

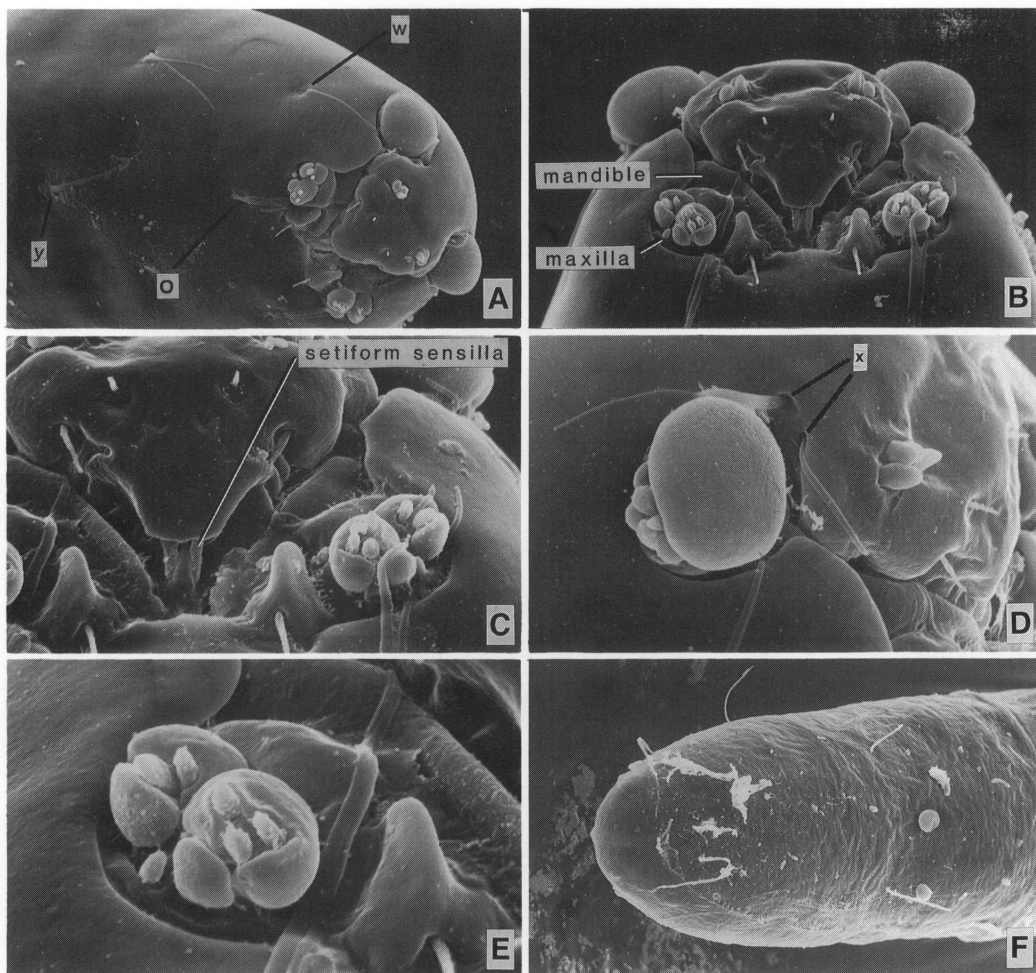
Zihali-Sebess (1940) used the ratio of wing vein $m/r-m$ to distinguish some *Serromyia* species but we found no statistically significant differences between the species.

Szadziewski (1988), in his study of Baltic amber ceratopogonids, used the ratio of hind femur length/width to distinguish some fossil *Serromyia* species. Because of marked variation within extant species, we found the character to be of very limited value for males (Table 6) and of no value for characterizing females, where total range values for all Holarctic species was 3.97–7.73. Intraspecific variation for females of some species was also large; for example

S. ledicola had a range from 4.09 to 7.73 ($n=37$). Szadziewski (1988) recorded some values for the fossil material, however, that exceeded these values.

Meillon & Wirth (1983) and Wirth & Grogan (1988) noted in their generic diagnoses that male genitalia are 'concealed beneath the tip of the pregenital terga' [= tergite 8]. Although true for some specimens of some species, we have been unable to confirm this for living or freshly killed specimens. It is possible that such a position is an artefact of preservation.

Meillon & Wirth (1983) mistakenly drew the female genitalia of *Serromyia aethiopiae* as



Figs 15A–F. SEM photomicrographs of first instar larva of *Serromyia nudicolis*; A, anterior portion of head capsule in anteroventral view; B, mouthparts in ventral view; C, mouthparts in ventral view; D, antenna and labrum in anterolateral view; E, right maxillary palp; F, terminal abdominal segments in dorsal view.

having a very broad sternite 8. The lateral margin of sternite 9 was included as part of sternite 8, which is, in fact, more narrow posteriorly.

It is likely that spermathecal shape differs between at least some species of *Serromyia* but we were unable to examine these in a consistent manner to categorize those differences. Apparent shape changes dramatically with different orientations of the spermatheca within the body cavity.

The only previous description of the pupal stage has been by Kettle & Lawson (1952), who characterized the pupa of *S. femorata* (perhaps misidentified to species; not seen), and by Mayer (1957), who tabulated some setal distributions. Our description of the pupa above is based on a few specimens ($n=5$) from the Strenzke and Thienemann collections (ZSMC). One of these contained a pharate adult of *S. atra* but the others could not be confidently identified.

Kettle & Lawson (1952) drew the respiratory organ of the pupa of *S. femorata* with the apex more narrow than that of any of the specimens we studied. This may indicate real variation but

may also be due to drawing the specimen at an angle.

Mayer (1957) noted that members of the Heteromyiini, Sphaeromyiini and Palpomyiini all have 3 anterior and 4 posterior dorsal setae on abdominal segment four. Each of these two groups of setae actually included a sensory pit. In the somewhat dirty pupal material of *Serromyia* examined we could not be certain whether sensory pits were present or not. The different sensilla counts, therefore, may not be significant.

Descriptions of larvae have been previously provided by Kettle & Lawson (1952) and Glukhova (1977, 1979). In addition, the first instar larva of *S. nudicolis* is described below. Our diagnosis above should allow recognition of the genus. The simple anal segment with very short setae is unusual but not unique, being characteristic in some *Paradasyhelea* Macfie, *Stilobezzia* Kieffer and *Sphaeromyias* Curtis.

We examined three fourth instar larvae of an unidentified *Serromyia* from the Strenzke and Thienemann collections (ZSMC). These matched in nearly every detail the excellent description by Glukhova (1979: 160). Glukhova, however, in drawing seta w in her ventral view of the head capsule, failed to draw it in her lateral view. The seta is just dorsal of the subgenal ring. We failed to confirm the observation that the posterior margin of the eye was slightly triangularly elongated. The specimens we examined had eyes which were generally spherical with a somewhat ragged edge. In addition, we could not locate sensory pits r and k.

We were unable to locate the specimens used by Kettle & Lawson (1952) in their description of *S. femorata* larvae. Considering the uncertainty in species identification at that time, these may have been the larvae of one or more other *Serromyia* species.

The description of the egg above is based mostly on the undeveloped ova within preserved female abdomens. Otherwise, only the egg of *S. nudicolis* is known (described below). A recent investigation of the surface sculpturing of eggs of *Culicoides* (Kariya *et al.*, 1989) show significant differences between species, indicating that this character may provide useful information in distinguishing the eggs of different *Serromyia* species.

The way the egg shell chorion is split is similar

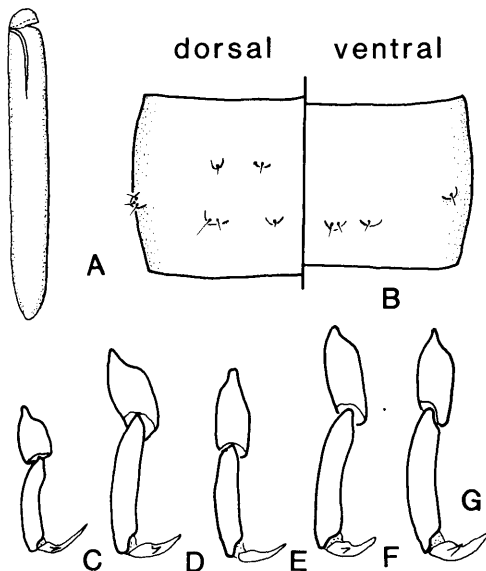


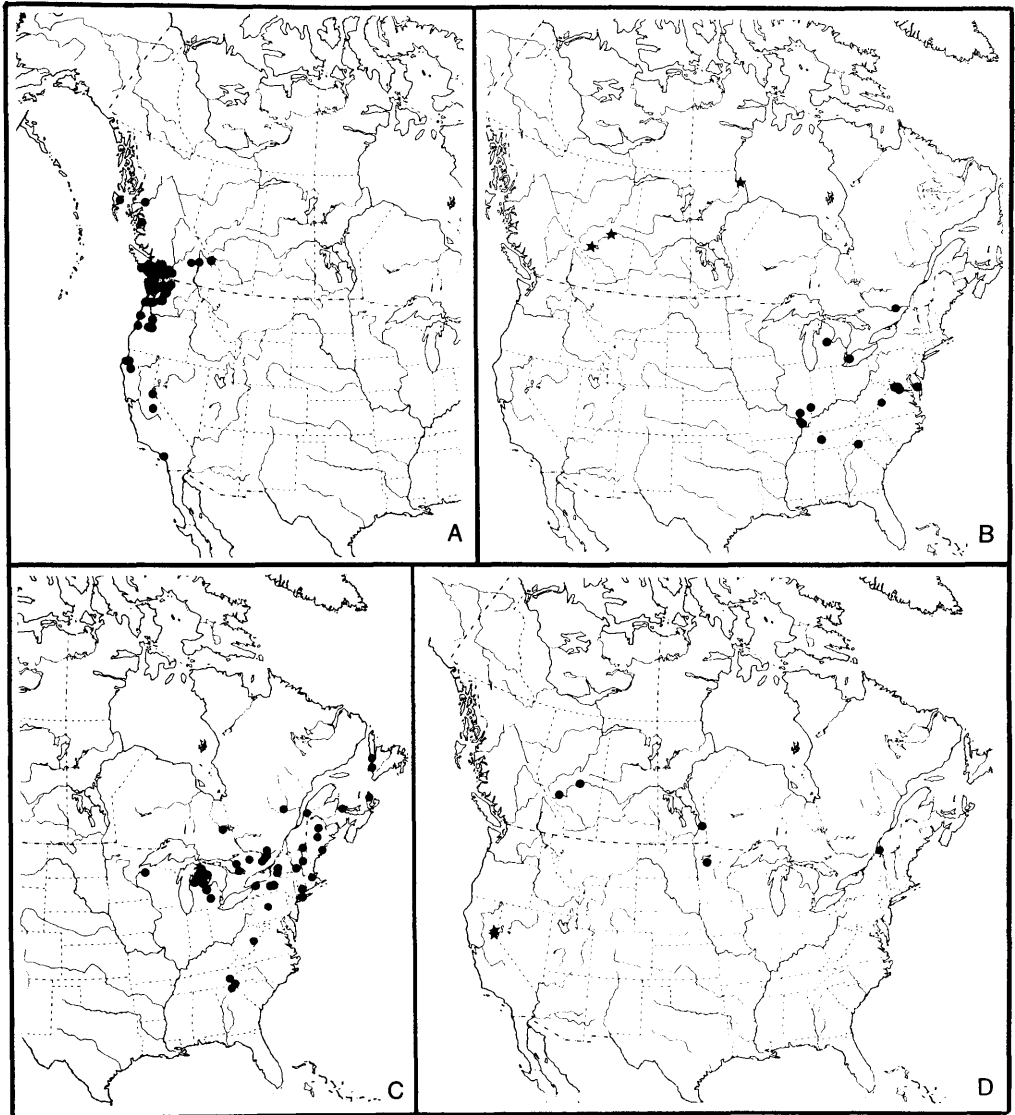
Fig. 16. A, egg shell of *Serromyia nudicolis*; B, setal distribution on fourth abdominal segment of pupa of unidentified *Serromyia*; C–G, medial view of posterior claw of female right fore leg: C, *Metacanthohelea cogani*; D, *S. nudicolis*; E, *S. silvatica*; F, *S. maculipennis*; G, *S. agathae*.

to that reported for *Culicoides circumscriptus* Kieffer by Becker (1961) and *Bezzia varicolor* (Coquillett) by Thomsen (1937), suggesting that this is a widespread characteristic at least within the Ceratopogoninae. Otherwise, so few egg shells have been described that no further comparisons are possible.

Meillon & Wirth (1983) noted the variation among species of southern hemisphere Old World *Serromyia* as compared to the relative homogeneity of species in the Holarctic. They

intimated the possibility of splitting the group into two or more genera but could find no evidence to support clear distinctions. We too could find no evidence to support the recognition of more than one genus.

Wirth & Grogan (1988) recently described the new monotypic genus *Metacanthohelea* from Africa. Further examination of two males and two females of *M.cogani* indicates that most character states which were indicated as distinguishing this genus also occur in at least some



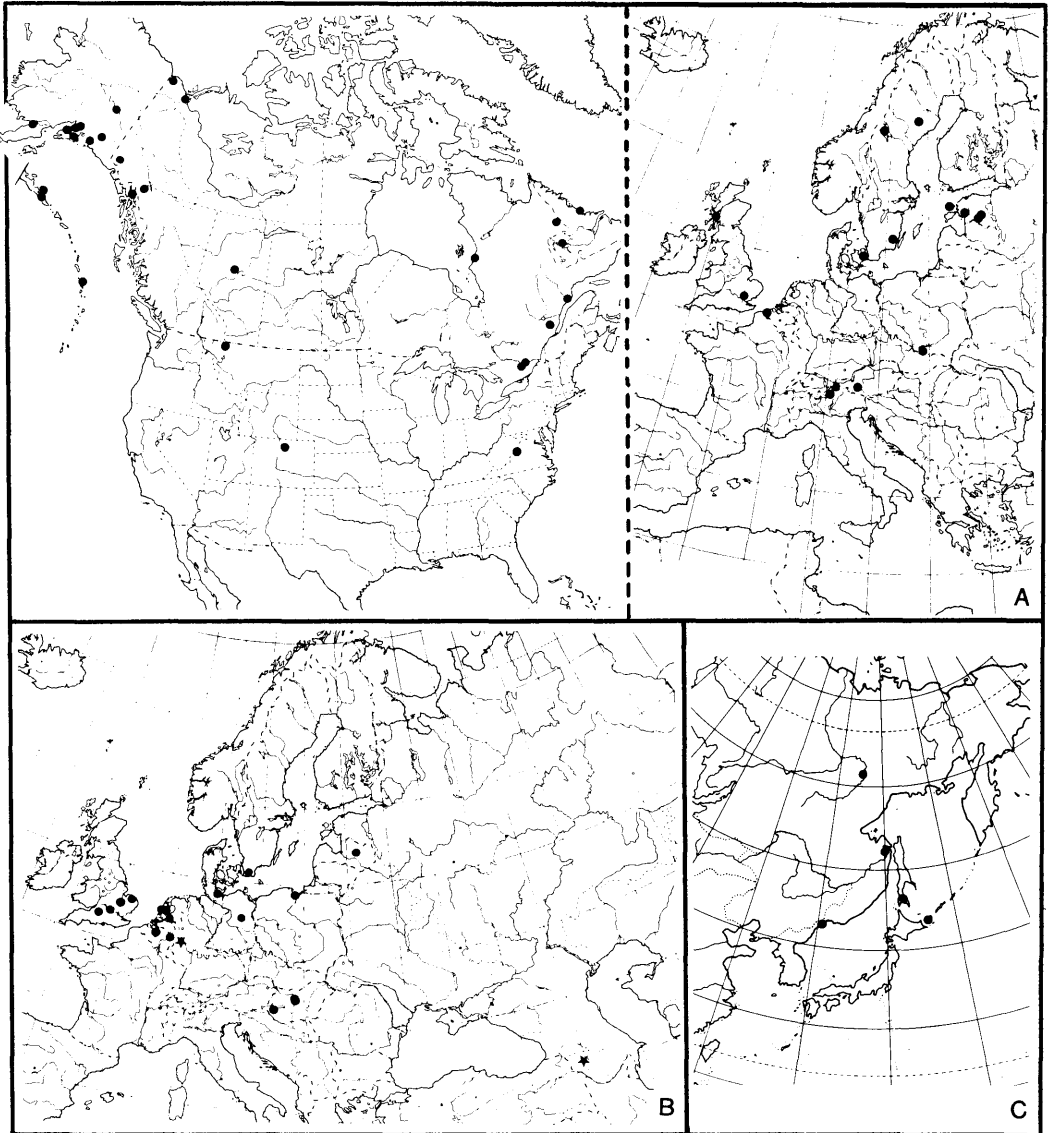
Figs 17A–D. Distributions of: A, *Serromyia barberi*; B, *S. borealis* (*), *S. crassifemorata* (●); C, *S. nudicolis*; D, *S. sierrenis* (*), *S. vockerothi* (●).

species of *Serromyia* (see discussion below under 'Phylogeny'). The key provided by Wirth & Grogan (1988) is therefore revised as follows:

- 22. Female claws with rounded or straight base, distal portion curved (Fig. 16D–G); female hind claws either single and elongate or, if short and equal, lacking inner tooth; male with more than 0.58 of apex of hind femur bearing strong bristles *Serromyia* Meigen
- 22. Female claws with marked bend at base, distal

portion straight (Fig. 16C); female hind claws short and equal, with well-developed inner tooth; male with less than 0.43 of apex of hind femur bearing strong bristles
 *Metacanthohelea* Wirth & Grogan

Boorman & Rowland (1988) recently provided a generic key to the ceratopogonid adults of Great Britain. However, many female specimens of *Serromyia* found there will not key out properly because of the presence of



Figs 18A–C. Distributions of: A, *Serromyia ledicola*; B, *S. atra* (●), *S. bicolor* (*); C, *S. pacifica*.

macrotrichia on the wing tip. The key will work if all specimens, regardless of sex, are treated as if they were male.

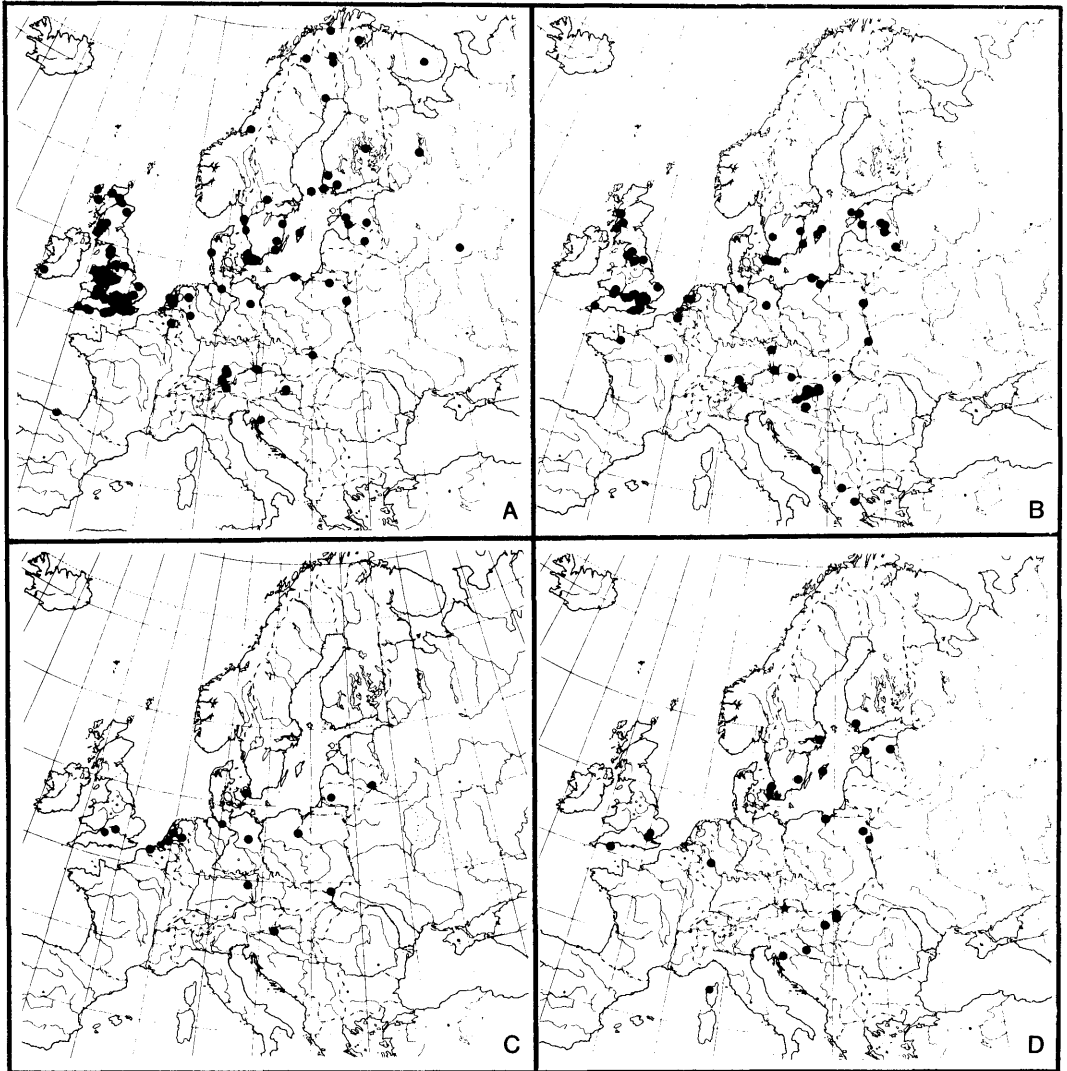
Keys

Members of the genus *Serromyia* may be recognized as such in the Holarctic Region using Downes & Wirth (1981) or on a worldwide

basis using Wirth & Grogan (1988) with the modifications suggested above allowing for better separation of *Metacanthohelea* and *Serromyia*.

Some terms in the keys presented below require special attention or interpretation and the reader is directed to the above section 'Terms and abbreviations for structures'.

Males are generally easier to identify than females, especially those of species from the Palaearctic.



Figs 19A–D. Distributions of: A, *Serromyia femorata*; B, *S. morio*; C, *S. rufitarsis*; D, *S. subinermis* (●), *S. tecta* (*).

Key to adult males of Nearctic *Serromyia* species

1. Mid femur yellow with apical portion more darkly pigmented2
Mid femur uniformly dark brown4
2. Hind coxa with 0–4 elongate lateral setae (Fig. 1B); fore femur with or without strong ventral bristles; scutum pruinose (as in Fig. 1A); adults present 13 July to 6 November (broadly Holarctic) *ledicola*
Hind coxa lacking elongate lateral seta; fore femur with or without strong bristles, if present situated at least anteriorly; scutum pruinose or lacking pruinosity; adults present 2 June to 3 July3
3. Fore femur with strong bristles anteriorly and posteriorly; scutum pruinose (Canada, northern United States) *vockerothi*
Fore femur with one strong bristle anteroapically; scutum lacking pruinosity (Sierra Nevada) *sierrensis*
4. Paramere with a distinctly pointed apex (Fig. 6B); west of continental divide (western Nearctic) *barberi*
Paramere with a rounded (sometimes difficult to see) apex (Figs 6E, 7B, 7E); east of continental divide5
5. Fore femur with stout bristles at least anteriorly and posteriorly (eastern Nearctic) *nudicolis*
Fore femur lacking strong bristles6
6. Scutum pruinose; aedeagus with lateral prongs (Fig. 6D) (Alberta, Manitoba) *borealis*
Scutum lacking pruinosity; aedeagus lacking lateral prongs (Fig. 7A) (eastern Nearctic) *crassifemorata*
3. Cells r_1 and r_{2+3} pale to dark brown; hind claw longer than tarsomere 5 ($HC/Ta_5 = 1.07-1.65$) 4
Cells r_1 and r_{2+3} dark brown; hind claw equal to or shorter than tarsomere 5 ($HC/Ta_5 = 0.62-1.08$) 6
4. Cells r_1 and r_{2+3} dark brown; fore and mid tibiae brown (Sierra Nevada) *sierrensis*
Cells r_1 and r_{2+3} pale to light brown; fore and mid tibiae pale or with just apex of mid tibia darkly pigmented5
5. Coxa of hind leg with one or more strong lateral setae (as in Fig. 1B); scutum pruinose (broadly Holarctic) *ledicola*
Coxa of hind leg lacking strong lateral setae; scutum lacking pruinosity (western Nearctic) *barberi*
6. Ratio of antennal flagellomeres $8/9 = 0.62-0.82$ (eastern Nearctic) *nudicolis*
Ratio of antennal flagellomeres $8/9 = 0.59-0.60$ (Canada, northern States) *vockerothi*

Key to adult males of Palearctic *Serromyia* species

1. Body pale yellow (Egypt) *mangrovi*
Body dark brown to black2
2. Parameres tapered apically to a definite point (Figs 9B, 11B, E)3
Parameres rounded apically, shrivelled in some, but apex not pointed (Figs 8E, 9E, 10B, E, 12B) .5
3. Scutum lacking pruinosity; each paramere bifurcate (Fig. 11B) apically (Europe) ... *rufitarsis*
Scutum pruinose; each paramere ending in a single point (Figs 9B, 11E)4
4. Apex of paramere bent laterally at about a 45–90° angle (Fig. 11E) (Europe) *subinermis*
Apex of paramere straight, sword-like (Fig. 9B) (Federal Republic of Germany, Caucasus) *bicolor*
5. Thorax shiny; cells r_1 and r_{2+3} dark brown; aedeagus with side prongs directed anterolaterally (Fig. 10A)6
Thorax pruinose; cells r_1 and r_{2+3} light to pale brown; aedeagus with side prongs directed dorsolaterally, laterally or posterolaterally (Figs 8D, 9D, 10D, 12A)7
6. Fore femur with three rows of strong bristles; wing length = 2.0–2.5 mm (Europe) *morio*

Key to adult females of Nearctic *Serromyia* species

1. Claws of hind leg equal, markedly shorter than tarsomere 52
Hind leg claw single and elongate, with one small side tooth; claw equal to or longer than tarsomere 53
2. Mandible serrate; fore and mid tibiae darkly pigmented (Fig. 4F); scutum pruinose (Alberta, Manitoba) *borealis*
Mandible reduced, lacking teeth; fore and mid tibiae pale or yellow; scutum lacking pruinosity (eastern Nearctic) *crassifemorata*

- Fore femur with one ventral row of strong bristles and 0–2 anterior or posterior strong bristles; wing length = 1.3–1.9 mm (Europe) *atra*
7. Fore femur with three rows of strong bristles; hind femur with anterior strong bristles (as in Fig. 1D) (Europe) *femorata*
- Fore femur lacking strong bristles or with one row of strong bristles in some composed of only a few spines, some with 1–2 additional strong posterior bristles; hind femur lacking anterior strong bristles 8
8. Each of fore and mid femora and tibiae at most only partly pigmented (Fig. 3B, C); parameres markedly swollen in apical half (Fig. 8E); gonostylus narrow and pointed apically (Fig. 8F) (broadly Holarctic) *ledicola*
- Fore and mid femora and tibiae entirely brown (as in Fig. 3D); parameres sausage shaped, apical half about equal in diameter for entire length (Figs 10E, 12B); gonostylus with rounded apex (Figs 10F, 12C) 9
9. AR = 1.17; wing length 2.2 mm; apex of gonostylus markedly swollen (Fig. 10F) (eastern Palearctic) *pacifica*
- AR = 1.00–1.03; wing length 1.6–1.8 mm; apex of gonostylus at most only slightly swollen (Fig. 12C) (Federal Republic of Germany) *tecta*

Key to adult females of Palearctic

***Serromyia* species**

1. Body pale yellow (Egypt) *mangrovi*
 Body dark brown to black 2
2. Hind claws equal, similar to fore and mid leg claws 3
 Hind claws unequal (a single claw present), longer than fore and mid leg claws 4
3. Scutum pruinose; hind coxa lacking strong lateral bristles (Federal Republic of Germany) *tecta*
 Scutum lacking pruinosity; hind coxa with 1–2 strong lateral bristles (as in Fig. 1B) (Europe) *atra*
4. Palpus mostly pale, with only segments 4 and 5 darkly pigmented (Federal Republic of Germany, Caucasus) *bicolor*
 Palpus uniformly dark brown 5
5. Scutum pruinose 6
 Scutum lacking pruinosity 10
6. Fore tibia nearly entirely darkly pigmented (as in

- Fig. 4F) 7
- Fore tibia only partially pigmented (Figs 4E, 5B, C, E, F) 8
7. Hind coxa lacking strong lateral bristles (Europe) *subinermis* (in part)
 Hind coxa with about 4 strong lateral bristles (eastern Palearctic) *pacifica*
8. Coxa of hindleg with 0–4 strong lateral bristles; collected 20 July to 6 November (broadly Holarctic) *ledicola*
 Coxa of hindleg lacking strong lateral bristles; collected before 14 August 9
9. Wing slightly infuscated, with cells r_1 and r_{2+3} dark brown (Europe) *subinermis* (in part)
 Wing pale, with cells r_1 and r_{2+3} pale or slightly pigmented (Europe) *femorata*
10. Mid femur entirely dark brown; HC/Ta₅ = 0.67–0.89 (Europe) *rufitarsis*
 Mid femur pale basally; HC/Ta₅ = 0.97–1.32 (Europe) *morio*

***Serromyia barberi* Wirth**

Serromyia barberi Wirth 1952: 205. Holotype, ♂ adult, pinned, labelled ‘Eureka, Cal. 22.5’, ‘HS Barber Collector’, ‘Holotype *Serromyia barberi* W.W. Wirth’ (USNM); allotype ♀ labelled as for holotype but collected 6.vi (USNM); paratypes: 17♂, 2♀ from type locality collected either 22.v or 6.vi (USNM); U.S.A.: 1 ♀, Cal., Humboldt Co., Hely Creek, 11.viii.1948 (USNM); 1 ♀, Cal., San Luis Obispo Co. Blac. Lake Canyon (not found).

Diagnosis. Male: only Nearctic species with a paramere with a distinctly pointed apex. Female: only Nearctic species with the fore and mid tibiae pale or with only apex of mid tibia pigmented, with the scutum lacking pruinosity, and with a single elongate hind claw.

Description. Male adult. Descriptive statistics: see Tables 2–7.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus dark brown.

Thorax: dark brown; scutum bare of pruinosity.

Legs: coloration pattern as indicated in Fig. 2A, B; strong bristles on femora, tibiae distributed as follows: 1 present anteriorly, to 21 present anteriorly, ventrally, posteriorly on fore femur, present or absent posteriorly on fore

tibia, present or absent anteriorly, ventrally, posteriorly on mid femur, present or absent posteriorly on mid tibia, present ventrally on hind femur, present or absent anteriorly on hind femur, dorsally on hind tibia; ventral bristles on hind femur arising from slightly developed tubercles; hind ta_1 straight; ta_4 setae straight or slightly curved.

Wing: pale with veins of cells r_1 , r_{2+3} darkly pigmented.

Abdomen: dark brown.

Genitalia (Fig. 6C): gonostylus with outer margin evenly curved, tapering gradually to slightly swollen, rounded or somewhat pointed apex; paramere (Fig. 6B) slender, with pointed apex; aedeagus (Fig. 6A) lacking lateral prongs, distal portion a simple, slender projection, extreme apex directed ventrally.

Female adult. Descriptive statistics: see Tables 8–13. Similar to male except for usual sex differences and as follows:

Head: mandible serrate.

Legs: coloration pattern as indicated in Fig. 4E; strong bristles absent on femora, tibiae except ventrally on hind femur; claw of hind leg single, elongate, with basal tooth.

Wing: pale or pale with veins of cells r_1 , r_{2+3} darkly pigmented; macrotrichia restricted to apical margin.

Genitalia (as in Fig. 12D): sternite 9 truncate medially to somewhat truncate but with anteromedial margin developed, pointed; two spermathecae, additional spermathecal duct terminating in pigmented apex.

Distribution and bionomics. *S. barberi* is known from the southern half of British Columbia south to California (Fig. 17A). The only other species west of the continental divide are *S. sierrensis* from the Sierra Nevada of California and *S. ledicola* which has been collected just west of the continental divide in Montana and Colorado. Adults of *S. barberi* have been collected from 17 May to 11 August.

The most southerly locality of *S. barberi* was a specimen labelled 'S. Fork Santa Ana R., Calif., 18 June, 1945'. This disjunct indicates further profitable collecting in southern California.

We found *S. barberi* most common in areas of seeps and along the margins of small streams, nearly always associated with flowing water. A few specimens were found along the margins of larger rivers. However, we found one female at the margin of a fen, 3 km E Salmon Arm,

British Columbia, with no flowing water nearby.

Although rarely abundant, a large collection of six males and 100 females was made at Mary's Peak (Parker's Creek), 21 km W Corvallis, Oregon on 19.vii.1985. In most other areas, however, it often took 1–2 h to locate one specimen.

During broad daylight *S. barberi* adults were most commonly collected low in the vegetation and the edge of the net was held on the ground, while sweeping, to obtain these individuals. However, some specimens were collected by sweeping at arm level, especially along the margins of streams. Adults were restricted to a limited area within a habitat so that, for example, the margin of a stream could be swept for several hundred metres without finding a specimen and then suddenly two or three would be collected in the space of 5 m. We are unable to report any generalization which would predict where these specimens might be located.

In general, females were collected more frequently than males and this is reflected in their relative numbers in the collections made and in the museum collections examined.

Observations of female feeding were made at two localities. At 6.5 km SE of Hebo, Oregon, female *S. barberi* flew out of stream margin vegetation throughout the afternoon to dart into small chironomid swarms which formed in dark enclaves in the stream bank. At least some of these were of males of *Nilotanytus* Kieffer. Female *S. barberi* assumed a ragged up and down flight, somewhat mimicking the chironomid flight pattern, and then left the swarm to return to the vegetation. We succeeded in collecting one female with a chironomid male but could make no detailed observations as to how the prey was captured or held. At Parker's Creek on Mary's Peak, 21 km W Corvallis, Oregon, females were quiescent until after dusk when they could be collected along the narrow gravel road which bisected the stream where many had been resting earlier. They were especially common between 09.00 and 09.30 p.m. Females flew in directed flight at the height of about 2–2.5 m until they met with chironomid swarms which formed along this road. They then joined the swarm and assumed a similar ragged up and down flight. We were unable to make further observations on prey capture or feeding. We placed white sheets under such swarms but no *S. barberi* females landed on

these, as may happen with prey capture in other groups (Downes, 1978).

W. W. Wirth collected a male at Revelstoke, British Columbia, on an Umbelliferae, where the specimen was presumably feeding on flower nectar.

We examined a gynandromorph female from Cowichan Lake, B.C. (CNCI) in which flagellomeres 1–8 of the right antenna are male-like and plumose.

Taxonomic discussion. One character, generally of good diagnostic value within the genus, exhibited a puzzling degree of variation in male *S. barberi*. The number of strong bristles on the fore femur varied from 1 to 21, representing individuals with a near total lack of strong bristles on all the legs to very bristly specimens. In some areas, such as southern Vancouver Island, variation ranged virtually continuously from 2 to 21 bristles, while on Mary's Peak, 21 km W Corvallis, Oregon the senior author collected 6 males on 19.vii.1985 with 1, 1, 1, 10, 13 and 17 bristles on the fore femur. We were unable to find any correlation with size, geographical or temporal distribution, although it should be noted that only sixty-six males were available for study.

The sex of one of the paratypes from Eureka was incorrectly given as male by Wirth (1952). We were unable to locate the paratype from Black Lake Canyon.

Material examined. Seventy-two males and 268 females.

Derivation of specific epithet. The name *barberi* refers to the collector of the type series, H. S. Barber.

***Serromyia borealis* Borkent sp.n.**

Diagnosis. Male: only Nearctic species with mid femur completely pigmented brown and aedeagus with lateral prongs. Female: only Nearctic species with claws of hind leg equal, short (male-like) and mandible well developed, with teeth.

Description. Male adult. Descriptive statistics: see Tables 2–7.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus dark brown.

Thorax: dark brown; scutum pruinose.

Legs: coloration pattern as indicated in Fig. 2C; strong bristles absent on femora, tibiae

except ventrally on hind femur, arising from slightly developed tubercles; hind Ta_1 straight to with slight basal curvature; Ta_4 setae straight or with slight curve.

Wing: pale with veins of cells r_1 , r_{2+3} slightly pigmented.

Abdomen: dark brown.

Genitalia (Fig. 6F): gonostylus with outer margin evenly curved, tapering gradually for basal half, with rounded, slightly to moderately swollen apex; paramere (Fig. 6E) with apical half somewhat swollen, somewhat rounded, but with apex difficult to discern; aedeagus (Fig. 6D) with lateral prongs, directed laterally, distal portion a simple, slender projection markedly longer than lateral prongs, extreme apex directed ventrally.

Female adult. Descriptive statistics: see Tables 8–13. Similar to male except for usual sex differences and as follows:

Head: mandible serrate.

Legs: coloration pattern as indicated in Fig. 4F; claws of hind leg equal, small.

Wing: pale with veins of cells r_1 , r_{2+3} darkly pigmented; macrotrichia absent.

Genitalia (Fig. 12D): sternite 9 truncate medially; two spermathecae, additional spermathecal duct terminating in pigmented apex.

Distribution and bionomics. *S. borealis* is known from Alberta to Manitoba (Fig. 17B). Adults have been collected from 15 June to 4 July.

We collected this species at two localities. At 10 km E Spruce Grove, Alberta, two males were swept from the upper branches of short (3–4 m) spruce trees in a well-developed sphagnum bog. At the type locality, both males and females were swept from grassy tussocks, very near to the ground, in a black spruce bog. Adults were restricted to a small patch of ground about 15 m in diameter, which was a little drier than the surrounding area.

Taxonomic discussion. The association of males and females was based on the number of each collected at the type locality. It should be noted, however, that one female of *S. vockerothi* was also collected at this site.

Types. Holotype, ♂ adult on microscope slide, labelled 'Holotype *Serromyia borealis* Borkent, CNC No. 20128, ♂, 3.2 km. N. Nordegg, Alta., 28-VI-1985, A. Borkent CD379', allotype on microscope slide labelled as for holotype (CNCI); paratypes: 9♂, 9♀

labelled as for holotype (CNCI, USNM); CANADA: 1♂, Alberta, Nordegg, 15.vi.1921 (CNCI); 2♂, Alberta, 10 km E Spruce Grove (Wagner Bog), 24–26.vi.1985 (CNCI); 1♀, Manitoba, Churchill, 4.vii.1947 (CNCI).

Derivation of specific epithet. The name *borealis* (northern) refers to the perceived boreal habitat of this species.

***Serromyia crassifemorata* Malloch**

Serromyia crassifemorata Malloch 1914: 218.

Lectotype designated by Frison (1927), ♀ adult, pinned, labelled '1789', '*Serromyia crassifemorata* Malloch (Type)', '♀', 'Lectotype ♀ *Serromyia crassifemorata* Malloch', 'Property of the Illinois Natural History Survey' (INHS); paralectotype ♀ on pin from same locality (as indicated by Malloch, 1914), with additional labels stating: '#1789 IL, Mt. Carmel 28 May 1884 from leaves of *Quercus*' '*Serromyia crassifemorata* Det. A. Borkent' (INHS).

Diagnosis. Male: only Nearctic species lacking strong bristles on legs, with mid femur uniformly dark brown, with aedeagus lacking side prongs and paramere with rounded apex. Female: only Nearctic species with short, equal hind claws and reduced, nonserrate mandibles.

Description. Male adult. Descriptive statistics: see Tables 2–7.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus light to dark brown.

Thorax: medium to dark brown; scutum bare of pruinosity.

Legs: coloration pattern as indicated in Fig. 2D; strong bristles absent on femora, tibiae except ventrally on hind femur, present or absent dorsally on hind tibia; ventral bristles on hind femur arising from slightly developed tubercles; hind Ta₁ straight; Ta₄ setae straight or with slight curve.

Wing: slightly infuscated, with veins of cells r₁, r₂₊₃ darkly pigmented.

Abdomen: dark brown.

Genitalia (Fig. 7C): gonostylus with outer margin evenly curved, tapering gradually to slightly swollen, rounded to somewhat pointed apex; paramere (Fig. 7B) with apical half sausage shaped, rounded apex; aedeagus (Fig. 7A) lacking lateral prongs, distal portion a

simple, slender projection, extreme apex directed ventrally.

Female adult. Descriptive statistics: see Tables 8–13. Similar to male except for usual sex differences and as follows:

Head: mandible vestigial, no teeth evident.

Legs: coloration pattern as indicated in Fig. 5B; strong bristles absent on femora, tibiae except ventrally on hind femur; claw of hind leg single, elongate, with basal tooth.

Wing: macrotrichia absent or restricted to apical margin.

Genitalia (as in Fig. 12D): sternite 9 truncate medially to somewhat truncate but with anteromedial margin developed, pointed; two spermathecae, additional spermathecal duct terminating in pigmented apex.

Distribution and bionomics. *S. crassifemorata* is known from southern Ontario and Quebec, south to Tennessee and Georgia (Fig. 17B). Adults have been collected from 2 May to 22 June. Johannsen (1928, 1943) reported this species from Lewiston, New York, and, though the species almost certainly does occur in New York, we failed to examine any material from that state.

The nonfunctional mandibles of the female, unique in the genus, indicates that it does not feed on other insects.

The localities from which this species have been collected suggest that *S. crassifemorata* occurs in both lotic and lentic habitats. W. W. Wirth collected a series of females in Virginia in *Osmunda* bogs (a genus of fern, characteristic of wet woodland and some open swamps) and a few from a stream margin at Alexandria, Virginia. We collected one specimen from Rondeau Provincial Park in southern Ontario in a malaise trap located in a wet swampy area.

Taxonomic discussion. The recognition of the previously unknown male is based on the association of twenty males with two females of *S. crassifemorata* from Cobden, Illinois, collected 7–9.v.1918. One additional male was from Roaring Spring, Jonesboro, Illinois.

Wirth & Grogan (1981) provided a description of the female of *S. crassifemorata*.

Material examined. Twenty-one males and seventy-six females.

Derivation of specific epithet. The name *crassifemorata* means thickened femora and presumably refers to the thick hind femora of this and all other species in the genus.

***Serromyia nudicolis* Borkent sp.n.**

Diagnosis. Male: only Nearctic species with mid femur completely darkly pigmented, with numerous strong bristles on legs (at least fore femur with anterior and posterior strong bristles) and paramere with rounded apex. Female: only Nearctic species with a ratio of antennal flagellomeres $8/9 = 0.62-0.82$, and an elongate, single hind claw, with $HC/Ta_5 = 0.62-1.06$.

Description. Male adult. Descriptive statistics: see Tables 2–7.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus dark brown.

Thorax: dark brown; scutum pruinose.

Legs: coloration pattern as indicated in Fig. 2E; strong bristles of femora, tibiae distributed as follows: anteriorly, posteriorly on fore femur, present or absent dorsally, ventrally on fore femur, posteriorly on fore tibia, present or absent anteriorly, dorsally on fore tibia, at least some present but present or absent anteriorly, dorsally, ventrally, posteriorly on mid femur, posteriorly on mid tibia, present or absent anteriorly, dorsally on mid tibia, anteriorly, dorsally, ventrally on hind femur, dorsally on hind tibia; ventral bristles on hind femur arising from slightly developed tubercles; hind Ta_1 straight or with slight basal curvature; Ta_4 setae straight or with slight curve.

Wing: slightly infuscated with veins of cells r_1 , r_{2+3} darkly pigmented.

Abdomen: dark brown.

Genitalia (Fig. 7F): gonostylus with outer margin evenly curved, tapering gradually for basal half, with pointed apex or with slightly swollen, somewhat rounded apex; paramere (Fig. 7E) with apical half sausage shaped (sometimes somewhat shrivelled), apex rounded; aedeagus (Fig. 7D) lacking lateral prongs, distal portion a simple, slender projection, extreme apex directed ventrally.

Female adult. Descriptive statistics: see Tables 8–13. Similar to male except for usual sex differences and as follows:

Head: mandible serrate.

Legs: coloration pattern as indicated in Figs 4E, 5A; strong bristles of femora, tibiae distributed as follows: 1–2 apically on mid tibia (absent on one specimen), ventrally on hind femur; claw of hind leg single, elongate, with

basal tooth.

Wing: a few macrotrichia restricted to apical margin.

Genitalia (as in Fig. 12D): sternite 9 somewhat truncate but with anteromedial margin developed, pointed; two spermathecae, additional spermathecal duct terminating in pigmented apex.

First instar larva. Total length = 0.74–0.91 mm ($n=4$).

Head: length = 78.4–84.0 μm ($n=5$), length/width = 1.40–1.53 ($n=3$); capsule medium brown, with well developed, darkly pigmented egg burster (Fig. 14F); eye spot pigmented black, shaped as simple, elongate oval, oriented dorsoventrally; antenna large, flat disc, with 7 short sensilla at anterolateral margin of base (Figs 14E, 15D), setae x on medial margin of antenna base (Fig. 15D); labrum with anterolateral group of 4 short, thick sensilla with very fine spicules at bases, a more medial, short seta, an elongate ventrolateral seta, an apical setiform sensillum (Figs 15B, C, D); mandible sickle shaped, elongate, extending in adducted state to level of setae o , apex longitudinally corrugated but mandible not seen well enough to describe further; maxilla with 1 elongate seta at base of anteriorly projecting lobe, palpus reduced with 8 sensilla distributed as follows: 1 small aboral, 2 large, stout aboral sensilla, 2 on anterolateral lobe, 3 on anteromedial lobe (Figs 15C, E); labium with single, anteriorly projecting tooth (Fig. 15C); otherwise following setae present (Figs 14E, F, 15A, D): t , s , q , p , w , u , v , o , y (j could not be seen), distribution similar to that given by Glukhova (1979) for fourth instar but seta u directly dorsal to v ; sensory pits z , k , r , m , n absent; epipharynx with lateral arm well developed, with barely discernible, posteriorly directed comb.

Thorax, abdomen: lacking pigmentation; thorax with well-developed collar; proleg absent; perianal setae short, poorly developed, restricted to lateral, dorsal surface of segment 9 (Fig. 15F); no evidence of anus, anal papillae.

Egg. Dark brown, elongate, slightly curved (Fig. 14A), length = 592–632 μm , width = 79–87 μm , length/width = 6.8–8.0 ($n=10$); with short tubercles arranged in somewhat scattered, longitudinal rows (Figs 14A, B) (easily seen at $\times 100$ under compound microscope); tubercles longer around micropyle, arranged in circular pattern, amongst which are

very small, blunt tubercles (Figs 14C, D); egg shell with circular cap at very anterior end and dorsal, longitudinal fissure restricted to anterior 1/3 (Fig. 16A).

Distribution and bionomics. *S.nudicolis* is known from Ontario to Newfoundland, south to Tennessee and Georgia (Fig. 17C). The southern localities are restricted to the Appalachian Mountains and probably reflect the cool, wet habitat of this species. Adults have been collected from 23 May to 30 July, but seem most common, at least in southern Ontario and Quebec and the northeastern states, from mid June to mid July.

We collected adults of this species in moist deciduous or mixed deciduous–coniferous woods, always in the presence of small running seeps or streams. In some but not all instances these waters led to wet meadows or fens.

We made some observations on male adult behaviour at the type locality, 33.5 km S Ashland, Maine. At this place the vegetation had been recently cut and trees and shrubs were only about 2–3 m high. We were able to collect males from the very tops of small *Abies balsamea*. Sampling at regular intervals led to repeated collections, indicating that the males were actively seeking out these sites. In general, we were able to collect mostly females of *S.nudicolis* and these observations of tree topping may indicate that the males were scarce in collections because they swarm, or at least congregate, at the apices of tree tops where we, and most other collectors, have been unable to collect at most sites.

We were able to observe on two separate occasions female avoidance behaviour. We initially found each of two females hanging on the underside of leaves about 1 m above the ground. Upon being slowly approached to a distance of about 50 cm, each of these females dropped to the ground. Net collected specimens of this and of every other Nearctic species we collected, exhibited a similar behaviour of dropping to the net bottom when disturbed.

The eggs and first instar larvae of *S.nudicolis* were obtained by decapitating field caught females and placing these in petri dishes on a shallow layer of agar. Eggs from such females were laid at the rate of 12–16 per minute with some laid in a group and abutting laterally, while others were scattered on the agar. Fertile eggs were dark brown, while non-fertilized (i.e.

those which failed to develop) were pale or pale brown. Larvae hatched about 12–15 days after eggs were laid on agar plates and held at about 20°C. Emerging first instars were very active, moving with a slow snake-like motion characteristic of many other ceratopogonid larvae. We introduced nematodes (as described in Materials and Methods) but, in spite of observing one larva feeding, failed to rear these to even the second instar.

Taxonomic discussion. Wirth (1952: 206, 1965) identified members of *S.nudicolis* as *S.femorata*.

Types. Holotype, ♂ adult on microscope slide, labelled 'Holotype *Serromyia nudicolis* Borkent, CNC No. 20126, ♂, Maine, 33.5 km S Ashland CD587, 2-VII-1986, A. Borkent' (CNCI); allotype on microscope slide labelled as for holotype (CNCI); paratypes: 11 ♂, 17 ♀, 2 first instar larvae, 1 egg, 1 egg shell labelled as for holotype (CNCI, USNM); CANADA: 7 ♀, Ontario, Iroquois Falls, various dates ranging 18.vi–7.vii.1987 (CNCI); 1 ♀, Ontario, Black Lake, 15 km SW Lanark, 23.vi.1975 (CNCI); 1 ♀, Ontario, Algonquin Park, 8.vi.1960 (USNM); 2 ♀, 2 first instar larvae, 13 egg shells, Ontario, 10 km SW Richmond, 17.vi.1987 (CNCI); 8 ♀, Ontario, Ottawa, 17.vi.1946, 19.vi.1946, 8.vi.1951, 25.vi.1964, 23.vi.1980 (CNCI); 2 ♀, Ontario, Waubamik, 14.vi.1915 (USNM); 1 ♀, Ontario, Finland, 17.vii.1960 (CNCI); 3 ♀, Ontario, Maynooth, 19.vi.1953 (CNCI); 1 ♀, Ontario, Midland, 30.vii.1956 (CNCI); 1 ♀, Quebec, Mistassini, 12.vii.1956 (CNCI); 2 ♀, Quebec, Beechgrove, 7.vi.1955, 29.vi.1962 (CNCI); 2 ♀, Quebec, Gatineau Park, Black Lake, 27.vi.1985, 9.vii.1985 (CNCI); 4 ♀, Quebec, Gatineau Park, Bourgeois Lake, 11.vi.1987 (CNCI); 9 ♀, 1 first instar larva, 6 egg shells, Quebec, 5 km W Old Chelsea, 10.vi.1987 (CNCI); 5 ♀, Quebec, Old Chelsea, 21.vi.1959, 16.vi.1961, 8.vi.1964 (CNCI); 1 ♀, Quebec, Kam. Co., Parke Reserve, [32 km S Riviere du Loup], 4.vii.1957 (CNCI); 2 ♀, Quebec, Meach Lake, 21.vi.1916, 5.vii.1916 (CUIC); 1 ♂, 6 ♀, New Brunswick, Kouchibouguac National Park, vii.1977, 9–11.vii.1977, 11–12.vii.1978 (CNCI); 3 ♀, Nova Scotia, Cape Breton Highlands National Park, North Mountain, 1–4.ii.1983 (CNCI); 1 ♀, Newfoundland, mountains east of Codroy, 19–22.vii.1905 (MCZC); 1 ♀, Terra Nova National Park, Newfoundland, 6.vii.1961

(USNM); U.S.A.: 6♀, Wisconsin, Washburn Co., 20–21.vi.1953 (USNM); 2♀, Michigan, Gladwin Co., 14.vi.1958, 19.vi.1943 (USNM); 1♀, Michigan, Kalkaska Co., 23.vi.1951 (USNM); 1♀, Michigan, Livingston Co., E.S. George Reserve, 4.vi.1950 (USNM); 1♀, Michigan, Saginaw Co., 9.vi.1952 (USNM); 1♀, Michigan, Alpena Co., 4.vii.1941 (USNM); 2♀, Michigan, Wexford Co., 14.vi.1952 (USNM); 10♀, Michigan, Crawford Co., 17.vi.1951, 21.vi.1953 (USNM); 5♀, Michigan, Cheboygan Co., 4.vii.1953 (USNM); 3♀, Michigan, Midland Co., 14.vi.1952, 16.vi.1952 (USNM); 1♀, New York, Caroline-Harford, 15.vi.1904 (CUIC); 12♀, New York, Tompkins Co., Ringwood Reservoir, 16–17.vi.1963 (USNM); 3♀, New York, Orleans Co., Albion, 11.vi.1963 (USNM); 5♀, New York, St Lawrence Co., Cranberry L., 25.vi.1963 (USNM); 4♀, New York, St Lawrence Co., Benson Mines, 25.vi.1963 (USNM); 7♂, 14♀, New York, Lewis Co., Whetstone Gulf, 20–23.vi.1963 (USNM); 1♀, New York, North Beach, L.I., 30.v.1930 (MCZC); 1♀, New York, Slaterville [nr Candor], 13.vi.1904 (INHS); 2♂, 12♀, 1 first instar larva, 14 egg shells, Vermont, 5 km E Danby, 25–26.vi.1986 (CNCI, INHS, USNM, RYSC, NHMW); 1♀, New Hampshire, Third Connecticut Lake [10 km N Idlewild], 9.vii.1952 (USNM); 1♂, New Hampshire, Franconia (AMNH); 7♀, Maine, 14 km NW Camden, 1.vii.1986 (CNCI, RYSC); 1♀, Maine, Katahdin, 4.v.1959 (USNM); 1♀, Connecticut, Redding, 27.v.1933 (USNM); 1♀, Pennsylvania, Centre Co., Pine Grove Mills, 16.vi.1975 (CASC); 1♀, Pennsylvania, Centre Co., 4.vii.1972 (CASC); 1♀, Massachusetts, Burgess, 15.vi.1876 (USNM); 4♂, 4♀, Massachusetts, Holliston 26.v, 9.vi.1956 (MCZC, USNM); 1♀, West Virginia, Cranberry Glades [= 23 km E Richwood], 4.vi.1955 (USNM); 1♀, Tennessee, Gatlinburg, 29.vi.1947 (USNM); 1♂, 6♀, North Carolina, Highlands, 23.v.1957, 29.v.1957 (CNCI); 1♀ Georgia, Unicoi State Park (nr Helen), 17.v.1979 (CNCI).

Derivation of specific epithet. The name *nudicolis* (nude, penis) refers to the aedeagus which lacks side prongs.

***Serromyia sierrensis* Borkent sp.n.**

Diagnosis. Male: only Nearctic species with

mid femur yellow with apical portion more darkly pigmented and scutum lacking pruinosity. Female: only Nearctic species with fore and mid tibiae dark brown and with an elongated, single hind claw with the claw longer than Ta_5 .

Description. Male adult. Descriptive statistics: see Tables 2–6.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus dark brown.

Thorax: dark brown; scutum bare of pruinosity.

Legs: coloration pattern as indicated in Fig. 2F; strong bristles of femora, tibiae distributed as follows: one anteroapically on fore femur, one anteriorly, one posteriorly on mid femur, ventrally on hind femur, dorsally on hind tibia; ventral bristles on hind femur arising from slightly developed tubercles; hind Ta_1 straight; Ta_4 setae straight or with slight curve.

Wing: slightly infuscated with veins of cells r_1 , r_{2+3} darkly pigmented.

Abdomen: dark brown.

Genitalia: broken from specimen, lost.

Female adult. Descriptive statistics: see Tables 8–13. Similar to male except for usual sex differences and as follows:

Head: mandible serrate.

Legs: coloration pattern as indicated in Fig. 4F; strong bristles of femora, tibiae distributed as follows: single bristle at apex of mid tibia, ventrally on hind femur; claw of hind leg single, elongate, with basal tooth.

Wing: slightly infuscated with veins of cells r_1 , r_{23} darkly pigmented; a few macrotrichia restricted to apical margin.

Genitalia (as in Fig. 12D): sternite 9 truncate medially to somewhat truncate but with anteromedial margin developed, pointed; two spermathecae, additional spermathecal duct terminating in pigmented apex.

Distribution and bionomics. *S.sierrensis* is known only from the Sierra Nevada of California (Fig. 17D). Adults have been collected from 2 June to 3 July.

Taxonomic discussion. This is the only species described as new in which the holotype is a female. The single male was missing its genitalia, and although we are confident that it is correctly associated with the two females, we are reluctant to designate such a damaged specimen as the holotype.

The male of *S.sierrensis* has an unusually high

antennal ratio and this feature, once more material becomes available, may prove to be distinctive, at least within the western Nearctic.

CASC provides type numbers for all its holotypes and has assigned *S. sierrensis* no.16472.

Types. Holotype, ♀ adult on microscope slide, labelled 'Holotype *Serromyia sierrensis* Borkent, ♀, CAL [California] Placer Co., E. end Bear Val., 2-VI-1964, P.H. Arnaud, Jr.', '*Serromyia barberi* Det. W. Wirth, '76', (CASC); allotype ♂ on microscope slide. U.S.A: Cal., Nevada Co., Sagehen Creek, 26.vi.1974 (CASC); paratype: 1♀, Cal., Sierra Co., Webber Lake, 3.vii.1964 (CASC).

Derivation of specific epithet. The name *sierrensis* refers to the type locality in the Sierra Nevada of California.

***Serromyia vockerothi* Borkent sp.n.**

Diagnosis. Male: only Nearctic species with mid femur yellow and pigmented only apically, with strong bristles on fore femur (at least present anteriorly and posteriorly) and with scutum pruinose. Female: only Nearctic species with a ratio of antennal flagellomeres $8/9 = 0.59-0.60$ and an elongate, single hind claw about the same length as Ta_5 .

Description. Male adult. Descriptive statistics: see Tables 2-7.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus dark brown.

Thorax: dark brown; scutum pruinose.

Legs: coloration pattern as indicated in Fig. 3A; strong bristles of femora, tibiae distributed as follows: anteriorly, posteriorly on fore femur, present or absent ventrally on fore femur, posteriorly on fore tibia, present or absent anteriorly, dorsally on fore tibia, anteriorly, ventrally, posteriorly on mid femur, posteriorly on mid tibia, present or absent on mid tibia, anteriorly, ventrally on hind femur, present or absent posteriorly on hind femur, dorsally on hind tibia; ventral bristles on hind femur arising from slightly developed tubercles; hind Ta_1 straight or with slight basal curvature; Ta_4 setae straight or with slight curve.

Wing: slightly infuscated with veins of cells r_1 , r_{2+3} darkly pigmented.

Abdomen: dark brown.

Genitalia (Fig. 8C): gonostylus with outer margin evenly curved, tapering gradually for

basal half, with rounded or somewhat pointed apex; paramere (Fig. 8B) with apical half sausage shaped (sometimes somewhat shrivelled), apex rounded; aedeagus (Fig. 8A) with lateral prongs directed posterolaterally, somewhat reduced in some, distal portion a simple, slender projection, markedly longer than lateral prongs, extreme apex directed ventrally.

Female adult. Descriptive statistics: see Tables 8-13. Similar to male except for usual sex differences and as follows:

Head: mandible serrate.

Legs: coloration pattern as indicated in Fig. 5B; strong bristles of femora, tibiae distributed as follows: absent or 1 present on fore femur, 1 present apically on mid tibia, ventrally on hind femur; claw of hind leg single, elongate, with basal tooth.

Wing: a few macrotrichia restricted to apical margin.

Genitalia (as in Fig. 12D): sternite 9 somewhat truncate medially but with anteromedial margin developed, pointed; two spermathecae, additional spermathecal duct terminating in pigmented apex.

Distribution and bionomics. *S. vockerothi* is known from Alberta to southern Quebec and from one locality in Minnesota (Fig. 17D). Adults have been collected from 4 to 26 June. The holotype and allotype were collected near the margin of a shallow, small (i.e. 7-8 m by 2 m, woodland pool with thick moss and rich vegetation growing around its margin. The single female from 3.2 km N Nordegg was taken in a black spruce bog (habitat described more fully under *S. borealis*).

Taxonomic discussion. Although we are reasonably confident of the conspecificity of the three males and the allotype, we are less sure that the two female specimens from Alberta are accurately interpreted. It may be that they are actually members of *S. nudicolis* or of another undescribed species. Further collecting, especially of males in Alberta, is required.

The allotype is somewhat damaged and is missing all tarsomeres and flagellomeres 6-13. When first collected, this female was believed to be a specimen of *S. nudicolis* and was kept alive in the hopes of obtaining some eggs. Unfortunately, she died and was damaged before being properly preserved.

A male from Abbotsford, Quebec (11.vi.

1937, CNCI) may be a member of this species but lacked the lateral prongs on the aedeagus. One of the paratypes of *S. vockerothi* had somewhat reduced lateral prongs, indicating that lack of lateral prongs may be within the variation of the species. Further material is required to determine whether the Abbotsford specimen is *S. vockerothi* or represents an undescribed species.

Types. Holotype, ♂ adult on microscope slide, labelled 'Holotype *Serromyia vockerothi* Borkent CNC No. 20127, ♂, 10 km S Victoria Beach, Manitoba, 18.VI.1985, A. Borkent CD368', allotype ♀ on microscope slide labelled as for holotype (CNCI); paratypes: CANADA: 1♂, Quebec, Mt. St. Hilaire, 500–700 ft, 4.vi.1963 (CNCI); 1♀, Alberta, Edmonton, 1932 (CASC); 1♀, Alberta, 3.2 km N Nordegg (Wagner Bog), 28.vi.1985 (CNCI); U.S.A.: 1♂, Minnesota, Itasca Park [30 km N Park Rapids], 17.vi.1938 (USNM).

Derivation of specific epithet. The name *vockerothi* is proposed in appreciation of our friend and colleague Dr J. Richard Vockeroth. His outstanding collecting efforts in all the Diptera are reflected in this study. He collected specimens of nearly every Nearctic *Serromyia* species (including this one) as well as important series of *S. femorata*, *S. ledicola* and *S. morio* from Europe. In addition, his unstinting willingness to share his vast knowledge of Diptera, his knowledge of the literature and location of often difficult to find museum specimens added immeasurably to this study.

***Serromyia ledicola* Kieffer**

Serromyia ledicola Kieffer 1925a: 156. Neotype, here designated, ♂ adult, on microscope slide, labelled 'Estonia Hiiumaa, H. Remm, 8–8–53, *Serromyia ledicola* K det. H. Remm, Neotype CNC No. 20129'. (CNCI). Remm 1969: 214 (in part).

Serromyia macronyx Goetghebuer 1933: 355. Lectotype, here designated, ♂ adult, pinned but subsequently mounted on microscope slide, labelled 'La Panne 7.9.33 M. Goetghebuer', 'R.I.Sc.N.B. 18.073 Coll et det., M. Goetghebuer', 'macronyx', 'Type Lectotype ♂ M. Goetghebuer. *Serromyia ledicola* Det. A. Borkent' (ISNB); paralectotype ♀ adult on microscope slide from type locality but

dated 1–17.ix.33 (ISNB).

Serromyia europaea Claesrier 1963: 61. Holotype, ♂ adult on microscope slide, labelled 'Autriche [Austria] Heiligenblut 10–VIII–1960 à la lumière *Serromyia europaea* Holotype ♂ 2356, *Serromyia ledicola* Det. A. Borkent' (MNHN).

Ceratopogon femoratus: authors, not Meigen. Staeger 1839: 598 (in part).

Zetterstedt 1838: 822 (in part), 1850: 3665 (in part). Coquillett 1900: 396.

Serromyia femorata: of authors not Meigen.

Wirth 1965: 136. Havelka 1976: 236 (in part).

Havelka & Caspers 1981: 30 (in part).

Diagnosis. Male: only Holarctic species with fore femur, at most, with a few ventral strong bristles, mid femur pigmented only at apex, scutum pruinose, and parameres with apical half markedly swollen and rounded (in Nearctic, only species with short aedeagus, L/W = 0.39–0.54). Female: only Holarctic species with palpus uniformly dark brown, fore and mid tibiae pigmented only apically, hind coxa with 0–4 lateral strong bristles, scutum pruinose, and an elongate, unequal hind claw with HC/Ta₅ = 1.07–1.49.

Description. Male adult. Descriptive statistics: see Tables 2–7.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus dark brown.

Thorax: dark brown; scutum pruinose.

Legs: coloration pattern as indicated in Figs 3B, C; strong bristles of femora, tibiae distributed as follows: present or absent ventrally on fore femur, present or absent anteriorly, ventrally, posteriorly on fore tibia, present or absent ventrally on mid femur, present or absent anteriorly, ventrally, posteriorly on mid tibia, ventrally on hind femur, dorsally on hind tibia; ventral bristles on hind femur arising from slightly developed tubercles; hind Ta₁ straight; Ta₄ setae straight or with slight curve.

Wing: pale or pale with veins of cells r₁, r₂₊₃ darkly pigmented.

Abdomen: dark brown.

Genitalia (Fig. 8F): gonostylus with outer margin evenly curved, tapering gently for basal half, with pointed apex; paramere (Fig. 8E) with apical half markedly swollen, apex rounded; aedeagus (Fig. 8D) with lateral prongs, directed posterolaterally, distal portion a simple, slender projection, about twice as

long as lateral prongs, extreme apex directed ventrally.

Female adult. Descriptive statistics: see Tables 8–13. Similar to male except for usual sex differences and as follows:

Head: mandible serrate.

Legs: coloration pattern as indicated in Figs 4E, 5C; strong bristles absent on femora, tibiae except ventrally on hind femur; claw of hind leg single, elongate, with basal tooth.

Wing: pale or pale with veins of cells r_1 , r_{2+3} light brown; a few to many macrotrichia restricted to apical margin.

Genitalia (as in Fig. 12D): sternite 9 truncate medially to somewhat truncate but with antero-medial margin developed, pointed; two spermathecae, additional spermathecal duct terminating in pigmented apex.

Distribution and bionomics. *S. ledicola* is known in Europe from Sweden and Estonia south to England and northern Italy and in North America from Alaska to Newfoundland south to Colorado and Virginia (Fig. 18A). Adults have been collected from 13 July to 6 November.

Remm (1973a) noted the presence of *S. ledicola* in Mongolia, collected at the end of July. We have not examined the specimens but the records are consistent with the conclusion that *S. ledicola* is a Holarctic species.

The two disjunct southern Nearctic records are from Gould, Colorado and Reddish Knob, Augusta Co., Virginia.

The collections from Alaska, particularly along the Aleutian Island chain, support the conclusion that *S. ledicola* is a Holarctic species. Although not yet recorded from the far eastern Palaearctic, it is certainly to be expected there.

The record of *S. femorata* (as *Ceratopogon femoratus*) from Popof Island, Alaska by Coquillett (1900) is actually of a specimen of *S. ledicola*.

The few available records of habitat indicate that this species is associated with boggy areas, sometimes in the vicinity of seeps or small streams but also in areas with only standing waters. Goetghebuer (1936b) suggested that this species (as *S. macronyx*) was restricted to eutrophic lentic habitats in southern Belgium.

S. ledicola is virtually unique in the Holarctic fauna in being a late season emerger. Although the overall emergence period is from 13 July to 6 November, the earlier records are from

localities with climatic extremes: Adak and Popof Islands in the Aleutians of Alaska and Lake McDonald, Montana (35 km NE Columbia Falls). If these are excluded, the earliest collection we examined in North America was from 1 August. The only other Nearctic species which overlaps with *S. ledicola* is *S. barberi* of which a few specimens have been collected as late as 11 August. In Europe a similar pattern is apparent. With the exception of a sample from Obergurgl, Tirol, Austria, taken near the foot of a glacier from 20 July to 3 September, the earliest sample was from 1 August. Only the sympatric Palaearctic species *S. femorata* and *S. morio* overlap temporally with late records of 14 and 16 August respectively. *S. mangrovi*, from the Sinai, has been recorded as late as 18–19 November.

Taxonomic discussion. We attempted to locate the Kieffer holotype female of *S. ledicola*, collected by A. Dampf, but failed. Considering that so many of Kieffer's types are known to have been lost or destroyed, it is likely that the type of *S. ledicola* is also gone. We have therefore designated a neotype from the same area from which the holotype was originally collected (Mavli bog on Dago [= Hiiumaa Island], Estonia [U.S.S.R.]).

North American workers have uniformly considered Nearctic material of this species (sometimes also including material of other species) as *S. femorata*. However, it is clear from examination of the type of *S. femorata* that this was a misinterpretation.

Remm (1981) provided the synonymy listed here and we have been able to partially confirm this through examination of the types of *S. macronyx* and *S. europaea*. He correctly states that the late flight period may be taken as evidence of the synonymy, even though as far as *S. europaea* is concerned, some *S. femoratus* and *S. morio* also fly into August. However, we have been unable to confirm that the holotype of *S. ledicola* was collected late in the season and correspondence with Dr Remm questioning him about this reached him after his untimely death. Regardless, the rather general description by Kieffer (1925a) does fit the concept of *S. ledicola* as presented here (female with long hind claw and yellow legs lacking spines) and we accept Remm's suggestion of *ledicola* being the oldest available name.

Goetghebuer (1933) noted that there were

three males and fifteen females in the type series of *S. macronyx* but we were only able to examine the single male and female noted above.

Remm (1969) provided a key to the *Serromyia* species in the European portion of the U.S.S.R. Based on specimens he sent to us, his concept of female *ledicola* included specimens of *S. morio*.

We have examined Zetterstedt's collections and found a male and female of this species in material identified as *S. femorata*. In addition, Zetterstedt (1850) mentioned that he had collected material in September, which can only refer to *S. ledicola*.

One of the specimens identified by Staeger (in ZMUC) as *Ceratopogon femoratus* was in fact *S. ledicola*.

One of the paratypes of *S. europaea* (from Norway) (MNHN) is actually a male of *S. femorata*.

Material examined. 85 males and 109 females.

Derivation of specific epithet. The name *ledicola* (*Ledum* (labrador tea), dweller) probably refers to the boggy habitat of *S. ledicola*, where *Ledum* grows and from which Kieffer (1925a) recorded this species.

***Serromyia atra* (Meigen)**

Ceratopogon ater Meigen 1818: 84. Neotype, here designated, ♂ adult on microscope slide, labelled 'Ceratopogon ater Meigen, ♂, Serromyia atra Mg. H. Remm, Neotype, Latvia, Jumurda Lake [10 km E. Ergli], E. Remm, 21-6-67 CNC No. 20130 Serromyia atra Det. A. Borkent' (CNCI).

Prionomyia atra: Stephens 1829: 238.

Ceratolophus ater: Kertész 1902: 157.

Serromyia ater: Kieffer 1906: 65.

Serromyia atra: Kieffer 1919: 74.

Serromyia micronyx Kieffer 1919: 70. Neotype, here designated, ♂ adult on microscope slide, labelled 'Serromyia micronyx Kieffer, Neotype, ♂, 1967.V.16, leg. Mihályi, Kiskomarom [15 km. W. Marcali], Hungary, erdo, Serromyia atra Det. A. Borkent' (HNHM). **New synonym.**

Serromyia albitarsis Kieffer 1919: 71. Neotype, here designated, ♂ adult, labelled 'Serromyia albitarsis Kieffer, Neotype, 1965.V.19, leg. Mihályi, Ocsa, Hungary, laprét, Serromyia

atra Det. A. Borkent' (HNHM).

Serromyia spinosipes Kieffer 1919:72. Lectotype, here designated, ♂ adult on microscope slide, labelled 'spinosipes typus [in red] Kieff. det. Kieffer, ♂, Budapest Kertész, Purchd. from Budapest Mus. B.M. 1922-72. Lectotype, Serromyia atra Det. A. Borkent, Return to Brit. Mus. (N.H.)' (BMNH); paralectotype ♀ adult labelled as for lectotype but identified as *Serromyia morio* (BMNH). **New synonym.** *Serromyia nitens* Goetghebuer 1920: 73. Lectotype, here designated, ♂ adult on microscope slide, labelled 'Wemmel [just north of Brussels, Belgium], 4-6-18 [June 4, 1918], R.I.Sc.N.B. 18.073 Coll. et det., M. Goetghebuer, nitens Goetghe., Lectotype, ♂, Serromyia atra Det. A. Borkent' (ISNB); paralectotype: ♀ labelled as for lectotype but date probably incorrectly given as 4 June 1917 (ISNB). **New synonym.**

Diagnosis. Male: only Palaearctic species with fore femur with only one longitudinal, ventral row of strong bristles plus 0-2 strong bristles anteriorly, and with the prongs on the aedeagus directed anterolaterally. Female: only Palaearctic species with equal hind claws and a scutum bare of pruinosity.

Description. *Male adult.* Descriptive statistics: see Tables 2-7.

Head: dark brown; antennal flagellomere 10 with plume arranged in more than one whorl; palpus dark brown.

Thorax: dark brown; scutum bare of pruinosity.

Legs: coloration pattern as indicated in Fig. 3D; strong bristles of femora, tibiae distributed as follows: ventrally on fore femur, one bristle present or absent anteriorly on fore femur, ventrally on mid femur, present or absent anteriorly, posteriorly on mid femur, 0-3 bristles anteriorly on hind femur, ventrally on hind femur, dorsally on hind tibia; ventral bristles on hind femur arising from slightly developed tubercles; hind Ta₁ with slight basal curvature; Ta₄ setae straight or with slight curve.

Wing: slightly infuscated with veins of cells r₁, r₂₊₃ darkly pigmented.

Abdomen: dark brown.

Genitalia (as in Fig. 10C): gonostylus with outer margin evenly curved, tapering gradually for basal half, with somewhat pointed to swollen, rounded apex; paramere (as in Fig. 10B) with apical half markedly swollen, apex