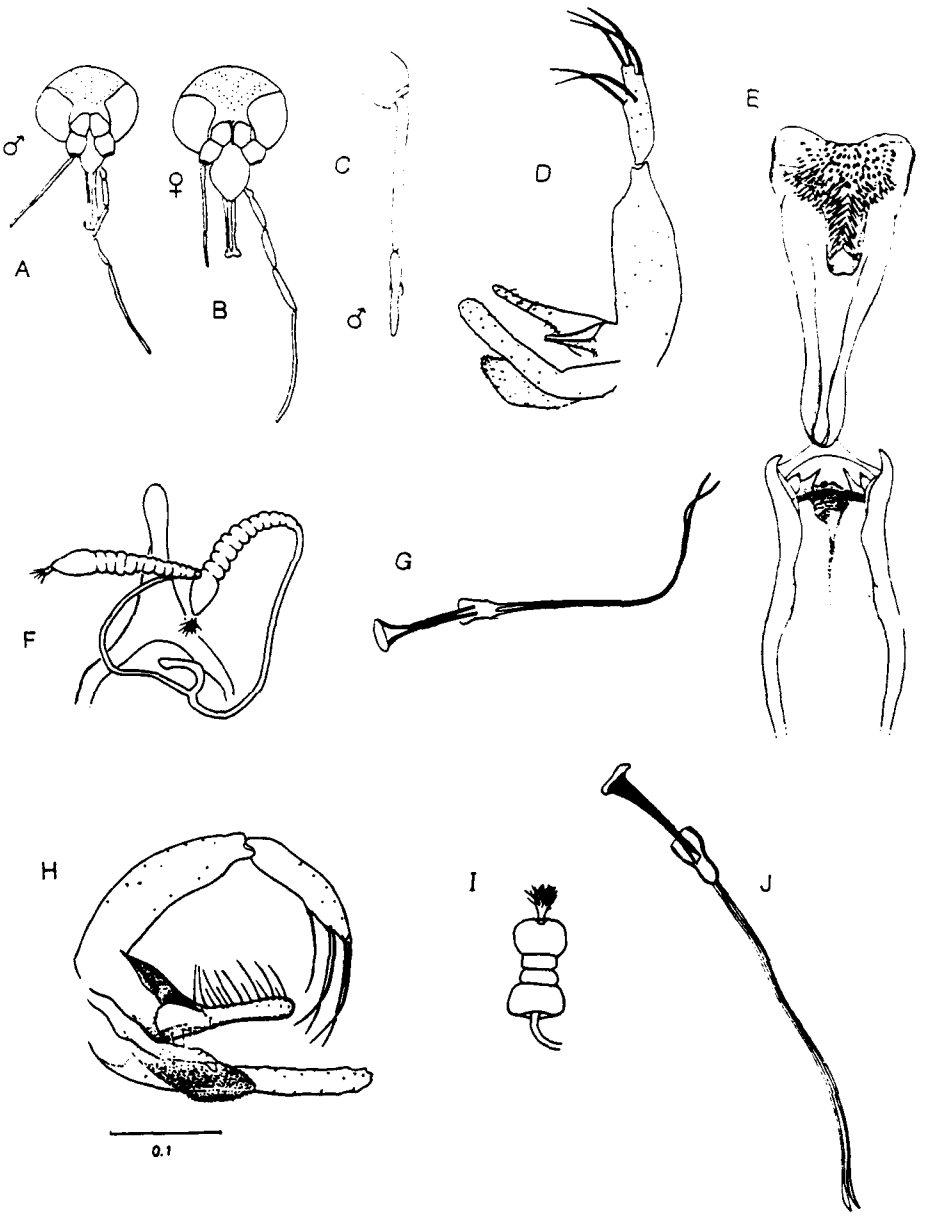
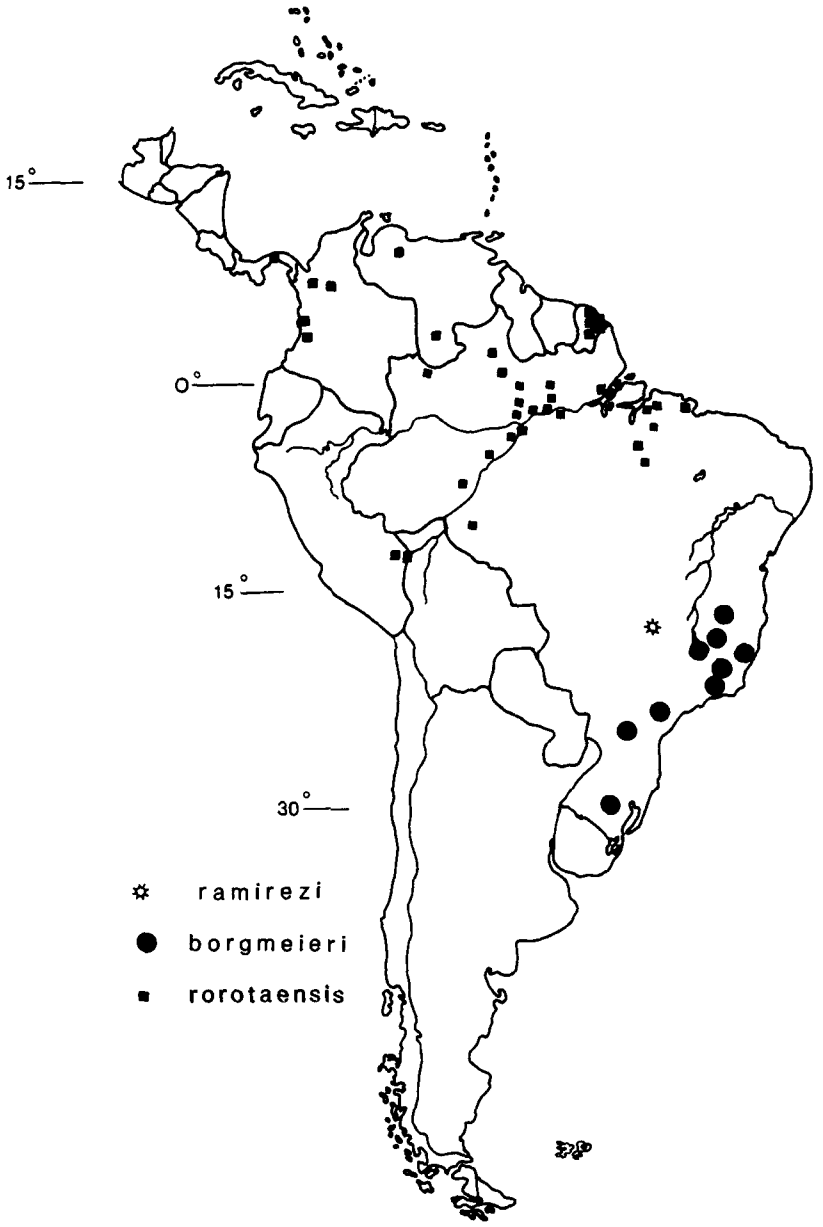
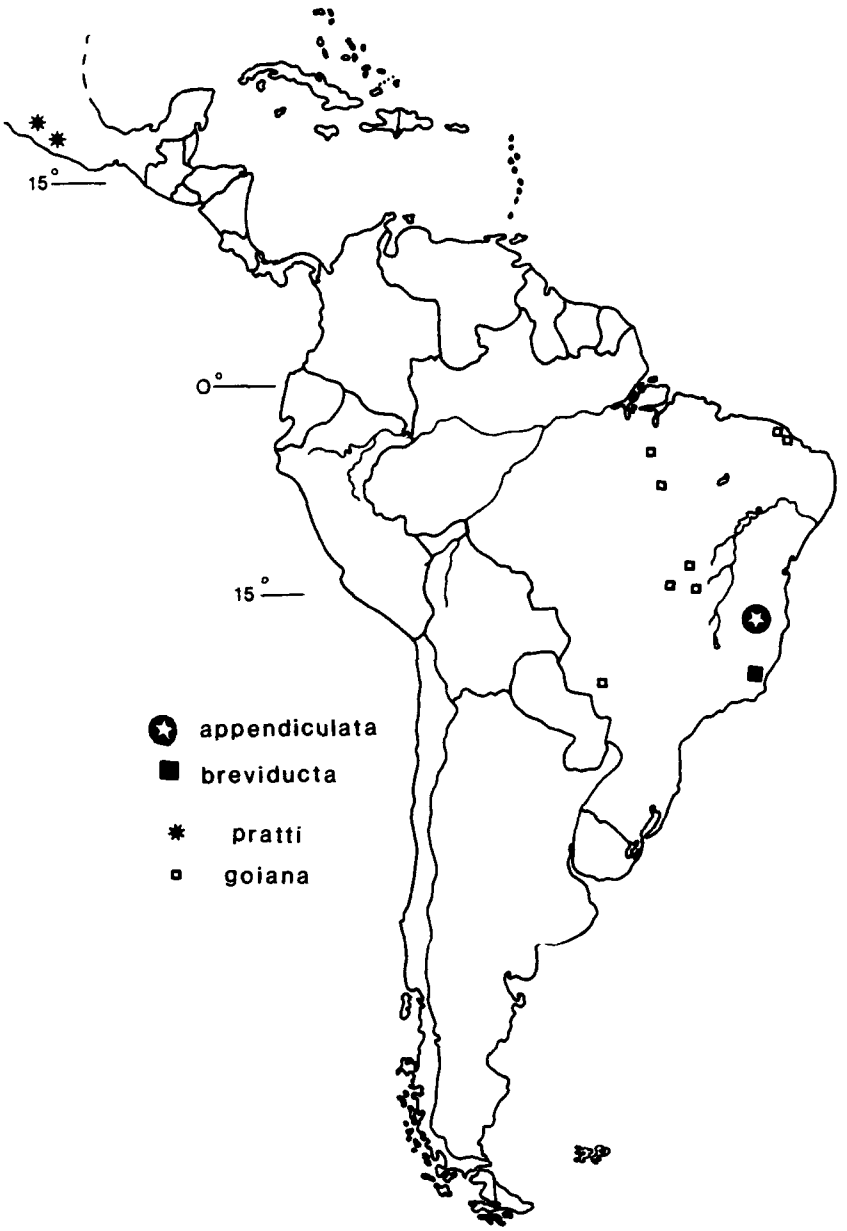


FIG. 291. ***Lutzomyia pusilla.*** A. Male head; B. Female head; C. Male antenna, pedicel & basal flagellomere; D. Male terminalia; E. Female cibarium & pharynx; F. Spermathecae; G. Genital pump & filaments (all figs., except E & F after Dias et al. 1986b).
Lutzomyia alphabetica. H. Male terminalia; I. Spermathecae; J. Genital pump & filaments (fig. I after Barretto 1950a).

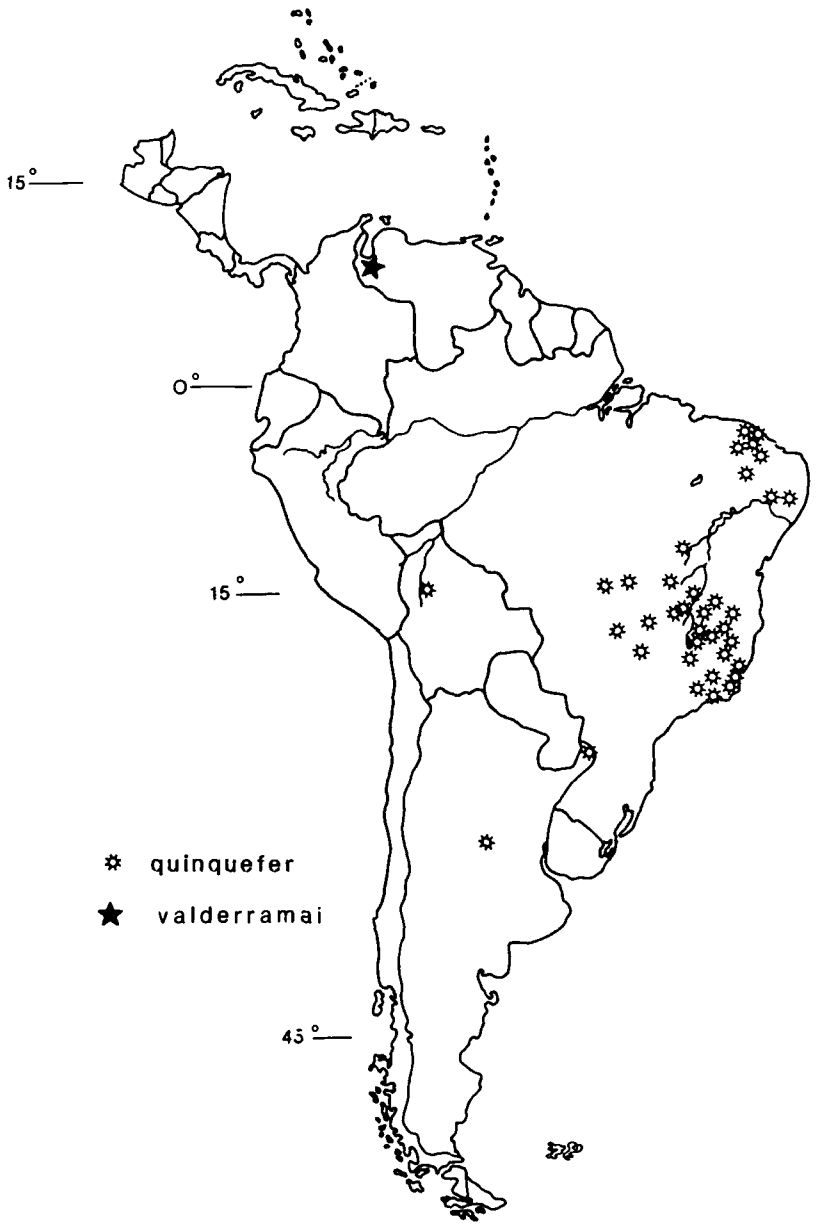


Map 143



Map 144

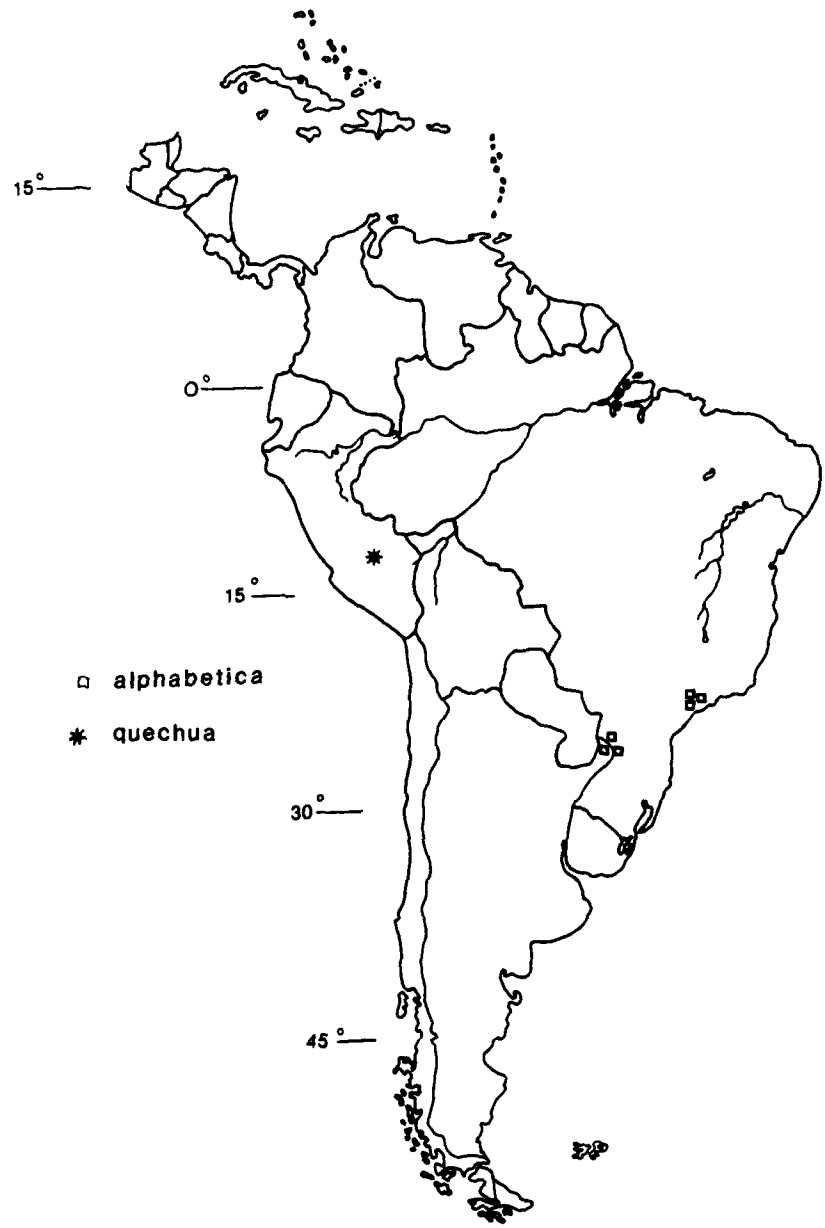
Map 145



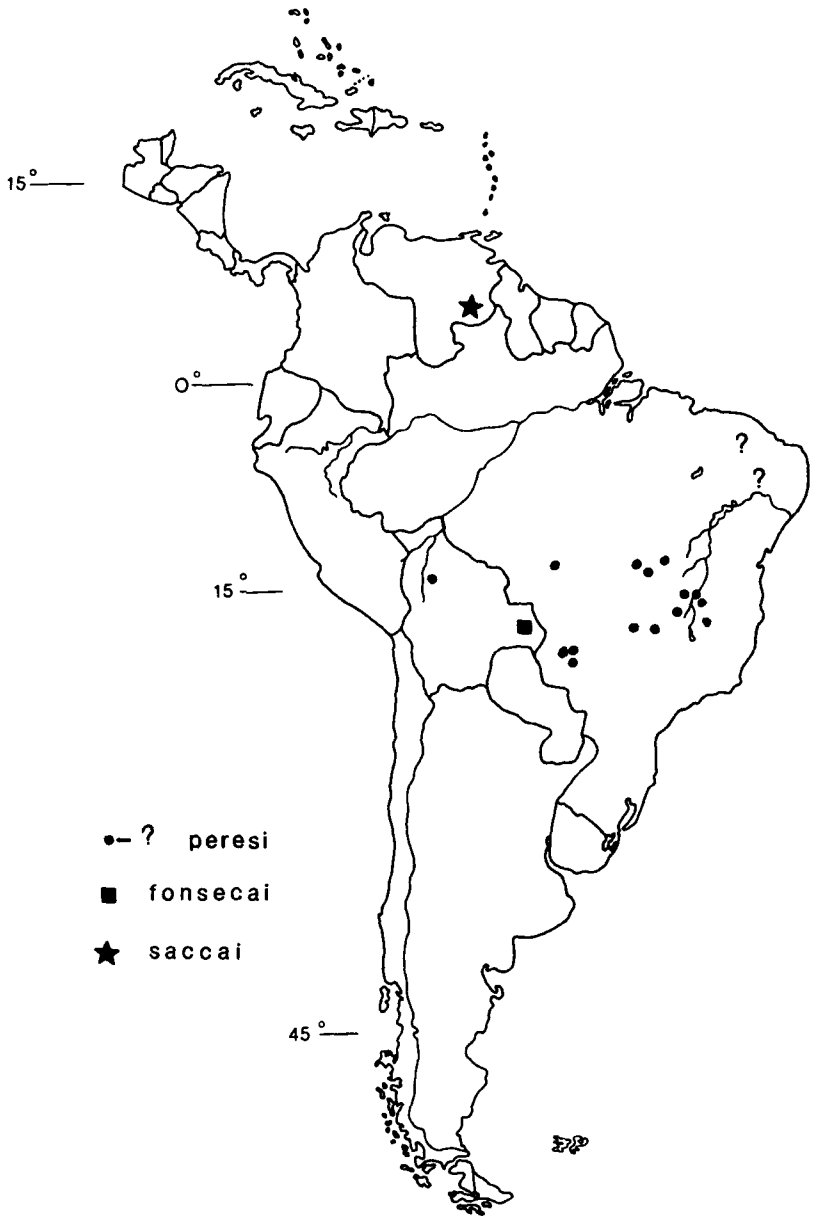
Map 146

Map 147

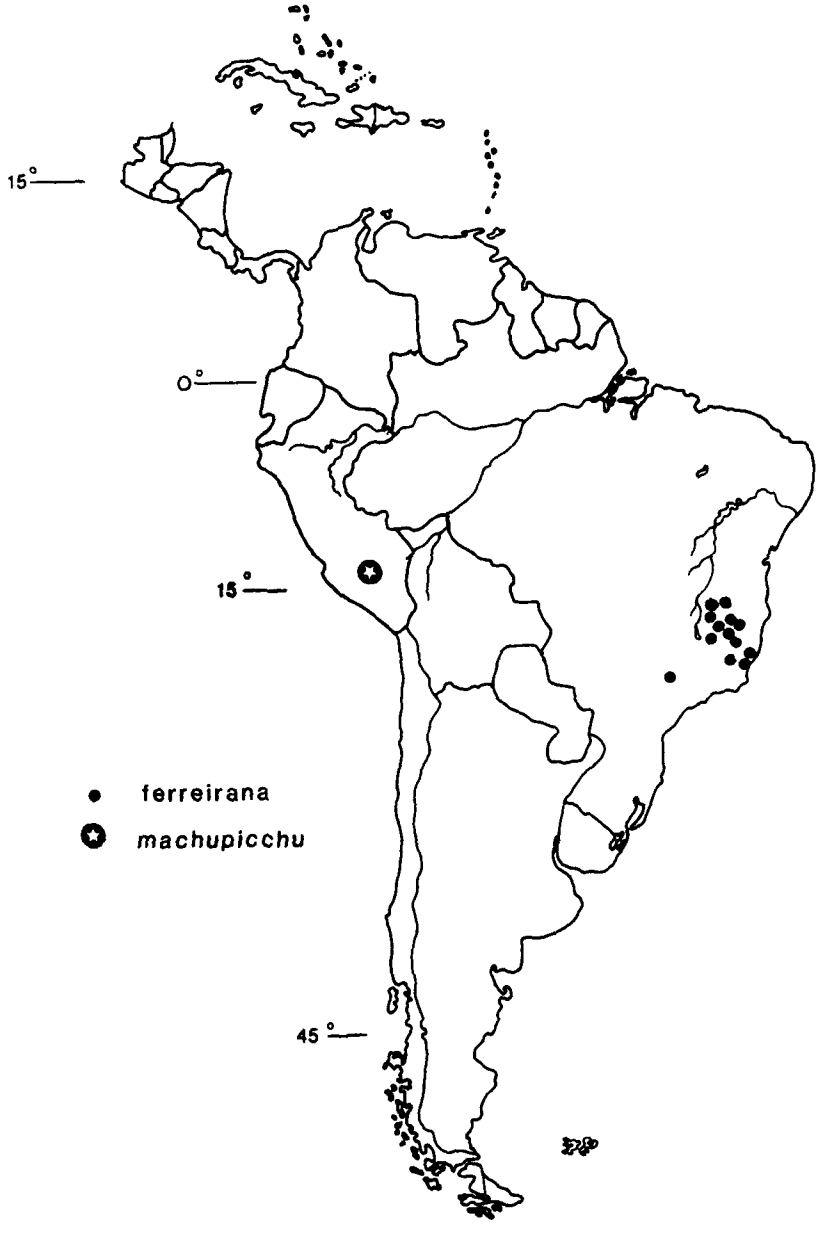
Map 148



Map 149

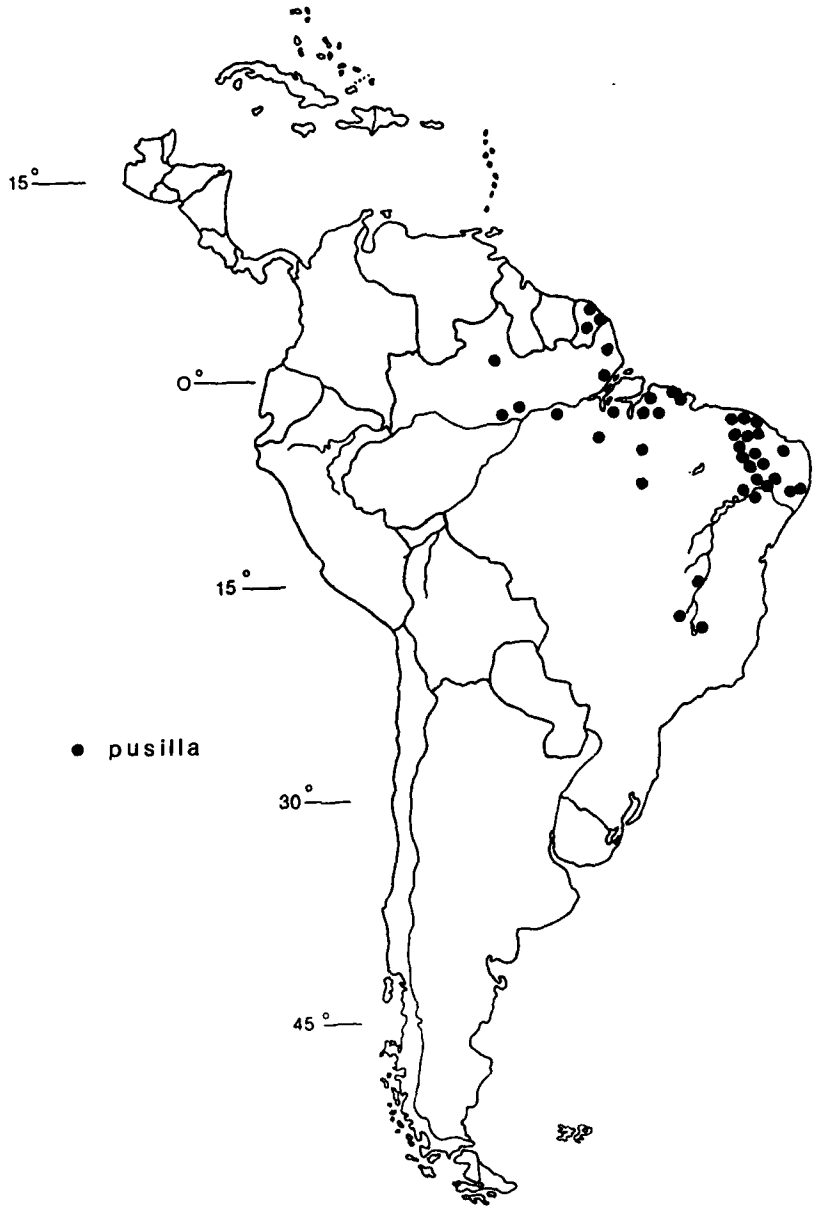


Map 150



Map 151

Map 152



Map 153

SUBGENUS *HELCOCYRTOMYIA* BARRETTO

Phlebotomus species group *vexator* Fairchild & Hertig 1957: 325 (species keyed).
Lutzomyia, subgenus *Helcocyrtomyia* Barretto 1962: 96 (type species: *Phlebotomus peruensis* Shannon by orig. designation). Martins et al. 1978: 68. Williams 1991: 535 (tax., dist.). Artemiev 1991: 73 (in part).
Phlebotomus species group *sanguinarius* Ortiz 1965b: 25 (in part).
Lutzomyia species group *vexatrix* Theodor 1965: 183 (defined). Lewis et al. 1977: 325 (as species group *vexator*).
Lutzomyia, subgenus *Lutzomyia*: Forattini 1971a: 99 (in part); 1973: 212 (in part).
Psychodopygus, subgenus *Trichophoromyia*: Forattini 1971a: 105 (in part); 1973: 416 (in part).
Isolutzomyia, genus Artemiev 1991: 72 [in part, type species: *Isolutzomyia cirrita* (Young & Porter, by orig. designation)].
Lutzomyia, subgenus *Sauromyia* Artemiev 1991: 74 (in part).

Identification. Coloration pale to dark. Antennal ascoids simple. Palpomere 5 variable, shorter than or longer than palps. 3 + 4. ♀ cibarium with 4 nonslanted horizontal teeth; 1 or more rows of vertical teeth; incomplete or complete arch & distinct pigment patch. Spermathecae with or without incipient or complete annulations; individual sperm ducts longer than common duct. ♂ *genitalia*. Coxite with 1 or more persistent setae (exception *L. tortura*). Style with 5 large spines. Aedeagus longer than wide, subtriangular; filament tips simple, inflated or modified. Lateral lobes without modified setae.

Unlike Martins et al. (1978), Williams (1991), and others, we exclude the *oswaldoi* group species from the subgenus *Helcocyrtomyia*. The males in these groups have 5 spines on their styles, the females have 4 horizontal teeth in their cibaria but in other aspects of structure and behavior, the taxa are distinct. Williams (1991) lists the species, plots their geographic distributions on a map and discusses the evolution of the group.

The *Lutzomyia* (*Helcocyrtomyia*) species related to *L. vexator* are reptile/amphibian feeders and occur in the northern Neotropics and in the Nearctic Region. The center of distribution of the other species related to *L. peruensis* is in South America mostly in mountainous areas where some of the species are remarkably similar in structure.

Medical Importance. Many species are anthropophilic and 3 are suspected of transmitting cutaneous leishmaniasis - *L. peruensis* in Peru, *L. ayacuchensis* in Ecuador, and *L. hartmanni* in Colombia.

Key to the Males of the Subgenus *Helcocyrtomyia**

1. Coxite with 7 or more setae forming a compact tuft or a loosely arranged basal median patch 2
   Coxite with 0-6 setae at base of structure 14

2. Style with 6 strong spines. Genital filaments >6.5X length of pump . . . . . *L. vargasi* (Fig. 292)
   Style with 5 strong spines. Genital filaments <6X length of pump 3

3. Coxite with persistent setae loosely arranged, some extending into middle third of structure. Palpomere 5 shorter than, or subequal to palp. 3. Genital filaments ca. 5X length of pump . . . . . *L. cirrita* (Fig. 293)
   Coxite with setae forming a distinct tuft or group at inner base of structure. Palpomere 5 longer than, or subequal, to palp. 3. Genital filaments shorter than 5X genital pump length 4

4. Style with 1 terminal spine . . . . . *L. reclusa* (Fig. 294)
   Style with 2 terminal spines 5

5. Palpomere 5 longer than flagellomere I 6
   Palpomere 5 shorter than flagellomere I 7

6. Paramere clubbed apically, distinctly thinner in middle than at end . . . . . *L. blancasi* (Fig. 295)
   Paramere subequal in width throughout . . . . . *L. noguchii* (Fig. 296)

7. Paramere with mostly spine-like dorsal setae on dorsum 8
   Paramere with thinner, longer dorsal setae on dorsum 10

8. Style with basal spine isolated . . . . . *L. tejadai* (Fig. 297)
   Style with paired basal spines, inserted more or less on same level 9

9. Coxite tuft with longest setae reaching to distal 1/3 of coxite . . . . . *L. ayacuchensis* (Fig. 298)
   Coxite tuft with longest setae reaching only to middle 1/3 of coxite . . . . . *L. peruensis* (Fig. 299)

10. Labrum & lateral lobe subequal in length. Style with isolated subterminal spine much closer to terminal spines than to closest proximal spine 11
    Labrum shorter than lateral lobe. Style with isolated subterminal spine inserted almost equally between terminal spines & closest proximal spine . . 12

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*The males of *L. botella* and *L. imperatrix* have not been discovered.

11. Flagellomere I very long (>0.65 mm), its end reaching beyond base of palpomere 5 . . . . . *L. larensis* (Fig. 301)*
Flagellomere I shorter (<0.50 mm), its end reaching only to palpomere 4 . . . . . *L. erwindonaldoi* (Fig. 302)

12. Paramere relatively broad, its narrowest width nearly as wide as minimum width of lateral lobe . . . . . *L. osornoi* (Fig. 303)
L. caballeroi (Fig. 304)
Paramere more slender as shown 13

13. Palpomere 3 subequal to, or slightly shorter, than twice length of palpomere 4. Paramere more slender in middle than at apex . . . . . *L. strictivilla* (Fig. 305)
Palpomere 3 clearly much shorter than twice length of palpomere 4. Paramere more slender at apex than in middle . . . . . *L. pescei* (Fig. 306)

14. Wing venation with *beta* longer than half of *alpha*. Genital filaments markedly inflated at or near each tip 15
Wing venation with *beta* shorter than half of *alpha*. Genital filaments not markedly inflated at or near each tip 18

15. Paramere as shown, its base with a dorsal spinose hump . . . . . *L. vindicator* (Fig. 308)
Paramere otherwise, without such a conspicuous hump 16

16. Paramere with dorsal setae restricted to apical third of structure . . . . . *L. oppidana* (Fig. 309)
Paramere with dorsal setae covering at least apical half of structure . . . 17

17. Lateral lobe barely surpassing end of paramere. Style with paired basal spines . . . . . *L. stewarti* (Fig. 310)
Lateral lobe extending well beyond end of paramere. Style with isolated basal spine . . . . . *L. vexator* (Fig. 311)

18. Basitarsus of hindleg subequal in length to hindfemur. Aedeagus & genital filament tips with blunt tips . . . . . *L. sanguinaria* (Fig. 312)
Basitarsus of hindleg clearly longer than hindfemur. Aedeagus & genital filament tips pointed 19

19. Coxite without persistent seta or setae . . . . . *L. tortura* (Fig. 314)
Coxite with 1-5 persistent setae at base 20

**Lutzomyia ceferinoi* will key to this couplet but no information is available on flagellomere length of this poorly known species. Arrendondo (1987) states that *L. ceferinoi* has fewer coxite setae (12-14) than *L. larensis* which has 20-24 such setae.

20. Coxite with 2-3 setae at base, one markedly wider than others. Style with all spines on distal half of structure . . . . . *L. scorzai* (Fig. 315)
    Coxite with 3-5 setae at base, none markedly wider than others. Style with basal spine usually on proximal half of structure 21

21. Coxite with 3 setae of equal length. Eyes separated by <4.5 facet diameters. Labrum or palpomere 5 longer than 0.30 mm . . . . . *Lutzomyia* sp. of Pichinde (Fig. 316)
    Coxite with 3-5 setae, one or more distinctly longer than others. Eyes separated by distance equal to 5 or more facet diameters. Labrum or palpomere 5 shorter than 0.28 mm 22

22. Coxite tuft with 2 or more setae clearly longer than greatest width of coxite . . . . . *L. kirigetiensis* (Fig. 318)
    Coxite tuft with no setae longer than greatest width of coxite . . . . . *L. hartmanni* (Fig. 317)

Key to the Females of the Subgenus *Helcocyrtomyia**

1. Wing venation with *beta* longer than half of *alpha* 2
   Wing venation with *beta* shorter than half of *alpha* 6

2. Spermathecae with distinct annulations 3
   Spermathecae otherwise, without annulations, but transverse striations may be present on individual ducts near spermathecae 4

3. Spermatheca with terminal annulation much larger than others. Labrum shorter than flagellomere I . . . . . *L. stewarti* (Fig. 310)
   Spermatheca with terminal annulation nearly same size as others. Labrum longer than flagellomere I . . . . . *L. blancasi* (Fig. 295)

4. Individual sperm ducts shorter than 4X length of genital fork stem 5
   Individual sperm ducts longer than 5X length of genital fork stem . . . . . *L. oppidana* (Fig. 309)

5. Spermathecae and lower portion of individual sperm ducts wider than genital fork stem . . . . . *L. vindicator* (Fig. 308)
   Spermathecae and lower portion of individual sperm ducts less than width of genital fork stem . . . . . *L. vexator* (Fig. 311)

6. Labrum subequal to, or shorter than, maximum head width 7
   Labrum clearly longer than maximum head width 11

*The female of *L. vargasi* remains unknown.

7. Spermathecae as shown. Basitarsus of hindleg shorter than or equal to length of hindfemur . . . . . *L. sanguinaria* (Fig. 312)
Spermathecae otherwise. Basitarsus of hindleg longer than hindfemur . . . 8

8. Palpomere 5 much longer than palpomere 3 9
Palpomere 5 subequal to, or shorter than, palpomere 3 . . . . . *L. hartmanni* (Fig. 317)
L. tortura (Fig. 314)
L. kirigetiensis (Fig. 318)

9. Labrum at least 10% shorter than flagellomere I 10
Labrum & flagellomere I subequal in length . . . . . *L. noguchii* (Fig. 296)

10. Flagellomere I longer than 0.6 mm, subequal to or longer than, head height . . . . . *L. larensis*
Flagellomere I shorter than 0.4 mm, clearly shorter than head height . . . . . *L. strictivilla* (Fig. 305)

11. Flagellomere I longer than labrum . . . . . *L. osornoi* (Fig. 303)
L. caballeroi (Fig. 304)
Flagellomere I subequal to, or shorter than, labrum 12

12. Spermathecae very large, sausage-shaped as shown . . *L. botella* (Fig. 313)
Spermathecae otherwise 13

13. Eyes small, maximum height of eye shorter than, equal to, or but slightly greater than interocular distance 14
Eyes larger, maximum height of eye greater than interocular distance . . 15

14. Spermathecae with distinct hemispherical terminal annulation larger than others . . . . . *L. peruensis* (Fig. 299)
Spermathecae with terminal annulation smaller than others, collar-like . . . . . *L. ayacuchensis* (Fig. 298)

15. Labrum shorter than 0.45 mm 16
Labrum longer than 0.45 mm 17

16. Spermathecae as shown, longer but with shorter individual ducts (<4X length of spermathecae). Scutum uniformly pigmented . . . . . *L. erwindonaldoi* (Fig. 302)
Spermathecae shorter but with long individual ducts (>7X length of spermathecae). Scutum with anterior pale band, contrasting with median-posterior parts . . . . . *L. tejadai* (Fig. 297)

17. Spermatheca as shown, its length ca. 2X maximum width *L. pescei* (Fig. 306)
? *L. imperatrix* (Fig. 307)
Spermatheca otherwise, its length at least 3X maximum width 18

18. Genital fork stem markedly enlarged at apex. Spermathecae & ducts as shown. Palpomere 5 shorter than palp. 3 . . . . . *L. cirrita* (Fig. 293)
Genital fork stem not enlarged at apex. Spermathecae & ducts otherwise. Palpomere 5 longer than palp. 3 . . . . . *L. scorzai* (Fig. 315)
Lutzomyia sp. of Pichinde (Fig. 316)
? *L. ceferinoi*

Lutzomyia* (*Helcocyrtomyia*) *vargasi (Fairchild & Hertig)
Fig. 292

Phlebotomus vargasi Fairchild & Hertig 1961a: 24 (♂, Canon de Lobos, Morelos, Mexico).
Lutzomyia vargasi: Theodor 1965: 183. Forattini 1971a: 103; 1973: 357 (♂, fig). Martins et al. 1978: 168).

Distribution (Map 154). MEXICO (type locality).

Remarks. This species remains known from a single male, the holotype, that may be aberrant because of the 6-spined style.

Lutzomyia* (*Helcocyrtomyia*) *cirrita Young & Porter
Fig. 293

Lutzomyia cirrita Young & Porter 1974: 321 (♂, ♀, Rio Anori, Antioquia, Colombia). Martins et al. 1978: 78. Young 1979: 197 (dist., ♂, ♀ figs.). Porter & De Foliart 1981: 157 (listed).
Phlebotomus cirrita: Ortiz 1978: 206 (listed).
Isolutzomyia cirrita: Artemiev 1991: 72 (as type species for genus *Isolutzomyia*).

Distribution (Map 155). COLOMBIA (Young 1979).

Remarks. Artemiev (1991) recently created the genus *Isolutzomyia* to include *L. cirrita* and 3 other species that were not listed by name. No reasons or diagnosis were given for creating this genus and we fail to understand the need for this proposal.

Lutzomyia* (*Helcocyrtomyia*) *reclusa Fernández & Rogers
Fig. 294

Lutzomyia reclusa Fernández & Rogers 1991: 129 (♂, El Monte, Catache, Cajamarca, Peru).

Distribution. (Map 154). PERU (type locality).

Remarks. The single apical spine of the style rather than paired spines, readily serves to separate the male of *L. reclusa* from others in the subgenus. There is a small subapical seta which apparently represents a vestige of the once present large spine.

Lutzomyia (Helcocyrtomyia) blancasi Galati & Cáceres
Fig. 295

Lutzomyia blancasi Galati & Cáceres 1990: 505 (♂, ♀, Punta de Huarcampun, Bolognesi, Ancash, Peru).

Distribution (Map 159). PERU (Galati & Cáceres 1990).

Remarks. The type locality where this newly described species has only been taken, is a dry, mountainous locality, 3,292 m a.s.l.

Lutzomyia (Helcocyrtomyia) noguchii (Shannon)
Fig. 296

Phlebotomus noguchii Shannon 1929, *in* Noguchi et al. 1929: 996 (♂, Rimac Valley, Lima, Peru). Shannon 1929: 84 (♂, ♀ figs.). Hertig 1938: 463 (♀ figs.); 1942: 23 (biol., relationship with *Bartonella*); 1943: 249 (tax.). Rozeboom 1947a: 181 (figs.). Fairchild & Hertig 1957: 330 (refs., keyed, tax.).
Flebotomus noguchii: Barretto 1947a: 214 (refs.).
Lutzomyia noguchii: Barretto 1962: 96 (listed). Forattini 1973: 261 (figs., tax.). Martins et al. 1978: 79 (dist.). Llanos 1983: 183 (listed, Peru). Young et al. 1985: 141 (♂, ♀ figs.). Vargas & Peréz 1985: 5 (Ancash, Peru). Galati & Cáceres 1990: 511 (♂, ♀, figs.). Fernández & Rogers 1991: 129 (Catache, Peru; cf. to *reclusa*).

Distribution (Map 156). PERU (Martins et al. 1978; ♂♂, near Arequipa, 1987, E. Rogers).

Remarks. Hertig (1942) summarized his extensive work on the distribution and habits of *L. noguchii*, noting that "the chief or perhaps sole hosts of this sandfly are field-mice." Earlier, Shannon (1929) misidentified many specimens of *L. noguchii* (as *L. verrucarum*) and mistakenly believed that *L. noguchii* was the vector of *Bartonella* to man in the Peruvian Andes (Hertig 1942). This species was recently collected in a cave near Arequipa, Peru (E. Rogers, pers. comm.), a locality representing the southernmost locality from which it has been found.

Lutzomyia (Helcocyrtomyia) tejadai Galati & Cáceres
Fig. 297

Lutzomyia tejadai Galati & Cáceres 1990: 510 (♂, ♀, Huncuymarán, Huánuco, Peru).

Distribution (Map 157). PERU (Galati & Cáceres 1990).

Remarks. The male of *L. tejadai* differs from *L. pescei* in details of the terminalia, especially the broader coxite setae and the shape and setation of the parameres. The female of *L. pescei* has longer individual sperm ducts and labrum, among other distinguishing features.

Lutzomyia (Helcocyrtomyia) ayacuchensis Cáceres & Galati
Fig. 298

Lutzomyia ayacuchensis Cáceres & Galati 1988: 55 (♂, ♀, Quebrada Saquihuacca, 2,740 m above sea level, Parinacochas Prov., Ayacucho, Peru). Takaoka et al. 1990: 701 (nat. leishmanial infections, Ecuador). Gomez & Hashiguchi 1991: 407. Alexander 1992a: 37 (Ecuador records); 1992c: 125 (Ecuador).

Distribution (Map 158). PERU (Cáceres & Galati 1988); ECUADOR (Takaoka et al. 1990; Alexander et al. 1992a,c).

Remarks. This species is closely allied to *L. peruensis* from which it differs in the female by the shape of the spermathecae. The male of *L. ayacuchensis* has longer setae of the coxite tuft, the longest of which extend to the level of the distal third of the coxite. Comparable setae of *L. peruensis* extend only to the middle third of the coxite. Other metrical differences are given by Cáceres & Galati (1988).

Females of *L. ayacuchensis* have been found naturally infected with *Leishmania* in Ecuador (Gomez & Hashiguchi 1991).

Lutzomyia (Helcocyrtomyia) peruensis (Shannon)
Fig. 299

Phlebotomus peruensis Shannon 1929, *in* Noguchi et al. 1929: 996 (♂, ♀, Matucana, Lima, Peru). Shannon 1929: 85 (♂, ♀). Hertig 1942: 23 (biol., relationship with *Bartonella*); 1943: 249 (♀ fig.); 1948a: 8. Fairchild & Hertig 1957: 330 (refs., figs., keyed).

Flebotomus peruensis Barretto 1947a: 217 (refs.).

Lutzomyia peruensis: Barretto 1962: 96. Theodor 1965: 183 (spermatheca fig.). Forattini 1973: 234 (figs., tax.). Llanos et al. 1975b: 671 (Peru). Martins et al. 1978: 79 (dist., refs.). Llanos 1983: 183 (listed, Peru). Young et al. 1985:

141 (♂, ♀ figs.). Pérez et al. 1991: 60 (nat. infection, *Leishmania*). Wallbanks et al. 1991: 60 (aphid honeydew ingestion).

Distribution (Map 158). PERU (Martins et al. 1978; Llanos 1983; Pérez et al. 1991; ♂♂, ♀♀, near Otuzco, Trujillo, 1981, L. Cruzado).

Remarks. *Lutzomyia peruensis*, a large & anthropophilic sand fly, occurs in the Peruvian Andes at elevations ranging from 800 m to above 3,200 m above sea level (Hertig 1942; E. Pérez, pers. comm.). Unidentified *Leishmania* (Romero et al. 1987) were recovered from hamsters that had been inoculated with triturated *L. peruensis* captured in the Rimac Valley (Herrer 1982). Later, Pérez et al. (1991) isolated *Leishmania peruviana* from *L. peruensis* from the Huayllacallan Valley, Ancash, Peru.

Cáceres & Galati (1988) illustrated both sexes of *L. peruensis* and compared them with *L. ayacuchensis*.

Lutzomyia* (*Helcocyrtomyia*) *ceferinoi (Ortiz & Álvarez)
Fig. 300

Phlebotomus ceferinoi Ortiz & Álvarez 1963a: 285 (♂, Biscucuy, Portuguesa, Venezuela); 1963b: 314 (♂). Ortiz 1978: 207 (♂, redescript.).
Lutzomyia ceferinoi: Theodor 1965: 183 (listed). Forattini 1973: 351 (♂ fig.). Martins et al. 1978: 78. Feliciangeli 1980: 261 (keyed). Ramirez Pérez et al. 1982b: 58 (♂ fig., Tachira, Venezuela). Cazorla & Añez 1988: 315 (tax., ♂, ♀). Añez et al. 1988: 457 (Mérida, Venezuela). Feliciangeli 1988: 109 (Venezuela).

Distribution (Map 155). VENEZUELA (Ortiz & Álvarez 1963a; Ramirez Pérez et al. 1982b; Cazorla & Añez 1988).

Remarks. The original description of *L. ceferinoi* was based on a single, partially damaged male which is now lost (Cazorla & Añez 1988). Ortiz & Álvarez (1963a,b) published the description twice, and, later Ortiz (1978) and Cazorla & Añez (1988) redescribed the male but their specimens were not taken from the type locality nor did they represent type material.

Furthermore, Cazorla & Añez (1988) described the female of "*L. ceferinoi*" from Mérida State, Venezuela but there is no convincing evidence that it is conspecific with *L. ceferinoi*.

Therefore, the identify and status of this species are uncertain. Efforts should be made to collect specimens at the type locality and designate a neotype, and, if possible, obtain associated females through individual rearings.

The records of *L. ceferinoi* from Tachira State, Venezuela (Ramirez Pérez et al. 1982b), like these others from localities located away from the type locality, may not represent this species.

Lutzomyia (*Helcocyrtomyia*) *larensis* Arredondo
Fig. 301

Lutzomyia larensis Arredondo 1987: 395 (♂, ♀, Yacambú National Park, Lara, Venezuela).

Distribution (Map 159). VENEZUELA (type locality & 1 ♂, Trujillo State, 1972, no other data).

Lutzomyia (*Helcocyrtomyia*) *erwindonaldoi* (Ortiz)
Fig. 302

Phlebotomus erwindonaldoi Ortiz 1978: 205 (♂, Caja Seca, Zulia, Venezuela).
Lutzomyia erwindonaldoi: Young et al. 1987: 588 (nat. flagellate infection, Colombia). Young & Morales 1987: 655 (♂, ♀ figs., Colombia). Kreutzer et al. 1988: 453 (karyotyping). Feliciangeli 1988: 109 (listed).

Distribution (Map 154). VENEZUELA (Ortiz 1978; 1 ♂, Bueniquea, Tachira, 1979, D. Feliciangeli); COLOMBIA (Young & Morales 1987).

Remarks. Females of *L. erwindonaldoi* are anthropophilic and are relatively common in coffee plantations at Arboledas and Durania, Norte de Santander Department, Colombia. The sexes have been properly associated (Young & Morales 1987).

Lutzomyia (*Helcocyrtomyia*) *osornoi* (Ristorcelli & Van Ty)
Fig. 303

Phlebotomus osornoi Ristorcelli & Van Ty 1941: 260 (♂, Valle de Capuli, Narino, Colombia). Rozeboom 1947a: 177 (♂).
Phlebotomus montoyai Sherlock 1962: 328 (♂, Chirristis, Nariño, Colombia). Young & Porter 1974: 324 (as synonym of *osornoi*, full refs.).
Lutzomyia osornoi: Barretto 1962: 96. Theodor 1965: 183. Martins et al. 1978: 79 (refs.). Young 1979: 201 (refs., ♂, ♀ figs.). Alexander et al. 1992a: 37 (Ecuador record); 1992c: 125 (Ecuador).
Lutzomyia montoyai: Forattini 1971a: 103; 1973: 261 (as junior synonym of *noguchii*).

Distribution (Map 154). COLOMBIA (type locality); ECUADOR (Alexander et al. 1992a,c); PERU (Pérez et al. 1991).

Remarks. Forattini's belief that *L. osornoi* and *L. noguchii* are conspecific is incorrect. There are numerous structural differences between the taxa as shown in Figs. 296 & 303. The Peruvian record of *L. osornoi* by Pérez et al. (1991) is based solely on the female.

Lutzomyia* (*Helcocyrtomyia*) *caballeroi Blancas, Cáceres & Galati
Fig. 304

Lutzomyia caballeroi Blancas, Cáceres & Galati 1989: 455 (♂, ♀, Pumanachay, Ancash, Peru).

Distribution (Map 157). PERU (Blancas et al. 1989).

Remarks. All specimens of *L. caballeroi* have been captured in the Department of Ancash, Peru at elevations between 2,550 m and 2,744 m a.s.l. Differences between both sexes of this species and those of *L. osornoi* are slight and the two forms may represent a single species (Blancas et al. 1989).

Lutzomyia* (*Helcocyrtomyia*) *strictivilla Young
Fig. 305

Lutzomyia strictivilla Young 1979: 206 (♂, ♀, Rio Anori, Antioquia, Colombia). Porter & De Foliart 1981: 158 (mention). Feliciangeli 1988: 109 (Venezuela). Alexander 1992a: 37 (Ecuador); 1992c: 125 (Ecuador).

Distribution (Map 157). COLOMBIA (type locality); ECUADOR (Alexander et al. 1992a,c); VENEZUELA (Feliciangeli 1988).

Remarks. Females of this species have been captured in human bait at the type locality (Young 1979).

Lutzomyia* (*Helcocyrtomyia*) *pescei (Hertig)
Fig. 306

Phlebotomus pescei Hertig 1943: 248 (♀, Pincos Valley, Apurimac, Peru). Fairchild & Hertig 1957: 332 (refs., ♂, tax.).
Lutzomyia pescei: Barretto 1962: 96. Theodor 1965: 183. Forattini 1971a: 100; 1973: 237 (♂, ♀ figs.). Martins et al. 1978: 80 (refs., dist.). Llanos 1983: 183 (listed). Galati & Cáceres 1990: 518 (♂, ♀, figs.).

Distribution (Map 154). PERU (Martins et al. 1978; Llanos 1983).

Remarks. Figure 306 of *L. pescei* is based on specimens illustrated and discussed by Fairchild & Hertig (1957). Hertig (1943) observed that females are anthropophilic.

Lutzomyia* (*Helcocyrtomyia*) *imperatrix (Alexander)
Fig. 307

Phlebotomus imperatrix Alexander 1944: 316 (♀, Huacapistana, Tarma, Junin, Peru). Dampf 1947a: 305 (♀, redescript.). Fairchild & Hertig 1957: 330 (refs.).
Lutzomyia imperatrix (or *imperator*): Theodor 1965: 183. Forattini 1971a: 103 (listed); 1973: 354 (♀ fig.). Martins et al. 1978: 168 (as inadequately described). Llanos 1983: 183 (listed).

Distribution (Map 155). PERU (type locality).

Remarks. *Lutzomyia imperatrix* remains known only from the female holotype, now in the collection of the USNM, Washington, D.C. Dampf (1947a) carefully redescribed the specimen but did not figure the spermathecae which, however, probably resemble those of *L. pescei* or other species in the *peruensis* complex. Associated males will have to be secured before this species can be recognized. The cibarium as shown by Dampf (1947a) is similar to that of *L. sanguinaria* (Fig. 312).

Lutzomyia* (*Helcocyrtomyia*) *vindicator (Dampf)
Fig. 308

Phlebotomus vindicator Dampf 1944: 248 (♀, Cuauthla, Morelos, Mexico); 1947c: 205 (♂). Fairchild & Hertig 1957: 334 (refs., keyed).
Lutzomyia vindicatrix: Barretto 1962: 96 (listed). Theodor 1965: 183. Forattini 1971a: 100 (as *vinaicatrix*); 1973: 273 (♂, ♀ figs.).
Lutzomyia vindicator: Martins et al. 1978: 77 (dist.).

Distribution (Map 157). MEXICO (Martins et al. 1978).

Lutzomyia* (*Helcocyrtomyia*) *oppidana (Dampf)
Fig. 309

Phlebotomus oppidanus Dampf 1944: 247 (♀, San Jacinto, Federal District, Mexico). Fairchild & Hertig 1957: 330 (♂, Mexico).
Lutzomyia oppidana: Barretto 1962: 96. Martins et al. 1978: 77 (dist.). Young & Perkins 1984: 277 (refs., dist., figs.).

Distribution (Map 156). MEXICO (Martins et al. 1978); USA & CANADA (Young & Perkins 1984).

Lutzomyia (*Helcocyrtomyia*) *stewarti* (Mangabeira & Galindo)
Fig. 310

Phlebotomus stewarti Mangabeira & Galindo 1944: 185 (♂, ♀, Livermore, California, U.S.A.). Dampf 1944: 238 (Sonora, Mexico). Fairchild & Hertig 1957: 326 (keyed, refs.). Chaniotis 1967: 221 (rearing data, biology, hosts). Chaniotis & Anderson 1968: 273 (pop. dynamics).

Lutzomyia stewarti: Barretto 1962: 96. Ayala 1973: 266 (parasite relationships). Young & Perkins 1984: 278 (refs., keyed, figs.).

Distribution (Map 158). MEXICO (Dampf 1944); USA (Young & Perkins 1984).

Lutzomyia (*Helcocyrtomyia*) *vexator* (Coquillett)
Fig. 311

Flebotomus vexator Coquillett 1907: 102 (♂, ♀, Plummer's Island, Maryland, U.S.A.). Barretto 1947a: 229 (full refs.).

Phlebotomus vexator occidentis Fairchild & Hertig 1957: 334 (♂, ♀, California, U.S.A.). Young & Perkins 1984: 280 (not recognized as subspecies).

Lutzomyia vexator (or *vexatrix*): Young & Perkins 1984: 278 (tax. review, dist.). Klein et al. 1987: 154 (as exp. vector of *Plasmodium mexicanum*). Endris et al. 1987b: 413 (egg structure). Klein et al. 1988: 261 (as exp. host of *Schellackia*).

Distribution (Map 157). MEXICO; USA; CANADA (Martins et al. 1978; Young & Perkins 1984).

Remarks. This species, like *L. oppidana*, *L. stewarti* and probably *L. vindicator*, feeds on reptiles and amphibians. Full references related to the habits, biology and disease relationships of *L. vexator* are given by Young & Perkins (1984) and Klein et al. (1987; 1988).

Lutzomyia (*Helcocyrtomyia*) *sanguinaria* (Fairchild & Hertig)
Figs. 312

Phlebotomus sanguinarius Fairchild & Hertig 1957: 332 (♂, ♀, Almirante, Bocas de Toro, Panama).

Lutzomyia sanguinaria: Barretto 1962: 96 (listed). Martins et al. 1978: 167 (refs., dist.). Young 1979: 201 (figs., refs.). Christensen & Herrer 1980a: 188 (experimental host of *Leishmania aristedesi*); 1980b: 523 (feeding habits). Chaniotis et al. 1982: 3 (control, Panama). Zeledón & Murillo 1983: 280 (Nicaragua). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 99 (figs., Costa Rica).

Psychodopygus sanguinarius: Forattini 1971a: 105; 1973: 123 (figs., tax.).

Distribution (Map 158). HONDURAS (Fairchild & Hertig 1957); NICARAGUA (Zeledón & Murillo 1983); COSTA RICA (Murillo & Zeledón 1985); PANAMA (Fairchild & Hertig 1957; Martins et al. 1978); COLOMBIA (Young 1979).

Remarks. The spermathecae of *L. sanguinaria* varies in length according to locality. Females from Costa Rica (Murillo & Zeledón 1985, fig. 42) have very long spermathecae similar to those examined by us from La Fortuna, Chiriqui Prov., Panama. Two males from the latter site have modified tips of the genital filaments unlike those from other localities. The significance of this observation is not yet known and, thus, we hesitate to name these forms as distinct taxa.

Trypanosomes have been isolated from wild-caught *L. sanguinaria* in Panama (McConnell 1963).

Lutzomyia (Helcocyrtomyia) botella (Fairchild & Hertig)
Fig. 313

Phlebotomus botellus Fairchild & Hertig 1961b: 250 (♀, El Volcan, Chiriqui, Panama).
Lutzomyia botella: Theodor 1965: 186. Martins & Morales-Farias 1972: 365. Martins et al. 1978: 161. Christensen et al. 1983: 466 (listed).
Psychodopygus botellus: Forattini 1971a: 105; 1973: 459 (figs., tax.).

Distribution (Map 159). PANAMA (Fairchild & Hertig 1961b).

Remarks. *Lutzomyia botella*, a little known species occurring at relatively high elevations in western Panama, remains known only from the female. Apart from the inflated spermathecae, which would resemble those of *L. sanguinaria*, if expanded, the character states of wing venation, cibarium, palpi, ascoids of *L. botella* suggest the placement of this species in *Helcocyrtomyia*.

Lutzomyia (Helcocyrtomyia) tortura Young & Rogers
Fig. 314

Lutzomyia tortura Young & Rogers 1984: 605 (♂, ♀, Limoncocha, Napo, Ecuador). Young & Morales 1987: 662 (Amazonas, Colombia). Alexander et al. 1992c: 125 (Ecuador records). Eshita et al. 1992: 22 (Ecuador).

Distribution (Map 159). ECUADOR (type locality; Alexander et al. 1992c); COLOMBIA (Young & Morales 1987).

Remarks. The male of *L. tortura* is the only one known, so far, that lacks persistent setae on the coxite. In other aspects, both sexes resemble *L.*

hartmanni. Females of *L. tortura* are anthropophilic. The species is likely more widespread in the western Amazon basin than present records indicate.

Lutzomyia (*Helcocyrtomyia*) *scorzai* (Ortiz)
Fig. 315

Phlebotomus scorzai Ortiz 1965b: 28 (♂, ♀, Rancho Grande, Aragua, Venezuela).
Lutzomyia scorzai: Forattini 1971a: 100 (listed); 1973: 213 (figs., tax.). Martins et al. 1978: 81 (listed). Ramirez Pérez et al. 1978: 52 (Aragua, Venezuela). Young 1979: 204 (♂, ♀ figs., Colombia). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Pérez 1982b: 58 (figs., Tachira, Venezuela). Feliciangeli 1988: 109 (Venezuela).

Distribution (Map 158). VENEZUELA (Ramirez Pérez et al. 1978; 1982b; Feliciangeli 1988); COLOMBIA (Young 1979).

Lutzomyia (*Helcocyrtomyia*) sp. of Pichinde Young
Fig. 316

Lutzomyia sp. of Pichinde Young 1979: 210 (♂, ♀, figs., tax., Colombia).

Distribution (Map 157). COLOMBIA (Young 1979).

Remarks. We are reluctant to provide a formal name for this species until we can study type material or topotype series of closely related species such as *L. scorzai*.

Lutzomyia (*Helcocyrtomyia*) *hartmanni* (Fairchild & Hertig)
Fig. 317

Phlebotomus hartmanni Fairchild & Hertig 1957: 328 (♂, ♀, Cerro Campana, Panama).
Lutzomyia hartmanni: Barretto 1962: 96 (listed). Martins et al. 1978: 79 (refs., dist.). Young 1979: 199 (refs., figs.). Porter & De Foliart 1981: 85 (ecology, biting habits, Colombia). Morales et al. 1981: 201 (Tolima, Colombia). Christensen et al. 1983: 466 (coll. data, Panama). Young & Rogers 1984: 599 (Ecuador, cf. to *tortura*). Murillo & Zeledón 1985: 99 (♂, ♀ figs., Costa Rica). Hashiguchi et al. 1985a: 533 (man biting activity, Ecuador); 1985b: 440 (nat. *Leishmania* infections, Ecuador). Loyola et al. 1988: 408 (mention). Alexander et al. 1992a: 37 (Ecuador records); 1992b: 28 (as vector of *Leishmania panamensis*, Ecuador); 1992c: 124 (Ecuador). Eshita et al. 1992: 22 (nat. *Leishmania* infections, Ecuador).
Psychodopygus hartmanni: Forattini 1971a: 105; 1973: 466 (♂, ♀ figs., tax.).

Distribution (Map 156). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Morales et al. 1981); ECUADOR (Young 1979; Hashiguchi et al. 1985a; Alexander et al. 1992a,b,c); PERU (Pérez et al. 1991).

Remarks. This species is a suspected vector of *Leishmania panamensis* in Ecuador (Alexander et al. 1992b). In Santander Dept., Colombia, peripylarian promastigotes were cultured from 2 wild-caught females of *L. hartmanni*. These were later determined to be a new species of *Leishmania* (*Le. colombiensis*; see Kreutzer et al. 1991).

Lutzomyia (*Helcocyrtomyia*) *kirigetiensis* Galati & Cáceres
Fig. 318

Lutzomyia kirigetiensis Galati & Cáceres 1992: 449 (♂, ♀, Kirigeti, La Convención Prov., Cuzco, Peru).

Distribution (Map 159). PERU (type locality).

Remarks. *Lutzomyia kirigetiensis* appears to be closely allied to *L. hartmanni*; the females are not separable with certainty based on available material. The single known female lacks several appendages on the head and thorax.

FIG. 292. ***Lutzomyia vargasi.*** A. Male head; B. Male flagellomere II; C. Genital pump & filaments; D. Male terminalia.

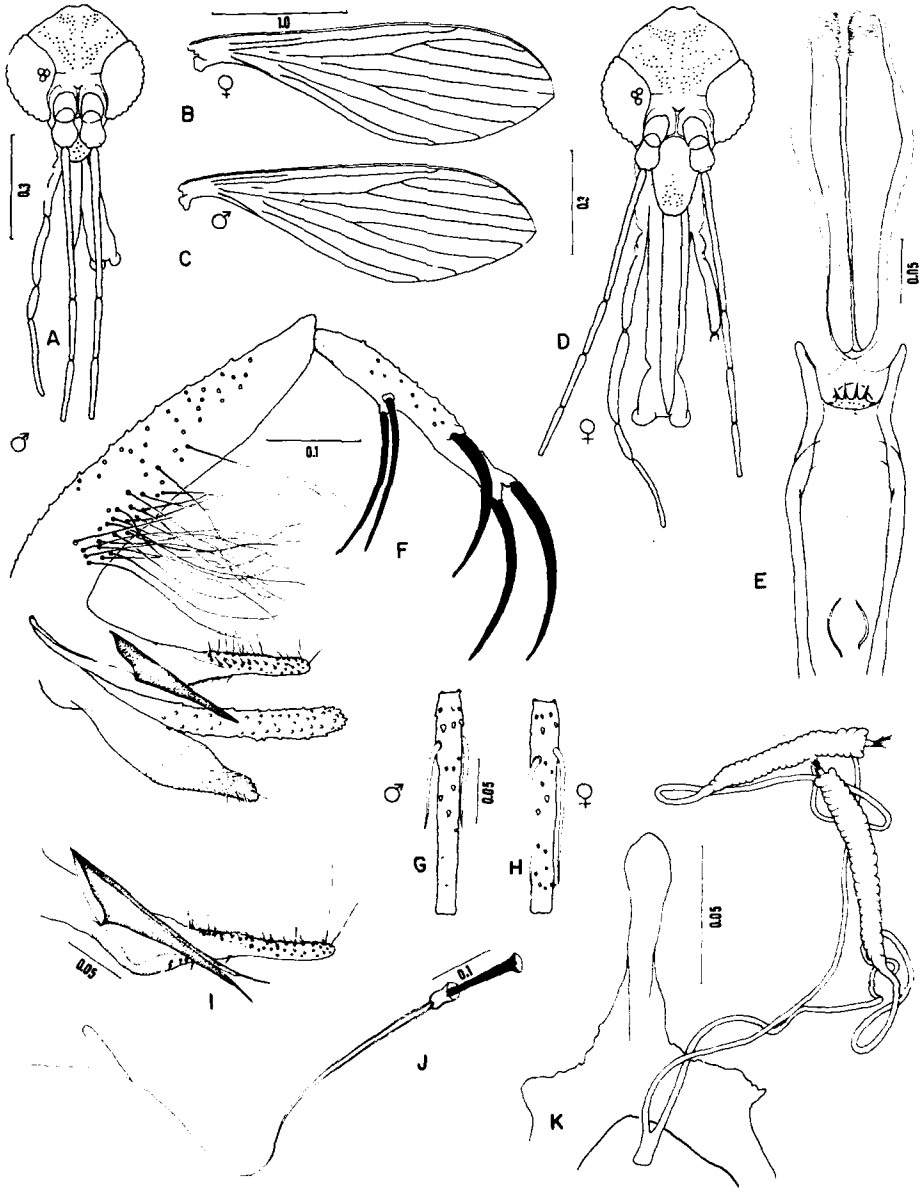


FIG. 293. ***Lutzomyia cirrita.*** A. Male head; B. Female wing; C. Male wing; D. Female head; E. Female cibarium & pharynx; F. Male terminalia; G. Male flagellomere II; H. Female flagellomere II; I. Aedeagus & paramere; J. Genital pump & filaments; K. Spermathecae (All figures from Young & Porter 1974).

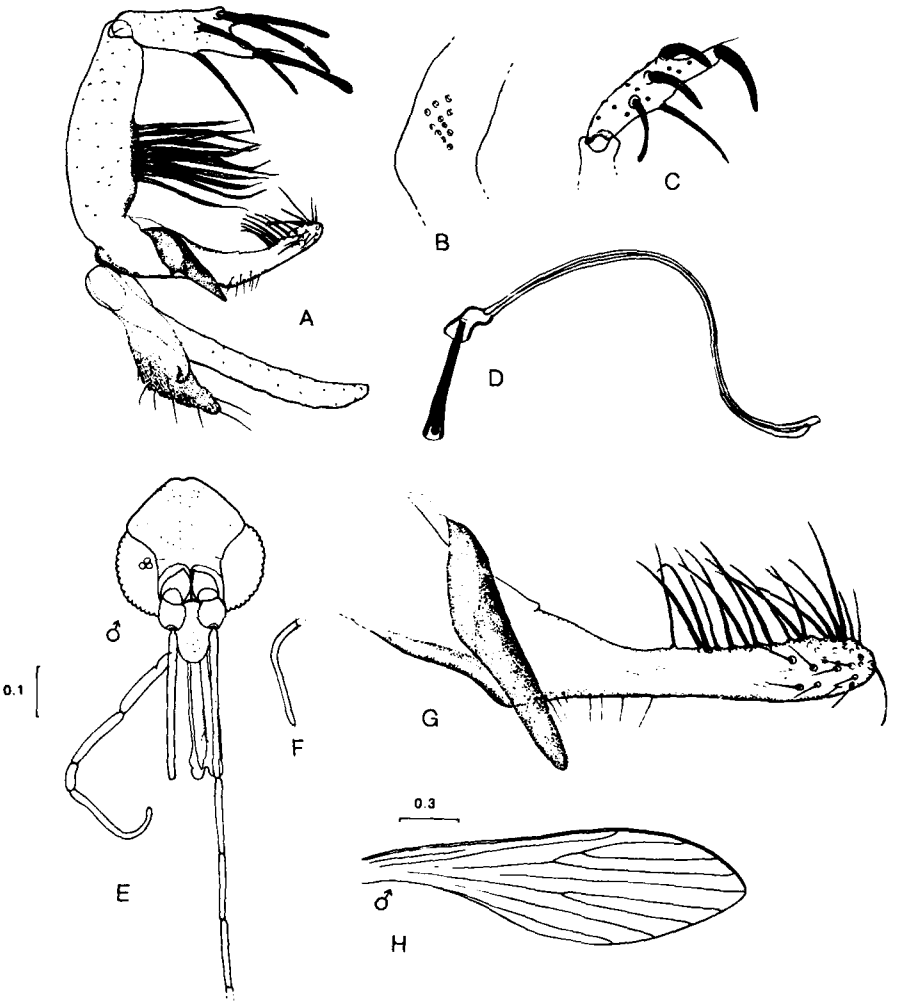


FIG. 294. ***Lutzomyia reclusa.*** A. Male terminalia; B. Coxite setal bases; C. Style; D. Genital pump & filaments; E. Male head; F. Fifth palp; G. Paramere & aedeagus; H. Male wing.

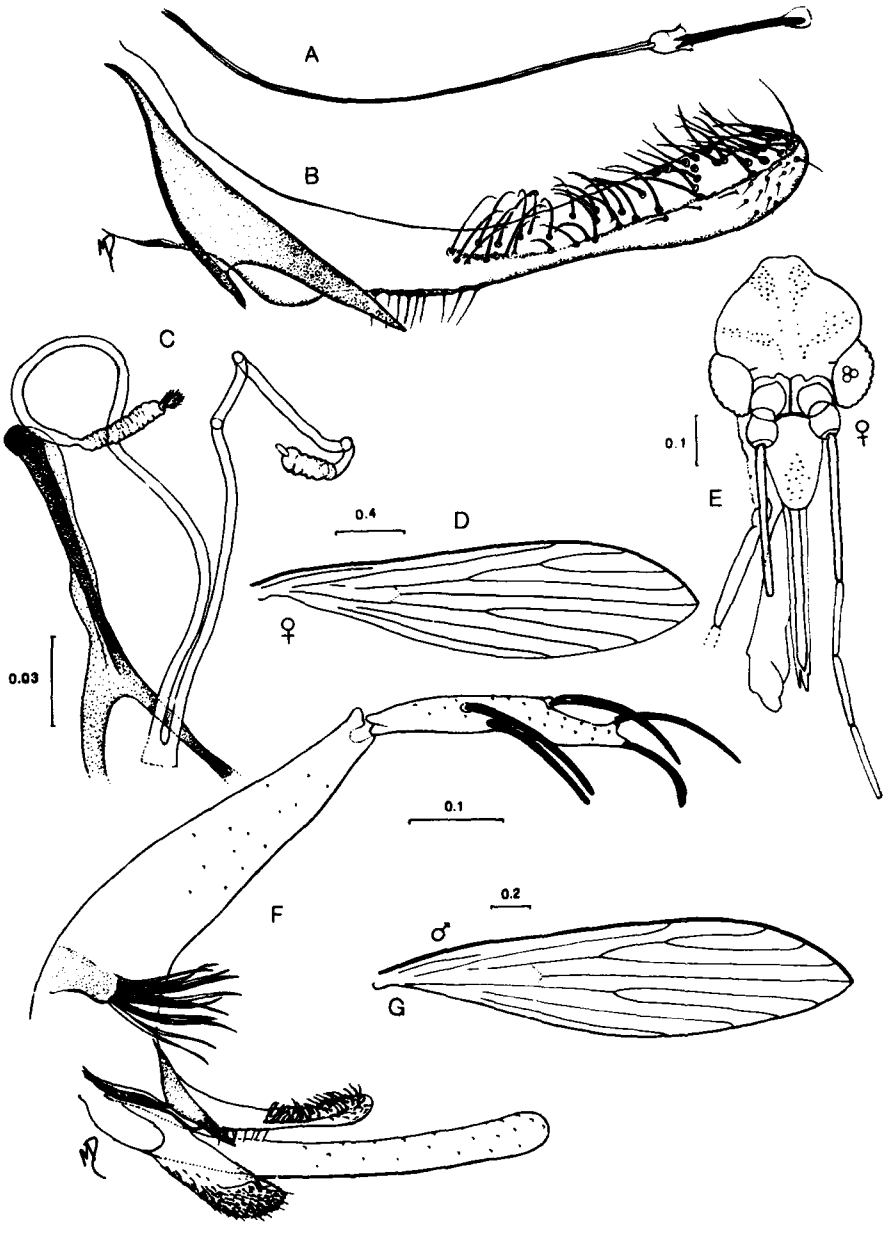


FIG. 295. ***Lutzomyia blancasi.*** A. Genital pump & filaments; B. Paramere; C. Spermathecae; D. Female wing; E. Female head; F. Male terminalia; G. Male wing.

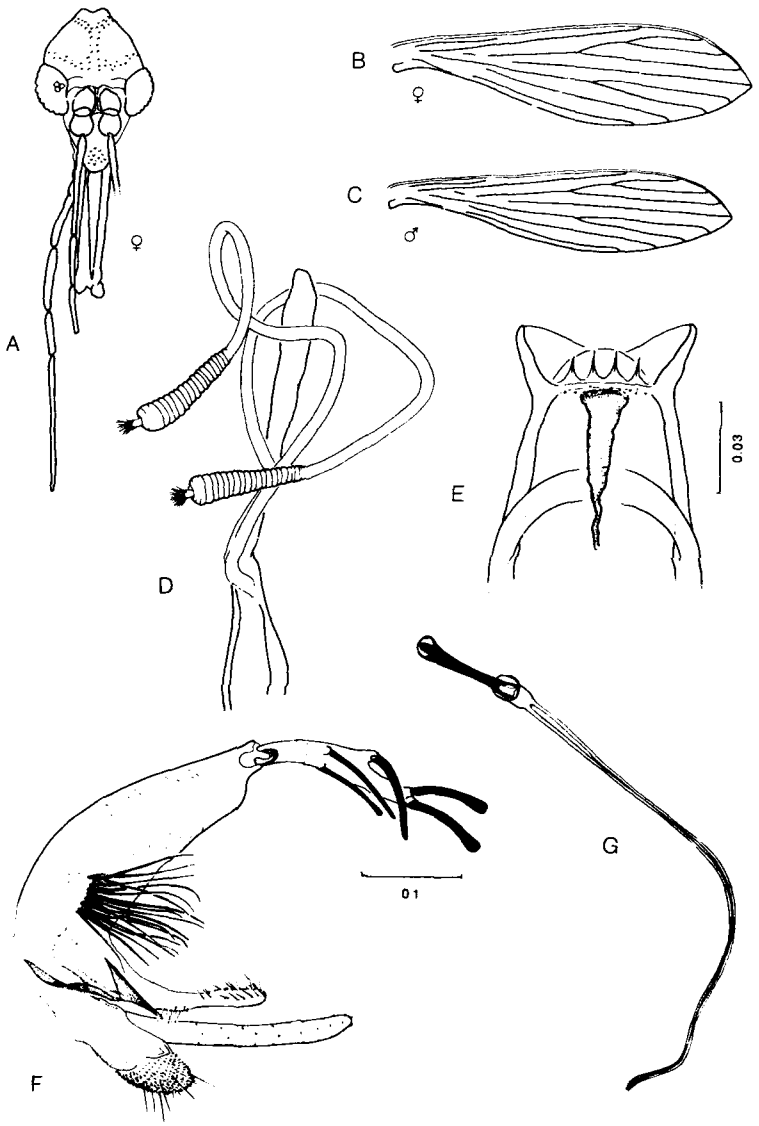


FIG. 296. ***Lutzomyia noguchii.*** A. Female head; B. Female wing; C. Male wing; D. Spermathecae; E. Female cibarium; F. Male terminalia; G. Genital pump & filaments (Figs. A-E from Young et al. 1985).

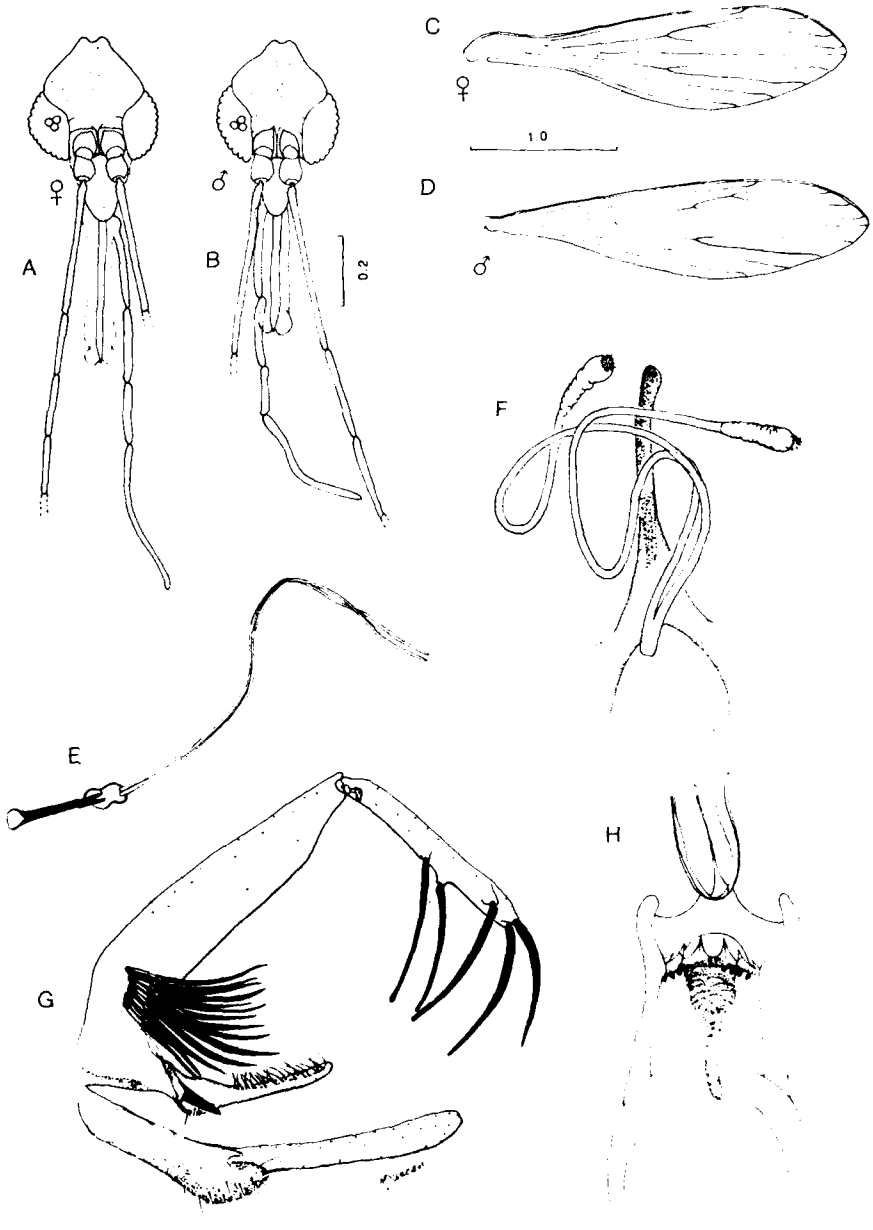


FIG. 297. ***Lutzomyia tejadai.*** A. Female head; B. Male head; C. Female wing; D. Male wing; E. Genital pump & filaments; F. Spermathecae; G. Male terminalia; H. Female cibarium.

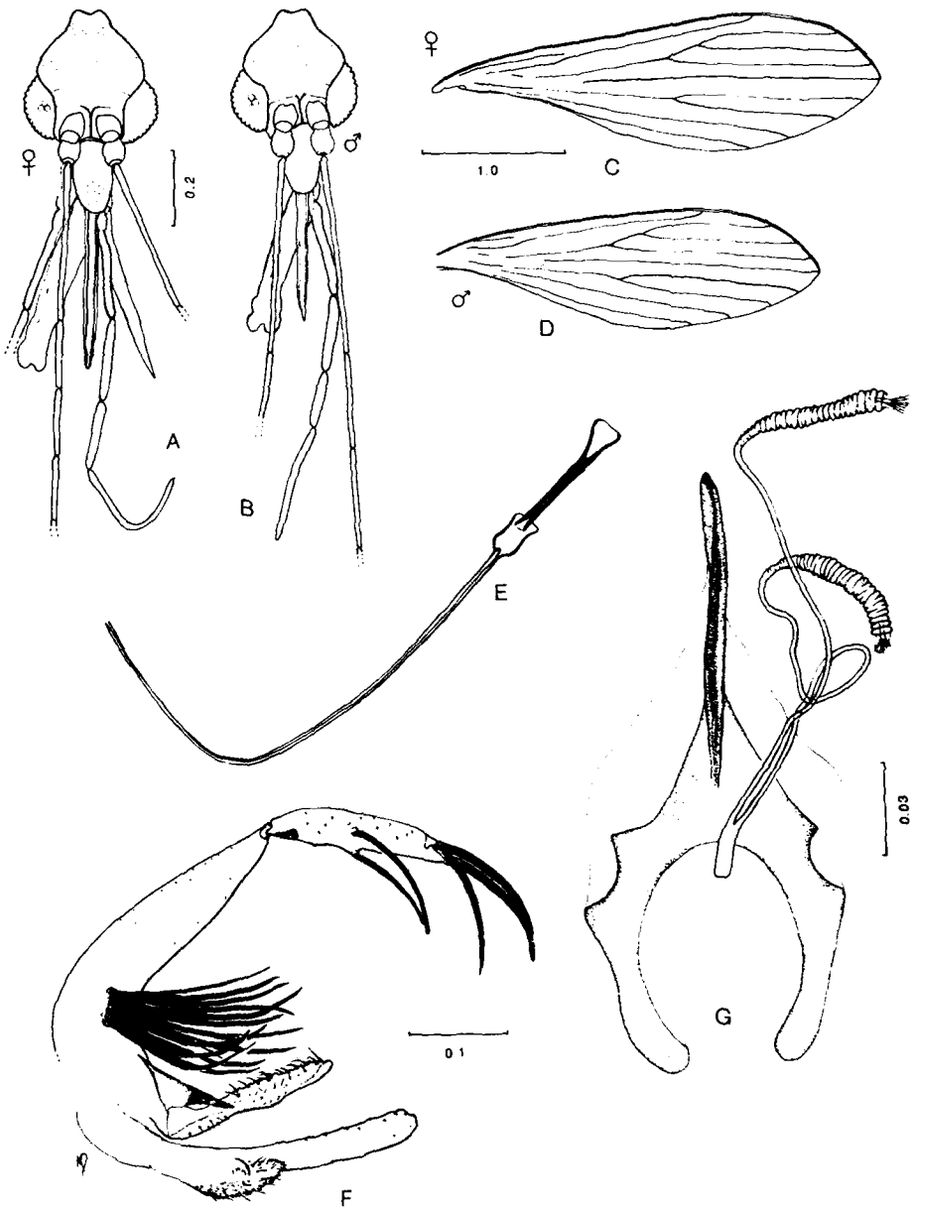


FIG. 298. ***Lutzomyia ayacuchensis***. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Genital pump & filaments; F. Male terminalia; G. Spermathecae.

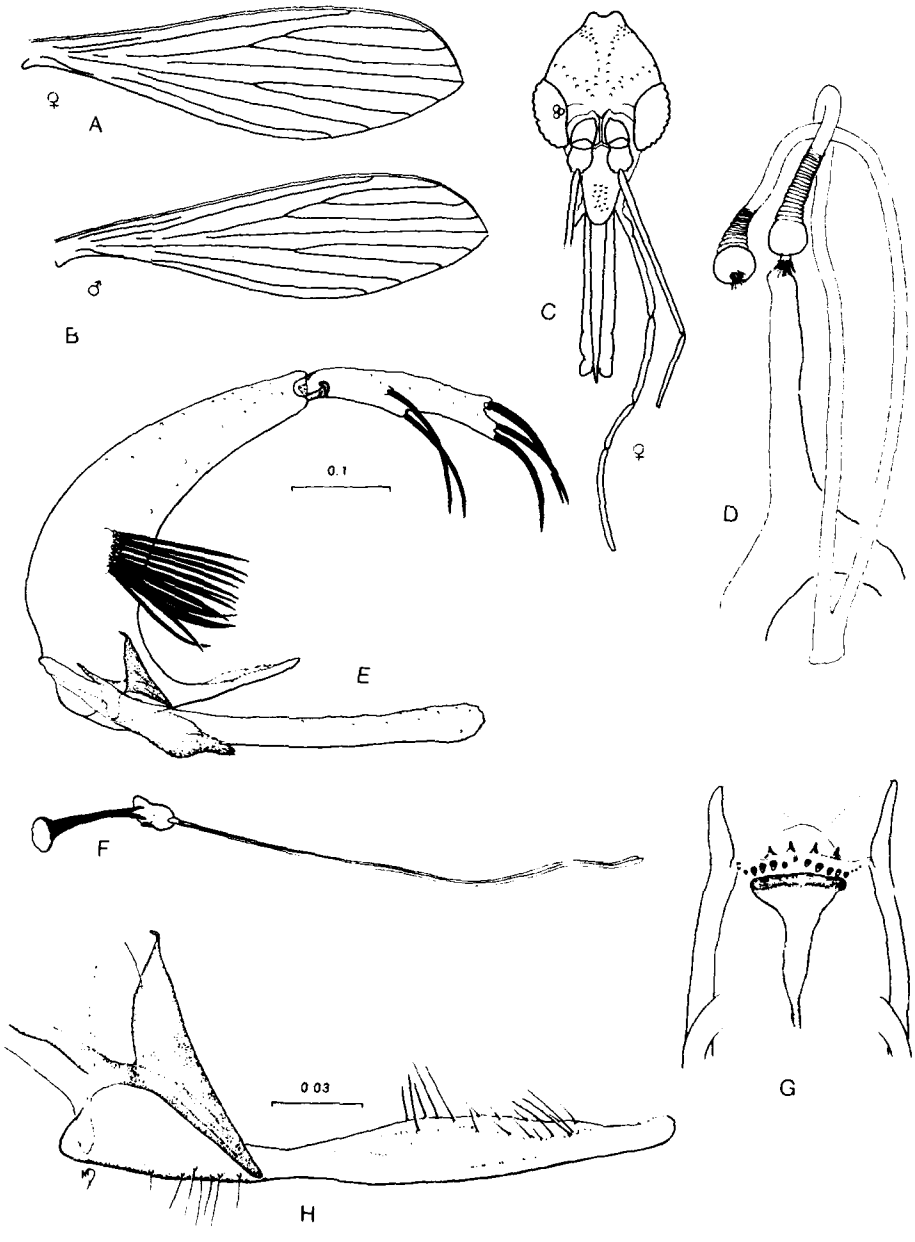


FIG. 299. ***Lutzomyia peruensis.*** A. Female wing; B. Male wing; C. Female head; D. Spermathecae; E. Male terminalia; F. Genital pump & filaments; G. Female cibarium; H. Paramere & aedeagus (Figs. A-D & G from Young et al. 1985).

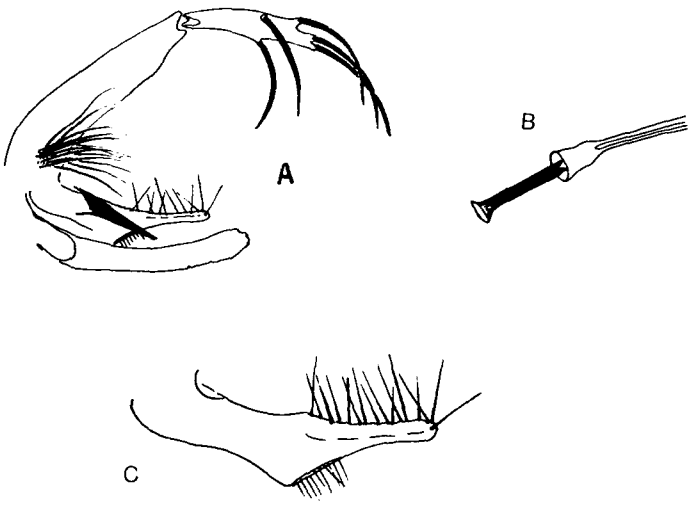


FIG. 300. ***Lutzomyia ceferinoi.*** A. Male terminalia; B. Genital pump; C. Paramere (figs. from Ortiz & Alvarez 1963b).

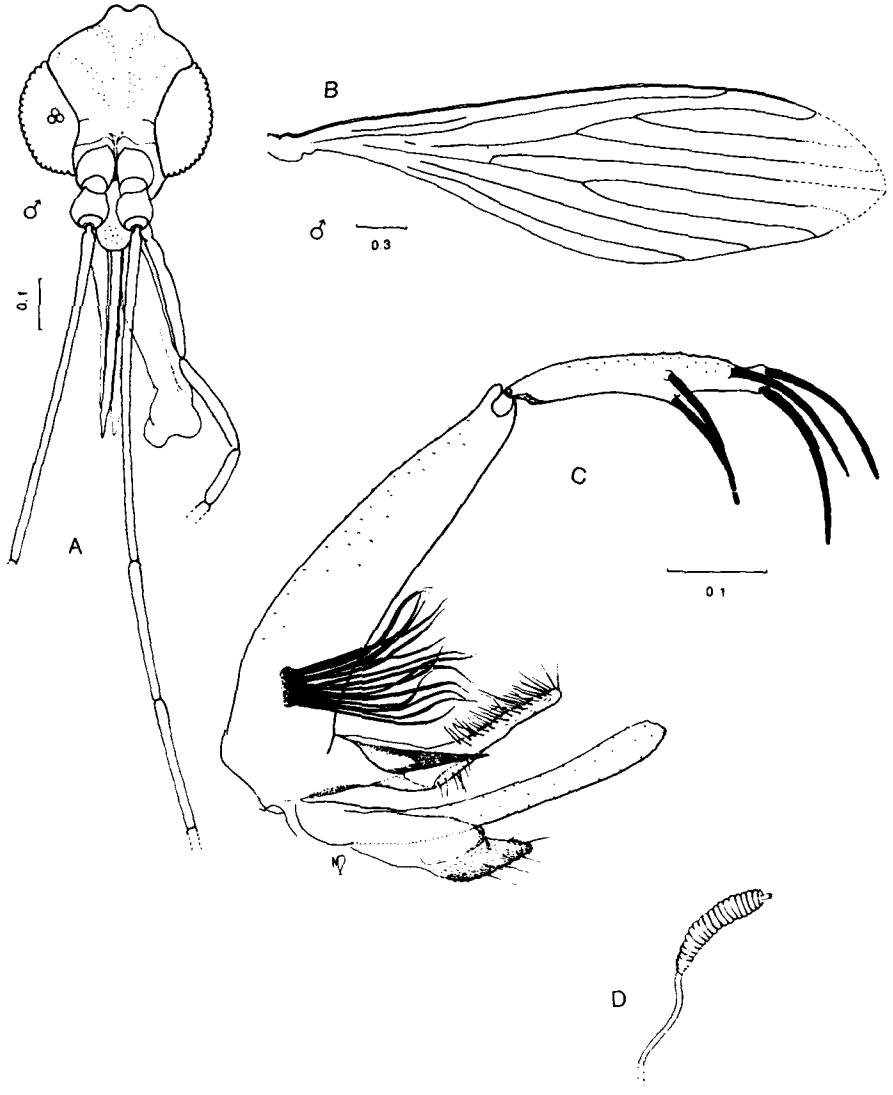


FIG. 301. ***Lutzomyia larensis***. A. Male head; B. Male wing; C. Male terminalia; D. Spermatheca (fig. D. from Arredondo 1987).

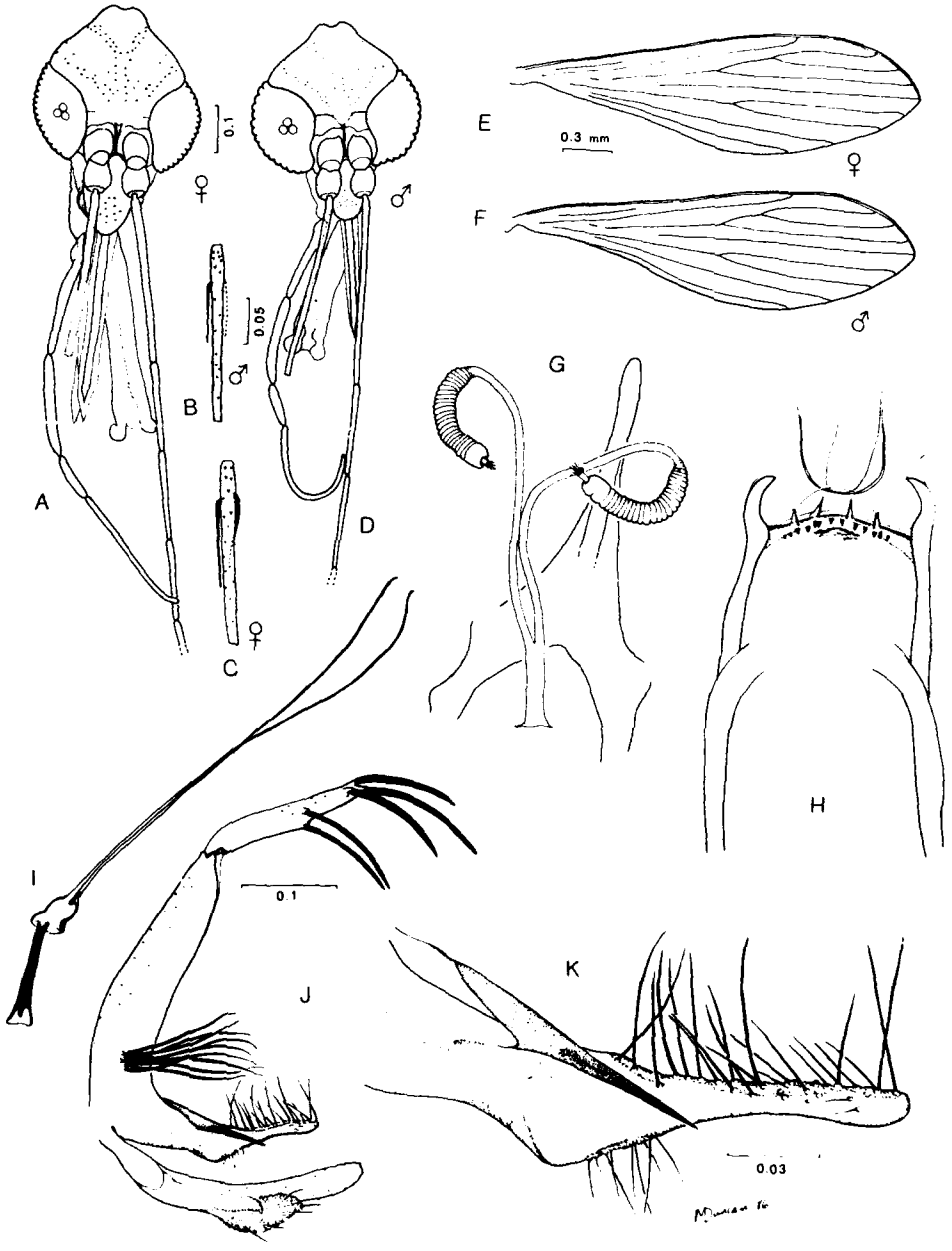


FIG. 302. ***Lutzomyia erwindonaldoi.*** A. Female head; B. Male flagellomere II; C. Female flagellomere II; D. Male head; E. Female wing; F. Male wing; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Male terminalia; K. Paramere (figs. from Young & Morales 1987).

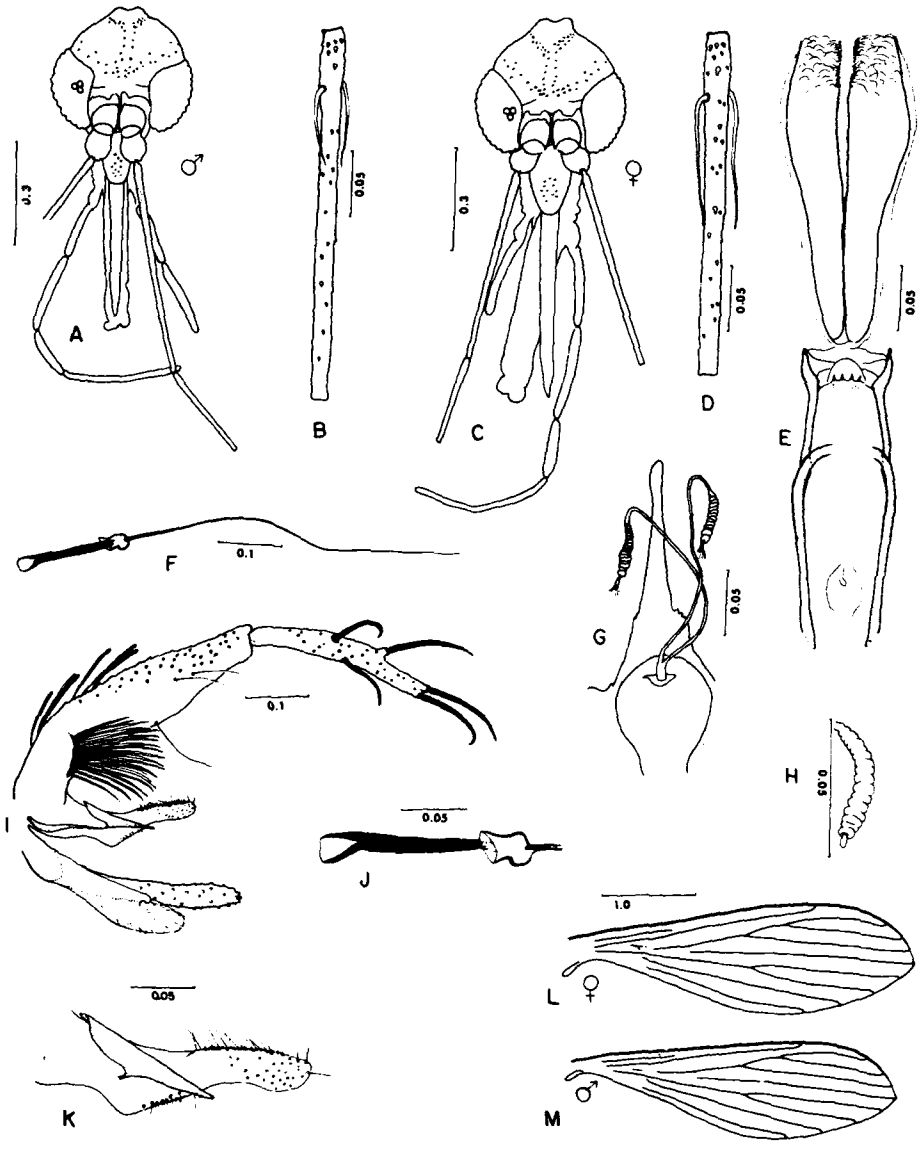


FIG. 303. ***Lutzomyia osornoi.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Spermathecae; H. Body of spermathecae; I. Male terminalia; J. Genital pump; K. Aedeagus & paramere; L. Female wing; M. Male wing (from Young 1979).

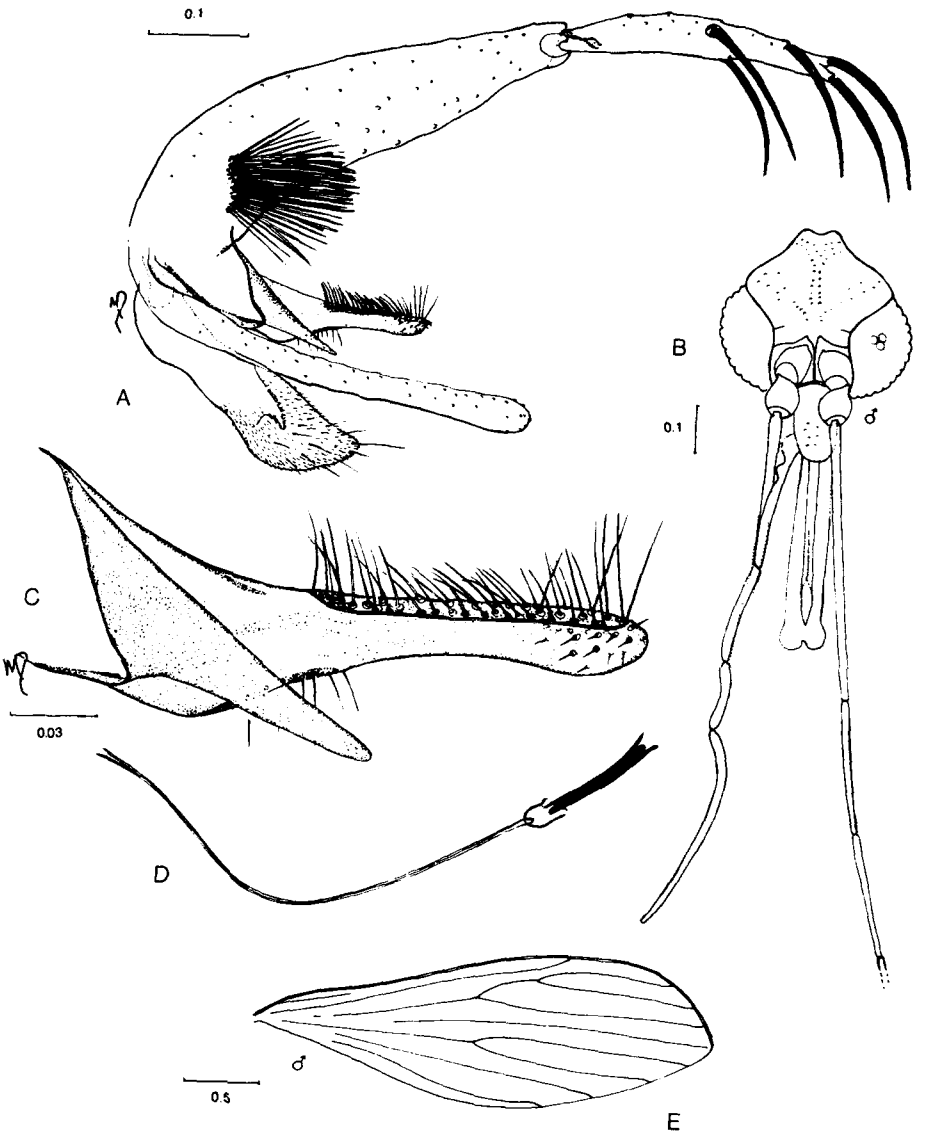


FIG. 304. ***Lutzomyia caballeroi.*** A. Male terminalia; B. Male head; C. Paramere & aedeagus; D. Genital pump & filaments; E. Male wing.

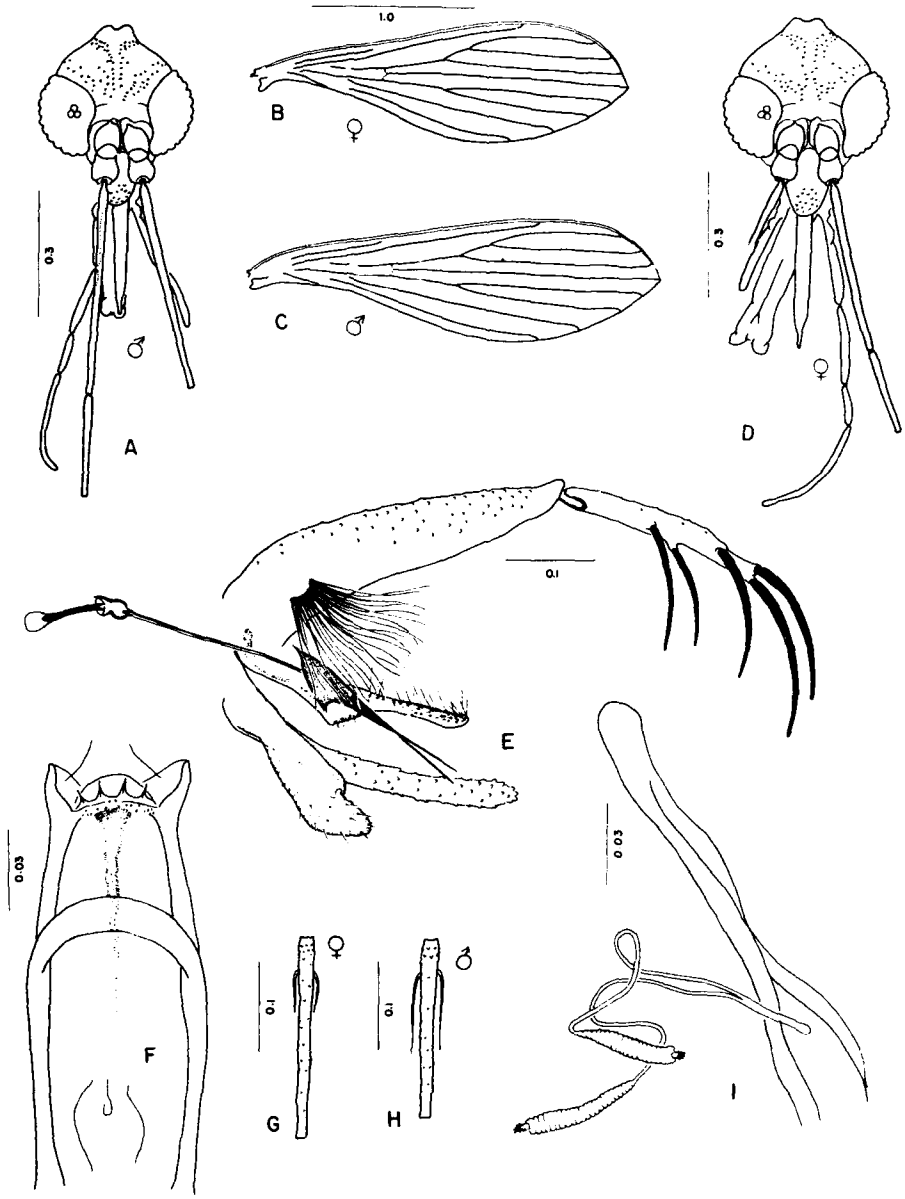


FIG. 305. ***Lutzomyia strictivilla.*** A. Male head; B. Female wing; C. Male wing; D. Female head; E. Male genitalia; F. Female cibarium; G. Female flagellomere II: H. Male flagellomere II; I. Spermathecae (from Young 1979).

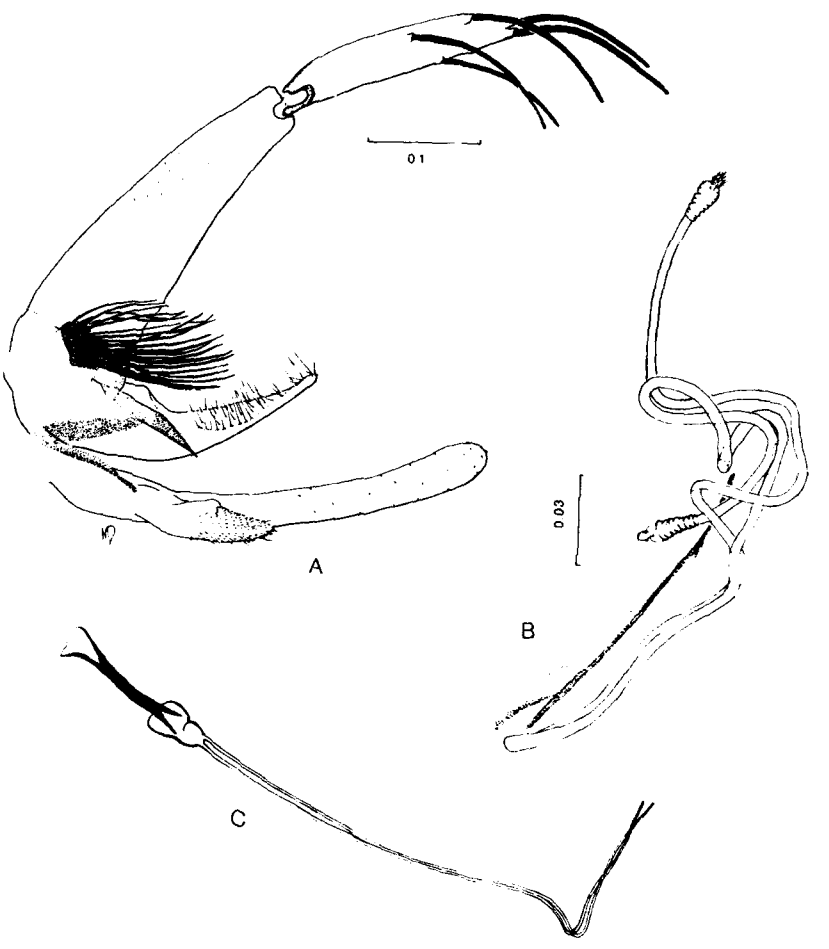


FIG. 306. ***Lutzomyia pescei.*** A. Male terminalia; B. Spermathecae; C. Genital pump & filaments.

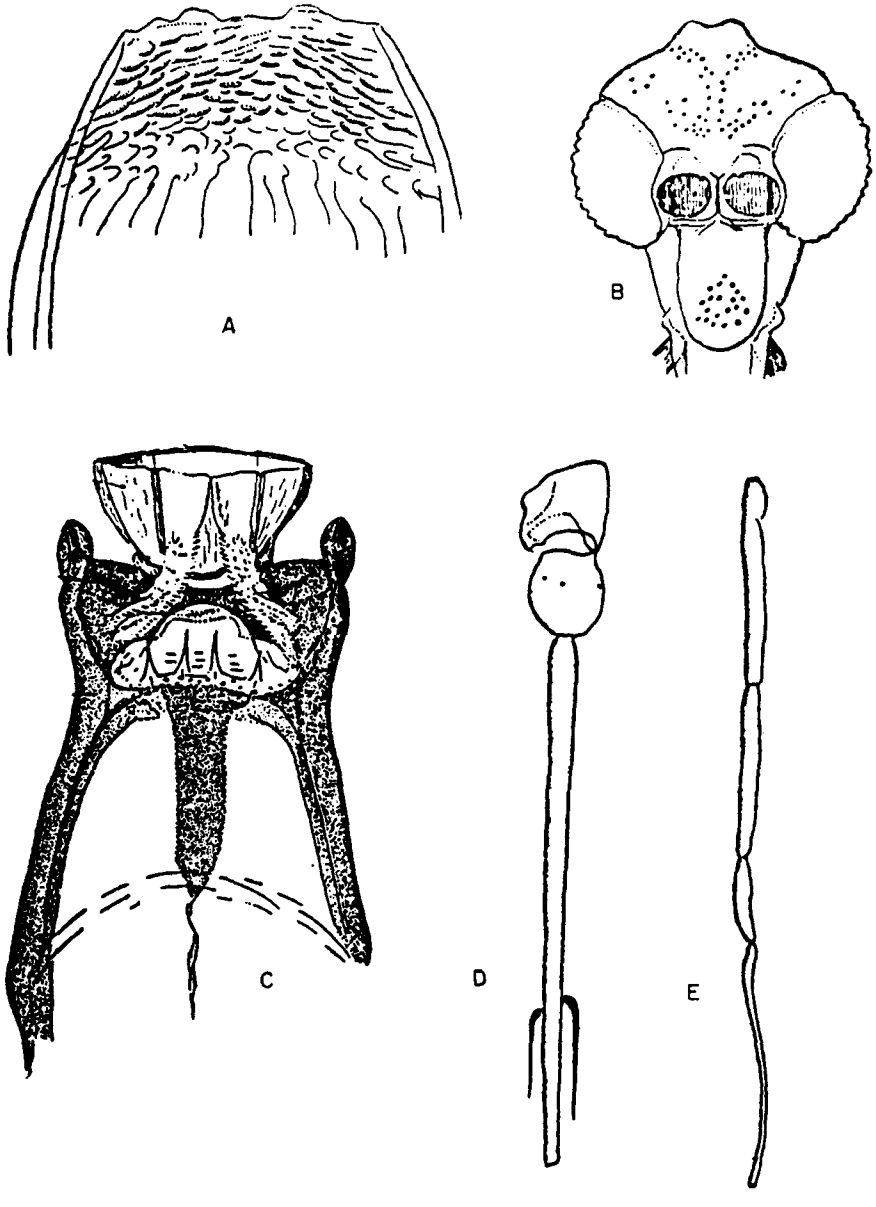


FIG. 307. ***Lutzomyia imperatrix.*** A. Posterior end of pharynx; B. Female head; C. Female cibarium; D. Proximal flagellomere showing ascoids & scape & pedicel; E. Female palpus (all figs. from Dampf 1947a).

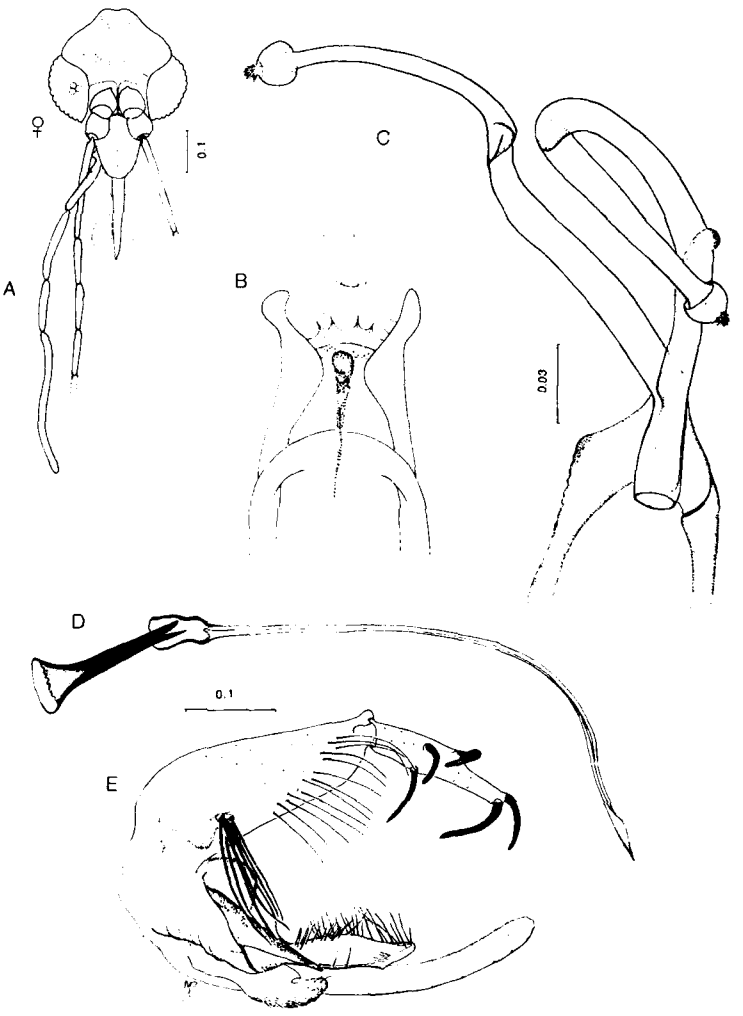


FIG. 308. ***Lutzomyia vindicator.*** A. Female head; B. Female cibarium; C. Spermathecae; D. Genital pump & filaments; E. Male terminalia.

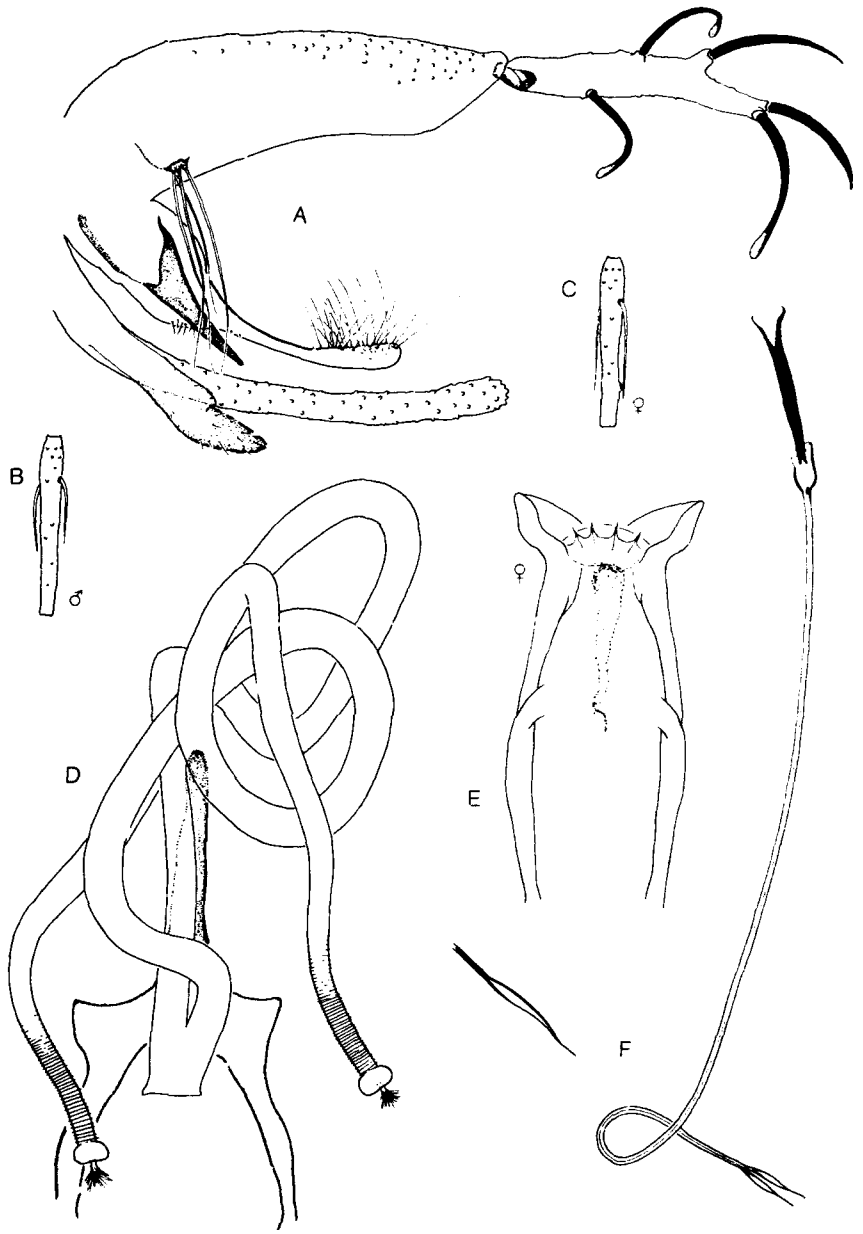


FIG. 309. ***Lutzomyia oppidana***. A. Male terminalia; B. Male flagellomere II; C. Female flagellomere II; D. Spermathecae; E. Female cibarium; F. Genital pump & filaments, tip of one filament enlarged (from Young & Perkins 1984).

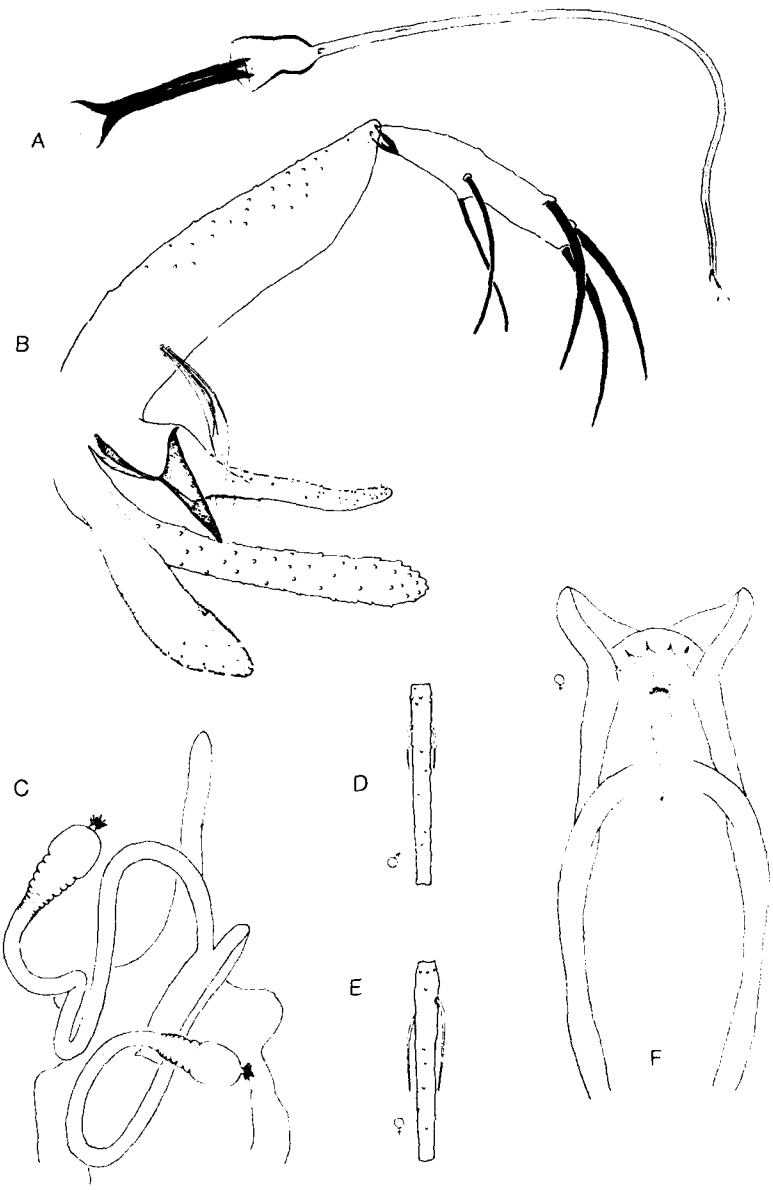


FIG. 310. ***Lutzomyia stewarti.*** A. Genital pump & filaments; B. Male terminalia; C. Spermathecae; D. Male flagellomere II; E. Female flagellomere II; F. Female cibarium (from Young & Perkins 1984).

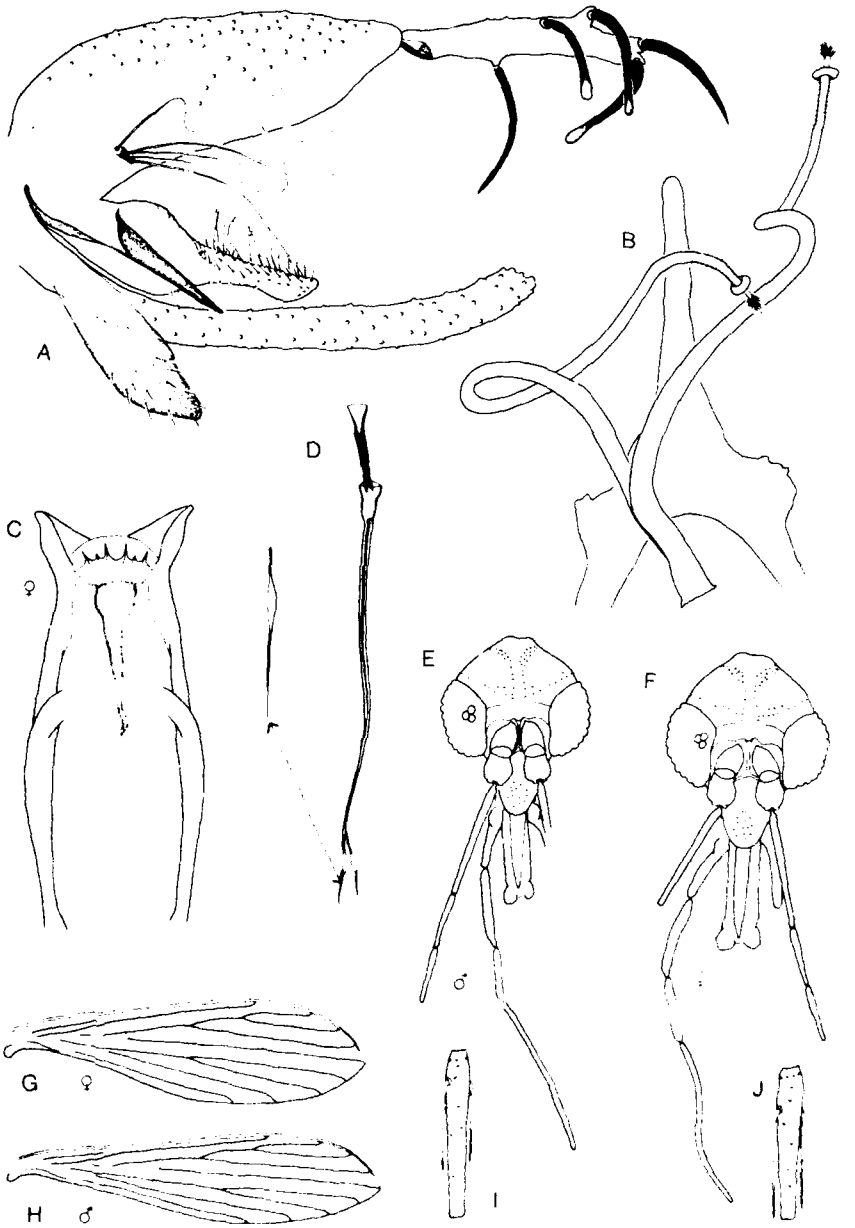


FIG. 311. ***Lutzomyia vexator.*** A. Male terminalia; B. Spermathecae; C. Female cibarium; D. Genital pump & filaments; E. Male head; F. Female head; G. Female wing; H. Male wing; I. Male flagellomere II; J. Female flagellomere II (figs. from Young & Perkins 1984).

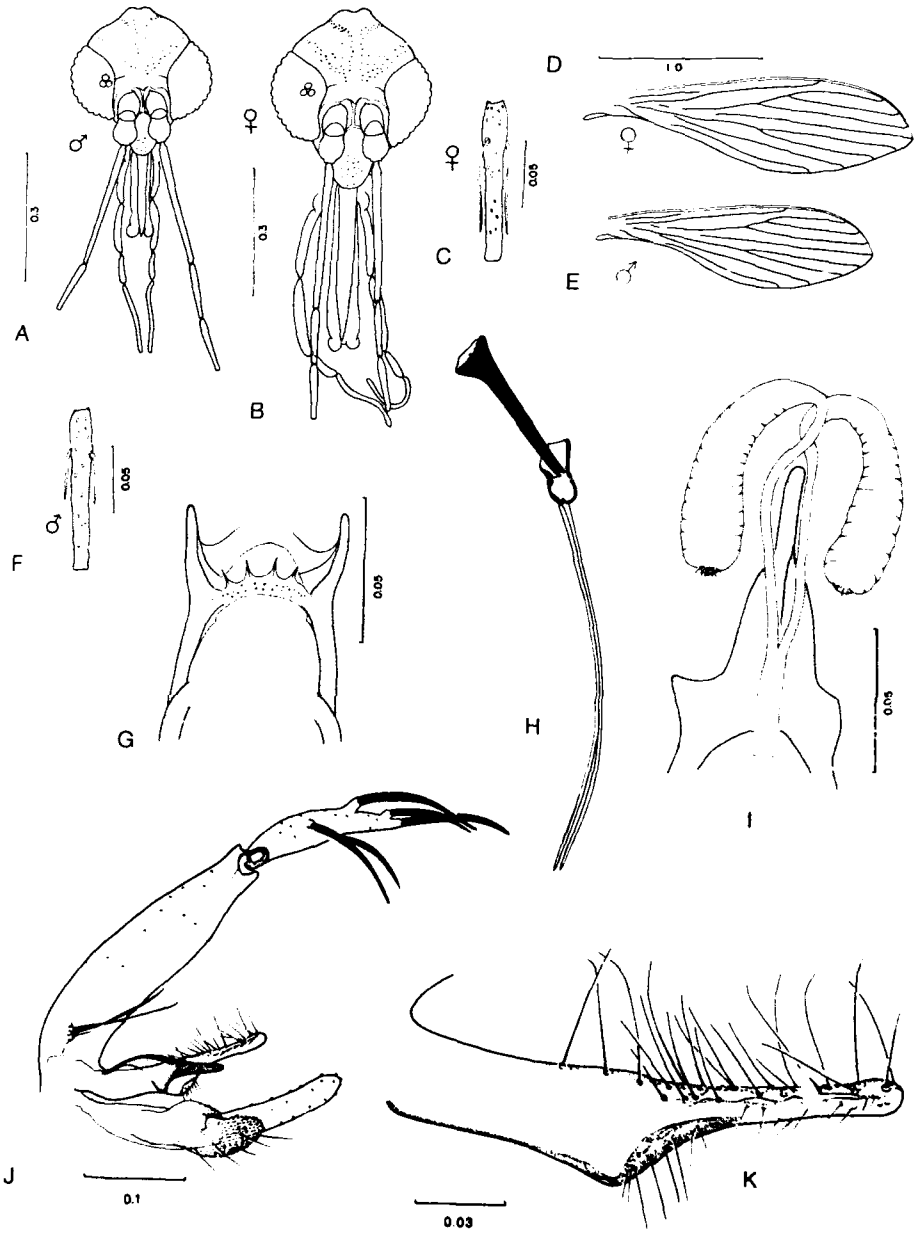


FIG. 312. ***Lutzomyia sanguinaria.*** A. Male head; B. Female head; C. Female flagellomere II; D. Female wing; E. Male wing; F. Male flagellomere II; G. Female cibarium; H. Genital pump & filaments; I. Spermathecae; J. Male terminalia; K. Paramere (from Young 1979).

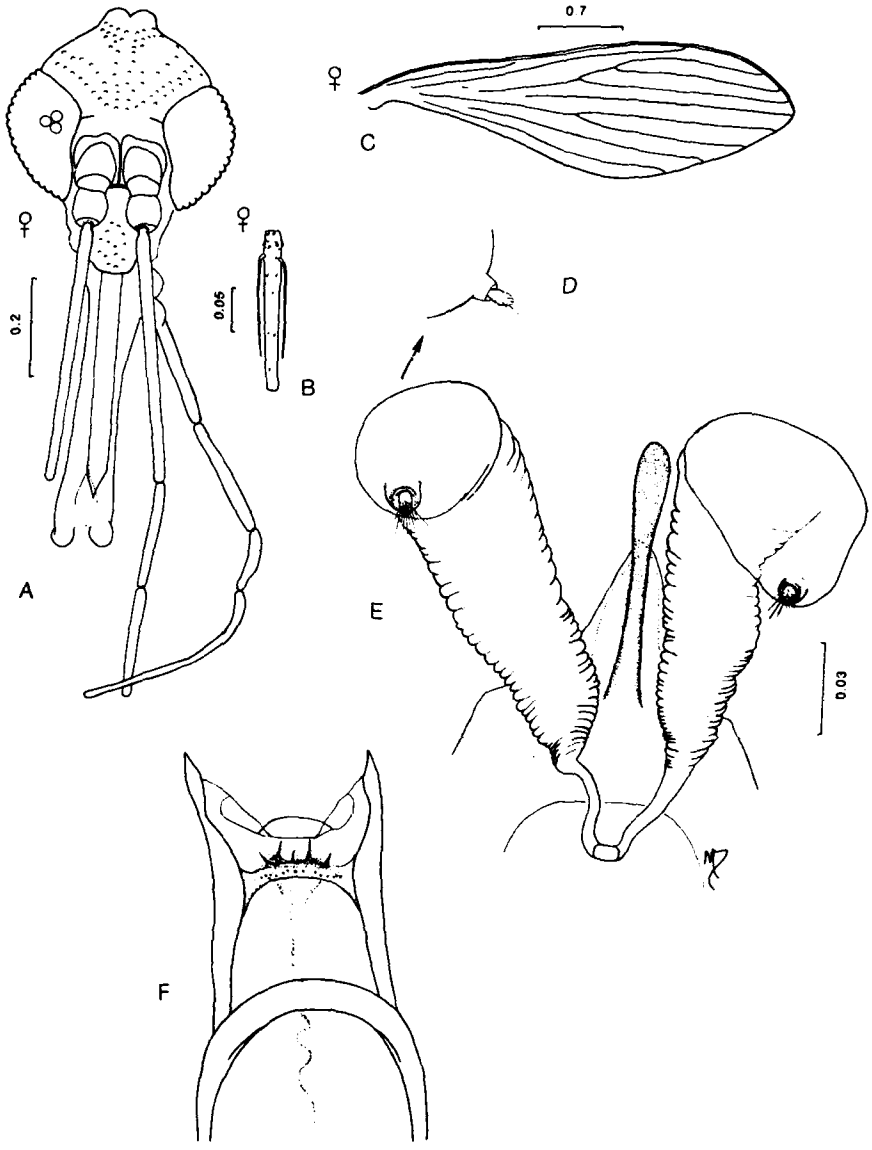


FIG. 313. ***Lutzomyia botella.*** A. Female head; B. Female flagellomere II; C. Female wing; D. End of spermatheca; E. Spermathecae; F. Female cibarium.

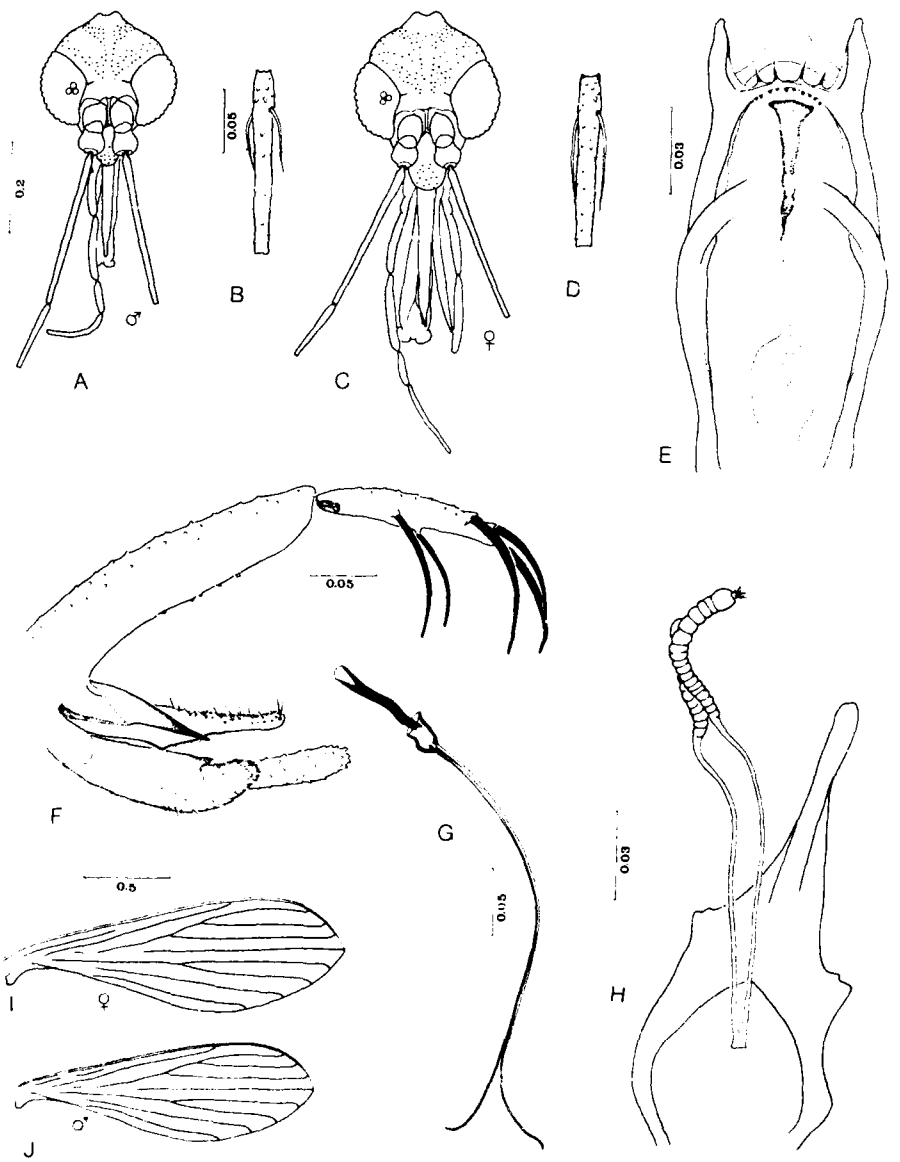


FIG. 314. ***Lutzomyia tortura***. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing (from Young & Rogers 1984).

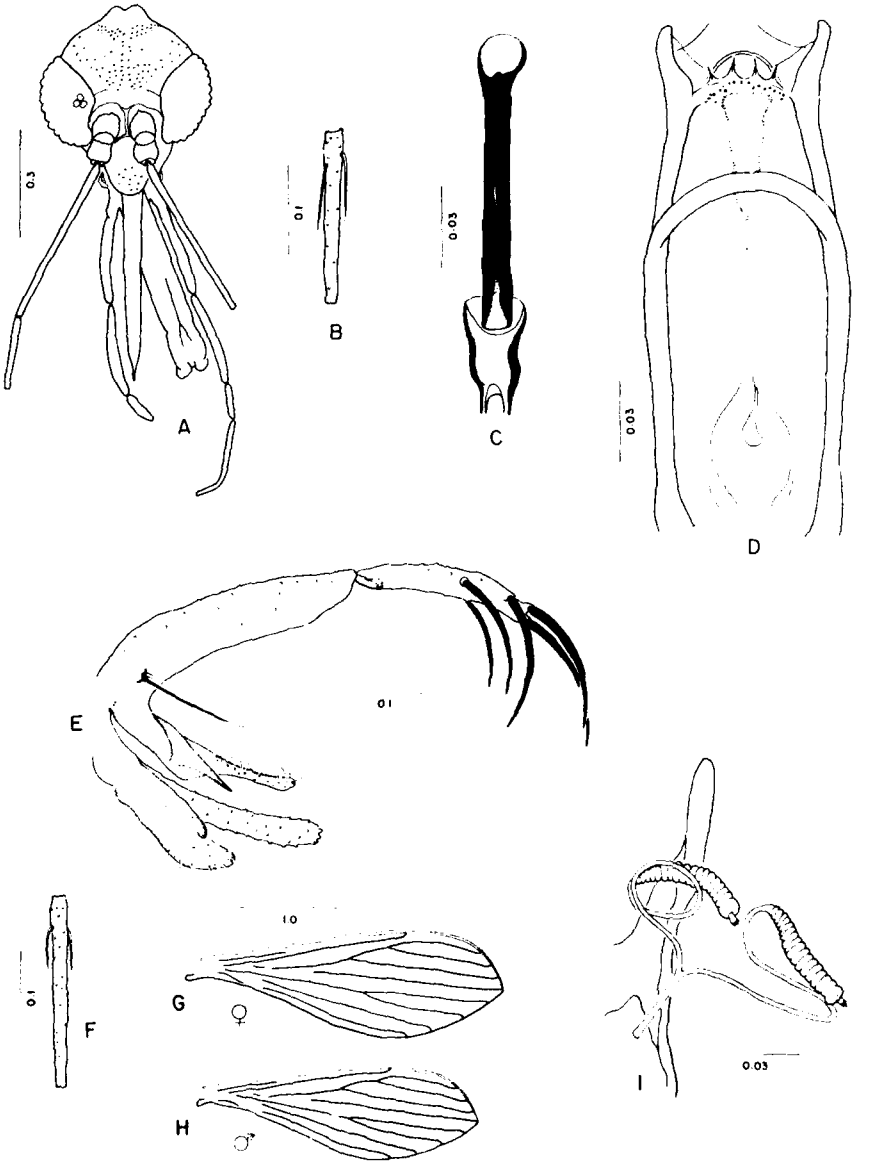


FIG. 315. ***Lutzomyia scorzai.*** A. Male head; B. Female flagellomere II; C. Genital pump; D. Female cibarium; E. Male genitalia; F. Male wing; G. Female wing; H. Male wing; I. Spermathecae (from Young 1979).

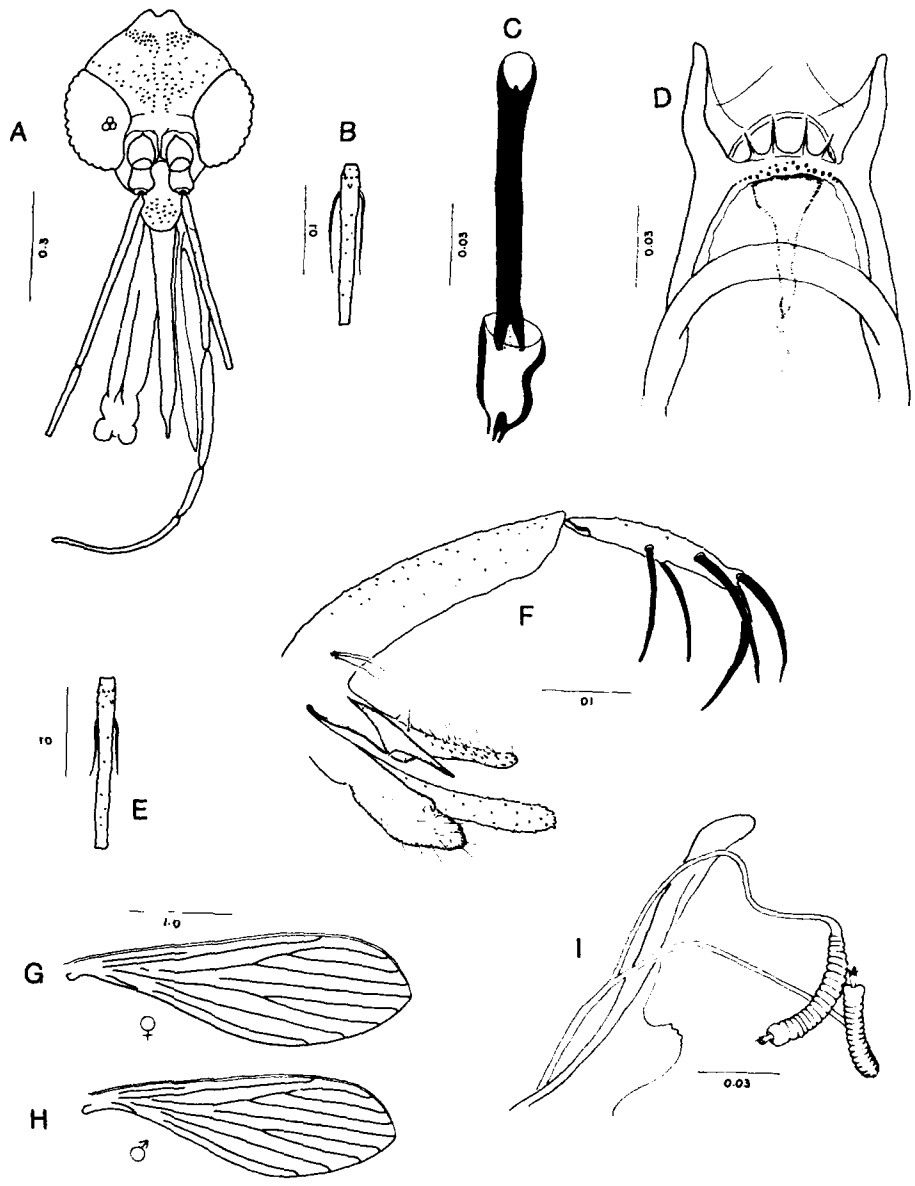


FIG. 316. ***Lutzomyia*** **sp. of Pichinde.** A. Female head; B. Female flagellomere II; C. Genital pump; D. Female cibarium; E. Male flagellomere II; F. Male genitalia; G. Female wing; H. Male wing; I. Spermathecae (from Young 1979).

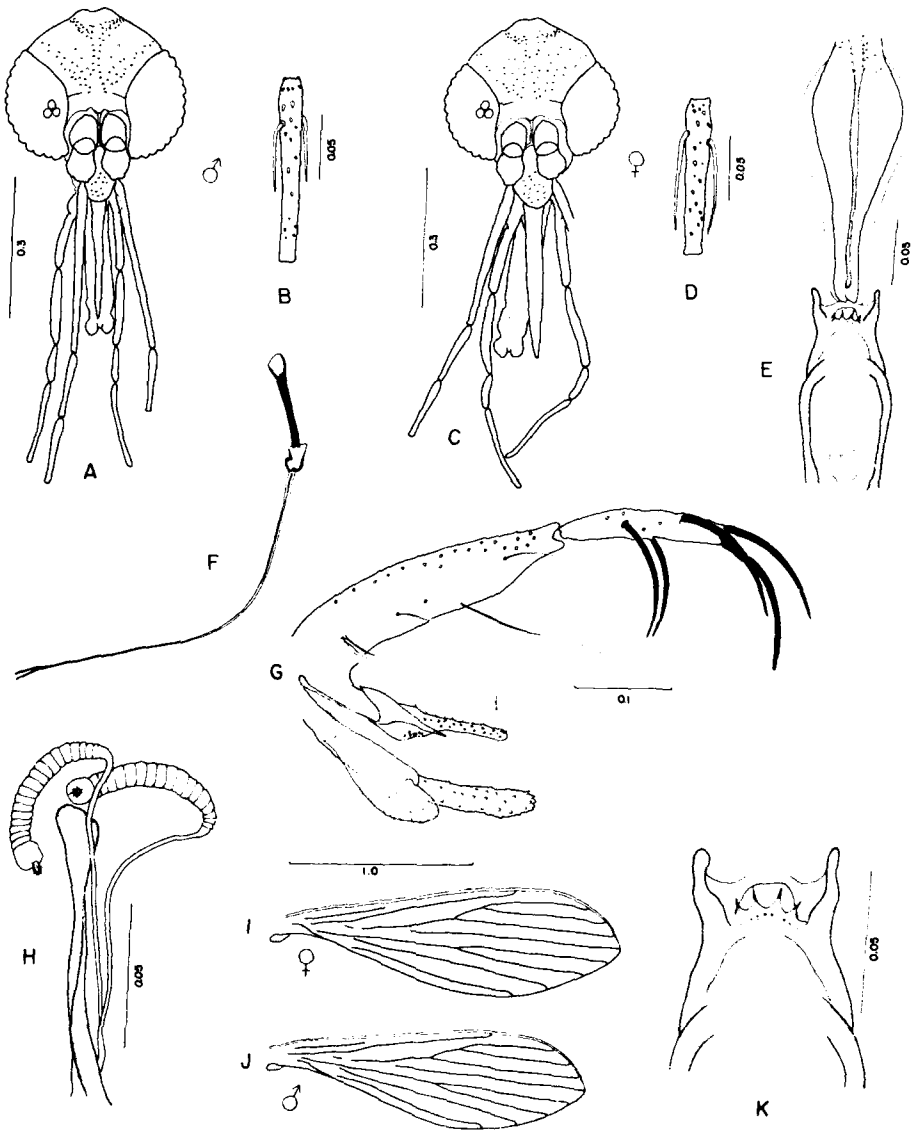


FIG. 317. ***Lutzomyia hartmanni.*** A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

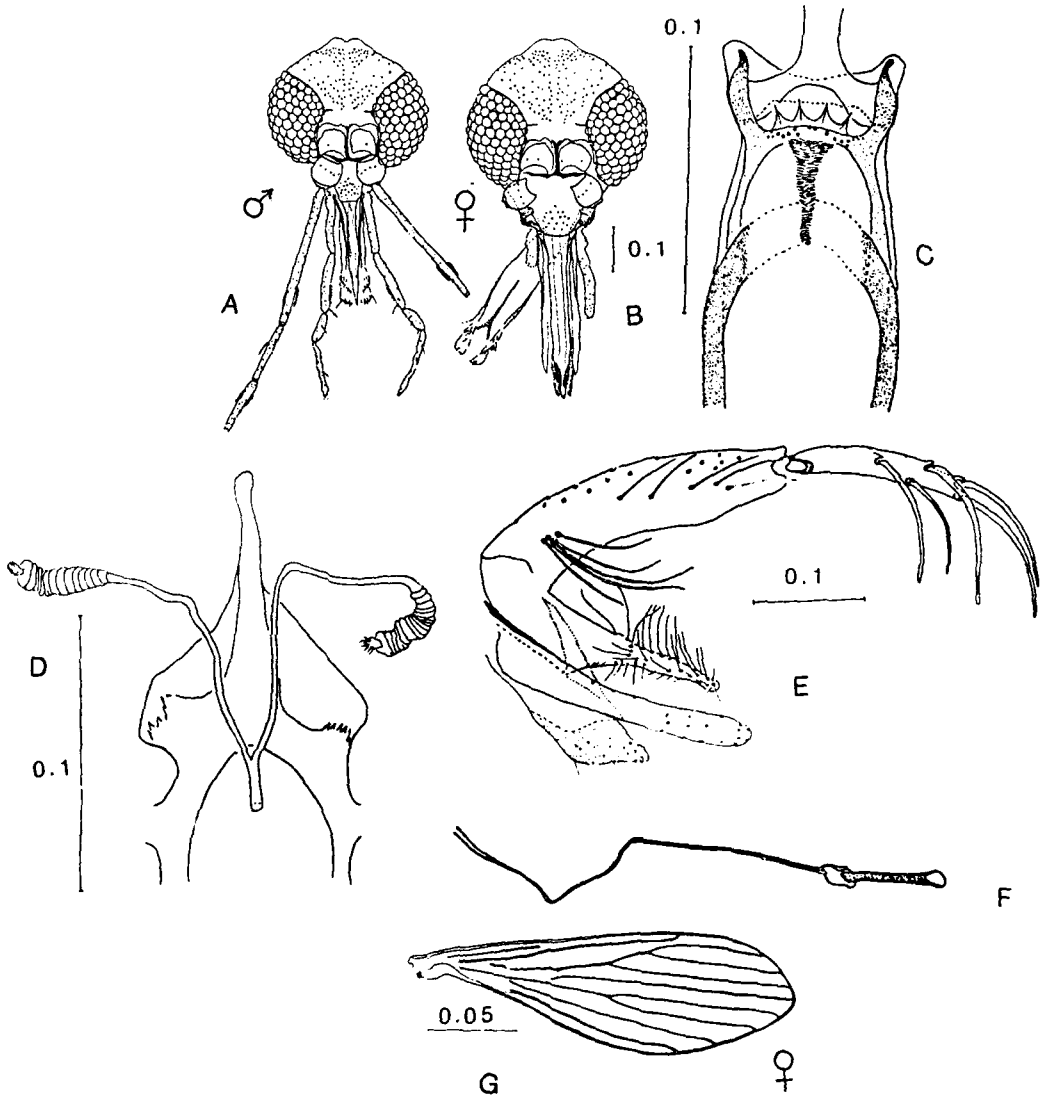
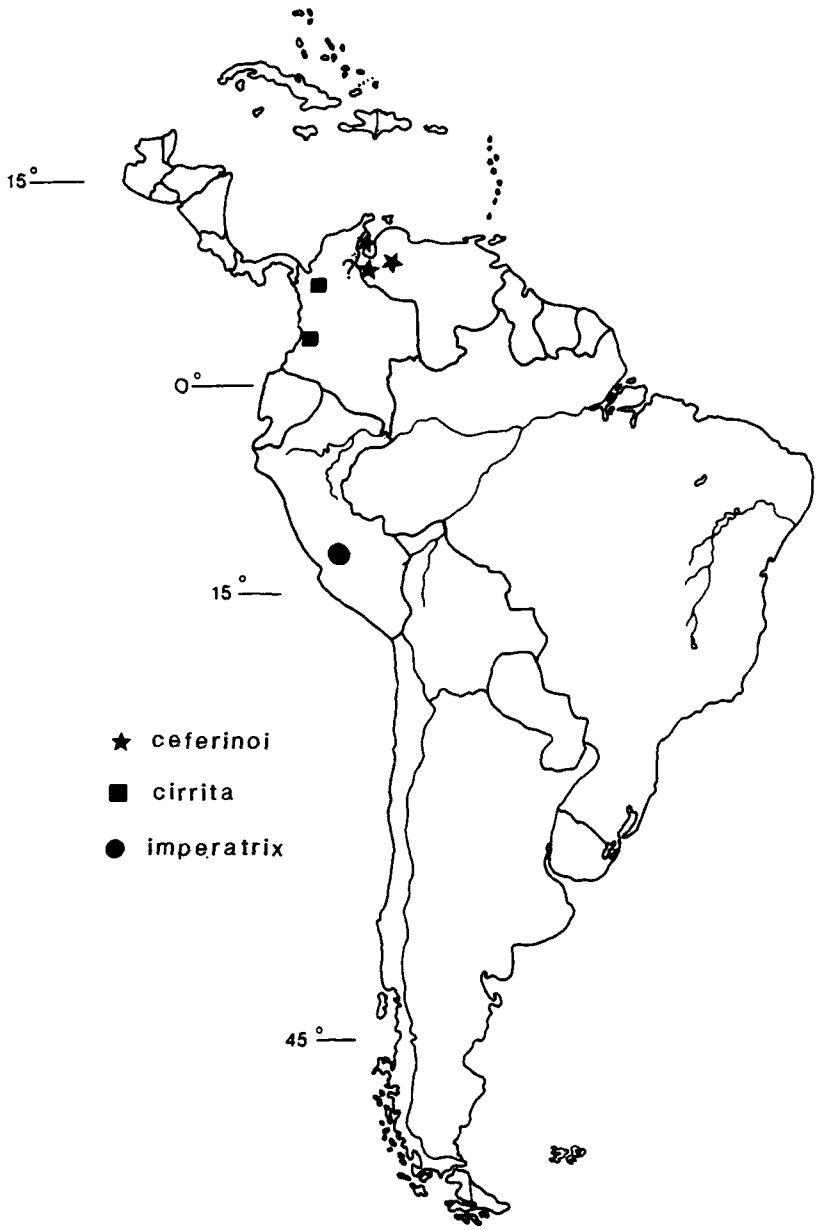
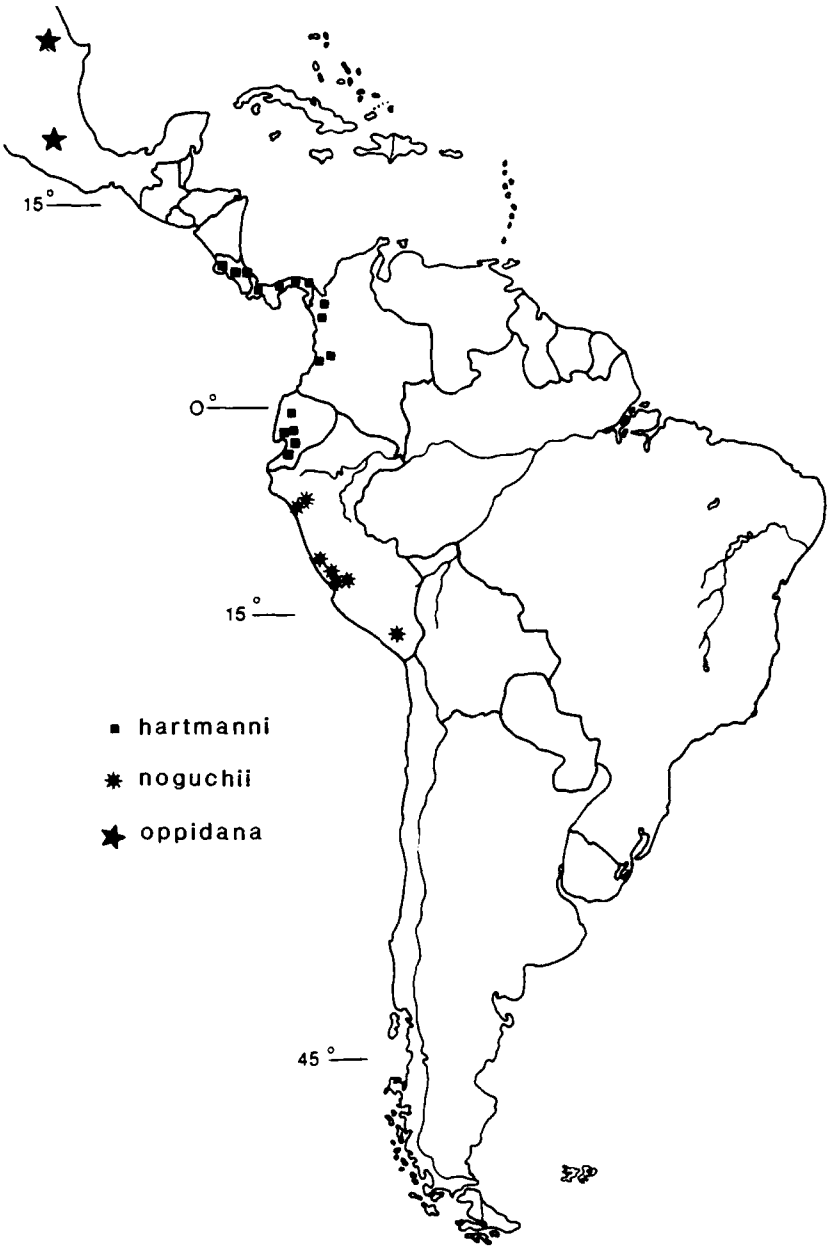


FIG. 318. ***Lutzomyia kirigetiensis***. A. Male head; B. Female head; C. Female cibarium; D. Spermathecae; E. Male terminalia; F. Genital pump & filaments; G. Female wing (from Galati & Cáceres 1992).

Map 154



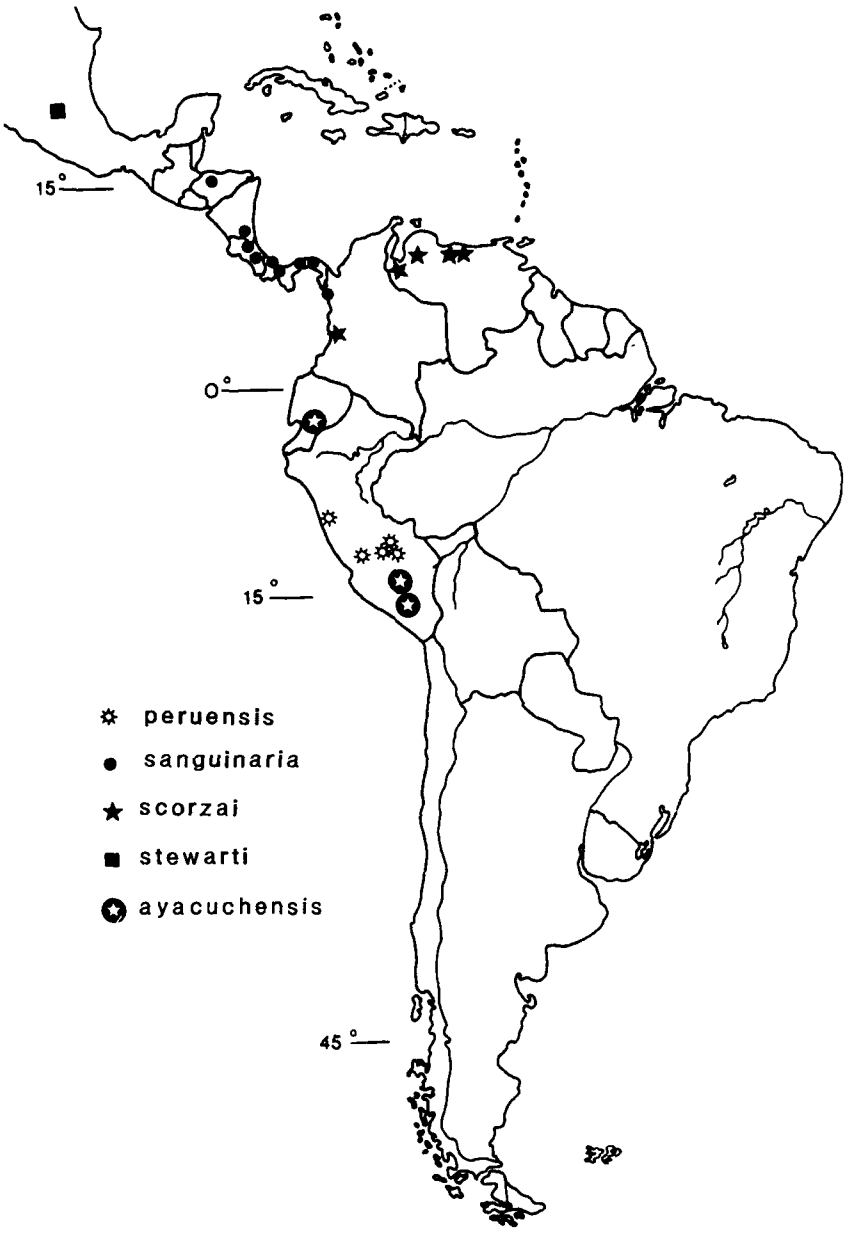
Map 155



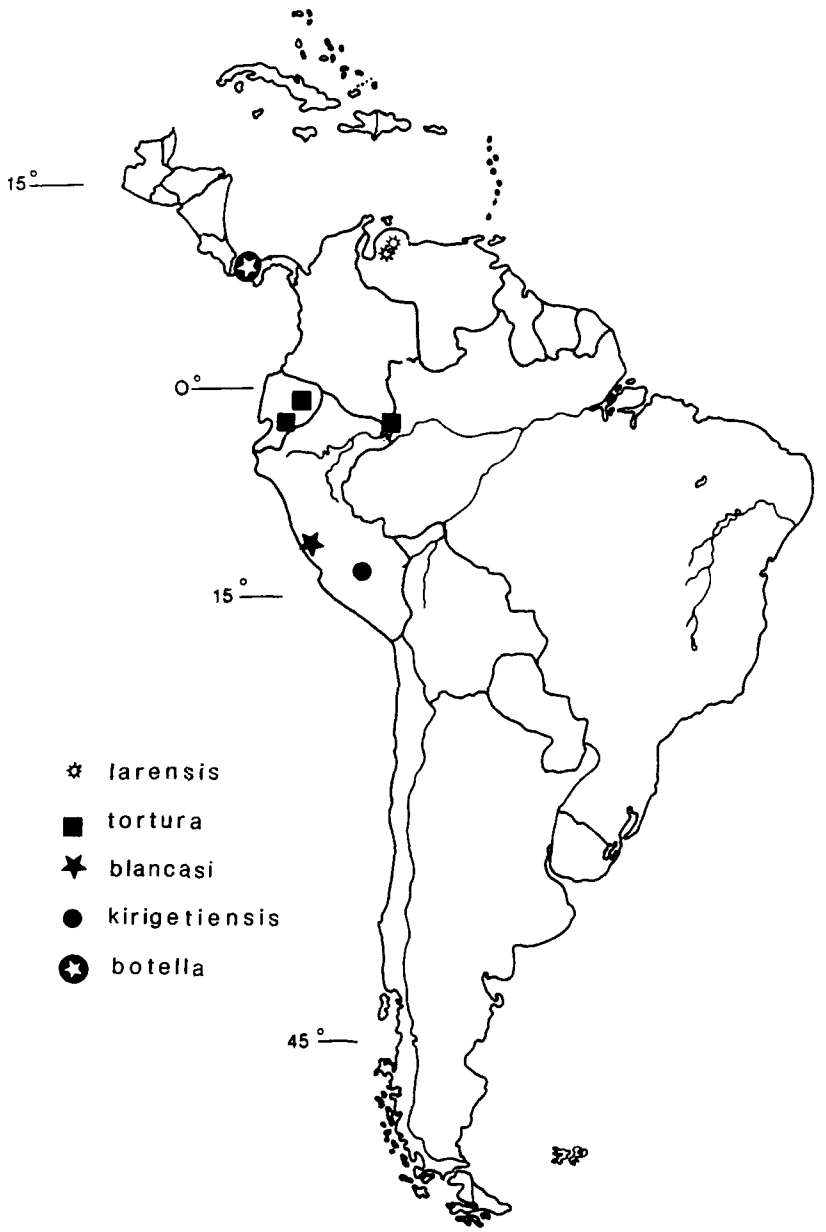
Map 156


15°
0°
15°
45°
vexator
Lutzomyia sp. of Pichinde
tejadai
strictivilla
caballeroi
vindicator

Map 157


15°
0°
15°
45°
peruensis
sanguinaria
scorzai
stewarti
ayacuchensis

Map 158


15°
0°
15°
45°
larensis
tortura
blancasi
kirigetiensis
botella

Map 159

UNGROUPED *LUTZOMYIA* SPECIES

The following species cannot be placed in existing species groups or subgenera because of unusual combinations of character states, existing specimens are damaged, or because only one sex is known.

Medical Importance: Unknown; several species have been reported biting man.

Lutzomyia monticola (Costa Lima)
Fig. 319 A-C

Phlebotomus monticolus Costa Lima 1932: 50 (♀, Serra da Bocaina, São Paulo, Brazil). Barretto & Coutinho 1941c: 177 (♂ descript.). Floch & Abonnenc 1952: 16 keyed, ♀ figs.). Bejarano 1959: 817 (dist., Argentina).

Flebotomus monticolus: Barretto 1947a: 213 (refs.); 1950a: 110 (keyed, ♀ fig.).

Lutzomyia monticola: Theodor 1965: 196 (?, in part). Martins et al. 1977a: 135 (cf. to *paulwilliamsi*); 1978: 165 (refs., dist.). Aguiar & Soucasaux 1984: 199 (human bait collections, Brazil). Aguiar et al. 1985a; b; c; 1986: 477 (coll. data, habits, Brazil). Aguiar & Vilela 1987: 585 (resting sites, Brazil). Gomes et al. 1989a: 32 (biting activity).

Psychodopygus monticolus: Forattini 1971a: 105 (listed); 1973: 474 (tax., figs.).

Lutzomyia paulwilliamsi Martins, Falcão & Silva 1977a: 135 (♂, Botanical Garden, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil). Martins et al. 1978: 166 (dist.). Mayrink et al. 1979: 134 (Minas Gerais, Brazil). **(NEW SYNONYMY)**

Distribution (Map 160). ARGENTINA; BRAZIL (Martins et al. 1978); PARAGUAY (1 ♂, Acá Poi, San Pedro, 20 April 1950, M. Hertig).

Remarks. The male of *L. paulwilliamsi* was distinguished from that of *L. monticola* by Martins et al. (1977a) mainly by the presence of a small subapical seta on each style that was supposedly absent in the latter species. However, Prof. E.A.B. Galati informed us that the *L. monticola* male described by Barretto & Coutinho (1941a) and housed at the Universidade de São Paulo, does indeed possess this small seta (in *litt.* 1992). A scattered group of persistant setae on the coxite is also present. The females are indistinguishable. We therefore follow Galati who suggests that these species are conspecific.

Aguiar et al. (1986) collected females of *L. monticola* from human and chicken bait in southern Brazil.

Lutzomyia misionensis (Castro)
Fig. 320

Flebotomus misionensis Castro 1959a: 331 (♀, Cerro Azul, Misiones, Argentina).
Flebotomus sp. Bejarano & Duret 1950: 327 (biting man, Cerro Azul, Argentina).
Lutzomyia coelhoi Coelho, Falcão & Falcão 1967a: 179 (*nomen nudum*, no description or figures given).
Lutzomyia misionensis: Forattini 1973: 354 (♀ fig.). Martins et al. 1977b: 569 (♂, ♀ figs., dist.); 1978: 165 (refs., dist.).

Distribution (Map 161). ARGENTINA; BRAZIL (Martins et al. 1978).

Lutzomyia pia (Fairchild & Hertig)
Fig. 321

Phlebotomus pius Fairchild & Hertig 1961b: 248 (♂, ♀, Chiriqui, Panama).
Lutzomyia pia: Theodor 1965: 187 (listed). Martins et al. 1978: 166 (dist.). Young 1979: 223 (figs., refs.). Ramirez Pérez et al. 1982b: 58 (keyed, figs., Venezuela). Murillo & Zeledón 1985: 117 (figs., Costa Rica). Young et al. 1987: 588 (Norte de Santander, Colombia). Warburg 1991: 189 (nat. infections of fungi, flagellates, Colombia). Warburg et al. 1991b: 9 (western Colombia, biol.).

Distribution (Map 161). COSTA RICA (Murillo & Zeledón 1985); PANAMA (Martins et al. 1978); COLOMBIA (Young 1979; Young et al. 1987); VENEZUELA (Ramirez Pérez et al. 1982b); PERU (Pérez et al. 1991).

Remarks. This anthropophilic species has been included with the *oswaldoi* group species in the past [e.g., Theodor (1965), Young (1979), & Murillo & Zeledón (1985)] based mainly on the 5-spined style of the male. However, other character states, such as the short palpomere 5, *verrucarum*-like spermathecae, presence of a subapical seta on the style and complete cibarial arch of the female, suggest that *L. pia* is more closely allied with the *verrucarum* group species.

Lutzomyia bursiformis (Floch & Abonnenc)
Fig. 322

Phlebotomus bursiformis Floch & Abonnenc 1944c: 5 (♀, Baduel, French Guiana); 1952: 183 (duplicate description, figs.).
Lutzomyia bursiformis: Theodor 1965: 196 (listed). Forattini 1973: 251 (♀ fig.). Léger et al. 1977: 219 (French Guiana). Martins et al. 1978: 161 (listed). Lebbe et al. 1987: 30 (computer aided ident.).

Distribution (Map 161). FRENCH GUIANA (Floch & Abonnenc 1944c; ♀♀, Paramana, Nov.-Dec. 1980, M. Claustre).

Remarks. Through the courtesy of L.P. Dedet, we examined 3 females of *L. bursiformis* from Paramana, French Guiana, taken while biting man. This species is easily identified by the enormous sac-like spermathecae. The male remains unknown.

Lutzomyia rangeliana (Ortiz)
Fig. 323

Phlebotomus rangelianus Ortiz 1952: 153 (♂, Duaca, Lara, Venezuela). Pifano et al. 1962c: 384 (♂, ♀, keyed, figs.).

Lutzomyia rangeliana: Theodor 1965: 196 (listed). Martins et al. 1978: 166 (refs., dist.). Ramirez Pérez et al. 1978: 52 (♂, ♀ figs., Aragua, Venezuela); 1982a: 14; 1982b: 58 (tax., Venezuela). Young 1979: 235 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (figs., keyed). Feliciangeli et al. 1984a: 360 (Venezuela). Morales et al. 1987: 93 (Colombia). Feliciangeli 1987a: 122; 1987b: 127 (Carabobo, Venezuela); 1988: 110 (Venezuela). Añez et al. 1988: 457 (Mérida, Venezuela). Bonfante-Garrido et al. 1991: 99 (Lara, Venezuela; 18 ♀♀ dissected but no flagellates observed).

Distribution (Map 160). COLOMBIA (Young 1979); VENEZUELA (Feliciangeli 1988); TRINIDAD; PANAMA (Young 1979).

Remarks. According to Ortiz (1968), [cited by Feliciangeli (1980)], females of *L. rangeliana* feed on bats and armadillos. Both sexes of this species resemble some species in the *verrucarum* group (Young 1979).

Lutzomyia ignacioi Young
Fig. 324

Lutzomyia ignacioi Young 1972a: 312 (♂, ♀, 2 km S of Mérida, Mérida, Venezuela). Feliciangeli 1980: 246 (keyed, figs.). Young & Morales 1987: 662 (Granada, Colombia).

Distribution (Map 162). VENEZUELA (type locality); COLOMBIA (Young & Morales 1987).

Remarks. *Lutzomyia ignacioi* has been found only at high elevations (ca. 2,000 m a.s.l.) in cloud forests in Venezuela and Colombia. Its nearest living relatives appear to be those in the subgenus *Psathyromyia*, but the male has persistent setae on each coxite.

Lutzomyia ponsi Perruolo
Fig. 325 C

Lutzomyia ponsi Perruolo 1984. 12: 130 (♀, El Tama National Park, Tachira, Venezuela).

Distribution (Map 163). VENEZUELA (type locality).

Remarks. *Lutzomyia ponsi* females were captured in a Shannon trap operated in a mountain forest, 2,200 m a.s.l. Based only on the original description, this species and *L. ignacioi* are closely allied but the *L. ponsi* female has 8, not 4, horizontal teeth in the cibarium. Both species are exceptionally large sand flies.

Lutzomyia torrealbai Martins, Fernandez & Falcão
Fig. 325 A & B

Lutzomyia torrealbai Martins, Fernandez & Falcão 1979b: 431 (♂, Vitisay, Trujillo, Venezuela). Feliciangeli et al. 1984b: 596 (cf. to *L. aulari*).

Distribution (Map 164). VENEZUELA (Martins et al. 1979b).

Remarks. The male has 5-6 spines on the style and a subterminal seta, the presence of which is unusual among 5-spined *Lutzomyia* males.

Lutzomyia brisolai Le Pont & Desjeux
Fig. 325 D-H

Lutzomyia brisolai Le Pont & Desjeux 1987b: 319 (♂, ♀, Serrania de Marimonos, Alto Beni, La Paz, Bolivia).

Distribution (Map 162). BOLIVIA (type locality).

Remarks. Like many females in the subgenus *Nyssomyia*, *L. brisolai* is anthropophilic but, unlike them, has only 4 horizontal teeth in the cibarium. The spermathecae and most other character states are similar to those in that subgenus but, for the present, this species is regarded as ungrouped.

Lutzomyia mollinedoi Le Pont & Desjeux

Lutzomyia mollinedoi Le Pont & Desjeux 1991a: 305 (♂, ♀, Toro Toro, Potosi, Bolivia).

Distribution (Map 162). BOLIVIA (type locality).

Remarks. Both sexes of *L. mollinedoi* were collected in limestone caves (2,700 m a.s.l.) at the type locality in association with vampire bats (*Desmodus*).

The female closely resembles that of *L. brisolai* in details of the spermathecae and cibarial armature. The males are also similar but can be distinguished by the position of the spines on their styles. The proximal spine of *L. brisolai* is inserted before the middle of the style, whereas, all spines of *L. mollinedoi* are situated beyond the middle of the style. There are other structural differences between these taxa as pointed out by Le Pont & Desjeux (1991a).

Lutzomyia Species of Anchicaya Young
Fig. 326

Lutzomyia sp. of Anchicaya Young 1979: 237 (♂, Anchicaya Dam, Valle, Colombia).

Distribution (Map 164). COLOMBIA (Young 1979); ECUADOR (1 ♂, 12 km E of Santo Domingo de Los Colorados, Pichincha, July 1982, D. Duckhouse).

Remarks. A second male of this informally named taxon from Ecuador closely resembles the male from Colombia (Young 1979). Its assignment to a species group and full description must await the discovery of the female.

Lutzomyia acanthopharynx Martins, Falcão & Silva
Fig. 327

Lutzomyia acanthopharynx Martins, Falcão & Silva 1962c: 387 (♂, ♀, Formosa, Goiás, Brazil). Theodor 1965: 195. Forattini 1973: 300 (tax., figs.). Lainson et al. 1976a: 57 (Mato Grosso, Brazil). Martins et al. 1978: 160 (refs., dist.). Arias et al. 1985: 1101 (neg. for flagellates, Brazil).

Distribution (Map 163). BRAZIL (Lainson et al. 1976a; Martins et al. 1978).

Remarks. The spermathecae of *L. acanthopharynx* resemble those of some *oswaldoi* group females, but the male has only 4 large spines on the style. The heavily spined pharynx is characteristic.

Lutzomyia samueli (Deane)
Fig. 328

Phlebotomus samueli Deane 1955: 251 (♂, Pé da Serra, Massapé, Ceará, Brazil). Deane & Deane 1957: 231 (coll. data, Ceará, Brazil).

Lutzomyia samueli: Theodor 1965: 193 (mention). Forattini 1971a: 100; 1973: 332 (♂ fig., tax., refs.). Martins et al. 1978: 167 (dist.). Martins et al. 1989: 353 (♀).

Distribution (Map 164). BRAZIL (Martins et al. 1978; 1989).

Remarks. The arrangement of the spines on the style and distinctive paramere serve as diagnostic characters for this species. Forattini (1973) places *L. samueli* in the subgenus *Dampfomyia*, but the female does not have similar cibarial armature or spermathecae (Martins et al. 1989). They point out some similarities of *L. samueli* with females in the subgenera *Lutzomyia* and *Helcocyrtomyia* but conclude that it is an isolated species.

Lutzomyia boliviana Velasco & Trapido
Fig. 329

Lutzomyia boliviana Velasco & Trapido 1974: 433 (♂, ♀, Rio Solacama, La Paz, Bolivia). Martins et al. 1978: 161 (listed).

Distribution (Map 160). BOLIVIA (type locality).

Lutzomyia torresi Le Pont & Desjeux

Lutzomyia torresi Le Pont & Desjeux 1991a: 301 (♂, ♀, Toro Toro, Potosi, Bolivia).

Distribution (Map 163). BOLIVIA (Le Pont & Desjeux 1991a).

Remarks. This recently described sand fly and *L. boliviana* form a species pair that is structurally similar. Both species occur at relatively high elevations a.s.l. in Bolivia. Le Pont & Desjeux (1991a) should be consulted for details on morphology and collection data.

Lutzomyia oligodonta Young, Peréz & Romero
Fig. 330

Lutzomyia oligodonta Young, Peréz & Romero 1985: 136 (♂, ♀, Cocachacra, Lima, Peru).

Distribution (Map 160). PERU (type locality).

Remarks. The female of *L. oligodonta* lacks a distinct cibarial armature, unlike other *Lutzomyia* females. This character state, when viewed in combination with other features of both sexes (Young et al. 1985), indicates that this species has no close allies in the genus.

Lutzomyia caminoi Young & Duncan, n.sp.
Fig. 331

Holotype ♂ (measurements in mm). Many structures including appendages of head, thorax & terminalia missing or damaged. Coloration dusky throughout. Head height from vertex to tip of clypeus 0.40; head width 0.21. Eyes small, separated by 0.12 or by distance = to 7.5 facet diameters. Labrum 0.19 long. Length of palpomeres: 1, 0.33; 2, 0.14; 3, 0.15; 4 & 5, missing, only 2 palpal sensilla visible on palp. 3 near middle. Cibarium unarmed; arch diffuse; pigment patch suboval, convex anteriorally, well-marked. Pharynx 0.17 long with posterior ridges. Pleura with 6-7 upper & 2-3 lower episternal setae. Length of hindfemur 0.78 (other legs missing). *Genitalia*. Style missing. Coxite 0.29 long with ca. 15 slender, upturned setae near middle, forming a distinct tuft. Paramere simple with terminal dorsal setae (ca. 10), a ventral group of 5 near level of aedeagus & ca. 10 fine setae on ventral margin beyond acute projection. Aedeagus broad, well- pigmented. Genital pump 0.20 long, each filament 0.35 long or 1.75X pump length; filament tips extremely enlarged as shown. Lateral lobes missing.

Allotype ♀. Wing length 1.96, width 0.61. Coloration dusky throughout. Head height 0.50, width 0.29. Eyes very small, separated by 0.145 or by distance equal to 7.7 facet diameters. Flagellomere I 0.33 long; II+III = 0.28; ascoids simple, those on III reaching to end of flagellomere; remainder of flagellomeres missing. Labrum 0.30 long. Length of palpomeres: 1, 0.03; 2, 0.154; 3, 0.182; 4, 0.11; 5, 0.37; palpal sensilla (ca. 20) mostly on palp. 3 but 4-5 at subapex of palp. 2. Cibarium with 6 sharp horizontal teeth, 2 groups of vertical teeth (3 in each group) near sides of pigment patch & 7-8 well-developed lateral teeth; pigment patch subspherical, prominent; arch strongly developed, complete. Pharynx 0.22 long, unarmed. Pleura with 9-10 upper & 3-4 lower episternal setae. Length of wing vein sections: α, 0.49; β, 0.33; δ, 0.21; γ, 0.35. Legs mostly missing; length of femora & tibiae of probable midleg, 0.80 & 0.90; probable hindleg, 0.78 & 1.13; basitarsus of midleg, 0.61 long. Spermatheca striated, sac-like with long, tapered & deeply recessed terminal knob; individual sperm ducts smooth-walled & as wide as, or wider than, spermatheca diameter; common duct much shorter than individual duct, its greatest width subequal to that of individual duct.

Type Material (Map 160). *Holotype* ♂. **MEXICO**: Morelos State, Miacatalan, 15-20 May 1980, flight trap, M. Camino. *Allotype* ♀. Same data but 15-17 May 1980. *Paratype* ♀. Same data as holotype but 22-29 May 1980 (Map).

Remarks. We associated the sexes of *L. caminoi* n.sp. on the basis of similar coloration, head & eye size (narrow & small, respectively), and collection data. The remarkable expanded tips of the male genital filaments correspond well to the very wide sperm ducts of the female. We know of no other *Lutzomyia*

species which, in the male, has such expanded filament tips. Unfortunately, certain male structures, including the styles of the terminalia are missing so that it is not possible with certainty to place this species into a subgenus or species group. It is likely, however, that *L. caminoi* is closely allied with some members of the subgenus *Coromyia* because of the sac-like spermathecae, palpomere lengths and paramere shape.

The type specimens of *L. caminoi* will be deposited in the collection at the Instituto de Salud, Mexico City, Mexico.

We are pleased to name this species in honor of our friend and colleague, Dr. Mario Camino Lavin, Instituto Politecnio Nacional, who collected the sand flies during an insect survey at the type locality in 1980.

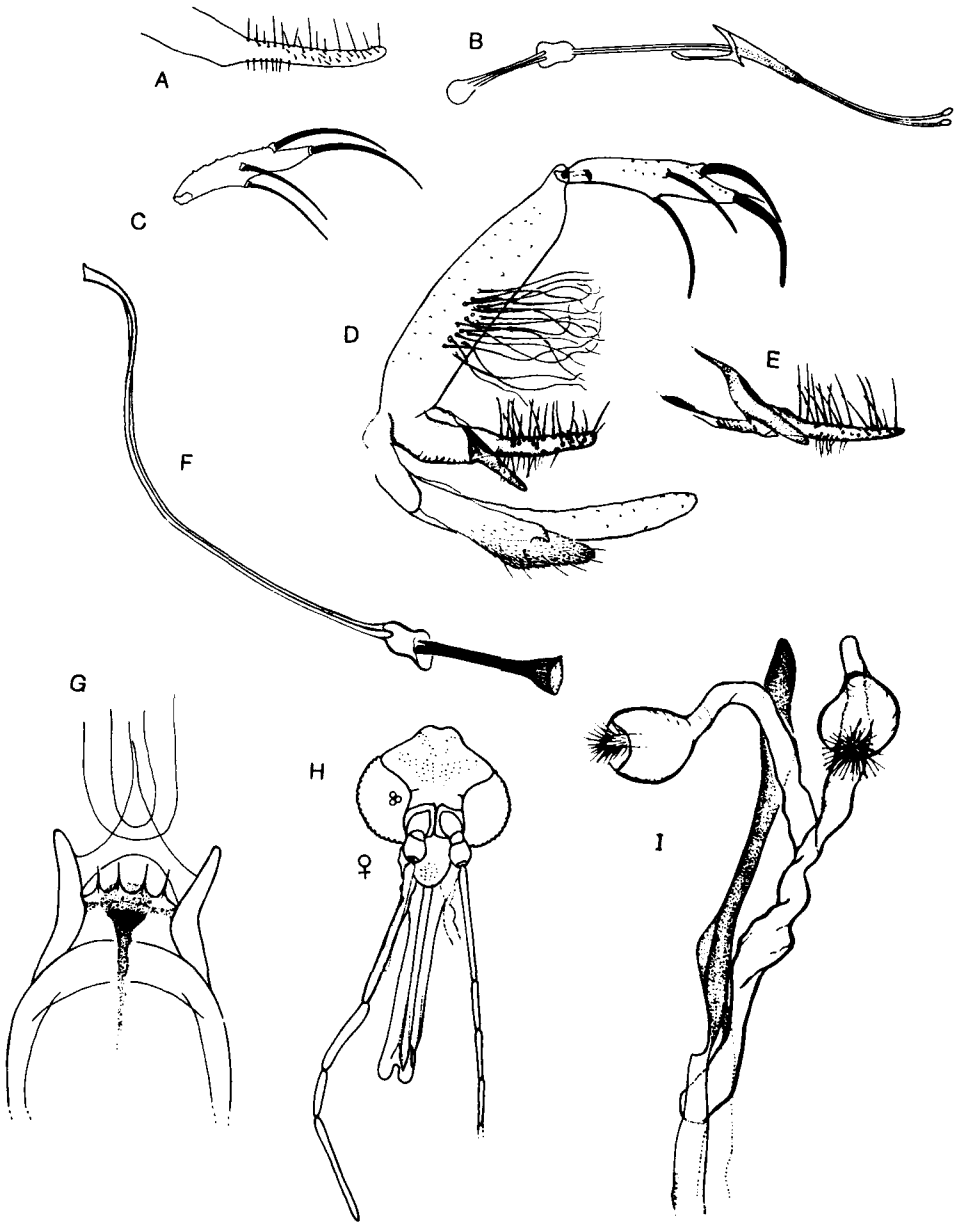


FIG. 319. ***Lutzomyia monticola.*** A. Paramere; B. Genital pump, filaments & aedeagus; C. Style (figs. from Barretto & Coutinho 1941c). ***Lutzomyia paulwilliamsi.*** D. Male terminalia; E. Paramere; F. Genital pump & filaments; G. Female cibarium; H. Female head; I. Spermathecae.

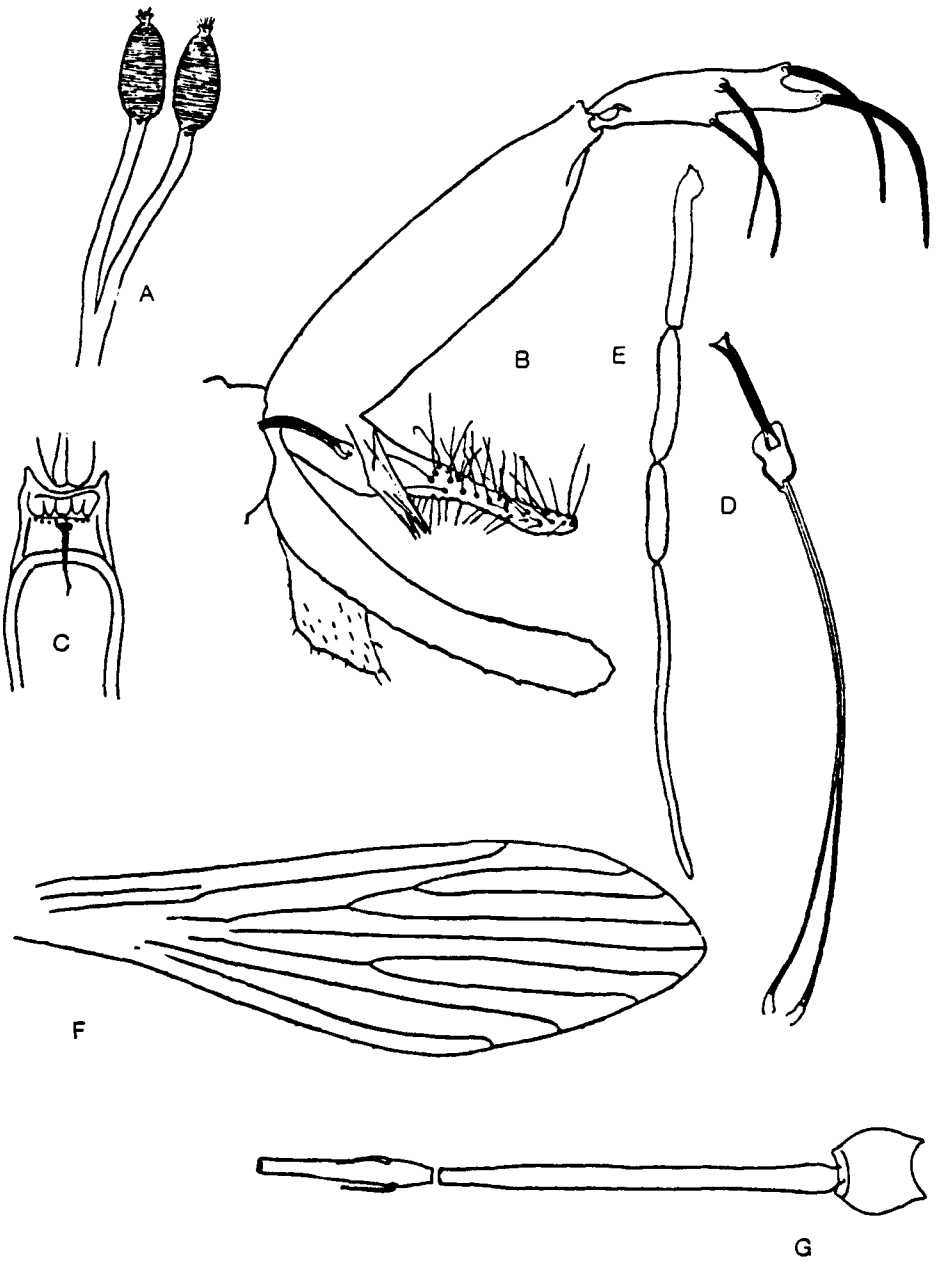


FIG. 320. ***Lutzomyia misionensis.*** A. Spermathecae; B. Male terminalia; C. Female cibarium; D. Genital pump & filaments; E. Male palpus; F. Female wing; G. Male pedicel & flagellomeres I & II (figs. from Martins et al. 1977b).

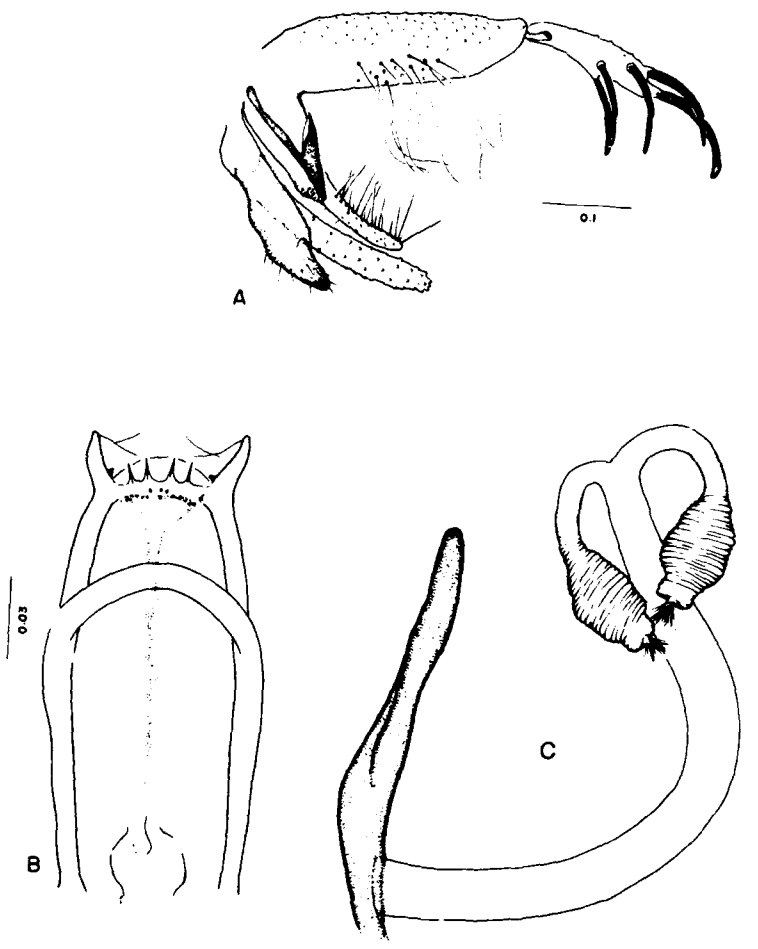


FIG. 321. ***Lutzomyia pia.*** A. Male terminalia; B. Female cibarium; C. Spermathecae (figs. A & B from Young 1979).

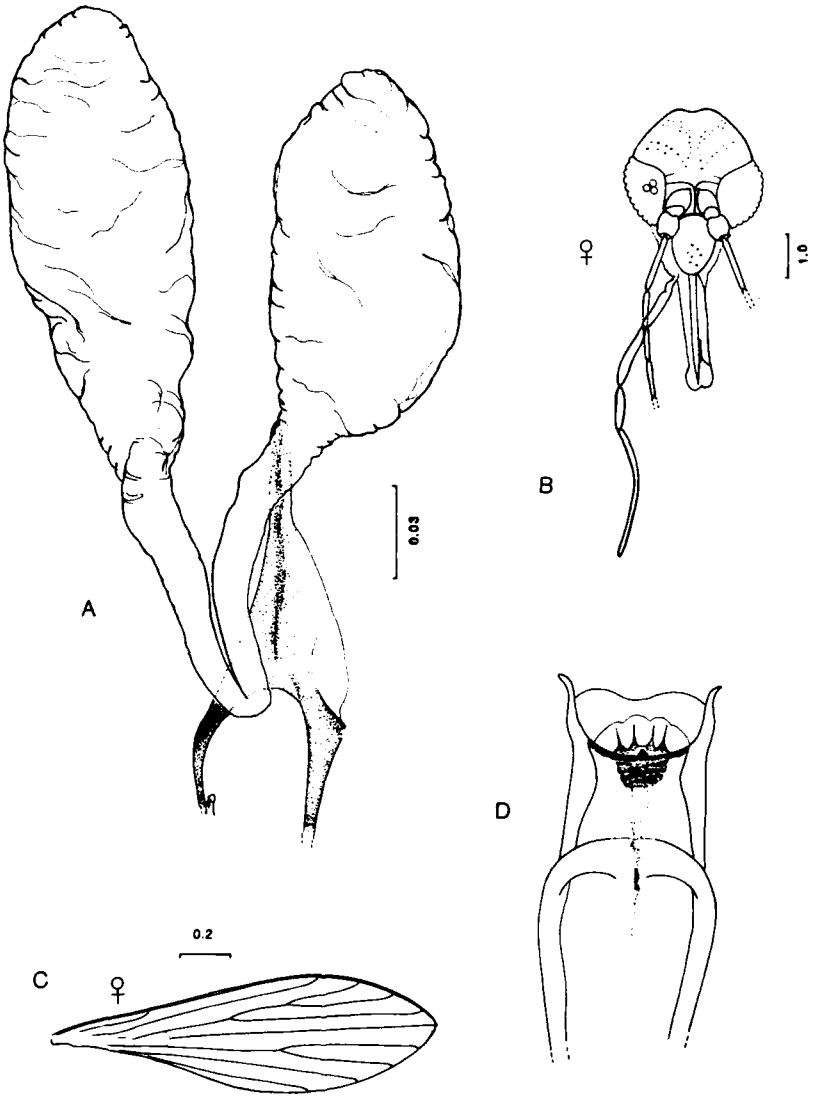


FIG. 322. ***Lutzomyia bursiformis.*** A. Spermathecae B. Female head; C. Female wing; D. Female cibarium.

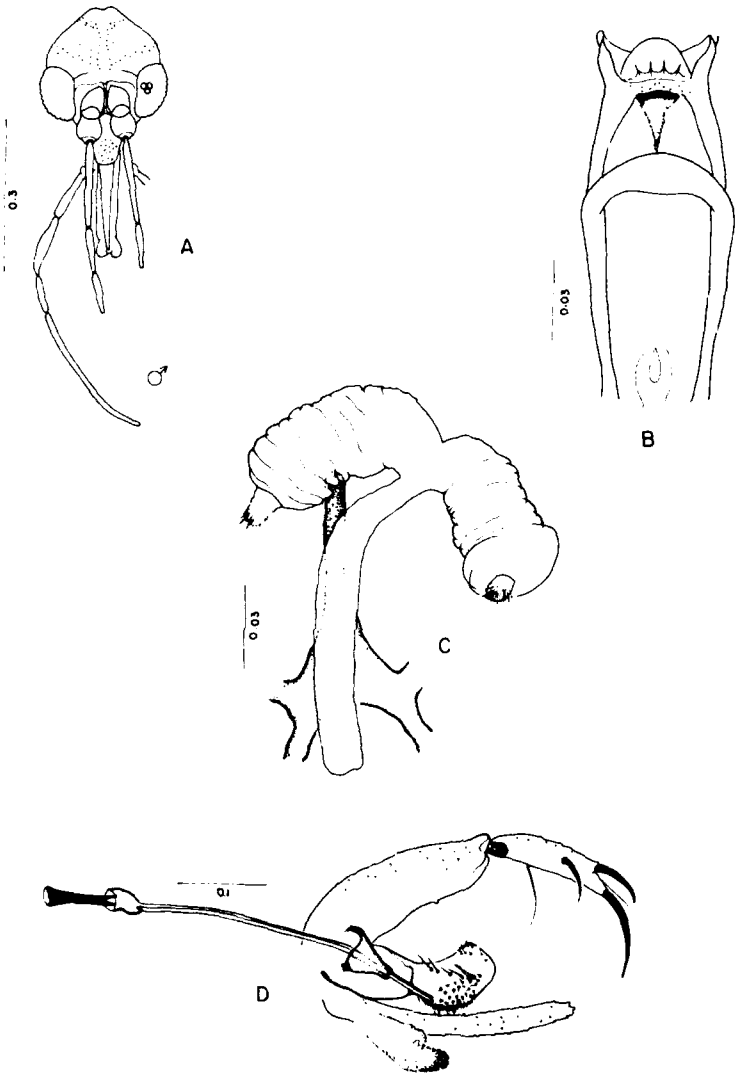


FIG. 323. ***Lutzomyia rangeliana.*** A. Male head; B. Female cibarium; C. Spermathecae; D. Male terminalia (from Young 1979).

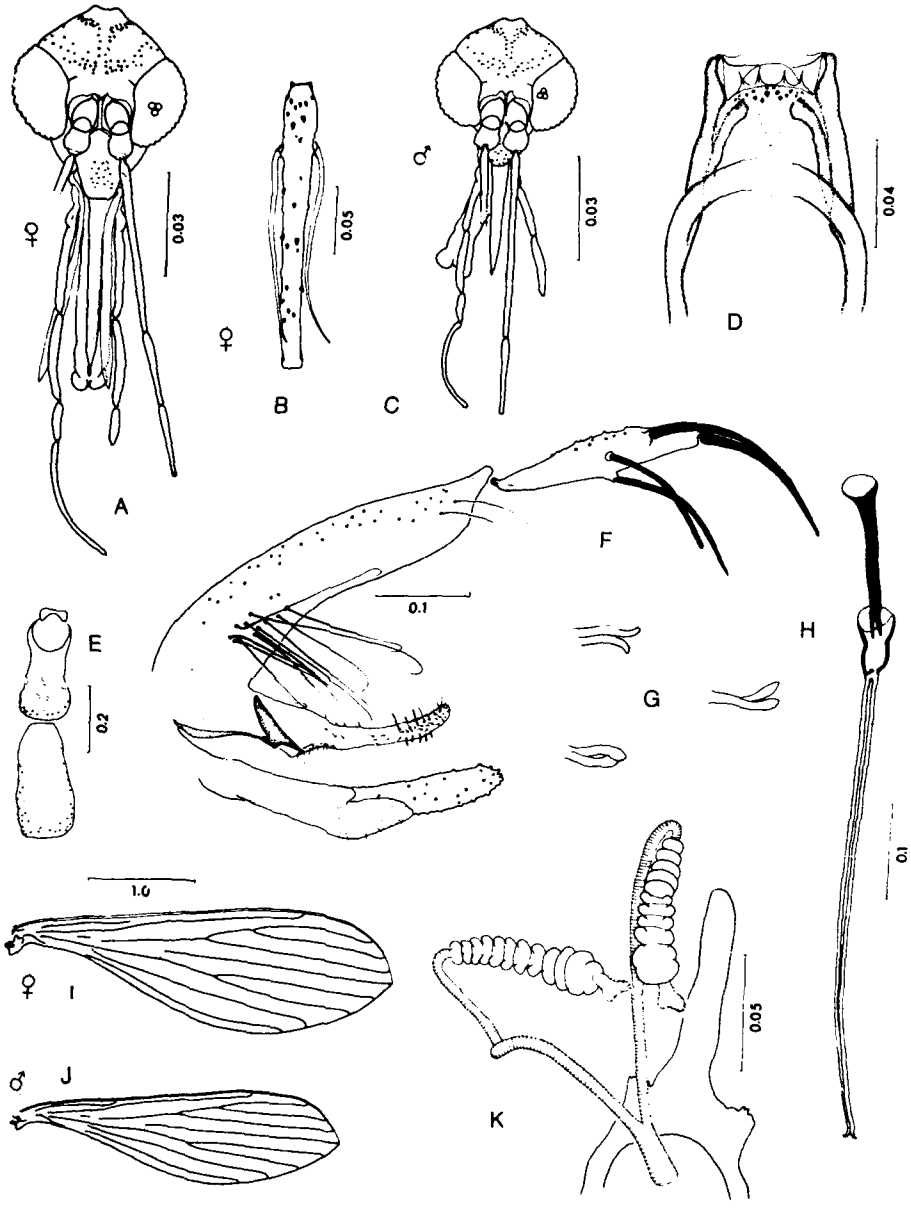


FIG. 324. ***Lutzomyia ignacioi.*** A. Female head; B. Female flagellomere II; C. Male head; D. Female cibarium; E. First 3 sternites, male; F. Male terminalia; G. Tips of genital filaments; H. Genital pump & filaments; I. Female wing; J. Male wing; K. Spermathecae (from Young 1972a).

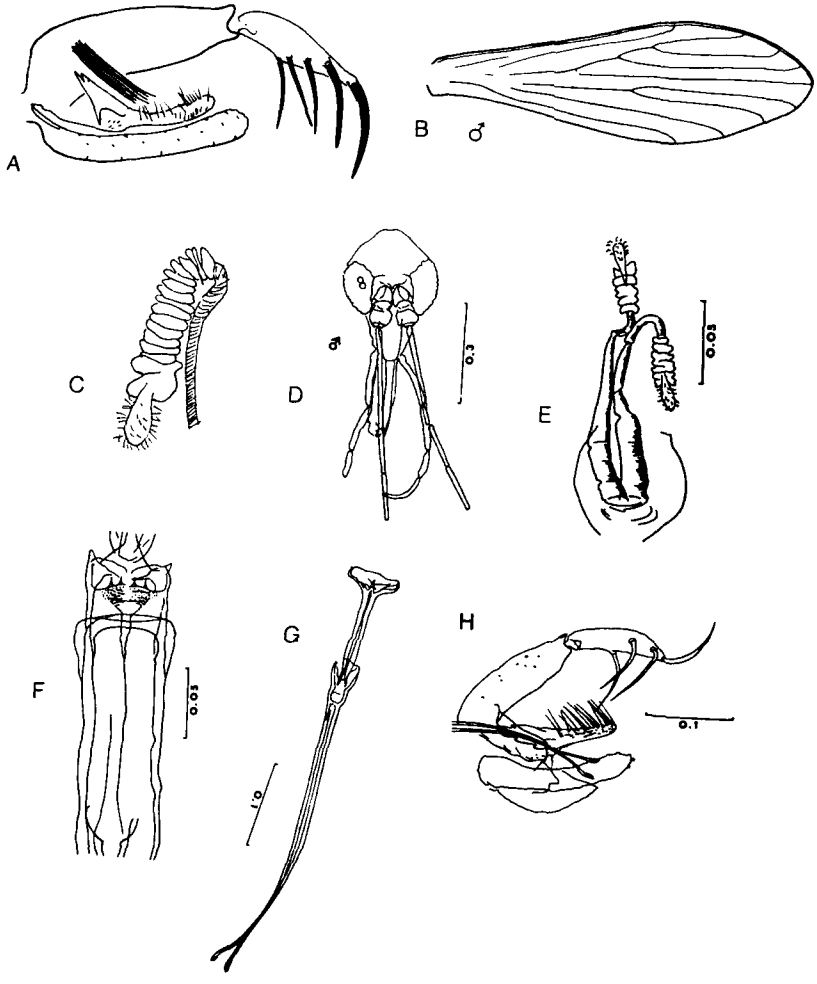


FIG. 325. ***Lutzomyia torrealbai.*** A. Male terminalia; B. Male wing (from Martins et al. 1979b).
Lutzomyia ponsi. C. Spermathecae (from Perruolo 1984).
Lutzomyia brisolai. D. Male head; E. Spermathecae; F. Female cibarium; G. Genital pump & filaments; H. Male terminalia (from Le Pont & Desjeux 1987b).

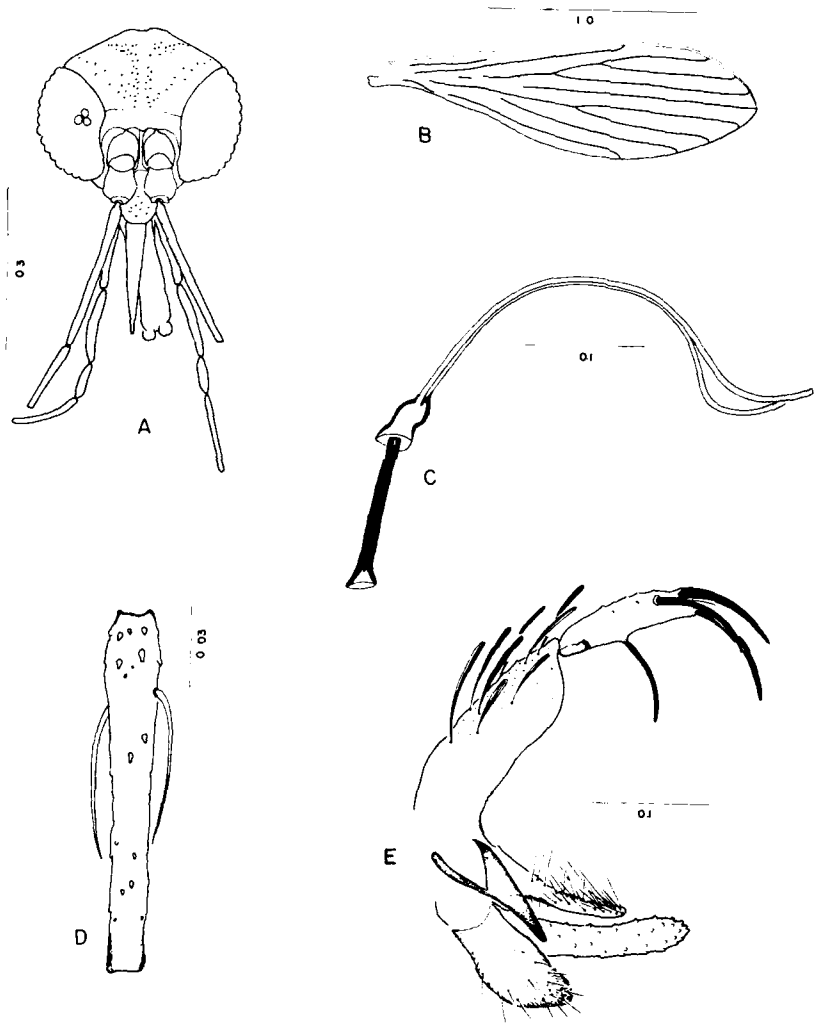


FIG. 326. *Lutzomyia* sp. of Anchicaya. A. Male head; B. Male wing; C. Genital pump & filaments; D. Flagellomere II; E. Male terminalia (from Young 1979).

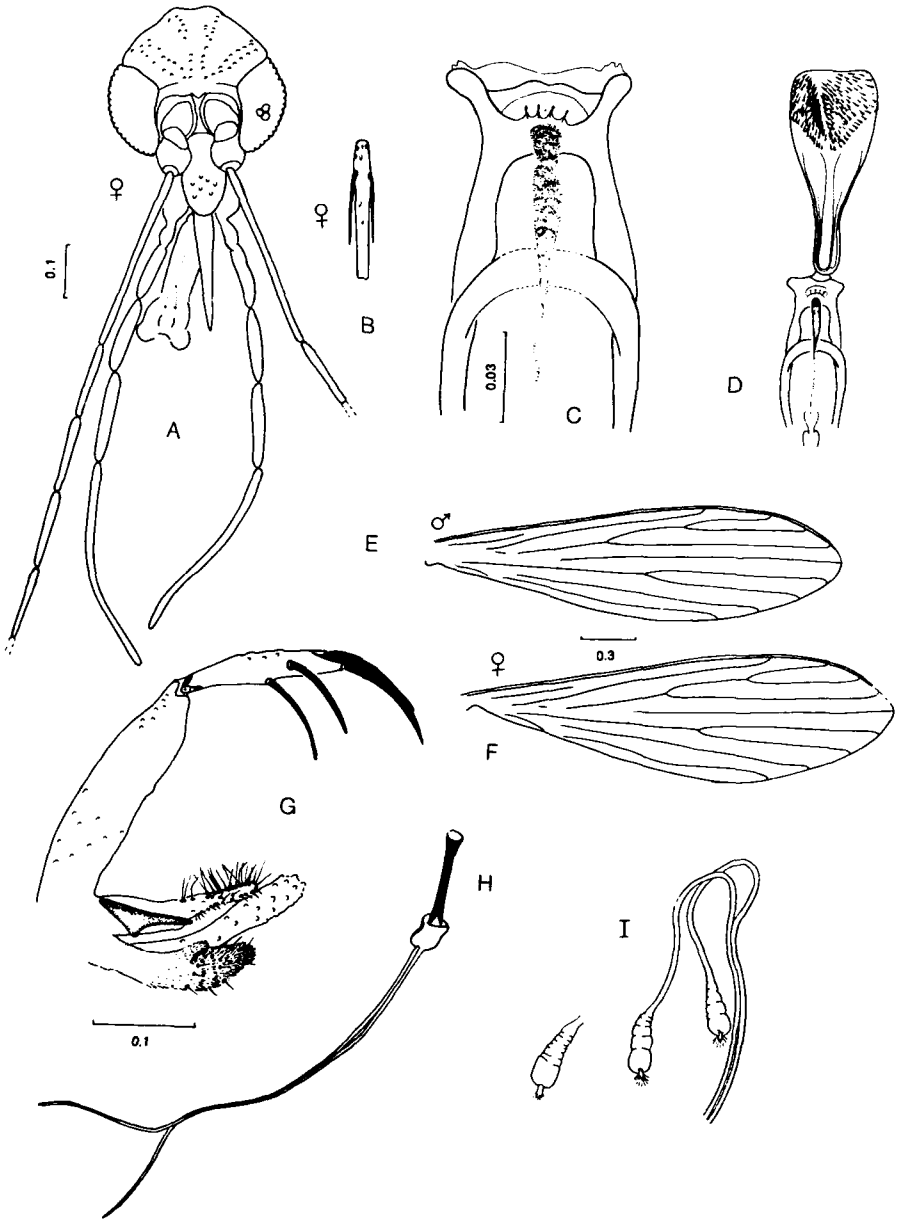


FIG. 327. ***Lutzomyia acanthopharynx.*** A. Female head; B. Female flagellomere II; C. Female cibarium; D. Female cibarium & pharynx; E. Male wing; F. Female wing; G. Male terminalia; H. Genital pump & filaments; I. Spermathecae (fig. I from Martins et al. 1962c).

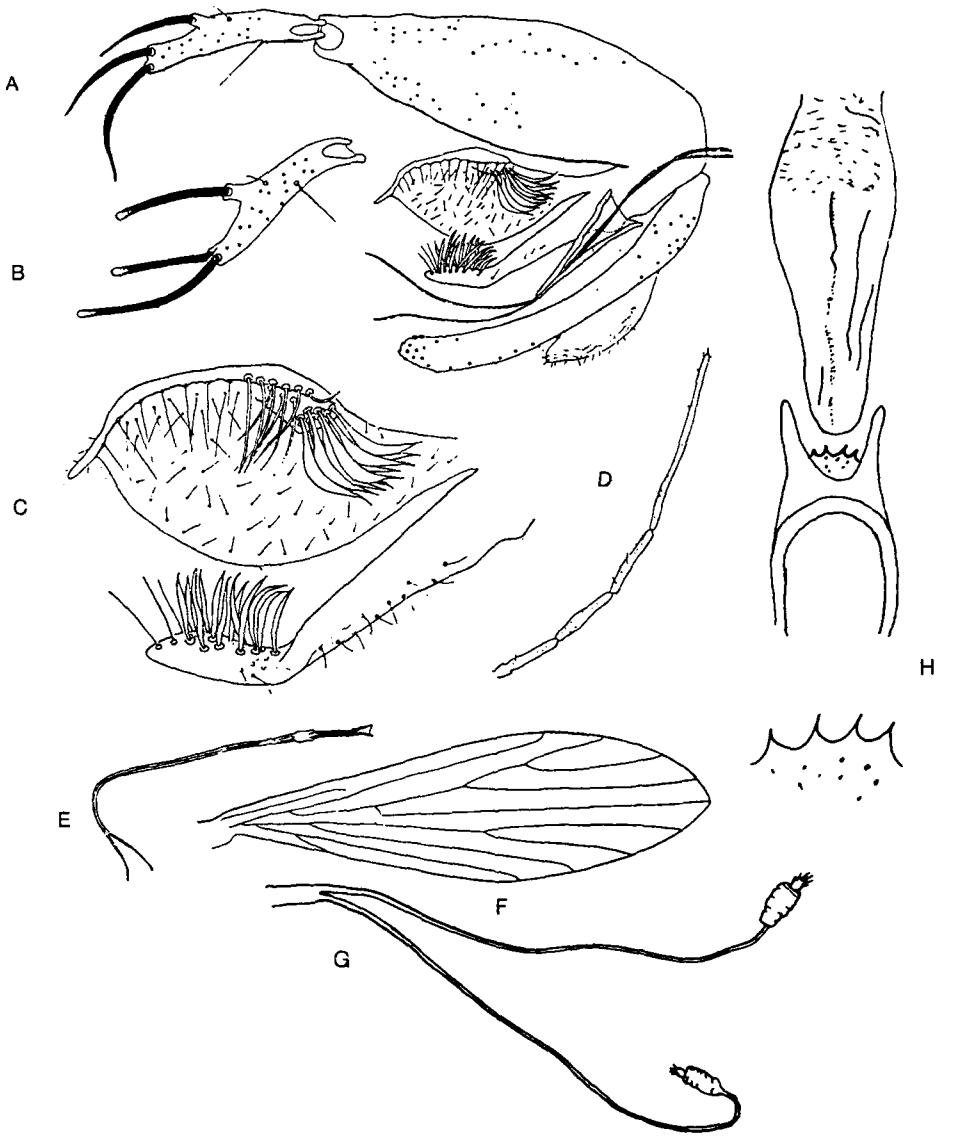


FIG. 328. ***Lutzomyia samueli.*** A. Male terminalia; B. Style; C. Paramere; D. Palpus; E. Genital pump & filaments; F. Male wing (figs. from Deane 1955).

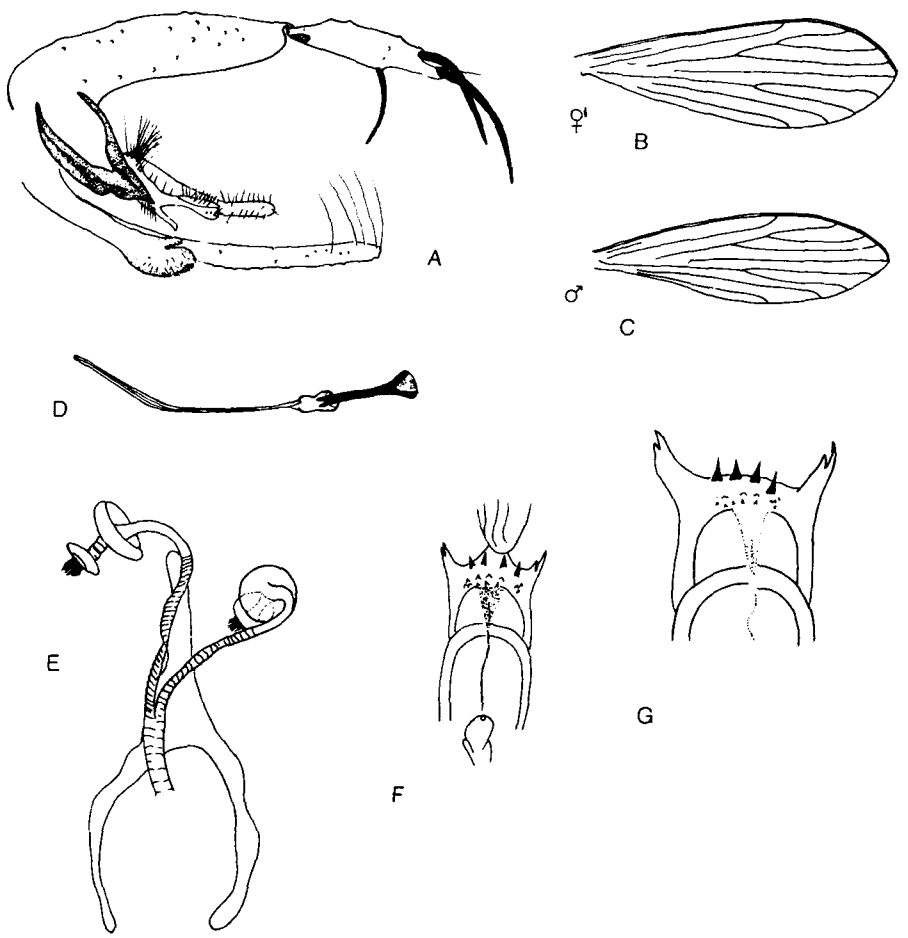


FIG. 329. ***Lutzomyia boliviana.*** A. Male terminalia; B. Female wing; C. Male wing; D. Genital pump & filaments; E. Spermathecae; F. Female cibarium; G. Female cibarium (figs. from Velasco & Trapido 1974).

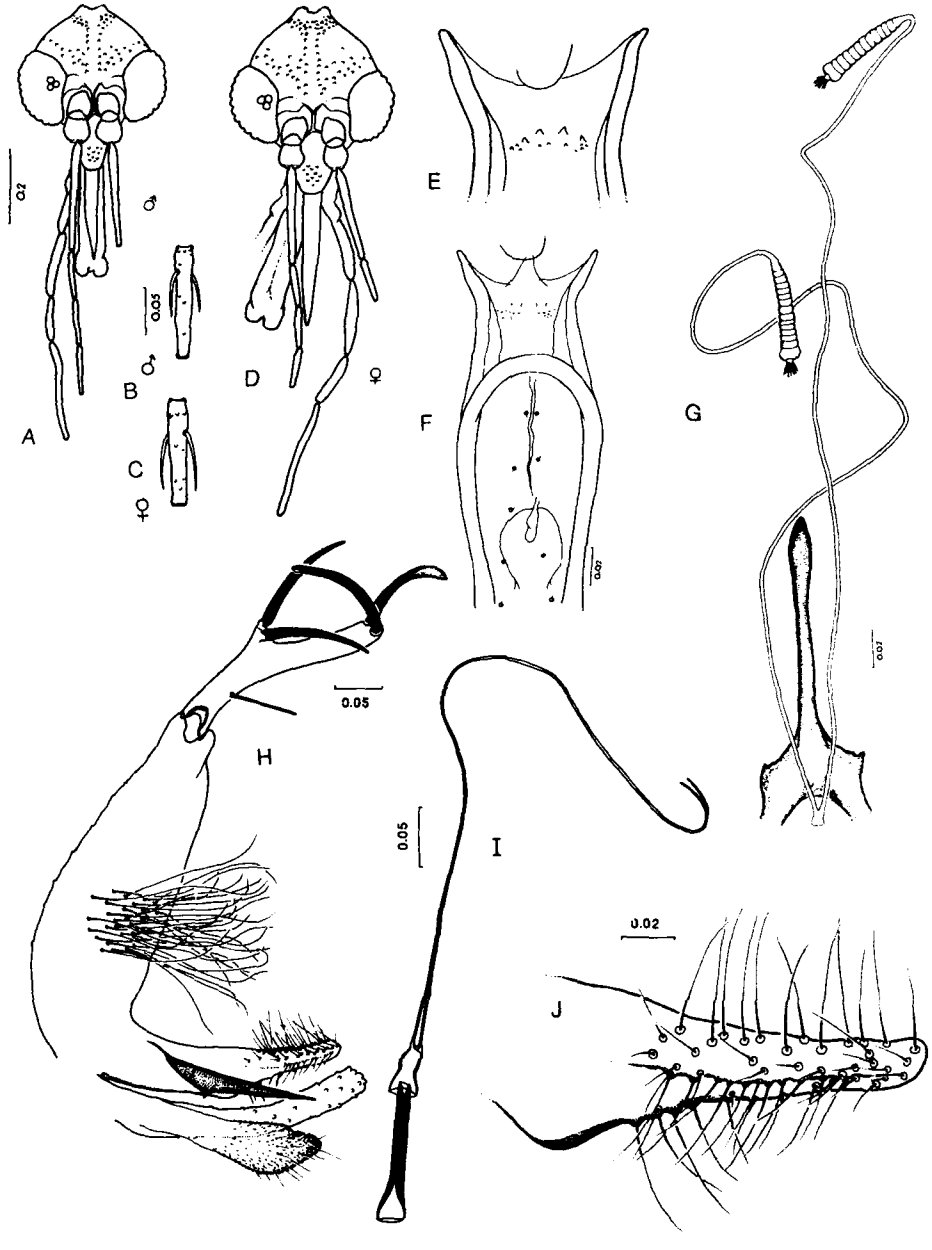


FIG. 330. ***Lutzomyia oligodonta.*** A. Male head; B. Male flagellomere II; C. Female flagellomere II; D. Female head; E. Female cibarium; F. Female cibarium & pharynx; G. Spermathecae; H. Male terminalia; I. Genital pump & filaments; J. Paramere (figs. from Young et al. 1985).

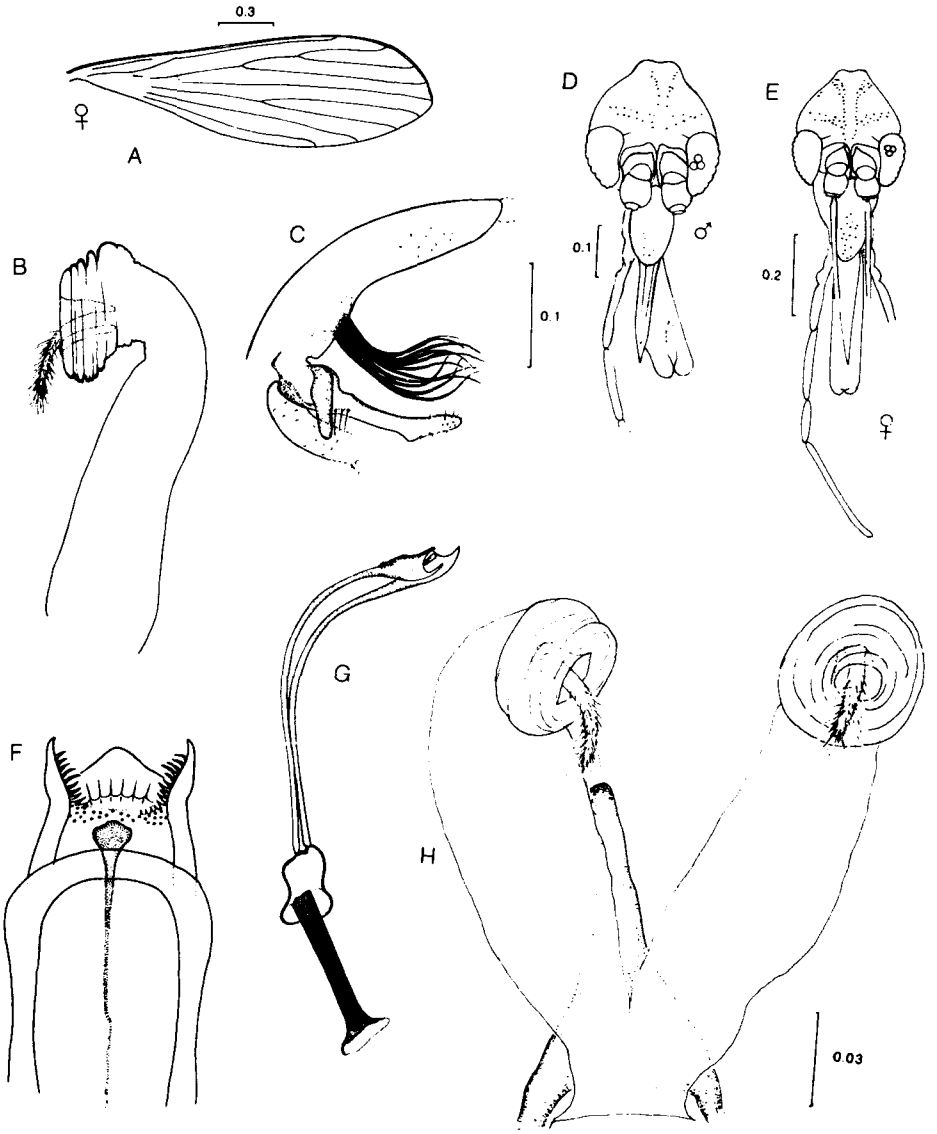
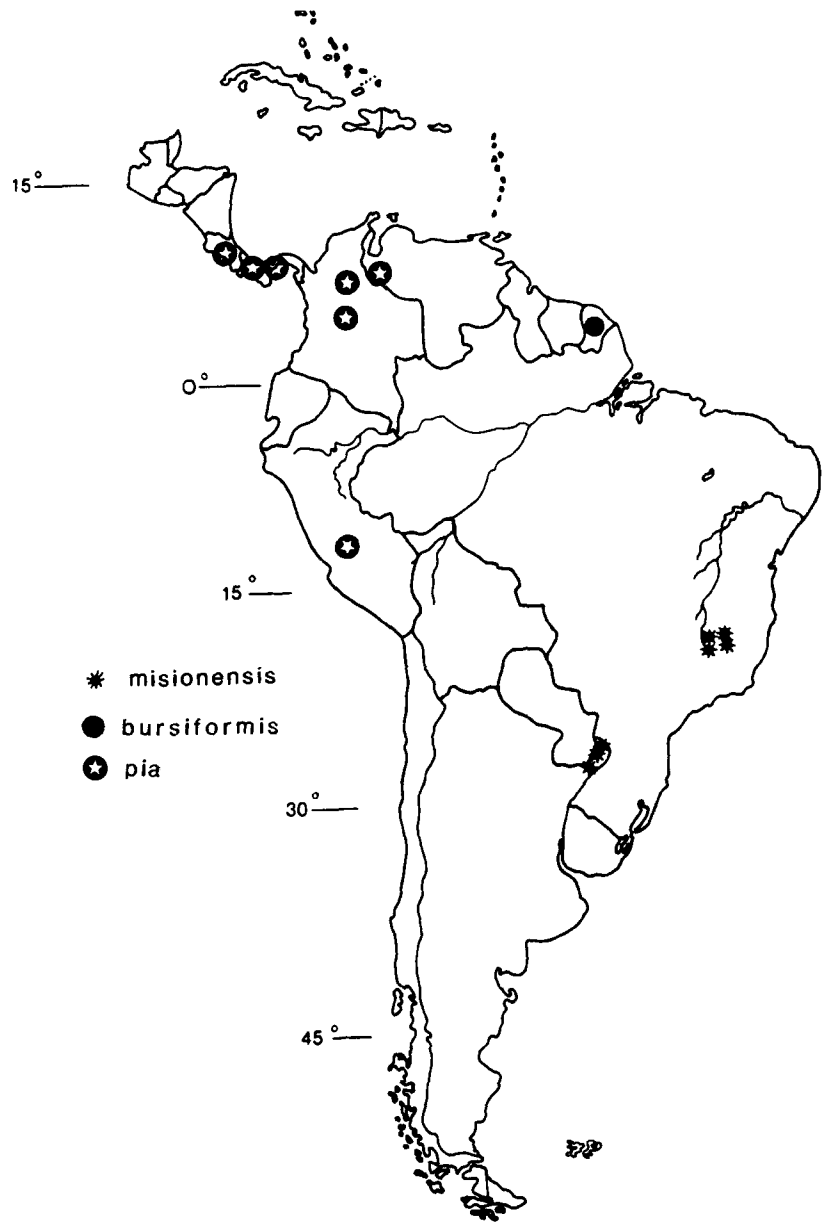


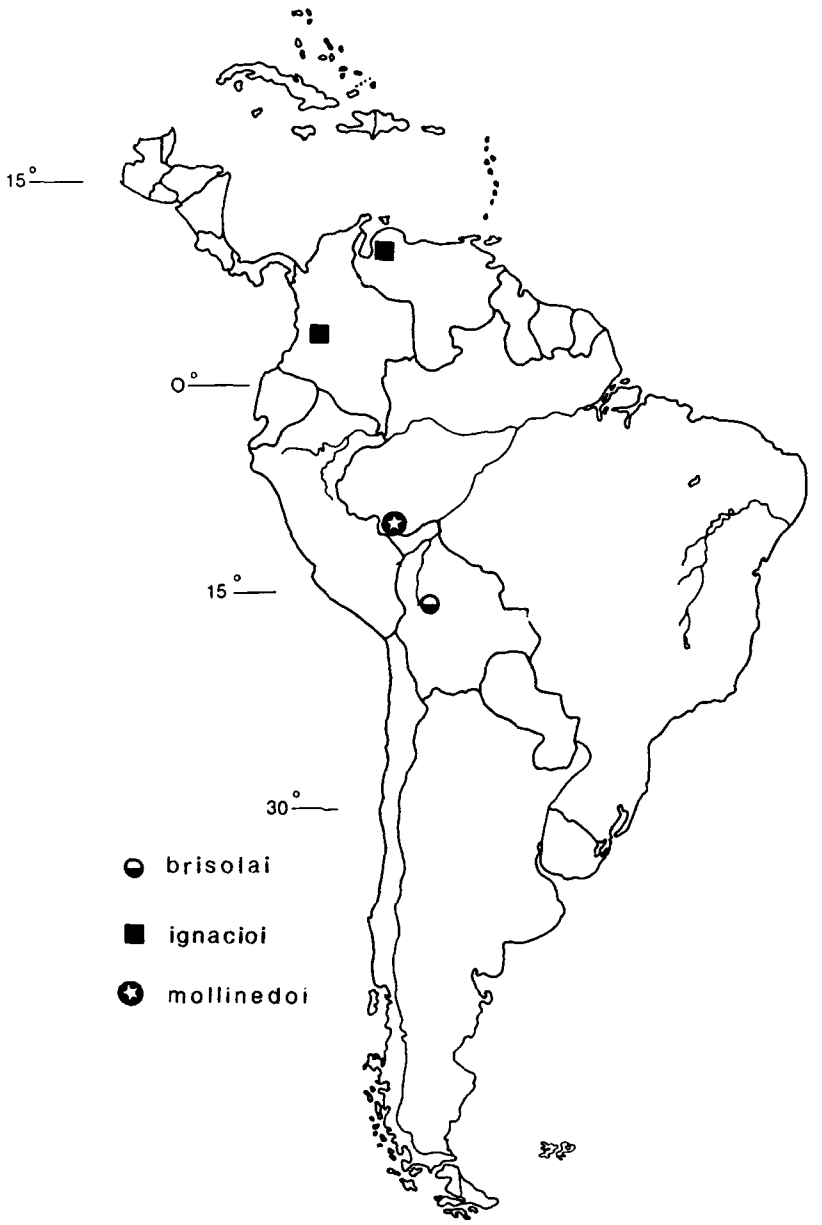
FIG. 331. ***Lutzomyia caminoi.*** A. Female wing; B. Spermathecae; C. Coxite & paramere (style & lateral lobe missing); D. Male head; E. Female head ; F. Female cibarium; G. Genital pump & filaments; H.Spermathecae.


15°
0°
15°
45°
monticola
boliviana
oligodonta
caminoi
rangeliana

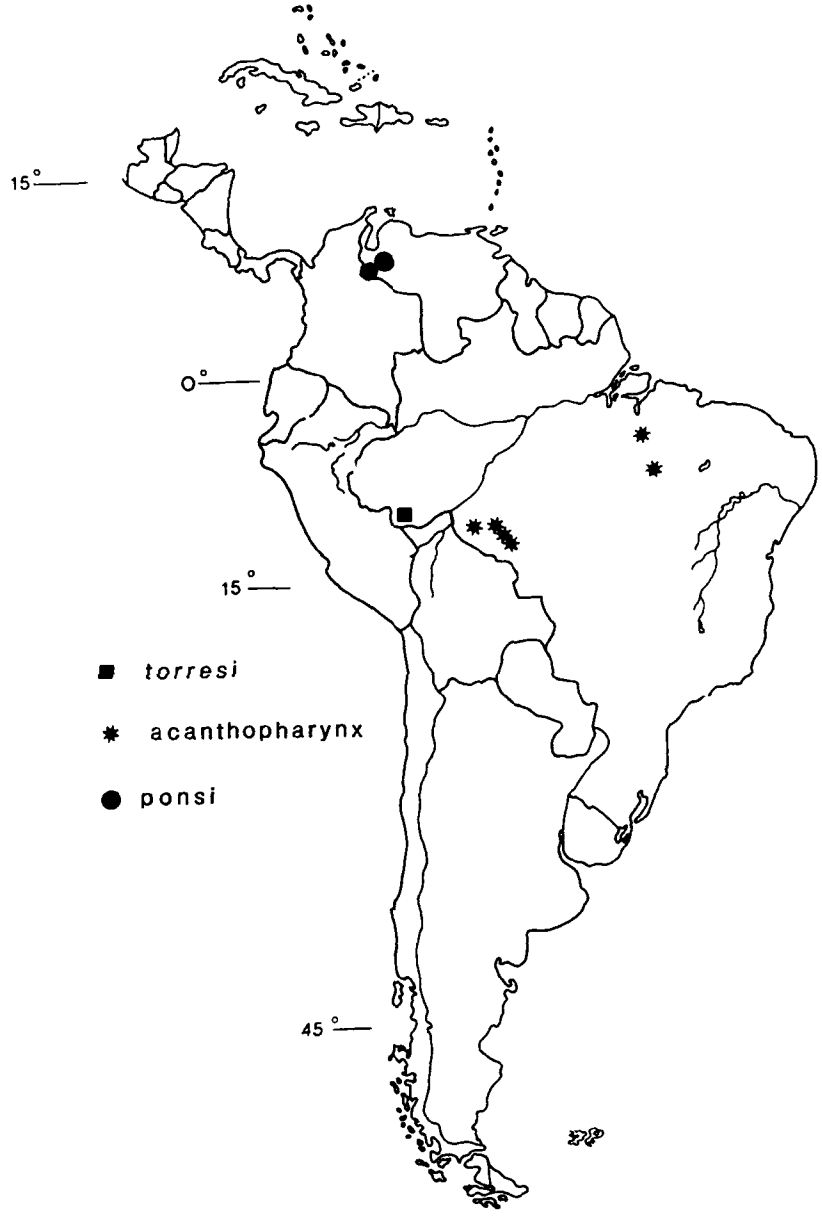
Map 160



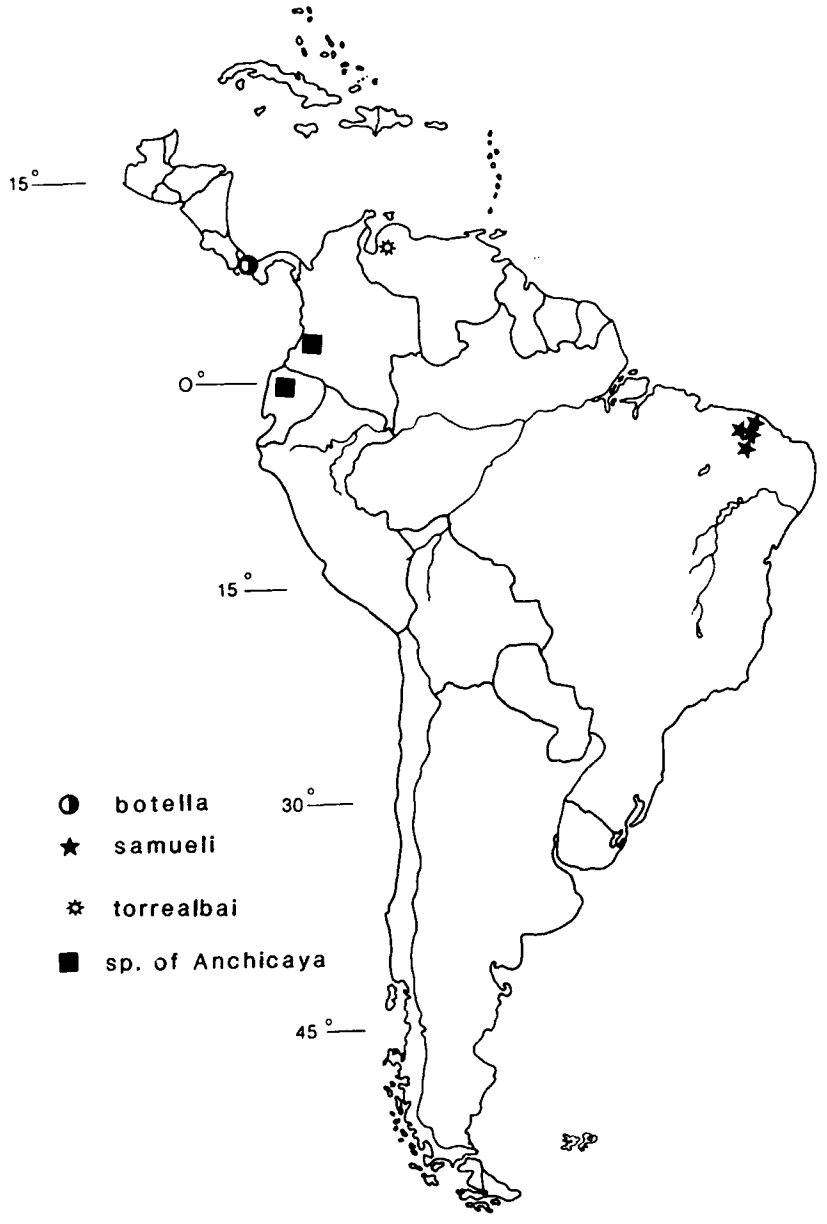
Map 161



Map 162



Map 163



Map 164

INADEQUATELY DESCRIBED *LUTZOMYIA* SPECIES

Several species included elsewhere in the text, such as *L. fonsecai*, *L. ceferinoi*, *L. parimaensis*, *L. imperatrix*, have not been fully described but their subgeneric or group status is determinable. In contrast, the identities of the 2 species in this section will remain a mystery, unless the type material is located.

Lutzomyia maracayensis (Nuñez-Tovar)
Fig. 332 A & B

Phlebotomus maracayensis Nuñez-Tovar 1924: 43 (Tucupido, Aragua, Venezuela). Forattini 1973: 358 (mention). Martins et al. 1978: 169 (listed).
Flebotomus maracayensis: Barretto 1947a: 210 (refs.).
Lutzomyia maracayensis: Theodor 1965: 196 (listed). Feliciangeli 1980: 263 (♂, fig.).

Distribution (Map 165). VENEZUELA (type locality).

Remarks. This species is unrecognizable; the types consisted of 2 males (Costa Lima 1932), but these have been lost or destroyed for decades.

Lutzomyia singularis (Costa Lima)
Fig. 332 C & D

Phlebotomus singularis Costa Lima 1932: 50 (♀, Juqueri, São Paulo, Brazil). Forattini 1973: 358 (listed). Martins et al. 1978: 169 (listed).
Flebotomus singularis: Barretto 1947a: 223 (refs.).
Lutzomyia singularis: Theodor 1965: 196 (listed).

Distribution (Map 165). BRAZIL (type locality).

Remarks. The original, inadequate description of *L. singularis* was based on a damaged female, the spermathecae of which resemble those of *L. intermedia*. Apparently, two females were examined by Costa Lima (1932). They may have been housed in the collection of the Instituto Oswaldo Cruz, Rio de Janeiro, but it is not known if they still exist.

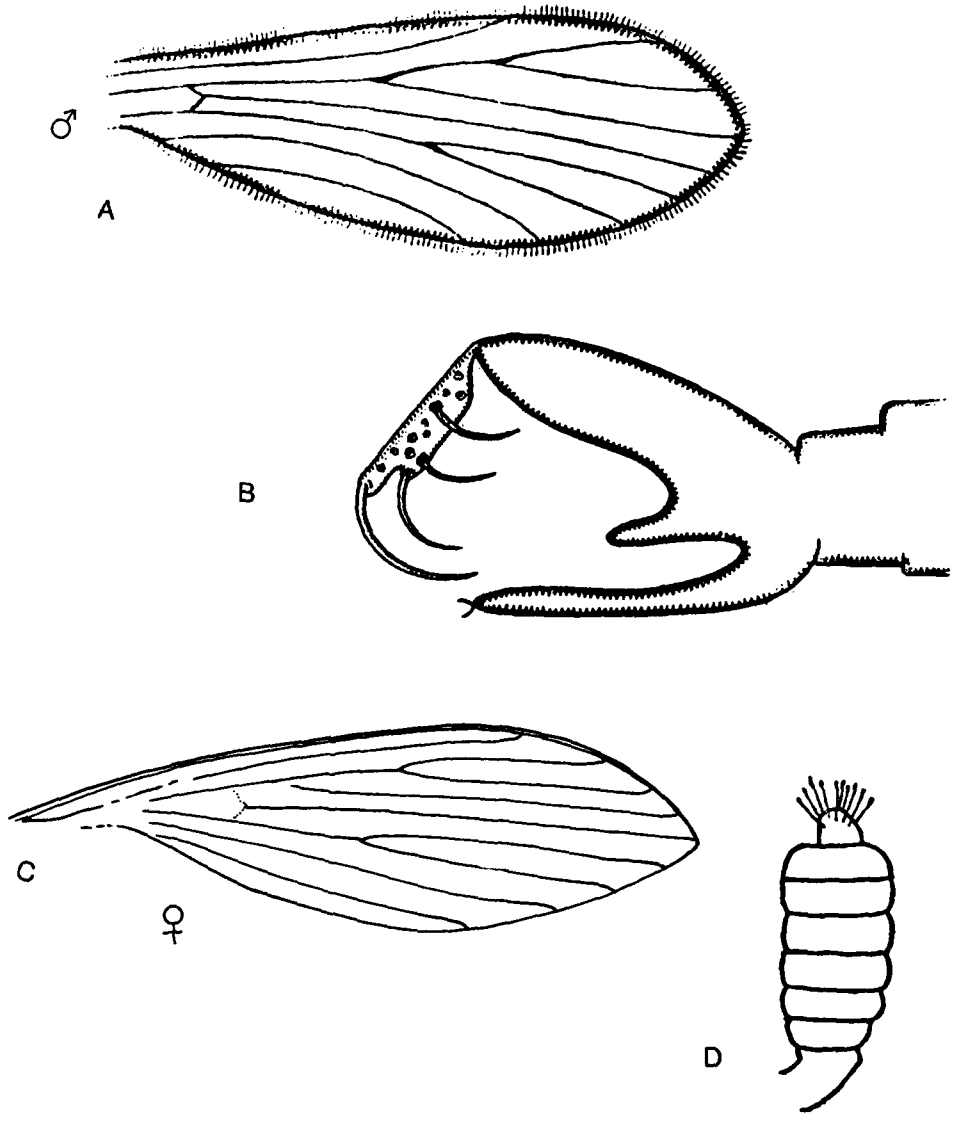
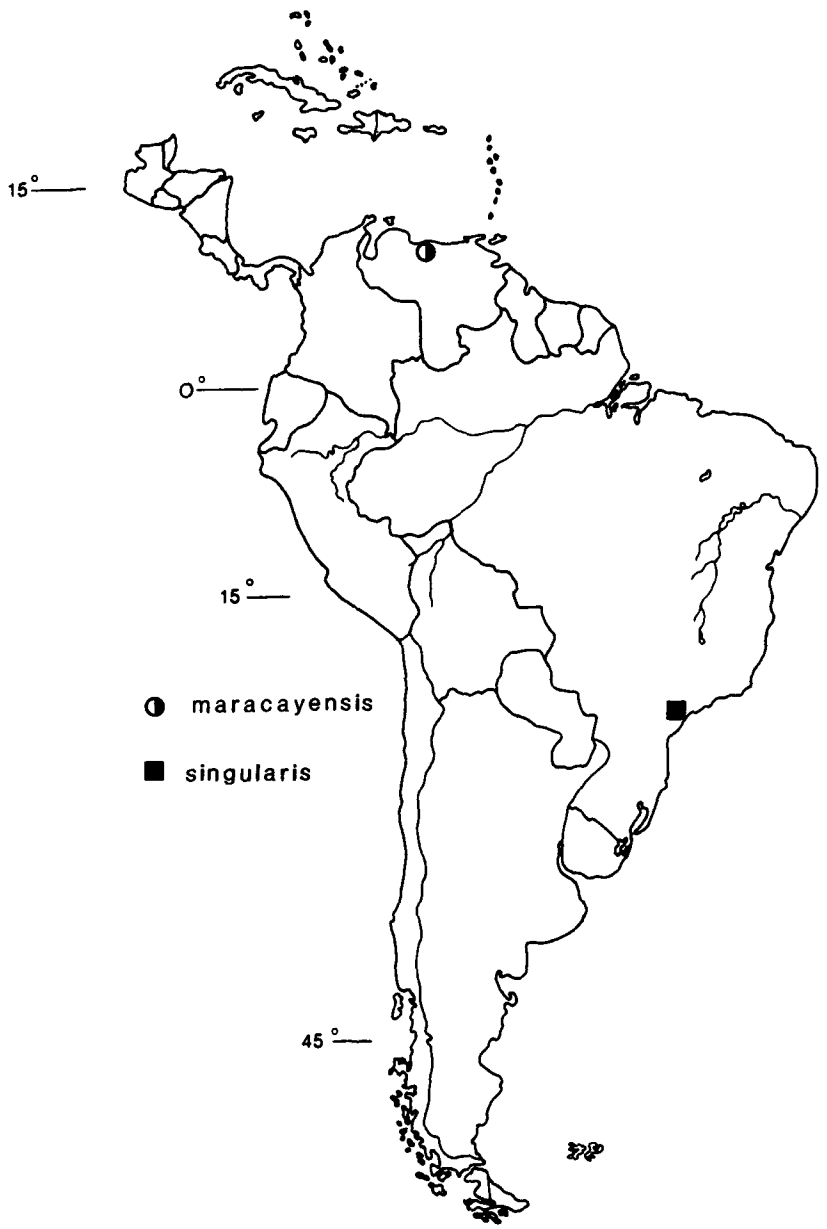


FIG. 332. ***Lutzomyia maracayensis***. A. Male wing; B. Male terminalia (figs. from Nunez-Tovar 1924).
Lutzomyia singularis. C. Female wing; D. Spermatheca (figs. from Costa Lima 1932).



Map 165

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SYSTEMATIC INDEX

Names of genera, subgenera, and species groups are listed at the far left at the margin; species and subspecies names are indented under the genus in which they are placed (mostly *Lutzomyia*). Names considered to be junior synonyms or homonyms are italicized.

*Not all of the informally named species are included in this review. Some are junior synonyms of other species or are inadequately known (see Martins et al. 1978 for additional names).