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The American species of the *annulatifipes* group  
of the subgenus *Lepidohelea*, genus *Forcipomyia*  
(Diptera: Ceratopogonidae)

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## Abstract

The *annulatifipes* group of the genus *Forcipomyia* Meigen, subgenus *Lepidohelea* Kieffer, is represented in the Western Hemisphere by 12 species. Keys are presented for their identification, and to distinguish them from other groups of the subgenus *Lepidohelea*. The three previously known species, *annulatifipes* Macfie, *brasiliensis* Macfie, and *kuanoskeles* Macfie, from southern Brazil, as well as the following nine new species, are described and illustrated: *bahiensis*, *basifemoralis*, *bifida*, *convexipenis*, *euthystyla*, *gravesi*, *herediae*, *hobbsi*, and *weemsi*.

## Introduction

Biting midges of the genus *Forcipomyia* Meigen are important pollinators of cocoa (*Theobroma cacao* L.) wherever it is grown throughout the tropics. Winder (1977) summarized the voluminous literature that appeared during the previous 30 years dealing with the taxonomy, biology, and relation to cocoa pollination of numerous species of *Forcipomyia*, especially of the subgenus *Euprojoannisia* Brethes (Bystrak & Wirth 1978). Cocoa-pollinating species of the subgenus *Forcipomyia* s. str. were reviewed by Wirth & Soria (1975, *genualis* group), and Wirth (1982, 1991a, *argenteola* group). The dominance of a species of the subgenus *Lepidohelea* Kieffer (*F. winderi* Wirth) in collections of cocoa pollinators in Bahia, Brazil, prompted Wirth (1991a,b) to begin revisionary studies of the Neotropical species of the subgenus *Lepidohelea*.

Following the definitive taxonomic analysis and revisionary study of the Australasian species of *Lepidohelea* by Debenham (1987), Wirth (1991a) proposed subdivision of the American species into two groups, the *bicolor* group and the *annulatifipes* group. Wirth (1991b) revised the known Neotropical species of the *bicolor* group. In the present study, we revise all the American species of the *annulatifipes* group.

Only three American species belonging to the *annulatifipes* group have previously been described, by Macfie (1939) from Santa Catarina, Brazil: *annulatifipes* Macfie, *brasiliensis* Macfie, and *kuanoskeles* Macfie. Study of extensive material in the collections of the U.S. National Museum of Natural History, and that provided by current workers in cocoa pollination studies, has yielded an additional nine undescribed species, which are herein described.

For detailed explanation of the taxonomic characters of all stages of *Forcipomyia*, consult the earlier studies of Saunders (1924, 1956), Wirth (1952), Chan & LeRoux (1965), and Bystrak & Wirth (1978). Downes & Wirth (1981) presented an excellent and well-illustrated general account of taxonomic characters of Ceratopogonidae. Our terminology of the larvae and pupae follows that of Saunders (1924, 1956) and Bystrak & Wirth (1978).

Holotypes of our new species are deposited in the U.S. National Museum of Natural History (USNM), Smithsonian Institution, in Washington, D.C. Paratypes, as available, will also be deposited in the California Academy of Sciences, San Francisco; Florida State Collection of Arthropods, Gainesville; Instituto Oswaldo Cruz, Rio de Janeiro, Brazil; Museo de La Plata, La Plata, Argentina; Museu de Zoologia, Universidade de São Paulo, Brazil; Museum National d'Histoire Naturelle, Paris; and Natural History Museum (BMNH), London.

### *Forcipomyia* (*Lepidohelea*) *annulatipes* Group.

**Diagnosis.** Body densely covered with flattened scales (Fig. 5), often grouped and distributed to form a complex pattern; wing and tarsi usually ornamented with pale and dark spots or bands.

Female antenna moderately slender, segments moderately swollen at bases, distal 5 segments not greatly elongated. Palpus 4-segmented; third segment moderately slender with small sensory pit at about midlength. Female wing usually dark with numerous appressed, long, flattened, scale-like macrotrichia usually larger and forming a loose clump over radial cells and a lesser dark area on anterior margin at midlength of cell R<sub>5</sub>; male wing paler with infuscation on these two areas and also over distal portions of posterior veins; costa short, not reaching middle of wing; radial veins as in Fig. 4 in female. Hind tarsal ratio approximately 1.0. Female ninth tergum (Fig. 5) prominent and convex, overlaying cerci and 10th sternum; cerci large and broadly flap-like, more or less forming a loose cup over tenth sternum; tenth sternum V-shaped with deep anteromedian notch, with 2 strong posteromedian setae. One spermatheca with short sclerotized neck. Male genitalia (Fig. 7) with well-developed, usually stout and variously ornamented parameres (Fig. 6); not usually joined at bases, but attached to diagonal basistylar apodemes. Ninth segment and basistyles short and stout; dististyles elongate, usually sinuate with distinct distal expansion, without any long setae.

**Note.** With few exceptions, females of this group are nearly impossible to key out and their positive identification must rest on repeated association (collection) with known males. Presence or absence of leg bands, straight or oblique neck of the spermatheca, and/or proportions of the antennae and palpi are helpful, but sexual dimorphism occurs in the leg pattern in some species.

**Immature Stages.** Larva. Length 3.20 mm. Color yellowish brown; head capsule dark brown; body hairs dark, their basal prominences strongly pigmented. Chaetotaxy as follows: Head (Fig. 75) with hairs *p* and *q* 2.5 times as long as antenna, broad at base, tip filiform; antenna pale distally, apex blunt. First thoracic segment (Fig. 76) with hair *a* short, tip pointed, variable in degree of swollen basal portion, but not petiolate, surface spiculose; *b* very large, slightly swollen basally; *d* stout, curved, arising from same tubercle as *b*; *c* thin, slightly longer than *d*. Second thoracic segment (Fig. 77) as in preceding segment except for *a* petiolate, spiculose only on distal 1/2; *d* straight; *c* stout. Third thoracic segment (Fig. 79) as in preceding segment except *b* stout, reduced, shorter than *d*. First abdominal segment (Fig. 80) as in preceding segment except for *d* large, about 3 times as long as *b*, tip filiform; *c* very slender, thin. Remaining abdominal segments (Fig. 82) with hair *a* as in preceding segment; *b* very large, slightly swollen at base, tip filiform; *d* stout, short, straight, arising from same tubercle as *b*; *c* relatively stout, curved. Terminal plate as in Fig. 81.

**Pupa.** Length 2.55 mm. Color of exuviae yellowish. Respiratory horn (Fig. 78) 3 times as long as broad, tapering to apex, with 12-14 spiracular openings in a row at apex and down posterior side. Proximal abdominal segments each with a pair of elongate lateral processes, each process with spiculose tip and a large apical seta.

### Key to species (mainly for males).

1. Proximal 1/2 of femora brown, distal 1/2 pale; knees pale; tibiae with subbasal pale rings, fore and hind tibia also pale at apices; apex of aedeagus conspicuously notched; parameres lanceolate ... *basifemoralis* n. sp.
- 1' Legs uniformly brown or differently banded; apex of aedeagus notched or not; parameres various, but not lanceolate ..... 2
- 2(1). Apices of parameres hook-shaped; dististyle slender, straight; female genital sclerotization rounded on anterior margin ..... *annulatipes* Macfie

- 2' Apices of parameres various, but not hook-shaped; dististyle straight or sinuate; female genital sclerotization subquadrangular ..... 3
- 3(2). Apices of parameres bifid; legs uniformly brown except knees pale ..... *bifida* n. sp.
- 3' Apices of parameres various, but not bifid; legs uniformly brown or banded ..... 4
- 4(3). Apices of parameres mesally directed, truncated on inner apex; aedeagus triangular, sclerotized mesally and sublaterally ..... 5
- 4' Apices of parameres various, differing from above; aedeagus sclerotized only on lateral margin ... 7
- 5(4). Legs uniformly brown; dististyle straight; spermatheca with oblique neck .... *gravesi* n. sp.
- 5' Legs banded; dististyle sinuate or straight; spermatheca with straight neck ..... 6
- 6(5). Dististyle sinuate ..... *brasiliensis* Macfie
- 6' Dististyle straight ..... *hobbsi* n. sp.
- 7(4). Dististyle sinuate; apex of aedeagus notched ..... 8
- 7' Dististyle straight; apex of aedeagus without notch ..... 10
- 8(7). Legs entirely dark brown, including knees; hind tarsal ratio 1.00; palpal pit very poorly developed; apices of parameres obliquely truncated ..... *kuanoskeles* Macfie
- 8' Legs banded (entirely brown in male of *youngi*); hind tarsal ratio approximately 0.75; palpal pit conspicuous; apices of parameres differing from above ..... 9
- 9(8). Aedeagus 1.5 times longer than basal breadth, basal arms poorly developed, apex slightly notched; apices of parameres slightly incurved mesally; spermatheca with oblique neck ..... *bahiensis* n. sp.
- 9' Aedeagus as long as basal breadth, basal arms well developed, apex broadly notched; parameres spur-like distolaterally; spermatheca with straight neck ..... *herediae* n. sp.
- 10(7). Legs uniformly brown, not banded; aedeagus triangular, apex rounded; apices of parameres obliquely truncated; spermatheca somewhat rounded with short straight neck ..... *weemsi* n. sp.
- 10' Legs banded; aedeagus and apices of parameres not as above; spermatheca ovoid with markedly oblique neck ..... 11
- 11(10). Third palpal segment much reduced with inconspicuous pit; aedeagus a broadly rounded plate distally, apex crenulate; apices of parameres twisted ventrolaterally ..... *convexipenis* n. sp.

- 11' Third palpal segment not reduced, pit well marked; aedeagus triangular, with slender apex split slightly in 2 ventrolaterally directed spurs; apices of parameres obliquely truncated, pointed ..... *euthystyla* n. sp.

### *Forcipomyia (Lepidohelea) annulatipes* Macfie (Figures 1 - 7)

*Forcipomyia annulatipes* Macfie, 1939: 154 (male; Brazil; fig. palpus, dististyle, paramere).

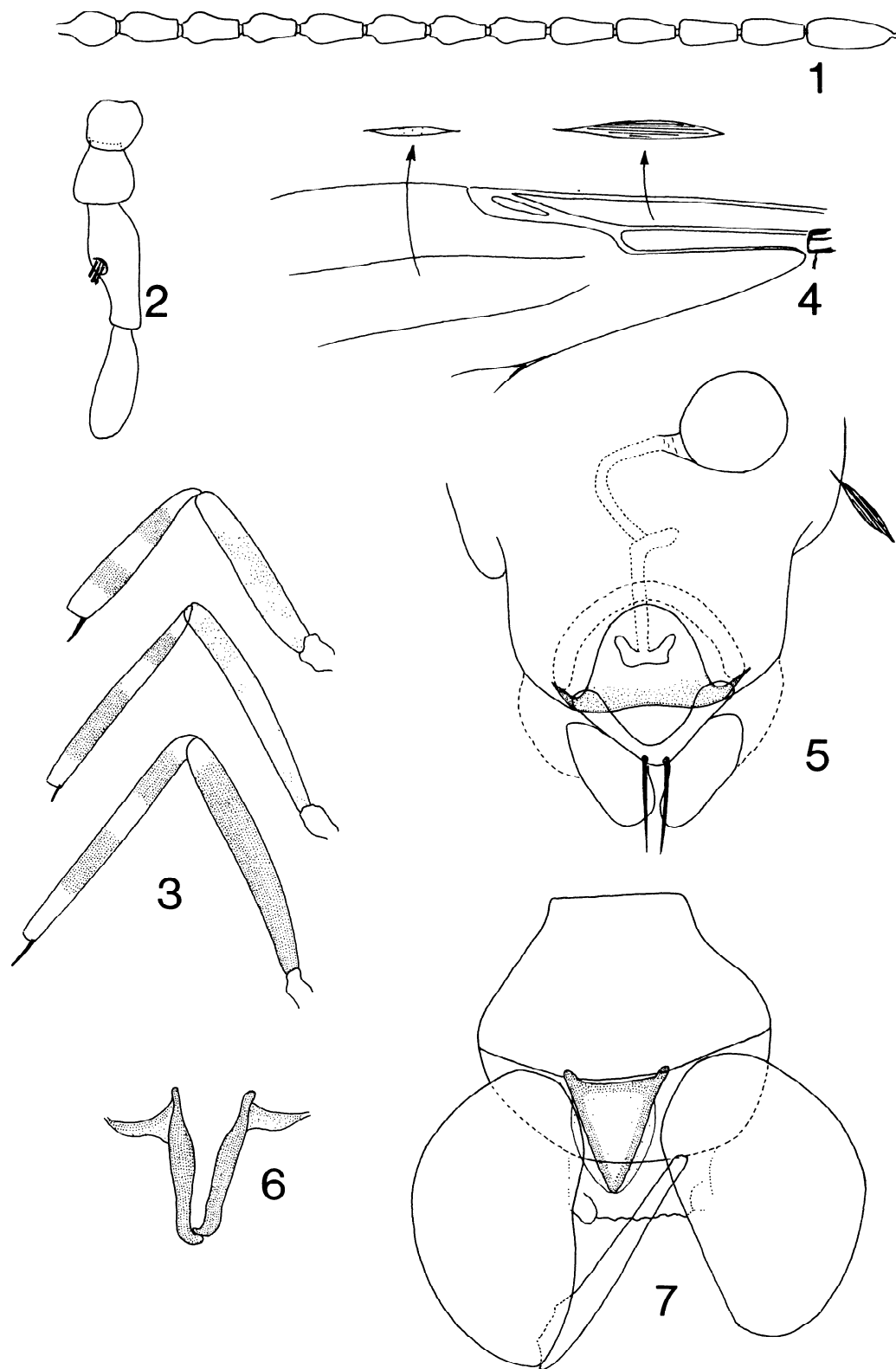
*Forcipomyia (Lepidohelea) annulatipes* Macfie: Wirth, 1974: 7 (status change; in catalog).

**Diagnosis.** A large-sized (wing length 1.00-1.10 mm), pale brown species. Antennal ratio 0.70 (Fig. 1). Lengths of palpal segments in proportion of 8-12-24-21; 3rd segment with small, shallow, rounded pit (Fig. 2). Thorax brown; scutum mottled with areas of dense whitish pollen. Legs (Fig. 3) yellowish brown, hind leg slightly darker; knees pale; tibiae with pale bands on midportion and at apices; hind tarsal ratio 1.10. Wing macrotrichia elongate, striate or plain (Fig. 4). Spermatheca (Fig. 5) ovoid with oblique neck; female genital sclerotization semicircular (Fig. 5). Male genitalia as in Fig. 7; dististyle straight, slender; aedeagus triangular, with delta-shaped marginal sclerotization and bluntly pointed tip; parameres (Fig. 6) short, main portion slender, nearly straight, apex hook-shaped, bent ventromesad.

**Distribution.** Brazil, Colombia.

**Type.** Holotype male, Brazil, Santa Catarina, Nova Teutonia, 27.x.1936, F. Plaumann (deposited in BMNH).

**Specimens Examined.** BRAZIL: Santa Catarina, Nova Teutonia, many dates, F. Plaumann, 7 females, 6 males (slides); vii.1940, 4 females, 2 males (pinned). Bahia, Itaguipé, Fazenda Almirante, many data, J. A. Winder, 11 females, 16 males; Itabuna, 8-10.vi.1970, J. A. Winder, 3 males. Para, Belem, APEG Forest, many dates, T. H. G. Aitken, 1 female, 13 males. COLOMBIA: Antioquia Dept., near Rio Anorí, tropic rain forest, ix.1970, D. G. Young, 3 females, 8 males. Valle, Rio Raposo, 15.vi.1964, V. H. Lee, light trap, 1 male.



**Figures 1-7.** *Forcipomyia annulatipes*; 1-5, female, 6-7 male: 1, antenna; 2, palpus; 3, femora and tibiae of (top to bottom) fore, mid, and hind legs; 4, radial field of wing; 5, genital sclerotization and spermatheca; 6, parameres; 7, genitalia, parameres omitted.

**Discussion.** The female of *Forcipomyia annulatipes* is easily recognized by the genital sclerotization rounded on anterior margin, and the male by the hook-shaped apex of the parameres, the delta-shaped sclerotization of the main body of the aedeagus, and the slender, straight dististyle.

***Forcipomyia (Lepidohelea) bahiensis* Wirth & Spinelli, new species**  
(Figures 8 - 13)

**Description. Female.** Wing length 0.96 (0.90-1.02, n = 5) mm; breadth 0.39 (0.33-0.42, n = 5) mm.

Head: Golden brown. Antenna slender, segments elongate; lengths of flagellar segments in proportion of 21-18-19-19-19-19-20-23-23-24-25-33; antennal ratio 0.81 (0.80-0.83, n = 5). Palpus (Fig. 8) brown; lengths of segments in proportion of 9-11-20-20; 3rd segment with shallow, rounded pit.

Thorax: Brown. Legs brown, knees pale; hind tibia with subbasal and apical pale rings; hind tarsal ratio 0.77 (0.70-0.85, n = 5). Wing with costal ratio 0.47 (0.44-0.48, n = 5). Halter brown.

Abdomen: Golden brown. Genital sclerotization with truncate anterior margin and large, shield-shaped lumen (Fig. 9). Spermatheca (Fig. 10) heavily sclerotized, dark brown; ovoid with oblique neck; measuring 0.048 x 0.038 mm.

**Male.** Wing length 0.92 mm; breadth 0.29 mm; costal ratio 0.44. Similar to female with usual sexual differences; 4th palpal segment slightly longer than 3rd.

Genitalia: Dististyle (Fig. 11) pale, deeply sinuate, apex broad. Aedeagus (Fig. 12) 1.5 times longer than basal breadth, basal arms poorly developed, distal portion with sides nearly straight, tapering to broad truncate apex with shallow notch. Parameres (Fig. 13) nearly straight except apex slightly incurved, slightly bent laterad, and obliquely pointed.

**Distribution.** Brazil, Trinidad.

**Types.** Holotype male, Brazil, Bahia, Itajuípe, Fazenda Almirante, 7.viii.1989, J. A. Winder; allotype female, same data except 26.iv.1989 (dep. in USNM). Paratypes, 11 females, 8 males, as follows: BRAZIL: Same data as types except 31.i.1990, 5 females, 7 males; 24.ii.1990, 1 female; 13.vii.1990, 1 male. TRINIDAD: St. Augustine, San Salvador Est.,

24.vii.1990, A. M. Young, 5 females, reared ex rotting cocoa pod husk.

**Discussion.** *Forcipomyia bahiensis* is very similar to *F. herediae*, from which it can be distinguished by the spermatheca with oblique neck, slender aedeagus slightly notched distally, and shape of the tip of the parameres. The 3rd palpal segment of the female is more elongate than in other species.

***Forcipomyia (Lepidohelea) basifemoralis* Wirth & Spinelli, new species**  
(Figures 14 - 20)

**Description. Female.** Wing length 0.99 (0.89-1.17, n = 5) mm; breadth 0.42 (0.38-0.51, n = 5) mm.

Head: Yellowish brown. Lengths of flagellar segments in proportion of 18-15-16-17-17-17-17-19-19-18-18-28; antennal ratio 0.78 (0.74-0.83, n = 5). Palpus (Fig. 14) pale brown; lengths of segments in proportion of 8-15-21-20; 3rd segment with shallow sensory pit.

Thorax: Brown. Legs banded; femora brown, knees pale; tibiae with subbasal pale rings, fore and hind tibiae also pale at apices; tarsomeres 1-3 brown basally, pale distally. Hind tarsal ratio 0.90 (n = 5). Wing with costal ratio 0.50 (0.48-0.51, n = 5). Halter brown.

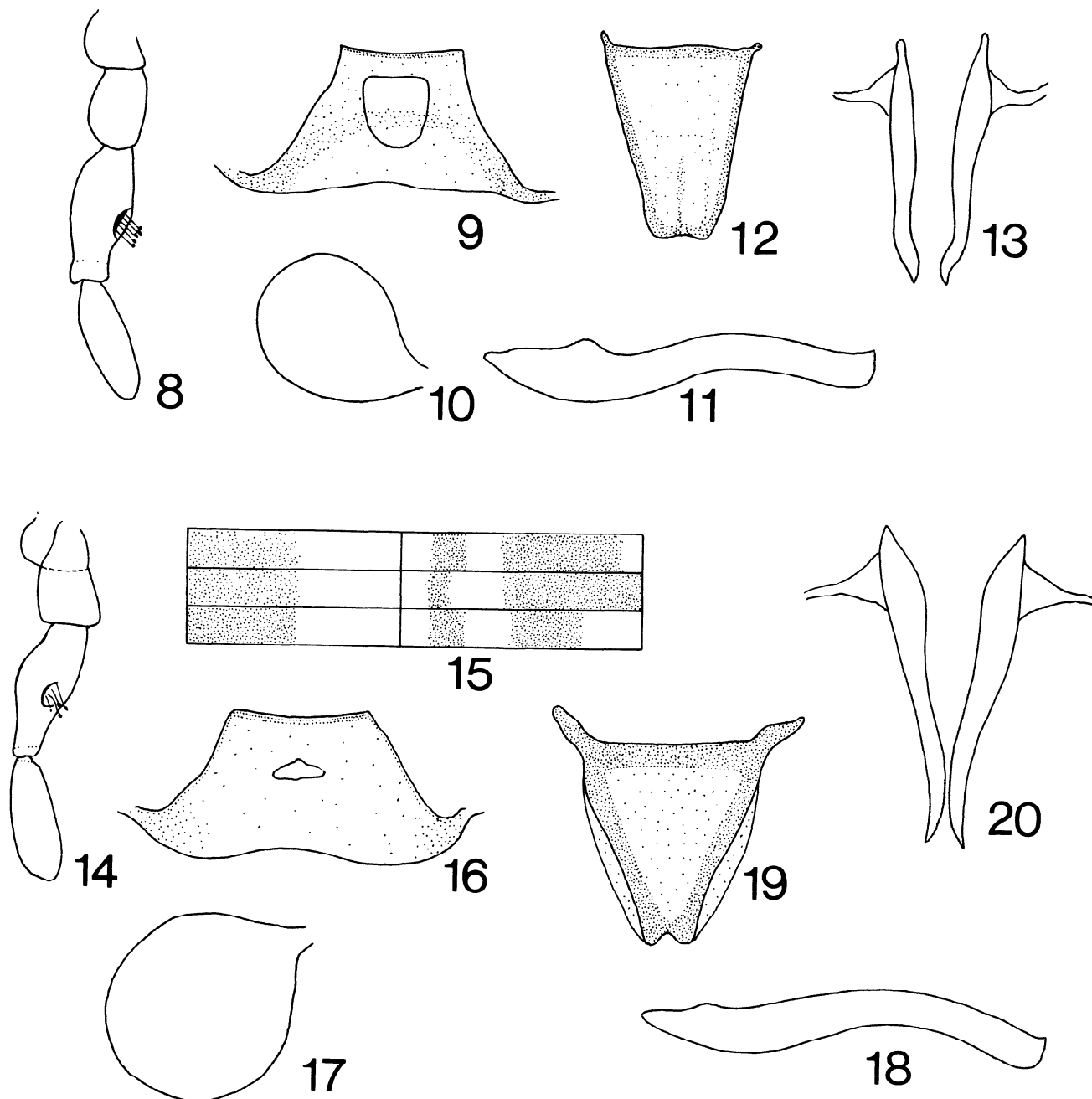
Abdomen: Golden brown. Genital sclerotization (Fig. 16) with broad truncate anterior margin and small elliptical lumen. Spermatheca (Fig. 17) ovoid, neck slender and slightly oblique; measuring 0.059 x 0.048 mm.

**Male.** Wing length 1.12 mm; breadth 0.36 mm; costal ratio 0.43. Similar to female with usual sexual differences. Legs (Fig. 15) with proximal 1/2 of femora brown, distal 1/2 pale.

Genitalia: Dististyle (Fig. 18) slender, deeply sinuate, apex broad. Aedeagus (Fig. 19) triangular, broad basally, basal arms well developed, apex narrowly truncate with conspicuous notch. Parameres (Fig. 20) narrowed distally, apices lanceolate, slightly divergent.

**Distribution.** Florida, Jamaica, Panama, Puerto Rico, Trinidad.

**Types.** Holotype male, allotype female, Jamaica, Hardwar Gap, Hollywell, 16.vi.1970, E. G. Farnworth (dep. in USNM). Paratypes, 12 females, 21 males, as follows: FLORIDA: Dade Co., Homestead, 9.ix.1968,



**Figures 8 - 20.** 8-13. *Forcipomyia bahiensis*; 14-20, *F. basifemoralis*; 8-10, 15-17, female; 11-13, 15, 18-20, male: 8, 14, palpus; 9, 16, genital sclerotization; 10, 17, spermatheca; 11, 18, dististyle; 12, 19, aedeagus; 13, 20, parameres; 15, color pattern of femora (left) and tibiae of (top to bottom) fore, mid, and hind legs (diagrammatic).

R. M. Baranowski, blacklight trap, 1 male. JAMAICA: Same data as types, 6 females. Hardwar Gap, 20.ii.1969, W. W. Wirth, light trap, 4 females, 11 males. Runaway Bay, 16-28.ii.1969, WWW, light trap, 1 female, 1 male. Portland Parish, Inst. Jamaica Field Sta., 13.xii.1969, EGF, 1 female, 7 males.

The following males are smaller with femora entirely dark, but have genitalia identical with those of the types. They are not designated paratypes: PANAMA: Canal Zone, Barro Colorado Island, vii.1967, WWW, at light, 2 females, 3 males. PUERTO RICO: Maricao Fish Hatcher, 23.xii.1962, P. & P.

Spangler, light trap, 1 female. Maricao Forest Res., 10.ii.1961, A. B. Gurney, at light, 1 female, 1 male. Mayaguez, 29.i.1953, L. G. Saunders (PR-21), on wood in stream, 4 females, 1 larva, 1 pupa; Mayaguez, Univ. Puerto Rico campus, 9.i.1969, Walker & Drummond, light trap, 6 females. TRINIDAD: Macqueripe U.S. Naval Sta., 3.i.1958, T. H. G. Aitken, light trap, 1 male; same data except Grandwood, 1 male.

**Discussion.** *Forcipomyia basifemoralis* differs from the other species of the *annulatipes* Group in the coloration of the male legs, with proximal 1/2 of femora brown and distal 1/2 pale. Also, the combination of male genital characters is characteristic of this species. Females are included in the type series by association with the males, though differing in leg pattern, as sexual dimorphism in this character seems likely.

***Forcipomyia (Lepidohelea) bifida* Wirth & Spinelli, new species**  
(Figures 21 - 26)

**Description. Female.** Wing length 0.79 (0.76-0.82,  $n = 2$ ) mm; breadth 0.31 ( $n = 2$ ) mm.

Head: Yellowish brown. Antenna with lengths of flagellar segments in proportion of 16-15-15-15-14-14-14-15-16-16-16-16-26; antennal ratio 0.76 ( $n = 2$ ). Palpus (Fig. 21) brown; lengths of segments in proportion of 9-10-20-18; 3rd segment with small, faintly marked sensory pit.

Thorax: Brown. Legs uniformly brown except knees slightly pale; hind tarsal ratio 1.05 ( $n = 2$ ). Wing with costal ratio 0.47 ( $n = 2$ ). Halter brown.

Abdomen: Brown. Genital sclerotization with broad truncate anterior margin, lumen small (Fig. 22). Spermatheca (Fig. 23) ovoid with short, straight, broad neck; measuring 0.039 x 0.035 mm.

**Male.** Wing length 1.02 mm; costal ratio 0.45. Similar to female with usual sexual differences; hind tibia with faint narrow subbasal and apical pale rings.

Genitalia: Dististyle (Fig. 24) dark, slender, sinuate, apex bluntly rounded. Aedeagus (Fig. 25) stout; basal arms straight, poorly developed; distal portion broad, apex broadly rounded, surface irregular. Parameres (Fig. 26) each with stout, nearly straight main portion; apex deeply bifid, inner lobe straight, outer claw-shaped, both pointed.

**Distribution.** Jamaica.

**Types.** Holotype male, allotype female; Jamaica, Trelawny Parish, Tyre, 2 mi. N. Troy, 26.vii.1969, R. E. Woodruff (in USNM). Paratype female, Trelawny Parish, 1.9 mi N Burn & Hill, 16.v.1969, R. E. Woodruff.

**Discussion.** *Forcipomyia bifida* is easily distinguished from the remaining species of the *annulatipes* Group by the bifid apices of the parameres.

***Forcipomyia (Lepidohelea) brasiliensis* Macfie**  
(Figures 27 - 33)

*Forcipomyia brasiliensis* Macfie, 1939: 153 (male; Brazil; fig. palpus, dististyle, paramere).

*Forcipomyia (Lepidohelea) brasiliensis* Macfie; Wirth, 1974: 7 (status change; in catalog).

**Diagnosis.** A large-sized (wing length 1.00-1.10 mm), dark brown species. Antennal ratio 0.75. Palpus (Fig. 27) dark brown, lengths of segments in proportion of 10-14-22-25. Thorax dark brown; femora dark brown, knees pale; tibiae with subbasal and apical pale rings; hind tarsal ratio 0.95. Spermatheca (Fig. 29) ovoid, neck straight, broad; female genital sclerotization with broad, truncate, anterior margin, corners slightly produced, lumen shield-shaped (Fig. 28). Male genitalia with dististyle (Fig. 30) sinuate, apex broad, bluntly rounded. Aedeagus (Fig. 31) triangular, with short, horizontal, basal arms; main portion gradually tapering to blunt tip. Parameres (Fig. 32) each with straight, slender, main portion; apex mesally directed, truncated on mesal side.

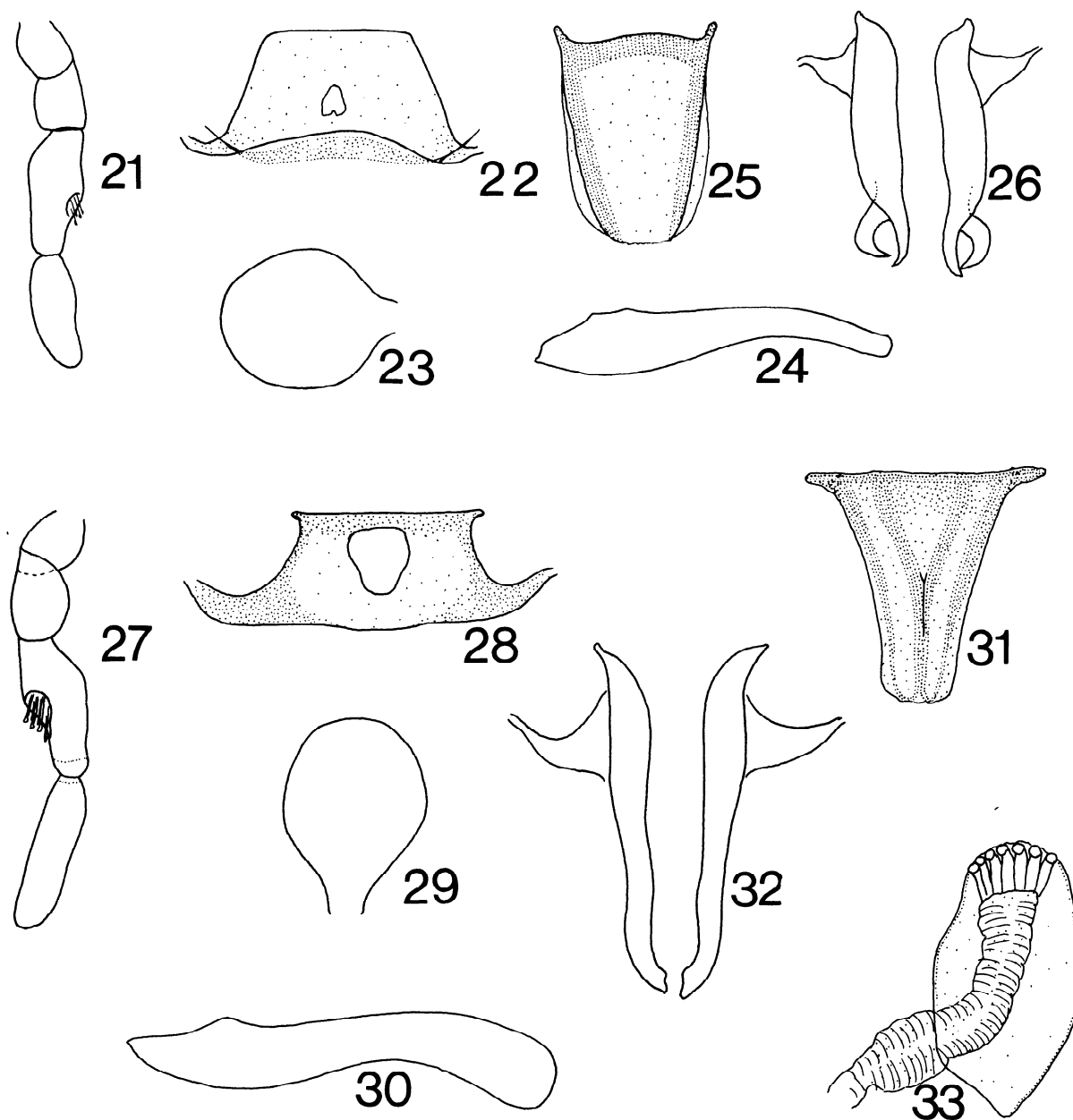
**Pupa.** Length 2.55 mm. Color of exuviae yellowish. Respiratory horn (Fig. 33) short, globose; apex rounded, with 6-8 spical spiracular openings. Exuviae not in position to describe and illustrate tubercles of cephalothorax and abdomen.

**Distribution.** Brazil, Ecuador, Trinidad.

**Type.** Brazil, Santa Catarina, Nova Teutonia, 27.viii.1937, F. Plaumann (in BMNH).

**Specimens Examined.** BRAZIL: Santa Catarina, Nova Teutonia, many dates, F. Plaumann, 6 females, 5 males. ECUADOR: Pichincha Prov., Santo Domingo de los Colorados, L. A. Leon, coll., 1 male. TRINIDAD: Maracas, 18.vii.1957, L. G. Saunders (T-10), 2 males (with pupal exuviae), on cacao leaves.





**Figures 21-33.** 21-26, *Forcipomyia bifida*; 27-33, *F. brasiliensis*; 21-23, 27-29, female; 24-26, 30-32, male; 33, pupa: 21, 27, palpus; 22, 28, genital sclerotization; 23, 29, spermatheca; 24, 30, dististyle; 25, 31, aedeagus; 26, 32, parameres; 33, respiratory horn.

**Discussion.** This species is very similar to *Forcipomyia gravesi* n. sp. and *F. hobbsi* n. sp. Characters for separating the three species are found in the key.

*Forcipomyia (Lepidohelea) convexipenis* Wirth & Spinelli, new species  
(Figures 34 - 38)

**Description. Female.** A small yellowish species with short, stubby palpus and banded legs. Wing length 0.69 mm; breadth 0.26 mm.

Head: Brown. Antenna with lengths of flagellar segments in proportion of 13-11-12-13-13-13-13-13-15-16-16-16-23; antennal ratio 0.85. Palpus (Fig. 34) brown, short; lengths of segments in proportion of 7-

16-10-13; 3rd segment very reduced, globular, with poorly marked, rounded sensory pit.

Thorax: Yellowish brown, scutum dark brown anteriorly. Femora dark brown (slightly paler on fore leg); knees pale; tibiae with subbasal and apical pale rings; hind tarsal ratio 1.00. Wing with costal ratio 0.50. Halter brown.

Abdomen: Brown. Genital sclerotization not in position to describe and illustrate. Spermatheca (Fig. 35) ovoid with markedly oblique neck, measuring  $0.046 \times 0.042$  mm.

**Male.** Wing length 0.71 mm; breadth 0.24 mm; costal ratio 0.45. Similar to female with usual sexual differences.

Genitalia: Dististyle (Fig. 36) pale, long and slender, straight; apex moderately slender. Aedeagus (Fig. 37) stout; basal arms slender, anteriorly directed; apex broad, crenulate, broadly rounded. Parameres (Fig. 38) each stout, slightly sinuate, apex slender, twisted ventrolaterally.

**Distribution.** Colombia.

**Types.** Holotype male, Colombia, Rio Raposo, 28.vii.1964, V. H. Lee, light trap; allotype male, same data except ii.1965 (in USNM). Three male paratypes, same data except vii.1963, ii.1964, and viii.1965. One female paratype, Colombia, Turbo, Rio Leon, v.1964, C. J. Marinkelle, light trap.

**Discussion.** *Forcipomyia convexipennis* is very similar to *F. euthystyla*, from which it can be distinguished by its smaller size, very reduced, globular 3rd palpal segment with inconspicuous pit; and aedeagus with main body forming a broad plate evenly rounded distally, from which the species takes its name.

***Forcipomyia (Lepidohelea) euthystyla* Wirth & Spinelli, new species**  
(Figures 39 - 44)

**Description. Female.** A moderately small brownish species with banded legs; setae of head and body rather strong; body and legs with abundant, broad, striated, appressed scales. Wing length 0.84 (0.77-0.89,  $n = 5$ ) mm; breadth 0.31 (0.29-0.33,  $n = 5$ ) mm.

Head: Brown. Antenna with lengths of flagellar segments in proportion of 20-17-17-19-19-19-20-20-22-22-22-23-29; antennal ratio 0.80 (0.78-0.84,  $n = 5$ ). Palpus (Fig. 39) brown; lengths of segments in

proportion of 9-12-22-20; 3rd segment with small, round, shallow, sensory pit.

Thorax: Brown; pleura golden brown. Legs prominently banded; fore and mid femora pale brown, hind femur dark brown; knees pale; tibiae pale brown, with subbasal and subapical dark rings; basitarsi brown, remaining tarsomeres pale brown with brown apices; hind tarsal ratio 0.85 (0.78-0.90,  $n = 5$ ). Wing with costal ratio 0.45 (0.43-0.47,  $n = 5$ ). Halter brown.

Abdomen: Golden brown, with abundant long brown setae; tip dark. Genital sclerotization with narrow elliptical lumen (Fig. 40) (illustrated from paratype from Antioquia). Spermatheca (Fig. 41) ovoid with oblique neck; measuring  $0.051 \times 0.041$  mm.

**Male.** Wing length 0.76 mm; breadth 0.27 mm; costal ratio 0.43. Similar to female with usual sexual differences.

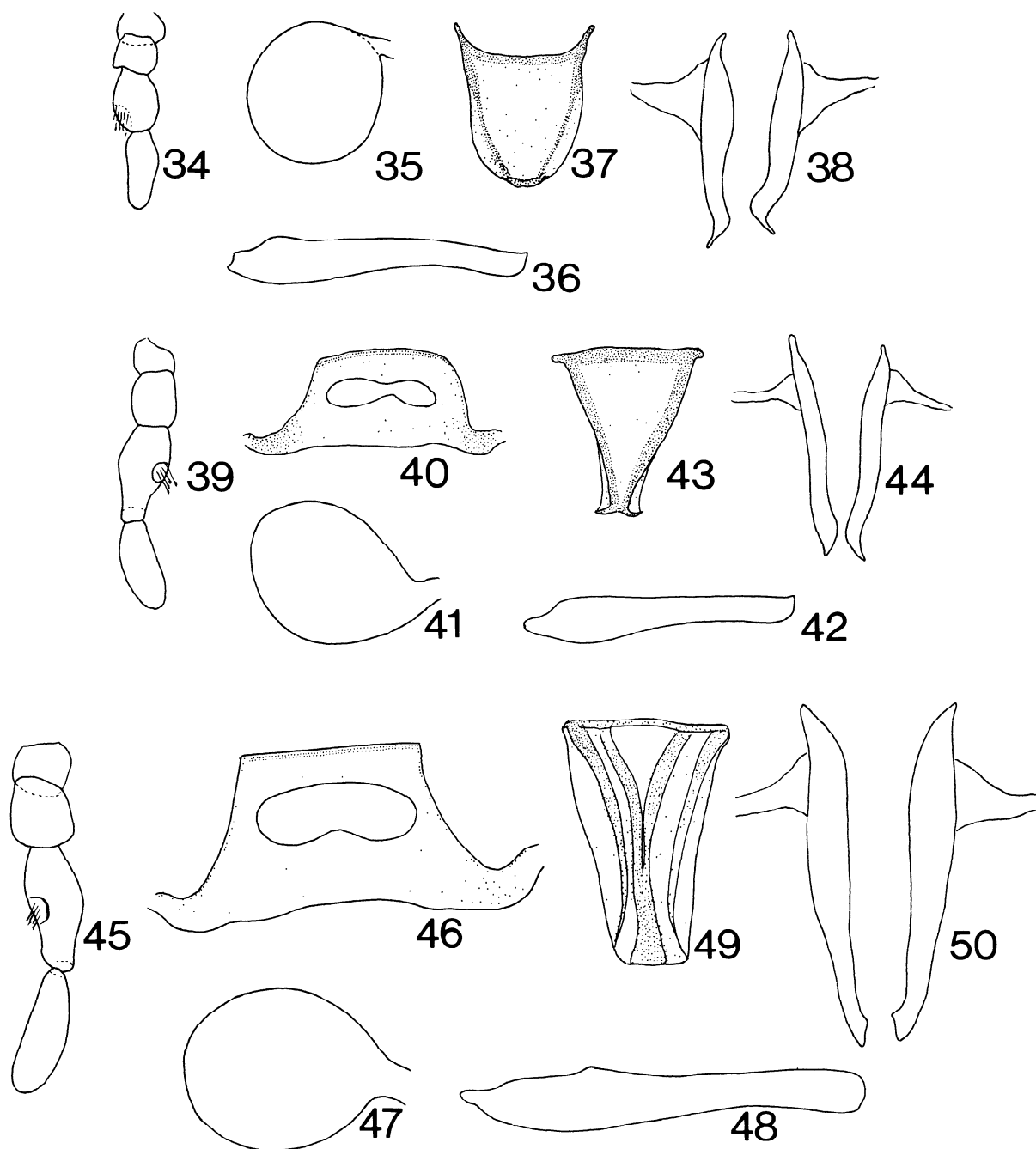
Genitalia (illustrated from paratype from Antioquia): Dististyle (Fig. 42) slightly pale, slender, straight, apex broad. Aedeagus (Fig. 43) triangular, with short, stout, laterally-directed basal arms; lateral margins straight narrowly sclerotized; apex slender and split into 2 slender, laterally directed spurs. Parameres (Fig. 44) each slightly sinuate; apex obliquely bent, pointed, tips divergent.

**Distribution.** Colombia, Panama.

**Types.** Holotype male, Colombia, Rio Raposo, iii.1964, V. H. Lee, light trap; allotype female, same data except 23.iii.1964 (in USNM). Paratypes, 22 females, 2 males, as follows: COLOMBIA: Same data as types except vi.1963, with aspirator, 1 female; ii.1964, 5 females; iii.1964, 1 female; 23.iii.1964, 5 females; v.1964, 2 females; vi.1964, 4 females; l.vii.1964, 1 female; vi.1965, 1 female. Antioquia, near Rio Anori, tropic rain forest, ix.1970, D. G. Young, blacklight trap, 1 female, 1 male. Turbo, Rio Leon, v.1964, C. J. Marinkelle, light trap, 1 female. PANAMA: Canal Zone, Balboa, monsoon forest, fogging *Cassia* tree canopy, 19.vii.1979, E. Broadhead (#12), 1 male.

**Discussion.** *Forcipomyia euthystyla* is very similar to *F. convexipennis*, from which it can be distinguished by the characters pointed out in the key.

The shape of the male aedeagus is diagnostic. The species takes its name from the slender, straight, male dististyles.



**Figures 34-50.** 34-38, *Forcipomyia convexipenis*; 39-44, *F. euthystyla*; 45-50, *F. gravesi*; 34-35, 39-41, 45-47, female; 36-38, 42-44, 48-50, male: 34, 39, 45, palpus; 35, 41, 47, spermatheca; 36, 42, 48, dististyle; 37, 43, 49, aedeagus; 38, 44, 50, parameres; 40, 46, genital sclerotization.

***Forcipomyia (Lepidohelea) gravesi* Wirth & Spinelli, new species**  
(Figures 45 - 50)

*Forcipomyia* (new subgenus near *Lepidohelea*) new species 1; Graves & Graves, 1985: 87 (North Carolina; reared from shelf fungi).

**Description. Female.** Wing length 1.15 mm (1.10-1.20,  $n = 5$ ) mm; breadth 0.46 (0.44-0.48,  $n = 5$ ) mm.

Head: Golden brown. Antenna with lengths of flagellar segments in proportion of 18-16-18-19-19-19-20-22-22-22-21-31; antennal ratio 0.74 (0.72-0.80,  $n = 5$ ). Palpus (Fig. 45) pale brown; lengths of segments in proportion of 10-12-22-23; 3rd segment with round, shallow, sensory pit.

Thorax: Golden brown. Legs brown; knees and narrow apex of hind tibia pale; hind tarsal ratio 1.00 (0.98-1.05,  $n = 5$ ). Wing with costal ratio 0.45 (0.43-0.46,  $n = 5$ ). Halter brown.

Abdomen: Golden brown. Genital sclerotization with broad truncate anterior margin and broad elliptical lumen (Fig. 46). Spermatheca (Fig. 47) ovoid with slightly oblique neck; measuring 0.063 x 0.051 mm.

**Male.** Wing length 1.40 mm; breadth 0.40 mm; costal ratio 0.44. Similar to female with usual sexual differences.

Genitalia: Dististyle (Fig. 48) dark brown, long, straight, apex bluntly rounded. Aedeagus (Fig. 49) stout, basal arms not developed; sclerotized mesally and sublaterally. Parameres (Fig. 50) nearly identical with those described and illustrated for *Forcipomyia brasiliensis*.

**Distribution.** Nearctic, from Quebec to North Carolina.

**Types.** Holotype male, allotype female, North Carolina, Macon Co., Highlands, 22.vi.1962, R. & A. Graves, ex *Boletus* fungi (in USNM). Paratypes, 59 females, 11 males, as follows: CONNECTICUT: Storrs, vi.1953, F., B. Lewis, light trap, 1 female. NORTH CAROLINA: Same data as types, 3 females, 1 male. Macon Co., Highlands, Cullasaja R. Gorge, 10.vi.1962, R. & A. Graves, ex *Polyporus* fungi, 1 female; same data except ex *Stereum* shelf fungi, 2 females; same data except 17.vii.1962, ex *Gonoderma* shelf fungi, 1 male; Highlands, 23.vii.1962, R. & A. Graves, ex *Polyporus*, 1 female; Highlands, vii.1965, P. M. Marsh, malaise trap, 12 females, 4 males. Transylvania Co.,

near Webb Lowe place, E side horse pasture, 21.vii.1962, R. C. Graves, ex *Fomes* shelf fungi, 1 female; Gorge Area, 17.vii.1962, R. C. Graves, ex *Gonoderma*, 1 female; "Cane Brake," Thompson R. Gorge, 15.vi.1962, R. C. Graves, ex *Polyporus*, 5 females; 1.6 km SW Brevard, 660 m, 21.vi.1962, R. C. Graves, ex *Polyporus*, 7 females, 5 males. QUEBEC: Hull, 10.viii.1965, W. W. Wirth, malaise trap, 2 females. WEST VIRGINIA: Hardy Co., Lost River St. Park, 8-14.vii.1963, K. V. Krombein, 21 females.

**Discussion.** *Forcipomyia gravesi* is very similar to *F. brasiliensis*, from which it can be distinguished by the slightly oblique neck of the spermatheca, nearly uniformly brown legs, and straight dististyle. This species is dedicated to Robert C. Graves of Bowling Green University, Ohio, in appreciation of his interest in ceratopogonid midges living in fungi in the Appalachian Mountains.

Graves & Graves (1985) reported that "This was the commonly collected ceratopogonid in this study, and was found at 13 sites, all of which were fungi. However, only a single specimen was obtained from each site, except for a sporocarp of *Polyporus gilvus* (Schw.) Fries which was riddled with the tunnels of termites, *Reticulitermes virginicus* Banks, and contained 15 *Forcipomyia* n. sp. 1."

***Forcipomyia (Lepidohelea) herediae* Wirth & Spinelli, new species**  
(Figures 51 - 56, 75 - 81)

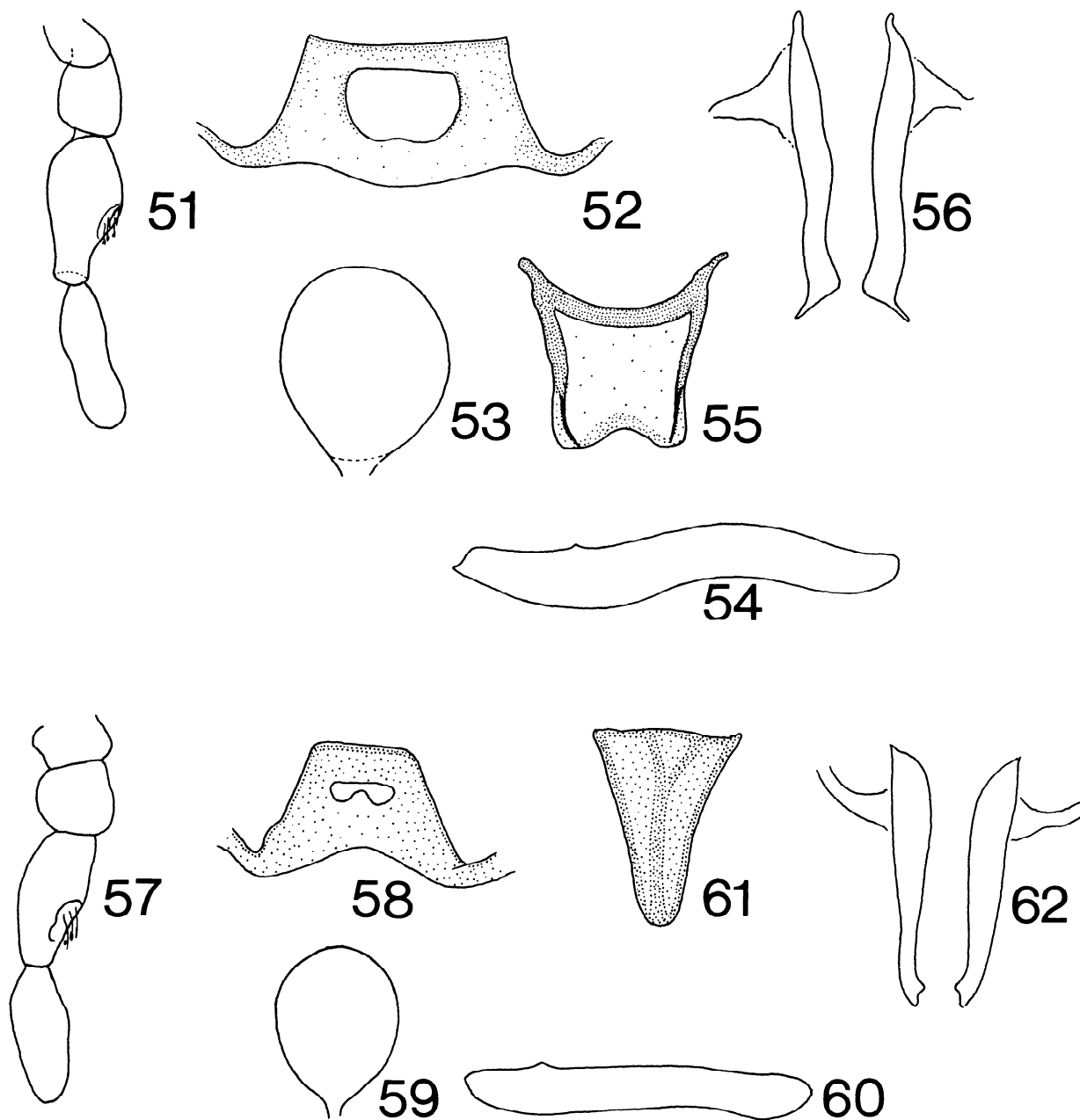
**Description. Female.** Wing length 0.90 (0.89-0.93,  $n = 5$ ) mm; breadth 0.34 (0.33-0.35,  $n = 5$ ) mm.

Head: Brown. Antenna with lengths of flagellar segments in proportion of 20-18-18-19-20-20-20-20-22-22-22-25-34; antennal ratio 0.80 (0.78-0.81,  $n = 5$ ). Palpus (Fig. 51) brown; lengths of segments in proportion of 7-12-21-22; 3rd segment with shallow, round, sensory pit.

Thorax: Brown. Legs banded as in *F. annulatipes*; hind tarsal ratio 0.74 (0.70-0.76,  $n = 3$ ). Wing with costal ratio 0.43 ( $n = 5$ ). Halter brown.

Abdomen: Brown. Genital sclerotization with broad truncate anterior margin and broad shield-shaped lumen (Fig. 52). Spermatheca (Fig. 53) ovoid with straight conical neck; measuring 0.046 x 0.041 mm.

**Male.** Wing length 0.96 mm; breadth 0.29 mm; costal ratio 0.46. Similar to female with usual sexual differences; legs entirely brown.



**Figures 51-62.** 51-56, *Forcipomyia herediae*; 57-62, *F. hobbsi*; 51-53, 57-59, female; 54-56, 60-62, male: 51, 57, palpus; 52, 58, genital sclerotization; 53, 59, spermatheca; 54, 60, dististyle; 55, 61, aedeagus; 56, 62, parameres.

**Genitalia:** Dististyle (Fig. 54) dark, sinuate, apex blunt.

**Aedeagus** (Fig. 55) broad, as long as basal breadth; basal arms well developed; apex broadly notched and bilobed. **Parameres** (Fig. 56) stout with slender apices bent 60° laterad, tips divergent.

**Distribution.** Costa Rica.

**Types.** Holotype male, allotype female, Costa Rica, Heredia Prov., Finca La Tigra, 14.xi.1981, A. M. Young, ex moss in forest (in USNM). Paratypes, 13 females, 7 larvae, 13 pupae, as follows: COSTA RICA:

Same data as types, 4 females. Limon, Siquirres, Hacienda Theobroma, 1.vi.1956, L. G. Saunders (CR-6), ex coconut husks, 9 females, 7 larvae, 13 pupae.

**Discussion.** *Forcipomyia herediae* is very similar to *F. bahiensis*; the latter can be distinguished from *F. herediae* by its more elongate, tapering aedeagus without bilobate tip, and the parameres are slender distally, lacking the obliquely truncate tip.

***Forcipomyia (Lepidohelea) hobbsi* Wirth & Spinelli, new species**  
(Figures 57 - 62)

**Description. Female.** Wing length 0.88 (0.84-0.90, n = 5) mm; breadth 0.35 (0.33-0.36, n = 5) mm.

Head: Brown. Antenna with lengths of flagellar segments in proportion of 18-16-16-16-16-16-16-20-19-19-18-30; antennal ratio 0.84 (0.81-0.87, n = 5). Palpus (Fig. 57) brown; lengths of segments in proportion of 6-10-19-20; 3rd segment with shallow, irregular sensory pit.

Thorax: Brown. Legs banded as in *F. brasiliensis*; hind tarsal ratio 0.93 (0.89-0.95, n = 5). Wing with costal ratio 0.47 (0.44-0.48, n = 5). Halter brown.

Abdomen: Brown. Genital sclerotization with narrow truncate anterior margin and narrow B-shaped lumen (Fig. 58). Spermatheca (Fig. 59) ovoid with slender straight neck; measuring 0.061 x 0.046 mm.

**Male.** Wing length 0.94 mm; breadth 0.28 mm; costal ratio 0.43. Similar to female with usual sexual differences.

**Genitalia:** Dististyle (Fig. 60) pale brown, straight, apex bluntly rounded. Aedeagus (Fig. 61) triangular, basal arms poorly developed; sclerotized mesally and sublaterally, tip broadly rounded. Parameres (Fig. 62) nearly identical with those described and illustrated for *F. brasiliensis* and *F. gravesi*.

**Distribution.** Colombia, Costa Rica, Dominica, El Salvador, Grenada, Honduras, Jamaica, Mexico.

**Types.** Holotype male, allotype female, Dominica, Pont Casse, 3.2 km W, 13.i.1965, W. W. Wirth, light trap (in USNM). Paratypes, 27 females, 44 males, as follows: DOMINICA: Pont Casse, same data as types, 3 males; same data but vi.1864, O. L. Flint, 8 females, 33 males; same data but 29.i.1965, WWW, light trap, 1 female. Central Forest Reserve, ii.v.1968, P. C. Drummond, UV light trap, 1 male. Clarke Hall, v-

vi.1964, O. L. Flint, light trap, 3 females, 1 male; viii-ix.1964, T. J. Spilman, light trap, 6 females; 2.ii.1965, WWW, light trap, 2 females, 1 male. Fond Figues River, rain forest, 9.ii, 13.iii.1965, WWW, 2 females. Manets Gutter, 15.iii.18965, WWW, light trap, 2 females, 2 males. Mouth Layou River, 20.i.1965, WWW, light trap, 1 female. Point Lolo, 5 mi W, 25.i.1965, WWW, at light, 1 female. South Chiltern Est., 19.ii.1965, WWW, light trap, 1 female. TRINIDAD: Maracas, 18.vii.1957, L. G. Saunders (#F10), ex cacao leaves, 3 males, 4 pupae.

The following specimens are not considered paratypes: COLOMBIA: Meta, Finca Barbascal, 27-30.ix.1964, V. H. Lee, at light, 1 male. COSTARICA: Limon, near Siquirres, Finca La Lola, 9.ii.1981, A. M. Young (#23), ex big red *Theobroma*, 1 male. Puntarenas, Sabalito, viii.1953, F. S. Blanton, light trap, 1 male, 4 females. EL SALVADOR: Cuscatlan, San Pedro Perulapan, ix.1966, FSB, 5 females, 2 males. La Paz, San Juan Tepezontes, 720 m, 22.vi.1966, J. F. Matta, 6 female. San Miguel, San Jorge, vii-ix.1966, FSB, 5 females, 6 males. Sonsonata, Armenia, iii-iv.1967, FSB, 4 females. GRENADA: Mirabeau Agr. Sta., 30.i.1990, J. Telesford, UV light trap, 1 male. HONDURAS: Comayagua, Siguatepeque, viii.1967, FSB, 1 female. Copan, Santa Rosa, ii.1964, x.1966, ii.1967, FSB, 34 females, 16 males. JAMAICA: Trelawny, 3 km W Burnt Hill, 16.v.1969, R. E. Woodruff, 1 male; 3.2 km N Troy, 26.viii.1969, REW, 3 males, 2 females. MEXICO: Tabasco, Villahermosa, 6.viii.1964, P. J. Spangler, light trap, 1 male. PANAMA: Canal Zone, Balboa, fogging *Cassia* tree canopy, 19.vii.1979, E. Broadhead, 2 females, 9 males. Chiriqui, El Hato, 16.vi.1964, FSB, 2 females, 1 male.

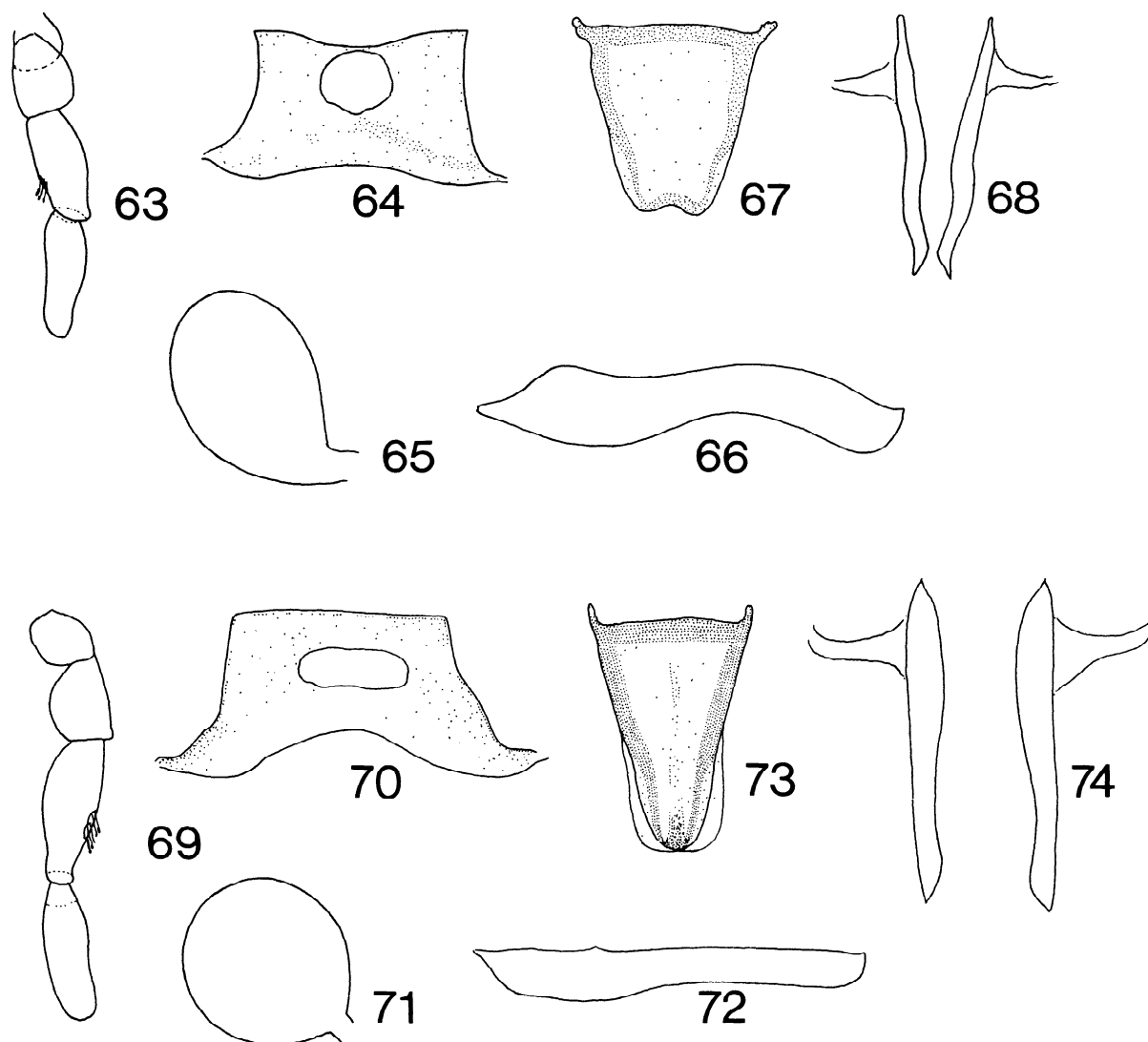
**Discussion.** This species is very similar to *Forcipomyia gravesi*, from which it can be distinguished by its smaller size, banded legs, and shorter antenna. The South American species *F. brasiliensis* is also similar to *F. hobbsi*, especially so in the aedeagus and parameres, but is also a larger species, and the dististyle is deeply sinuate.

***Forcipomyia (Lepidohelea) kuanoskeles* Macfie**  
(Figures 63 - 68)

*Forcipomyia kuanosceles* Macfie, 1939: 150 (male; Brazil; fig. genitalia).

*Forcipomyia (Lepidohelea) kuanoskeles* Macfie; Wirth, 1974: 7 (status; in catalog).

**Diagnosis.** A large-sized (wing length 1.00-1.15 mm), dark brown species. Antennal ratio 0.75. Palpus (Fig. 63) with lengths of segments in proportion of 7-9-16-16; sensory pit inconspicuous, sensilla borne on surface of segment. Thorax subshining dark brown, scutum whitish pollinose in a large prescutellar area. Legs entirely dark brown, including knees and tarsi.



**Figures 63-74.** 63-68, *Forcipomyia kuanoskeles*; 69-74, *F. weemsi*; 63-65, 69-71, female; 66-68, 72-74, male: 63, 69, palpus; 64, 70, genital sclerotization; 65, 71, spermatheca; 66, 72, dististyle; 67, 73, aedeagus; 68, 74, parameres.

Hind tarsal ratio 1.00. Spermatheca (Fig. 65) ovoid, with stout, oblique neck; female genital sclerotization with shallow depression on anterior margin, lumen round (Fig. 64). Male dististyle (Fig. 66) dark, stout, deeply sinuate, tip broad. Aedeagus (Fig. 67) broad basally, basal arms short; apex notched. Parameres (Fig. 68) each slender, slightly sinuate, apex obliquely truncated.

**Distribution.** Brazil, restricted to the type locality.

**Types.** Holotype male, and 1 male paratype, Brazil, Santa Catarina, Nova Teutonia, 6.viii.1936 and 12.vii.1938, F. Plaumann (in BMNH).

**Specimens Examined.** BRAZIL: Santa Catarina, Nova Teutonia, many dates, F. Plaumann, 48 females, 13 males (slides); vii.1940, 1 female, 3 males (pinned).

**Discussion.** The poorly-developed palpal pit, the legs entirely dark brown (including knees), and the male genitalic characters, are enough to distinguish *F. kuanosceles* from all related species in the *annulatifemur* Group. Macfie (1939) illustrated the male of *F. kuanosceles* (Fig. 6), but his figures c and d are mistaken, belonging to another species placed outside the *annulatifemur* Group.

***Forcipomyia (Lepidohelea) weemsi* Wirth & Spinelli, new species**  
(Figures 69 - 74)

**Description. Female.** Wing length 0.90 (0.84-1.02,  $n = 5$ ) mm; breadth 0.37 (0.32-0.44,  $n = 5$ ) mm.

Head: Yellowish brown. Antenna with lengths of flagellar segments in proportion of 18-15-18-18-18-18-19-22-22-21-21-30; antennal ratio 0.79 (0.70-0.82,  $n = 5$ ). Palpus (Fig. 69) brown; lengths of segments in proportion of 9-13-23-23; 3rd segment with shallow sensory pit.

Thorax: Brown. Legs brown, knees pale; tibiae with faint subbasal and apical pale rings; hind tarsal ratio 0.97 (0.93-1.00,  $n = 5$ ). Wing with costal ratio 0.47 (0.45-0.48,  $n = 5$ ). Halter brown.

Abdomen: Brown. Genital sclerotization with broad truncate anterior margin, lumen ellipsoid (Fig. 70). Spermatheca (Fig. 71) subspherical, with short, straight neck; measuring 0.048 x 0.46 mm.

**Male.** Wing length 1.20 mm; breadth 0.33 mm; costal ratio 0.47. Similar to female with usual sexual differences; leg bands prominent.

Genitalia: Dististyle (Fig. 72) pale, slender, straight. Aedeagus (Fig. 73) triangular, elongated, basal arms very short, anteriorly directed; apex rounded. Parameres (Fig. 74) each nearly straight, apex obliquely truncated.

**Distribution.** North America, eastern from Maryland to Florida; western in Arizona and Baja California.

**Types.** Holotype male, Florida, Alachua Co., Gainesville, Chantilly Acres, 11.vii.1967, F. S. Blanton, light trap; allotype female, same data except viii.1967 (in USNM). Paratypes, 20 females 25 males, as follows: ARIZONA: Cochise Co., Cochise Stronghold, Dragoon Mts., 16.vii.1958, C. W. O'Brien, 1 female; same data except 13.viii.1958, 6 females. FLORIDA: Alachua Co., same data as types except vi.1967, 3 females, 2 males; 2.vii.1967, 1 male; 5.vii.1967, 1 female; 9.vii.1967, 1 male; 11.vii.1967, 1 female, 3 males;

7.ix.1967, 1 female; ix.1967, 3 females, 2 males; viii.1967, 7 females; Gainesville, Oak Crest, 24.x.1986, W. W. Wirth, UV light trap, 1 female. Highlands Co., Lake Placid, Archbold Biological Station, 12.ix.1989, WWW, malaise trap, 3 females, 2 males. MARYLAND: Montgomery Co., Colesville, 7.ix.1977, WWW, light trap, 2 males. MEXICO: Baja California, 10 km SW Santiago, 30.viii.1959, Radford & Werner, light trap, 1 male. SOUTH CAROLINA: Charleston, ix.1969, W. B. Ezell, light trap, 4 males.

**Discussion.** We are pleased to dedicate this species to Howard V. Weems, Jr. of the Florida State Collection of Arthropods, Gainesville, in recognition of his prodigious contributions to our knowledge of Florida Diptera. *Forcipomyia weemsi* is similar to *F. euthystyla* and *F. convexipennis*; characters for their separation are given in our key.

## Acknowledgments

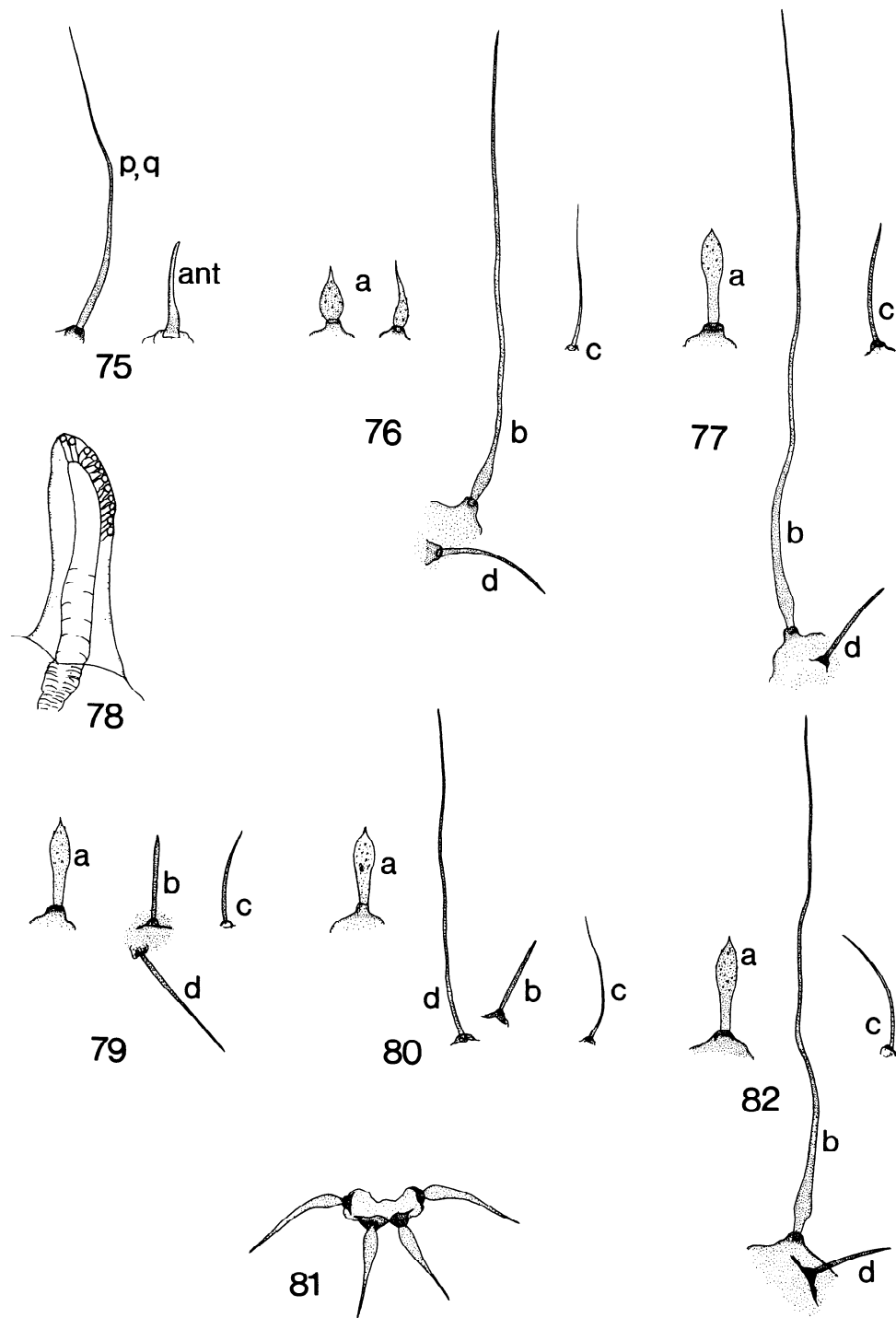
For the loan of types and the submission of specimens for taxonomic study we are indebted to the following persons and institutions: Instituto Oswaldo Cruz, Rio de Janeiro, Brazil, through the courtesy of Maria Luiza Felipe-Bauer; Natural History Museum, London, through Bruce C., Townsend, U.S. National Museum of Natural History, Washington, D.C., through B. V. Peterson and R. McGinley; Vernon H. Lee, formerly of the Rockefeller Foundation, Cali, Colombia; Saulo de J. Soria, Bento Gonçalves, Brazil; Raul Velez-Angel, Universidad Nacional de Colombia, Medellín; John A. Winder, Campinas, Brazil; and Allen M. Young, Milwaukee Public Museum, Wisconsin.

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## Literature Cited

- Bystrak, P. G., and W. W. Wirth. 1978. The North American species of *Forcipomyia* subgenus *Euprojoannisia* (Diptera: Ceratopogonidae). U.S. Dept. Agric. Tech. Bull. 1591, 51 pp.
- Chan, K. L., and E. J. LeRoux. 1965. Description of *Forcipomyia* (*Neoforcipomyia*) sp. n. and redescription of *Forcipomyia* (*Neoforcipomyia*) *eques* (Johannsen) (Diptera: Ceratopogonidae), with an account of the digestive and reproductive systems. *Phytoprotection* 46: 74-104.





**Figures 75-82.** *Forcipomyia herediae*; 75-77, 79-82, larva; 78, pupa: 75, head hairs *p* and *q* (left), antenna (right); 76, hairs (as lettered) of thoracic segment 1; 77, same, thoracic segment 2; 78, respiratory horn; 79, hairs of thoracic segment 3; 80, same, abdominal segment 1; 81, dorsal plate of last abdominal segment; 82, hairs of abdominal segments 2-8.

- Debenham, M. L. 1987. The biting midge genus *Forcipomyia* (Diptera: Ceratopogonidae) in the Australasian region (exclusive of New Zealand) III. The subgenera *Forcipomyia*, s. s., and *Lepidohelea*. Invert. Taxon. 1: 269- 350.
- Downes, J. A., and W. W. Wirth. 1981. Ceratopogonidae, pp. 393-421, In McAlpine, J. F., et al., eds., Manual of Nearctic Diptera, Vol. 1. Agric. Canada Monogr. 27, 674 pp.
- Graves, R. C., and A. C. F. Graves. 1985. Diptera associated with shelf fungi and certain other micro-habitats in the Highlands area of western North Carolina. Entomol. News 96: 87-92.
- Macfie, J. W. S. 1939. A report on a collection of Brazilian Ceratopogonidae (Dipt.). Revta. Entomol. 10: 137-219.
- Saunders, L. G. 1924. On the life history and the anatomy of the early stages of *Forcipomyia* (Diptera, Nemat., Ceratopogoninae). Parasitol. 16: 164-213, 3 pls.
- Saunders, L. G. 1956. Revision of the genus *Forcipomyia* based on characters of all stages (Diptera, Ceratopogonidae). Canadian J. Zool. 34: 657-705.
- Winder, J. A. 1977. Field observations on Ceratopogonidae and other Diptera: Nematocera associated with cocoa flowers in Brazil. Bull. Entomol. Res. 67: 57-63.
- Wirth, W. W. 1952. The Heleidae of California. Univ. California Pubs. Entomol. 9: 95-266.
- Wirth, W. W. 1974. Family Ceratopogonidae. In, A catalogue of the Diptera of the Americas south of the United States. 14: 1-89. Mus. Zool., Univ. Sao Paulo, Brazil.
- Wirth, W. W. 1982. The cacao-pollinating midges of the *Forcipomyia argenteola* group (Diptera: Ceratopogonidae). Proc. Entomol. Soc. Washington 84: 568-585.
- Wirth, W. W. 1991a. New and little-known species of *Forcipomyia* (Diptera: Ceratopogonidae) associated with cocoa pollination in Brazil. Proc. Entomol. Soc. Washington 93: 163-175.
- Wirth, W. W. 1991b. *Forcipomyia bicolor* and related species of the subgenus *Lepidohelea* in Brazil (Diptera: Ceratopogonidae). Florida Entomol. 74: 506-517.
- Wirth, W. W., and S. de J. Soria. 1975. A new Neotropical *Forcipomyia* midge closely related to *F. (F.) genualis* (Loew) (Diptera: Ceratopogonidae). Revta. Theobroma 5: 19-27.