

The Caddisfly Genus *Setodes* in North America (Trichoptera: Leptoceridae)¹

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ABSTRACT: Males and females of 2 new species of *Setodes* (Trichoptera: Leptoceridae) from the Coastal Plain of the southeastern United States are described and illustrated: *Setodes dixiensis* n. sp. from Alabama, Louisiana and Mississippi and *S. arenatus* n. sp. from South Carolina. The taxonomy of the other 6 North American species in the genus is reviewed. *S. autumnalis* Banks is a synonym of *S. incertus* (Walker). *S. floridanus* Banks is a species of *Oecetis* Mac Lachlan. Illustrations and a key to the males and females of the Nearctic species are presented.

During the course of a survey of the caddisflies of Louisiana and Mississippi a new species of *Setodes* was collected along drainages of the Gulf Coastal Plain. It was subsequently collected in Alabama by Dr. Steven C. Harris. A second new species was discovered from the Sandhills region of South Carolina, also in the Coastal Plain, by Dr. John C. Morse and his colleagues at Clemson University. These 2 Coastal Plain species are far removed from the main range of the genus in North America and are situated in habitat not considered characteristic of its species heretofore.

Examination of distribution records of the 6 previously known Nearctic species, *S. epicampes* Edwards, *S. guttatus* (Banks), *S. incertus* (Walker), *S. oligius* (Ross), *S. oxapius* (Ross), and *S. stehri* (Ross) indicated that members of the genus occur across the northeastern and central parts of the continent, the Ozark Uplands, and the southern Appalachians (Figs. 1, 2). Information on the biology of the genus provided by Merrill and Wiggins (1971) suggested that *Setodes* spp. inhabit cool, running waters. These authors collected larvae from sandy deposits on the leeward sides of rocks in strong current. The discovery of the 2 new species from the Coastal Plain and its associated warmer, slower flowing streams was indeed surprising and prompted an investigation into the systematics and distribution of this genus in North America.

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Complete bibliographies, including synonyms, for publications which appeared before 1961 were given by Fischer (1966, 1972). Only those with new synonyms and significant redescriptions are included here. Terminology for wing venation (Figs. 3, 4) follows Hamilton (1972) and Morse (1975) and, for genitalia, Schmid (1980) (except that the term "phallicata" is preferred here over the variously applied word "aedeagus"). Abbreviations for genitalic structures in Figs. 5-15 apply to the following terms: *a. p.* = bare acute mid-ventral projection of *inf.*, *ap. proj.* = apico-lateral projection of ♀ tergum IX, *atr.* = acrotergite, *fl.* = dorsal flange of phallicata, *inf.* = inferior appendage, *int.* = intermediate appendage, *par.* = lateral paramere, *pr.* = preanal appendage, *pro.* = protuberances of ♂ tergum X, *pt.* = midventral acute point of phallicata, *s. p.* = posterior sternal pockets of ♀ sternum VIII, *st. con.* = sternal concavities of ♀ sternum IX, *v.* = valve, *v. a.* = antero-ventral sclerotized projections of vaginal apparatus, *vent. proj.* = setose, baso-ventral projections of *inf.* A, B, and C in Figs. 5-19 are lateral, dorsal, and ventral views respectively.

Material was examined from the Clemson University Insect Museum (CU), the Illinois Natural History Survey (INHS), the Museum of Comparative Zoology, Harvard (MCZ), the United States National Museum (Natural History) (USNM), and personal collections. Types will be deposited in these institutions and also the Louisiana State University Collection (LSUC) and the Royal Ontario Museum (ROM) as indicated below.

Setodes Rambur

Setodes Rambur (1842:515). Genotype, by subsequent selection of Milne (1934:18): *Setodes punctella* Rambur = *Phryganea viridis* Fourcroy.

At least 23 extant species in this genus have been described from all continents except South America and Australia. This number will assuredly increase with the correct generic placement of the many species listed by Fischer (1966, 1972) under "*Setodes* or *Leptocerus*."

In North American *Setodes* spp. the wings are golden brown and covered with silvery white spots. In the forewing M is present and forked, the fork occurs beyond m-cu, and S₄ and M_A are fused (Fig. 3). In the narrow hindwing the costal border forms a fairly conspicuous angle and the convex posterior border has a fringe of long setae (Fig. 4). Also in the hindwing the stem of S is absent and, as in *Ceraclea (Pseudoleptocerus)* spp. and *Leptocerus* spp., the usual first fork of S branches beyond the fork of S₄, leaving a wide space behind R. The head has a long, distinct epicranial stem, indistinct lateral sutures, and a small dorsal triangle (Ross, 1944, fig. 737).

Males of the 8 North American species can be distinguished by the shapes of the inferior appendages and phallus, and especially by the presence or

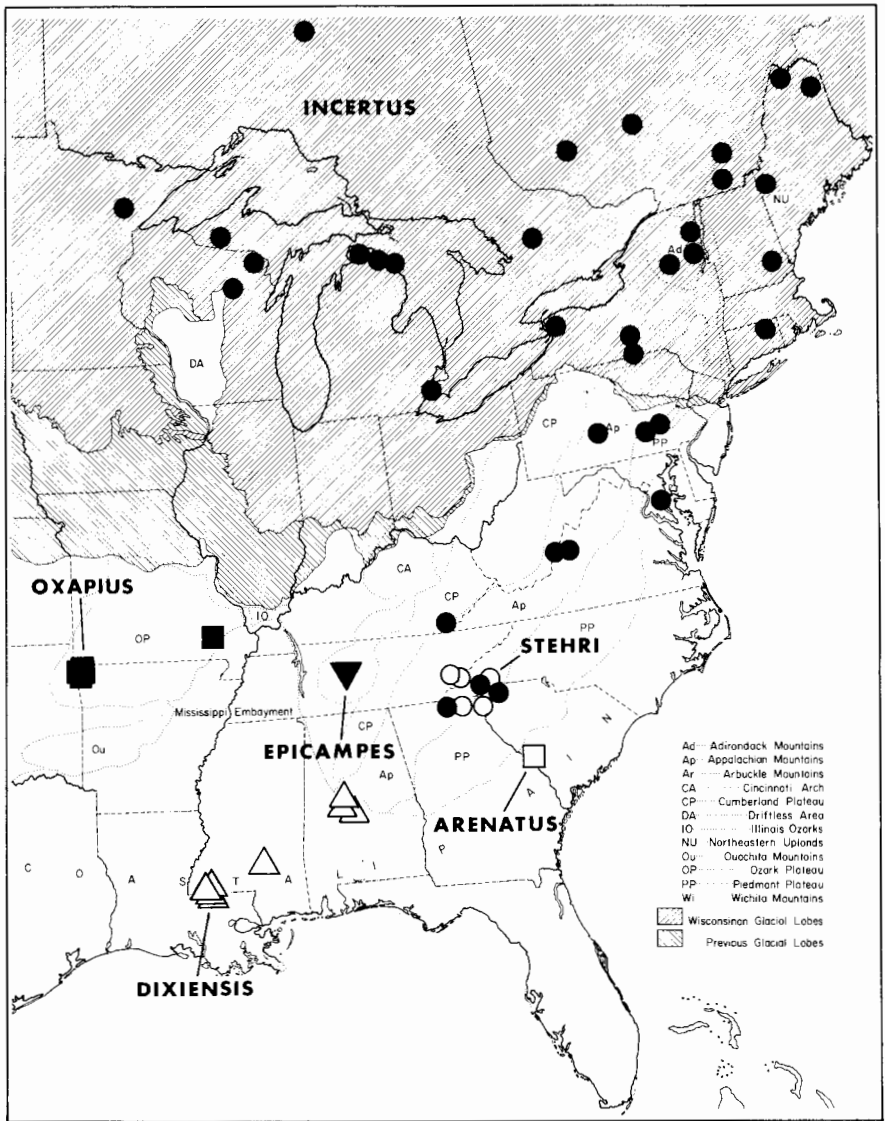


Fig. 1. Distribution of *Setodes arenatus* n. sp.—□, *S. dixiensis* n. sp.—△, *S. epicampes* Edwards—▼, *S. incertus* (Walker)—●, *S. oxapius* (Ross)—■, and *S. stehri* (Ross)—○.

absence of the preanal appendages and the shapes of the intermediate appendages. Females are distinguishable by the shapes and sizes of segment IX, the valves, and tergum X; and by the presence or absence of sclerotized projections of the vaginal apparatus.

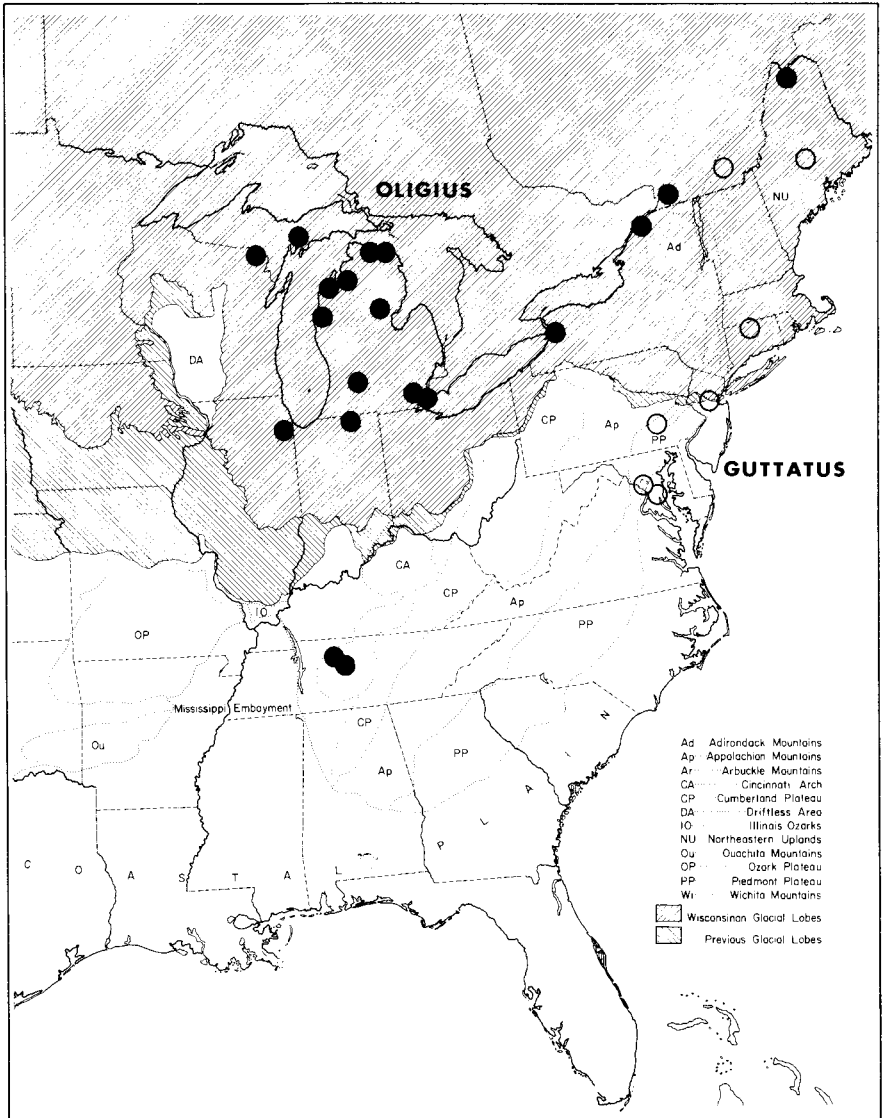


Fig. 2. Distribution of *Setodes guttatus* (Banks)—○, and *S. oligius* (Ross)—●.

Merrill and Wiggins (1971) described the immature stages of *S. incertus* and the larva of a second form, from the South Carolina mountains, which they referred to as *Setodes* sp. This form almost certainly represents the larva of *Setodes stehri* (Unzicker et al., in press).

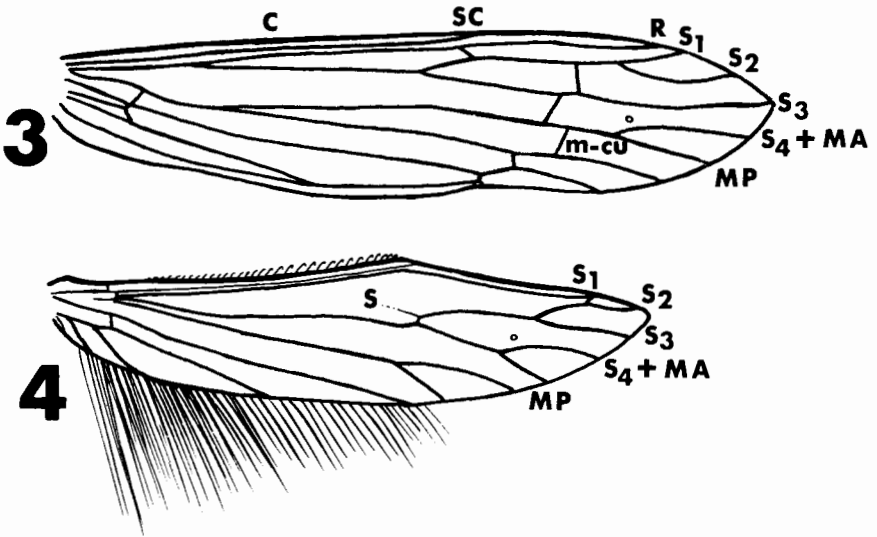


Fig. 3. *Setodes dixiensis* n. sp., male forewing.
 Fig. 4. *Setodes dixiensis* n. sp., male hindwing.

Setodes arenatus n. sp.
 Figures 5, 6

This is the most primitive member of the group of species in which the males possess lyrate preanal appendages. The male is easily separated from most other species by the phallus, which is almost identical to that of *S. epicampes* Edwards, and by the long, curved, bifid intermediate appendages. In the female the antero-ventral sclerotized projections of the vaginal apparatus are lacking.

MALE: Size 6.0 mm. Color and structure typical for genus.

Genitalia as in Fig. 5. Segment IX heavily sclerotized and annular, broad ventrally, narrow dorsally and fused with tergum X. Tergum X divided into 4 processes: one pair of lyrate preanal appendages (*pr.*) covered with short, appressed setae and one pair of intermediate appendages (*int.*). Intermediate appendages long and curved upwards in lateral view, slender and straight in dorsal view, tips bifid. Inferior appendages (*inf.*) long, falcate and covered with long setae on inner surfaces and tips; bases fused; each with large, bare mid-ventral acute projection (*a. p.*) present on inner basal face and acute projection on lower ventral edge. Phallic apparatus arched in lateral view, phallicata with prominent dorsal flanges (*fl.*), lateral parameres (*par.*) short.

FEMALE: Size 6.5 mm. Color and structure typical for genus.

Genitalia as in Fig. 6. Sternum VIII with pair of posterior, invaginated pockets (*s. p.*). Segment IX long, tubular and sclerotized. Sternum IX with

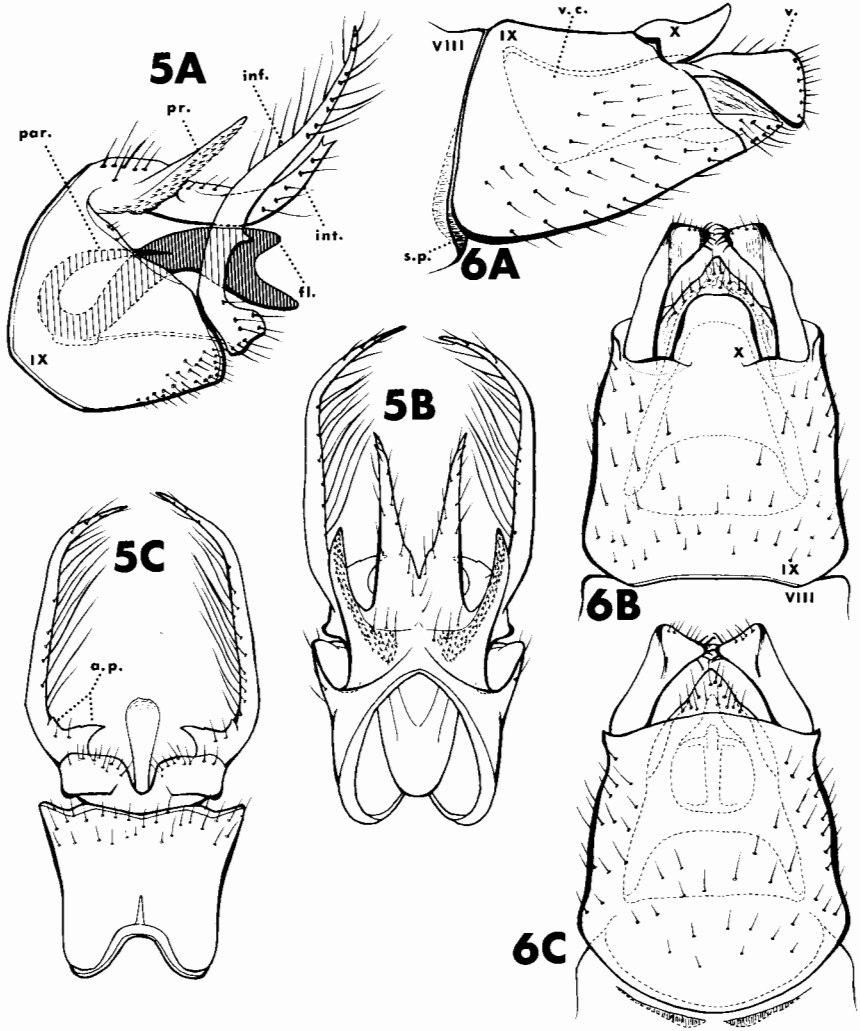


Fig. 5. *Setodes arenatus* n. sp., male genitalia (from Holotype).

Fig. 6. *Setodes arenatus* n. sp., female genitalia (from Paratype).

apico-lateral corners acute. Tergum X broad, somewhat truncate in dorsal view. Valves (v.) triangular in lateral view; heavy, hooked setae present on lower inner apical corners. Antero-ventral sclerotized projections of vaginal apparatus absent.

HOLOTYPE: ♂, SOUTH CAROLINA: Aiken Co., Savannah River Plant, Upper Three Runs Creek at SRP road 8-1, 13 June 1977, col. D. Herlong, S. Prichard (USNM).

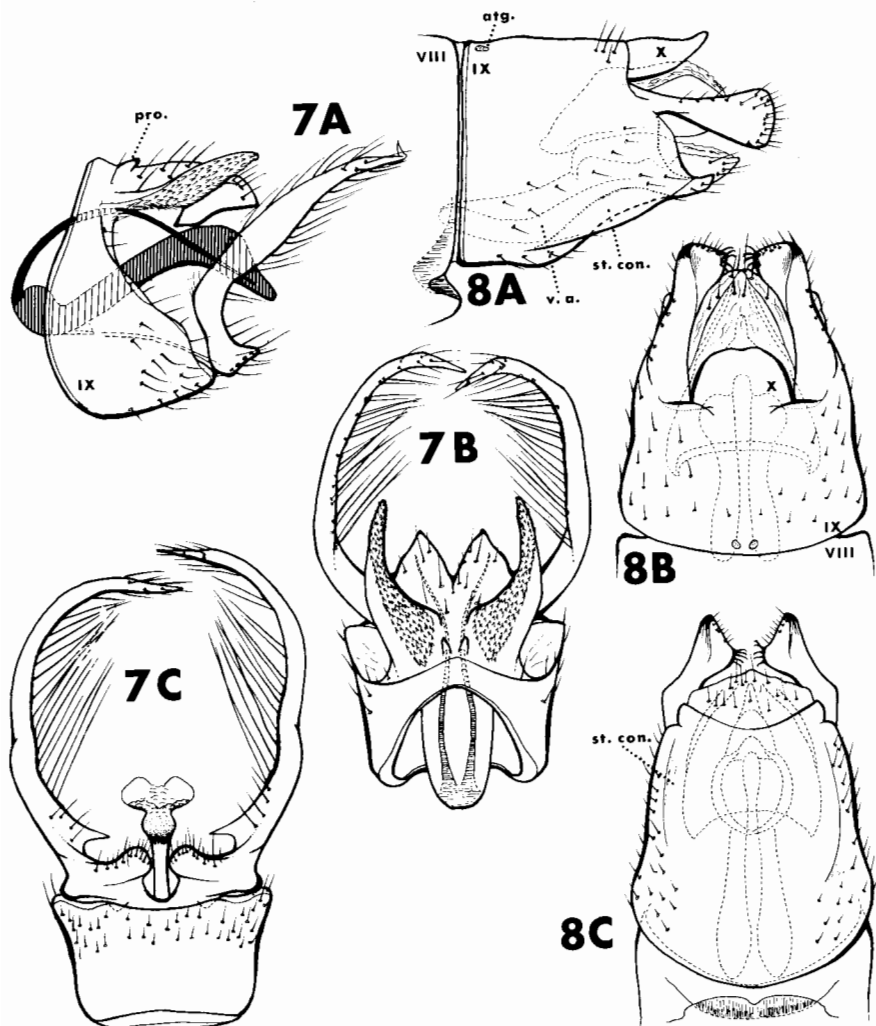


Fig. 7. *Setodes dixiensis* n. sp., male genitalia (from Holotype).

Fig. 8. *Setodes dixiensis* n. sp., female genitalia (from Paratype).

PARATYPES: Same data as holotype, 13 June 1977, 1 ♀ (USNM); same, 13 June 1977, 12 ♂, 116 ♀ (INHS); same, 4 September 1976, 11 ♂, 128 ♀ (USNM); same, 18 September 1976, 2 ♂, 1 ♀ (LSUC); same, 22 July 1977, 1 ♂ (MCZ); same, 28 June 1977, 1 ♂, 26 ♀ (MCZ); same, 8 July 1977, 1 ♂ (LSUC); same, 22 August 1977, 1 ♂, 2 ♀ (ROM); same, 11 June 1979, 5 ♀, col. R. Kelley, E. McEwan (ROM); same, 20 August 1979, 7 ♂, 11 ♀ (ROM); Aiken Co., South Fork Edisto River in Aiken State Park,

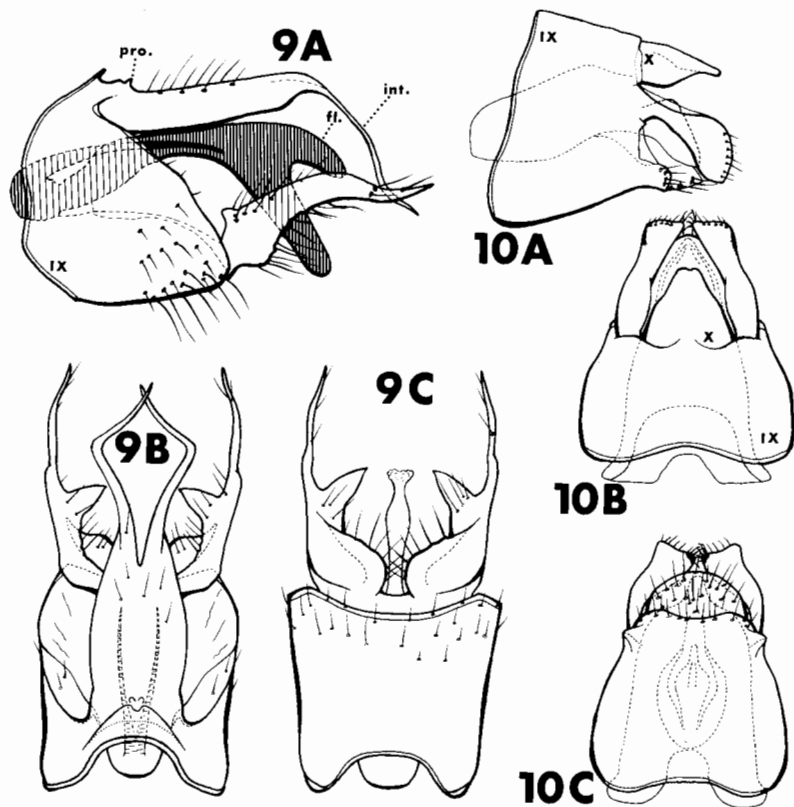


Fig. 9. *Setodes epicampes* Edwards, male genitalia (from Holotype).

Fig. 10. *Setodes epicampes* Edwards, female genitalia (from Paratype).

near Jackson, 3 June 1981, 4 ♂, 3 ♀, col. S. W. Hamilton, J. C. Morse (CU).

◆ **Etymology:** From the Latin *arenatus* meaning "with sand," in reference to the sandy bottomed streams of the Sandhills region of South Carolina with which the species is associated.

Setodes dixiensis n. sp.

Figures 3, 4, 7, 8

This species most closely resembles *S. oxapius* (Ross) but differs strikingly from that species in the shape of the intermediate appendages of the male and in the presence of a pair of concavities on sternum IX of the female.

MALE: Length 5.5 mm. Color and structure typical for genus.

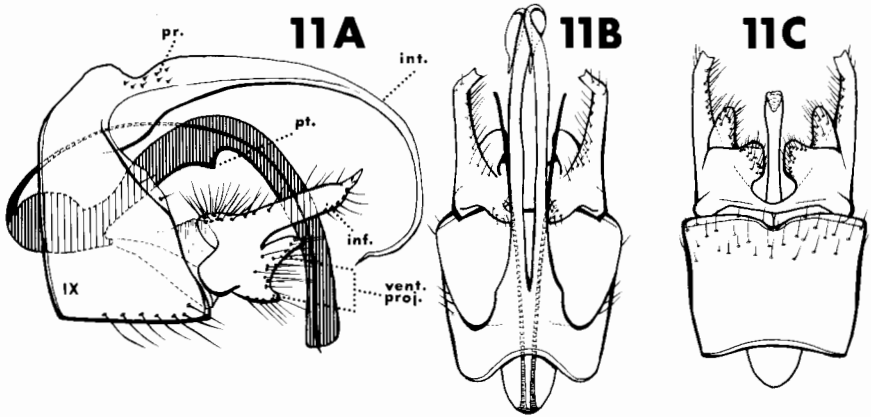


Fig. 11. *Setodes guttatus* (Banks), male genitalia (from Holotype).

Genitalia as in Fig. 7. Segment IX heavily sclerotized and annular, broad ventrally, narrow dorsally and fused with tergum X. Tergum X divided into 4 processes: one pair of lyrate preanal appendages covered with short, appressed setae and one pair of intermediate appendages. Intermediate appendages hatchet-shaped in lateral view, broadly triangular in dorsal view; shorter than preanal appendages. A pair of small protuberances (*pro.*) present at base of tergum X. Inferior appendages long, falcate and covered with long setae on inner surfaces and tips; bases fused and with pair of ventral thumb-like protuberances; large, bare, mid-ventral acute projection present on inner basal face. Phallicata in lateral view shaped like duck's head and phallus with pair of long, slender parameres.

FEMALE: Length 6.5 mm. Color and structure typical for genus.

Genitalia as in Fig. 8. Sternum VIII with pair of posterior, invaginated pockets, usually continuous across meson. Segment IX long, tubular and sclerotized. Pair of conspicuous concavities (*st. con.*) present on sternum IX, one on each side of mesal ridge formed by antero-ventral projections of vaginal apparatus (*v. a.*). Tergum X semicircular to subtruncate in dorsal view. Valves spatulate in lateral view; heavy, hooked setae present on inner apical faces. Antero-ventral sclerotized projections of vaginal apparatus (*v. a.*) present.

HOLOTYPE: ♂, MISSISSIPPI: Amite Co., West Fork Amite River at unmarked gravel road, 14.5 air km SSW Liberty, Sec. 27, R3E, T1N, 23 May 1979, col. R. W. Holzenthal (USNM).

PARATYPES: Same data as holotype, 2 ♂, 26 ♀ (USNM); MISSISSIPPI: Amite Co., East Fork Amite River at unmarked gravel road, 14.6 air km. S Liberty,

Sec. 27, R4E, T1N, 23 June 1979, 5 ♀, col. R. W. Holzenthal. (MCZ); Covington Co., Ocatoma Creek, 0.3 km W Sanford, 30 August 1979, 4 ♂, 4 ♀, col. R. W. Holzenthal (ROM); same, 30 August 1979, 2 ♂, 66 ♀ (INHS); LOUISIANA: East Feliciana Parish, confluence of East and West Prongs Amite River, 16.1 air km E Clinton, 6 August 1979, 1 ♂, 1 ♀, col. R. W. Holzenthal (LSUC); East Feliciana Parish, confluence of East and West Forks Amite River, 7.1 air km NNE Felixville, 5 August 1979, 2 ♂, 52 ♀, col. R. W. Holzenthal (CU); ALABAMA: Bibb Co., Cahaba River, upstream from Hwy. 29 bridge, 12 June 1981, 10 ♂, 1 ♀, col. S. C. Harris, P. O'Neil (USNM); Little Cahaba River, 0.8 km downstream from Bulldog Run, 12 June 1981, 15 ♂, col. S. C. Harris, P. O'Neil (INHS); Perry Co., Oakmulgee Creek at Hwy. 30 bridge, 15 June 1981, 2 ♂, col. S. C. Harris (CU).

◆ Etymology: The specific epithet *dixiensis* refers to that part of the southern United States where this species occurs.

Setodes epicampes Edwards

Figures 9, 10

Setodes epicampes Edwards, 1956, p. 3, figs. 1–5, ♂, ♀.

Apical half of intermediate appendages (*int.*) of male very slender, their tips bent inwards and crossing in dorsal view; pair of small protuberances (*pro.*) present at base; preanal appendages apparently absent. Inferior appendages relatively long; each with apical half very narrow in ventral view and with prominent, bare, mid-ventral, acute projection. Phallicata with dorsal flanges (*fl.*); parameres short.

Segment IX of female short. Tergum X triangular in dorsal view. Valves spatulate. Antero-ventral sclerotized projections of vaginal apparatus absent.

This species is known only from Davidson Co., Tennessee. I have examined the holotype and a male and female paratype.

Setodes guttatus (Banks)

Figure 11

Oecetina guttata Banks, 1900, p. 257.

Setodes guttatus, Flint, 1966, p. 382, fig. 4C, ♂.

Setodes oligius Schmid, 1980 (*nec* Ross, 1938a), p. 272, figs. 668–692, ♂, ♀.

Intermediate appendages (*int.*) of male very long and slender, gradually tapering their entire length; tips pointed. Preanal appendages (*pr.*) represented by patch of short setae. Inferior appendages (*inf.*) each with 2 setose, baso-ventral projections (*vent. proj.*). Phallicata with mid-ventral acute point (*pt.*). Lateral parameres very long and slender.

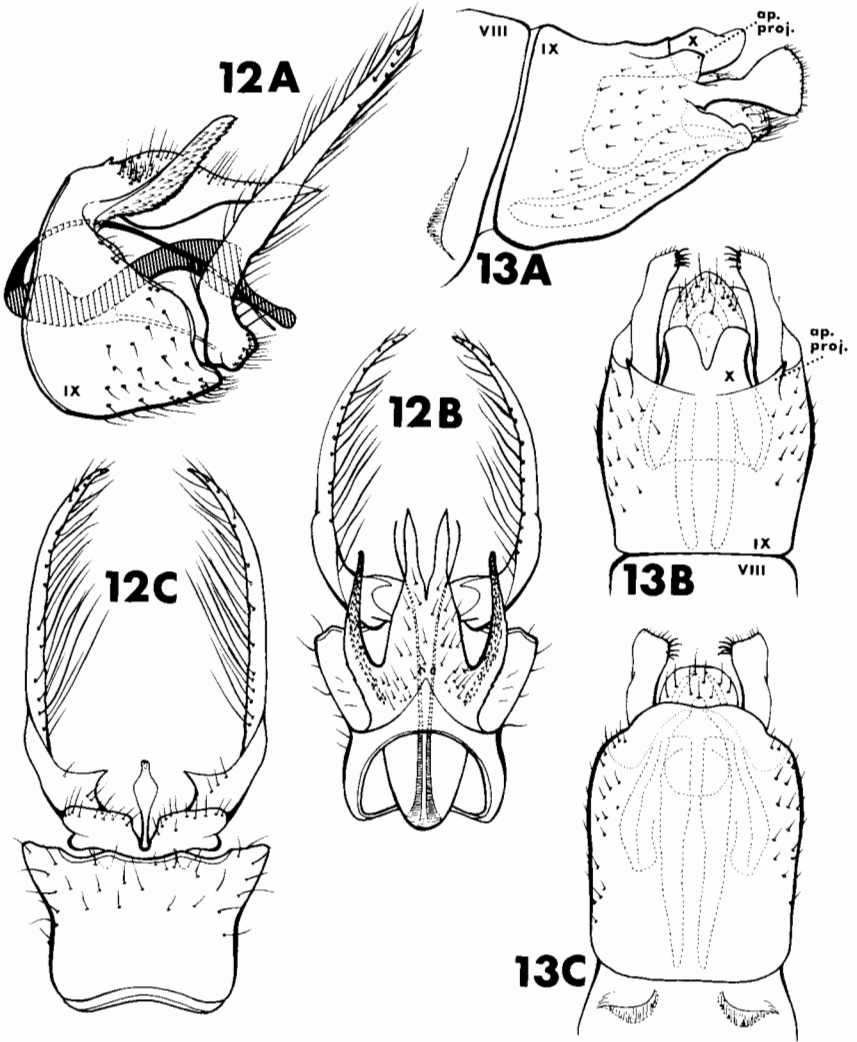


Fig. 12. *Setodes incertus* (Walker), male genitalia (specimen from North Carolina).

Fig. 13. *Setodes incertus* (Walker), female genitalia (specimen from North Carolina).

I have not seen females of this rare species which apparently is restricted to the Northeast. I have seen material from Connecticut, Maine, Maryland, New Jersey, Pennsylvania and Quebec. It is known also from the District of Columbia (Betten, 1934).

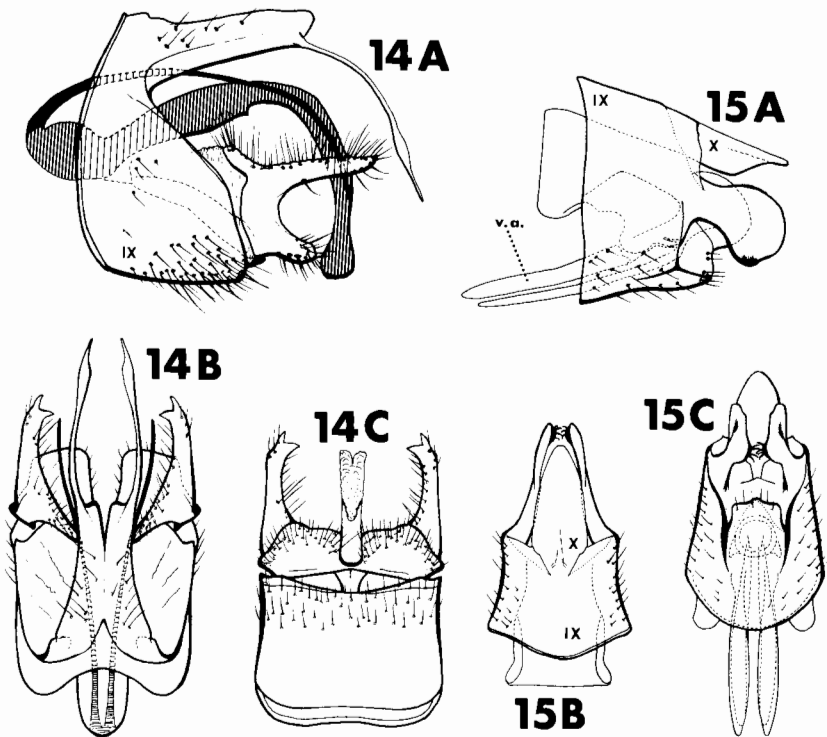


Fig. 14. *Setodes oligius* (Ross), male genitalia (specimen from Michigan).

Fig. 15. *Setodes oligius* (Ross), female genitalia (specimen from Michigan).

Setodes incertus (Walker)

Figures 12, 13

Leptocerus incertus Walker, 1852, p. 71.

Setodes vernalis Banks, 1907, p. 127, pl. 8, fig. 3, ♂. Ross, 1944 (syn. of *S. incerta*).

Setodes autumnalis Banks, 1907, p. 128, pl. 9, fig. 23 (the type is a ♀). NEW SYNONYM.

Setodes incerta, Ross, 1944, p. 302, figs. 737 (as *S. vernalis*), 872.

Setodes incerta, Merrill and Wiggins, 1971, p. 2, figs. 1-11, 13-14, larva, pupa, ♂, ♀.

Intermediate appendages of male long, straight and pointed; extending beyond tips of lyrate preanal appendages. A pair of small protuberances present at base of intermediate appendages.

Tergum X of female with deep emargination. Tergum IX with a pair of prominent, apico-lateral projections (*ap. proj.*).

This species is widespread across the central and northeastern parts of North America and extends down the Appalachian Mountains to Georgia and South Carolina. I have examined specimens from Connecticut, Georgia, Kentucky, Maine, Maryland, Michigan, New York, North Carolina, Ontario, Pennsylvania, Quebec, South Carolina, Virginia, and Wisconsin. It is known also from Minnesota (Etnier, 1965), New Hampshire (Morse and Blicke, 1953) and Tennessee (Etnier and Schuster, 1979).

Setodes oligius (Ross)

Figures 14, 15

Leptocerus oligius Ross, 1938a, p. 160, fig. 97, ♂, ♀.

Intermediate appendages of male very long, broad at base but suddenly narrowing at about $\frac{2}{5}$ their length to form pair of filamentous processes. Preanal appendages apparently absent. Inferior appendages each with only single, setose, baso-ventral projection.

Segment IX of female short, higher than wide and similar in dimension to VIII. Tergum X long and narrow in dorsal view. Valves disc-shaped; short, heavy, hooked setae present on inner, ventral faces. Antero-ventral sclerotized projections of vaginal apparatus (*v. a.*) present.

This species occurs in the northern and central part of the continent, as far south as Tennessee. Material was examined from Illinois, Indiana, Michigan and Ontario. *Setodes oligius* has also been reported from Maine (Blicke and Morse, 1966), New York (Betten, 1934), Quebec (Roy and Harper, 1979), Tennessee (Edwards, 1966) and Wisconsin (Hilsenhoff, 1980).

Setodes oxapius (Ross)

Figures 16, 17

Leptocerus oxapius Ross, 1938b, p. 88, pl. 1, fig. 1-1a, ♂.

Intermediate appendages of male bullet-shaped in lateral view; short, $\frac{1}{3}$ length of preanal appendages. Base of inferior appendages with large plate-like, setose projection; bare, mid-ventral acute projection lacking.

Female, described here for first time, with segment IX very long and tubular. Tergum X truncate dorsally. Antero-ventral sclerotized projections of vaginal apparatus very long and slender. Apico-lateral corners of sternum IX acute. Valves triangular in lateral view.

Setodes oxapius is apparently restricted in distribution to the Ozark Uplands. I have examined material from Arkansas and Missouri, the type material is from Oklahoma.

Setodes stehri (Ross)

Figures 18, 19

Leptocerus stehri Ross, 1941, p. 99, pl. 10, figs. 80-80C, ♂, ♀.

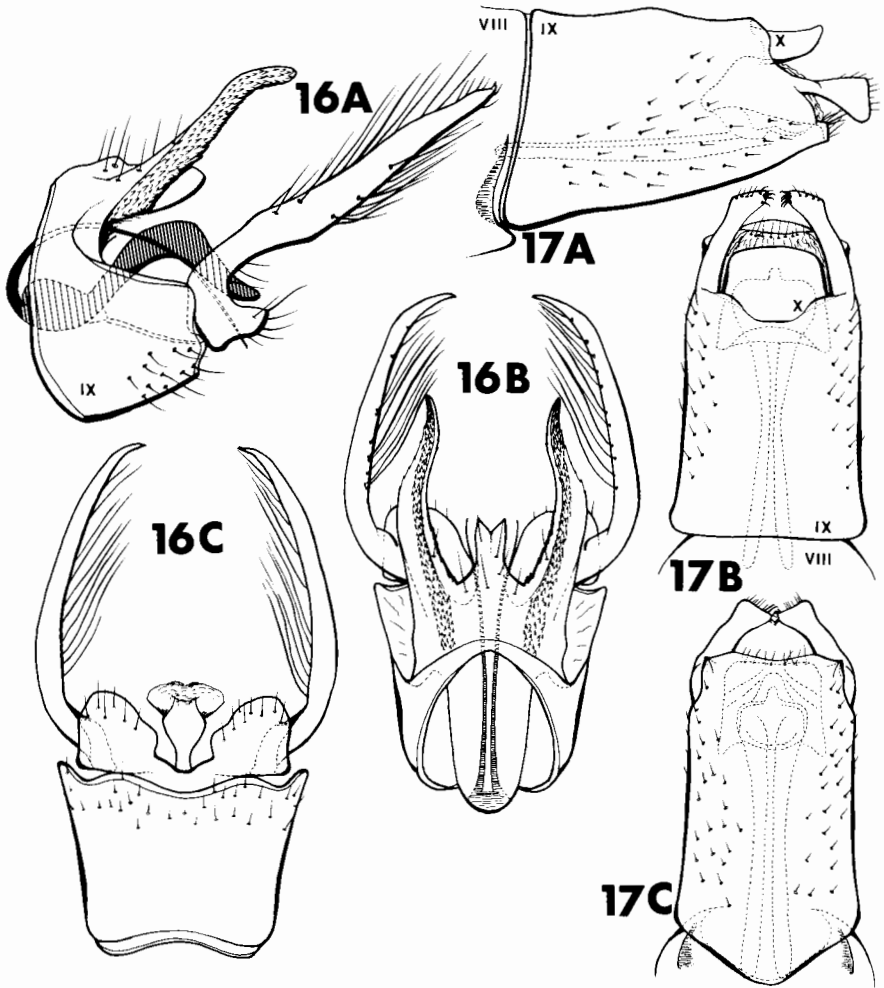


Fig. 16. *Setodes oxapius* (Ross), male genitalia (specimen from Arkansas).

Fig. 17. *Setodes oxapius* (Ross), female genitalia (specimen from Arkansas).

Intermediate appendages of male extending to tips of preanal appendages; narrow in dorsal view, foot-shaped in lateral view. A pair of small protuberances present at base of intermediate appendages.

Tergum X of female deeply emarginate in dorsal view. Apico-lateral projections of tergum IX lacking or only slightly developed; never as prominent as in *S. incertus*.

This species is endemic to the southern Appalachians. Specimens were

seen from Georgia and South Carolina. It is also known from North Carolina (Ross, 1941) and Tennessee (Etnier and Schuster, 1979).

Species Excluded

Setodes floridanus Banks

Setodes floridanus Banks, 1905, p. 19.

Leptocerus americanus (Banks, 1894); Milne, 1934, p. 19 (as *Ymymia*).

Setodes floridana Banks, 1905; Ross, 1944, p. 302 (unidentified ♀).

I have examined the female type of *Setodes floridanus* Banks and found it to be a species of *Oecetis* Mac Lachlan. Designating a new combination would make the name a secondary junior homonym of *Oecetis floridana* (Banks, 1899:216) (as *Oecetina floridana* = *Oecetis cinerascens* (Hagen)) and would require a new name if no available synonym exists. Further resolution of this problem is beyond the scope of this paper and should await a revision of North American *Oecetis* species.

Key to Males and Females of Nearctic *Setodes*

1. Genitalia with a pair of inferior appendages and with a phallus; males 2
 - Genitalia without inferior appendages and phallus, but with a pair of simple valves; females 9
2. Preanal appendages (*pr.*) lyrate and covered with short appressed setae (Figs. 5A, B) 3
 - Preanal appendages absent (Figs. 9A, 14A), or fused to intermediate appendages and represented only by a patch of short setae (Fig. 11A) 7
3. Intermediate appendages (*int.*) slender in dorsal view, extending to or beyond tips of preanal appendages (Figs. 5B, 12B, 18B) 4
 - Intermediate appendages broad and/or short in dorsal view, not as long as preanal appendages (Figs. 7B, 16B) 6
4. Intermediate appendages long and curved upwards in lateral view, tips bifid; phallicata with a prominent dorsal flange (*fl.*); lateral parameres (*par.*) short (Fig. 5) *S. arenatus* n. sp.
 - Intermediate appendages straight, their tips pointed (Fig. 12A) or slightly rounded (fig. 18A) in lateral view; dorsal flange of phallicata only slightly developed, lateral parameres very long and slender 5
5. Intermediate appendages narrow and pointed in lateral view, extending ½ times their length past preanal appendages (Fig. 12) ...
 - *S. incertus* (Walker)
 - Intermediate appendages short, foot-shaped in lateral view, extending to tips of preanal appendages (Fig. 18) *S. stehri* (Ross)
6. Intermediate appendages broad, hatchet-shaped in lateral view; in-

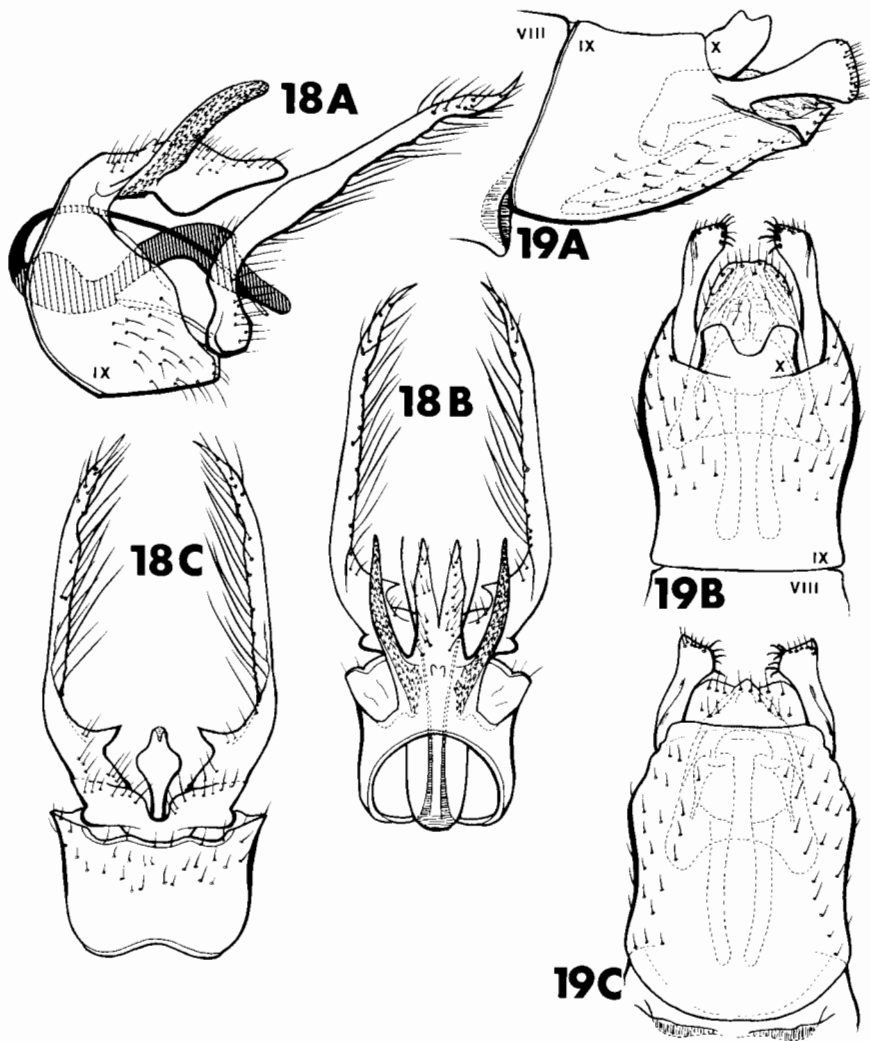


Fig. 18. *Setodes stehri* (Ross), male genitalia (from Holotype).

Fig. 19. *Setodes stehri* (Ross), female genitalia (from Allotype).

- ferior appendages with bare, mid-ventral acute projection (Fig. 7) *S. dixiensis* n. sp.
- Intermediate appendages very short, bullet-shaped in lateral view; inferior appendages without bare, mid-ventral acute projection (Fig. 16) *S. oxapius* (Ross)
- 7. Phallicata with a prominent dorsal flange (*fl.*) and without a mid-

- ventral acute point; parameres short; inferior appendages very narrow and pointed in ventral view and with a prominent, bare, mid-ventral acute projection (Fig. 9) *S. epicampes* Edwards
- Phallicata without a dorsal flange but with a mid-ventral point (*pt.*) (Fig. 11A); parameres very long and slender; inferior appendages (*inf.*) finger-shaped in ventral view, apical portion turned inwards and bifid, without a bare mid-ventral acute projection but with one or two setose, baso-ventral projections (*vent. proj.*) (Figs. 11A, C, 14C) 8
8. Intermediate appendages long and filamentous, gradually tapering their entire length; inferior appendages with two setose, baso-ventral projections (Fig. 11) *S. guttatus* (Banks)
- Intermediate appendages broad at base but suddenly narrowing at about $\frac{2}{5}$ their length to form a pair of filamentous processes; inferior appendages each with a single setose, baso-ventral projection (Fig. 14) *S. oligius* (Ross)
9. Segment IX long and tubular (Fig. 6A); sternum VIII with a pair of invaginated posterior pockets (*s. p.*) (Fig. 6A); tergum X with apex emarginate (Fig. 19B), truncate (Fig. 17B), or subtruncate (Fig. 6B) 10
- Segment IX short, higher than wide and similar in dimension to VIII (Fig. 15A); sternum VIII without invaginated posterior pockets; tergum X narrowed towards apex (Fig. 15B) 14
10. Tergum X deeply emarginate (Figs. 13B, 19B) 11
- Tergum X truncate or subtruncate (Figs. 6B, 8B, 17B) 12
11. Tergum X and valves subtended at base by a pair of prominent, raised apico-lateral projections (*ap. proj.*) of tergum IX (Fig. 13) *S. incertus* (Walker)
- Tergum IX not forming a pair of prominent, raised apico-lateral projections (Fig. 19) *S. stehri* (Ross)
12. Vaginal apparatus with a pair of antero-ventral sclerotized projections extending anteriorly the full length of segment IX (Fig. 8A) 13
- Antero-ventral sclerotized projections of vaginal apparatus absent (Fig. 6) *S. arenatus* n. sp.
13. Sternum IX with a pair of large concavities (*st. con.*); a pair of small punctate sclerites, or acrotergites (*atg.*), present on tergum IX (Fig. 8) *S. dixiensis* n. sp.
- Sternum IX without concavities; acrotergites absent (Fig. 17) *S. oxapius* (Ross)
14. Vaginal apparatus with a pair of antero-ventral sclerotized projections extending anteriorly well into segment VIII (Fig. 15) *S. oligius* (Ross)

- Antero-ventral sclerotized projections of vaginal apparatus absent
(Fig. 10) *S. epicampes* Edwards

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