SUBFAMILY
ORTHOCLADIINAE 7

DIAGNOSIS: **Antennae** with 3-7 segments; may be strongly reduced or may be longer than head capsule. **Labrum** with S I variable (simple, bifid, branched, serrated, palmate or plumose); S II usually simple but may be bifid, branched, palmate or plumose; S III simple (rarely bifid); S IV normal. Labral lamellae present or absent. **Mentum** usually well sclerotized, with several to more than 25 teeth; ventromental plates absent/vestigial to very large, without striae (occasionally with ridges in *Nanocladius*); beard present or absent. **Prementum** variably developed but never with dense well developed median brush of setae. **Body** with anterior parapods (sometimes reduced and/or fused); with posterior parapods well developed, separate or fused, or parapods reduced or absent. Setal fringe, setal tufts or long setae sometimes present. Anal tubules normally present, may be reduced or absent/vestigial.

NOTES: One of the most diverse of the chironomid subfamilies; orthoclad larvae are found in an amazing variety of habitats, running the gamut from terrestrial (corn fields, dung, greenhouses, leaf litter in hardwood forests) to seeps, springs, streams, rivers, ponds and lakes in freshwater, and coastal estuarine and littoral marine areas. Most larvae are scrapers, shredders or collectors-gatherers; some taxa are predators, some are parasites.

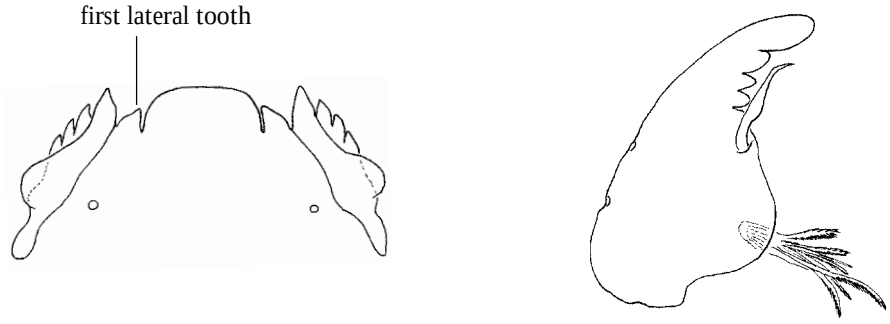
Key to the genera of larval Orthocladiinae of the southeastern United States

(larvae are unknown for *Apometriocnemus, Chasmatonotus, Diplosmittia, Lipurometriocnemus, Plhudsonia, Saetheriella, Sublettiella* and *Tavastia*)

1 Length of antennae at least 1/2 length of head capsule 2

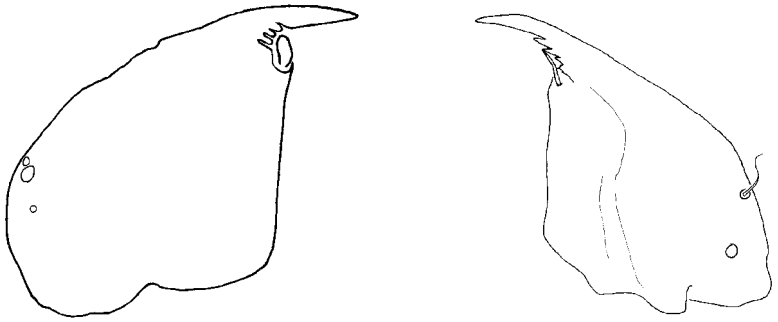
1' Length of antennae less than 1/2 length of head capsule 8

2(1) Mentum with wide, dome-like median tooth, first lateral tooth lower than median tooth and second lateral tooth; apical tooth of mandible long, rounded and expanded .... ***Heterotrissocladius*** (in part)



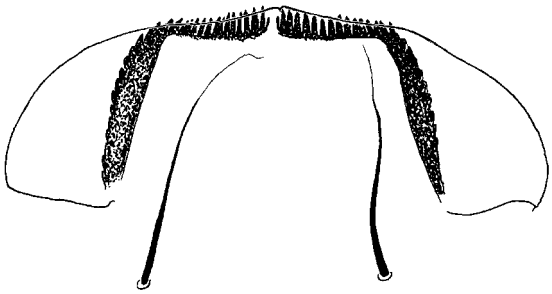
2' Mentum with bifid or trifid median tooth, or if single, not dome-like and first lateral tooth subequal to median tooth and second lateral teeth; apical tooth of mandible not as above 3

3(2') Well developed ventromental plates present (see figures in couplet 4); mandible with globose base 4

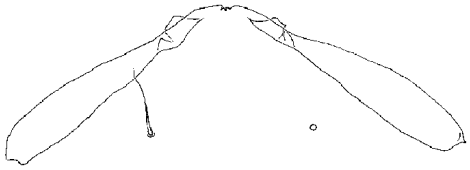


3' Ventromental plates weak or indistinguishable; mandible with normal base 5

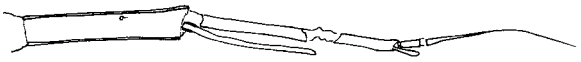
4(3) Dorsomentum with numerous fine anterior and lateral teeth ..... **Orthocladiinae sp. C**



4' Dorsomentum with a few rudimentary median teeth ..... ***Nanocladius*** (in part)

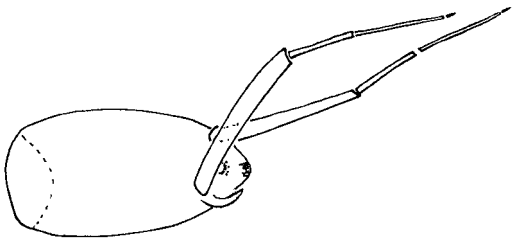


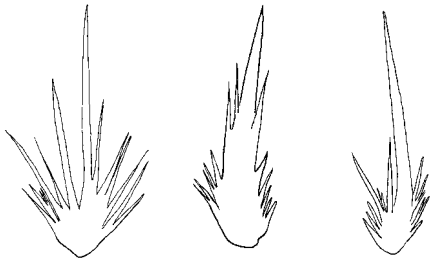
5(3') Last segment of antenna long, thin, whip-like ..... ***Lopescladius***



5' Last segment of antenna short (but may have short hair-like extension, see figure couplet 7') .. 6

6(5') Antennae with 4 distinct segments and usually much longer than head; head capsule sometimes with surface sculpturing; seta at base of posterior parapod with accessory spinelets .... ***Corynoneura***

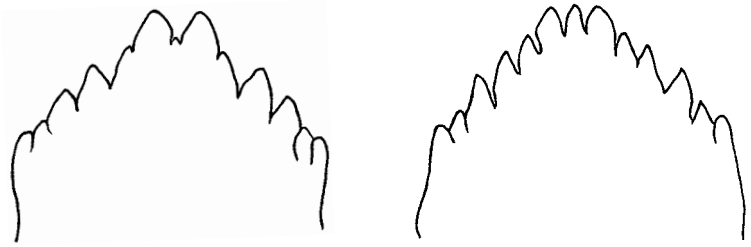


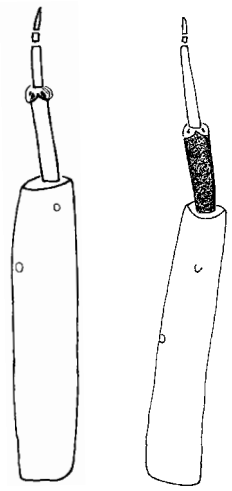


seta at base of posterior parapod of several *Corynoneura* species

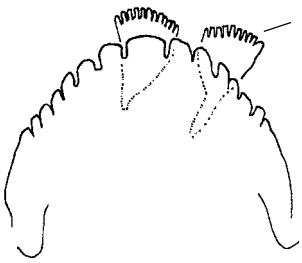
6’ Antennae with 5 distinct segments or 5-6 indistinct segments, at most as long as head, usually shorter; head capsule without surface sculpturing; seta at base of posterior parapod simple 7

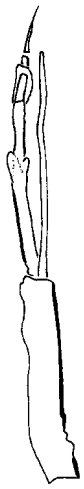
7(6’) Antennae with 5 distinct segments; mentum without a large pair of hypopharyngeal scales dorsal to it; a simple spine-like seta present at base of posterior parapod ..... ***Thienemanniella***



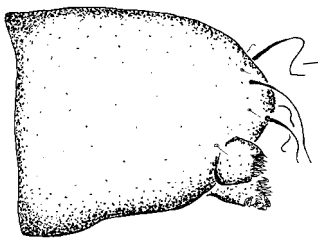


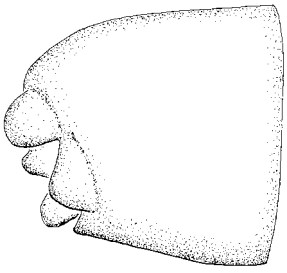
7’ Antennae with segment 2 unevenly sclerotized so that antennae may appear 6 segmented; mentum with a pair of large hypopharyngeal scales dorsal to it; no spine-like seta at base of posterior parapod ..... ***Rheosmittia***

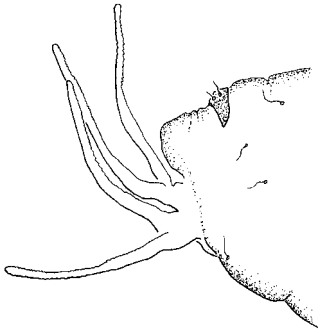




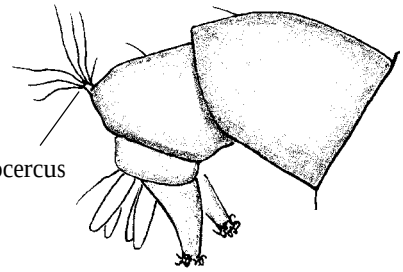
8(1’) Procerci absent, or at most a vestigial tubercle present, or if without procerci but strong anal seta present, then without anal tubules and in marine habitat 9
(most genera that will key here are marine, terrestrial/semi-terrestrial or parasitic)

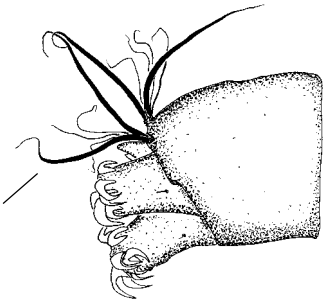




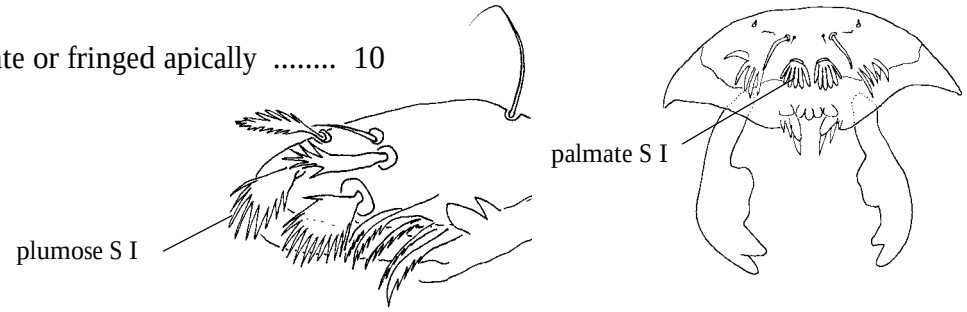


8’ Procerci present, but may be reduced - if reduced then strong anal setae present 21
(larvae found in a variety of habitats, but usually aquatic)

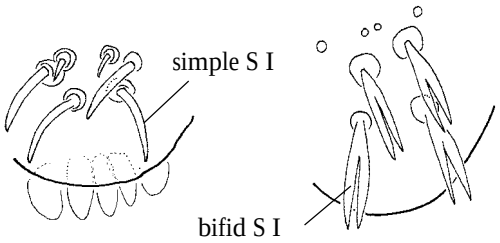




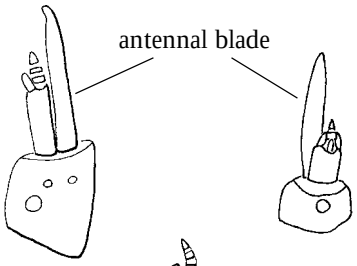
9(8) S I plumose, palmate or fringed apically 10



9' S I simple or bifid (if simple, may be weakly serrate laterally 13

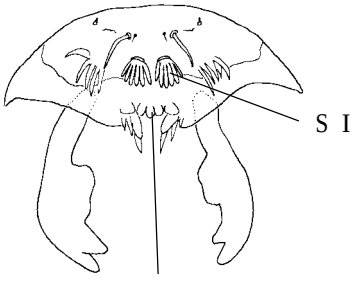


10(9) Antennal blade longer than flagellum 11

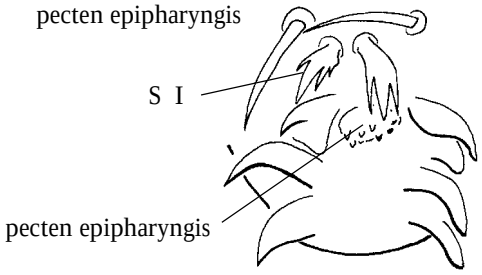


10' Antennal blade subequal to or shorter than flagellum 12

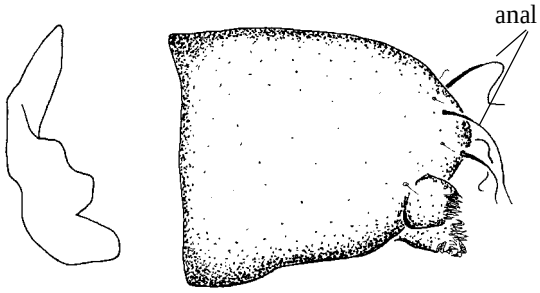
11(10) Pecten epipharyngis of 3 small scales; S I palmate .. .. ***Parasmittia***



11' Pecten epipharyngis with about 6-8 teeth; S I coarsely pectinate ..... ***Antillocladius***



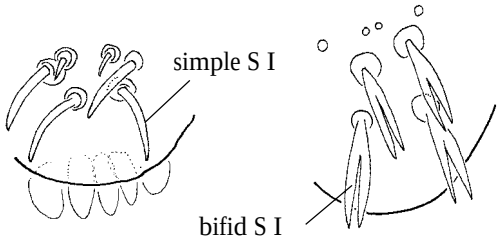
12(10') Marine; premandible apically simple; anal setae present ..... ***Clunio***



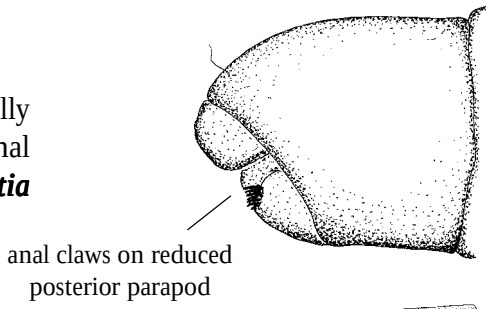
12' Not marine, but terrestrial or semi-aquatic; premandible apically bifid; no anal setae ..... ***Smittia***

13(9') S I bifid 14

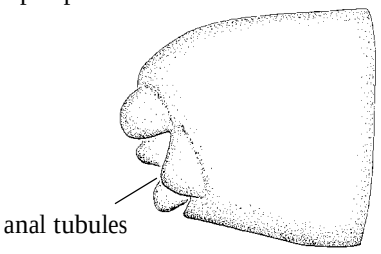
13' S I simple or weakly serrate laterally 15



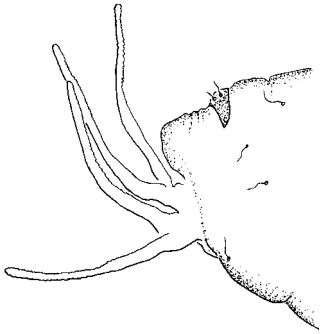
14(13) Anal claws and posterior parapods present, but occasionally claws absent and posterior parapods reduced; 1-3 weak anal setae present; premandible with brush ..... ***Pseudosmittia***

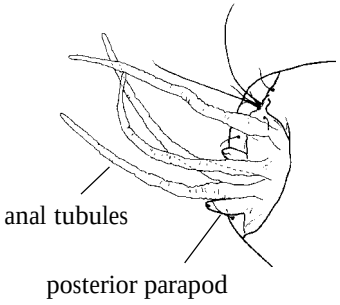


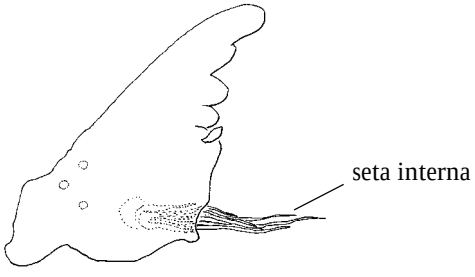
14' Anal claws, anal setae and posterior parapods absent; premandible without brush ..... ***Camptocladius***



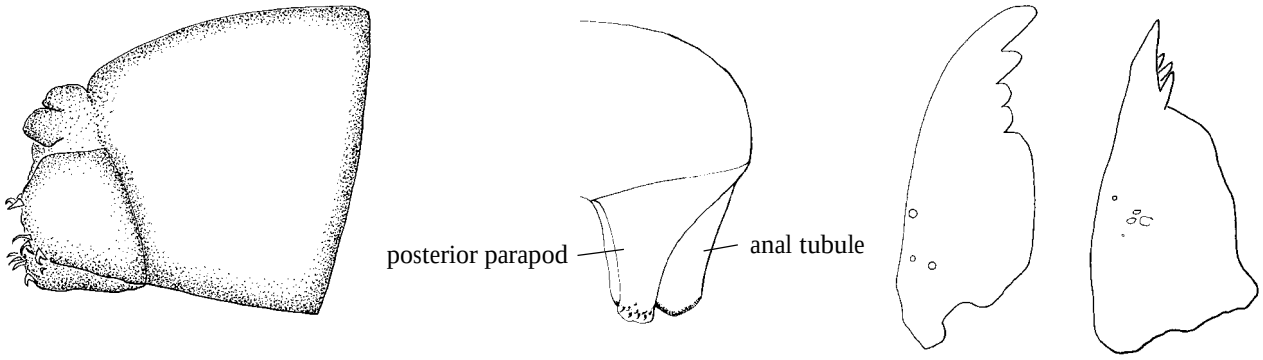
15(13') Anal tubules long, with numerous constrictions, always longer than posterior parapods (if posterior parapods present - they may be absent); mandible with well developed seta interna 16



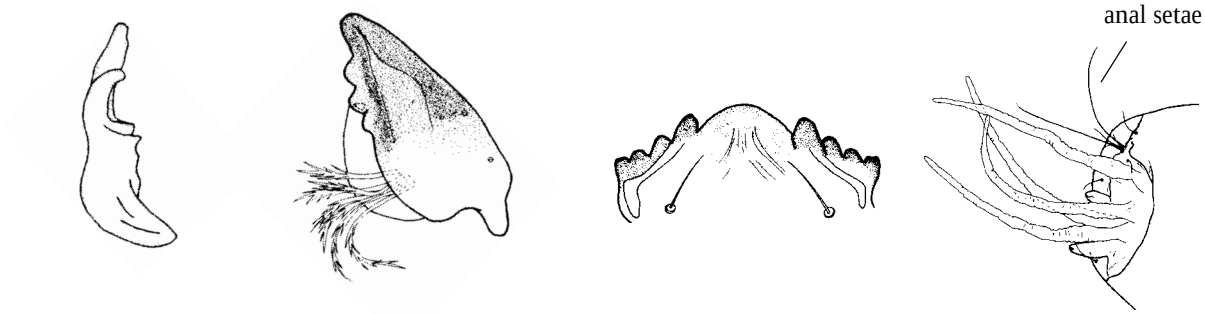




15’ Anal tubules absent or short and squat, shorter than or subequal to posterior parapods; mandible without seta interna 18

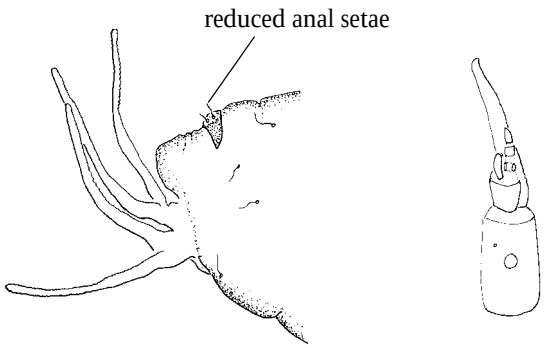


16(15) Premandible simple; mandible with 2 inner teeth; mentum with single, wide median tooth; anal setae well developed ..... ***Georthocladius*** (in part)

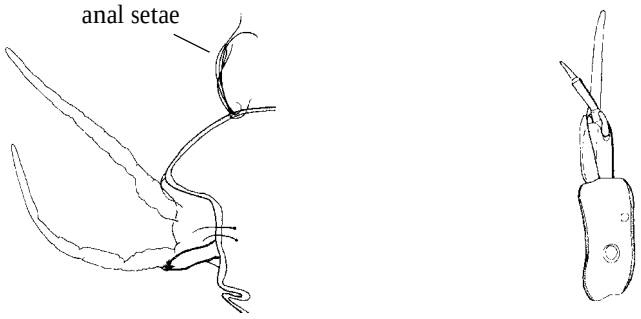


16’ Premandible apically bifid; mandible with 3 inner teeth; mentum with weakly divided median tooth; anal setae developed or reduced (see anal setae figures in couplet 17) 17

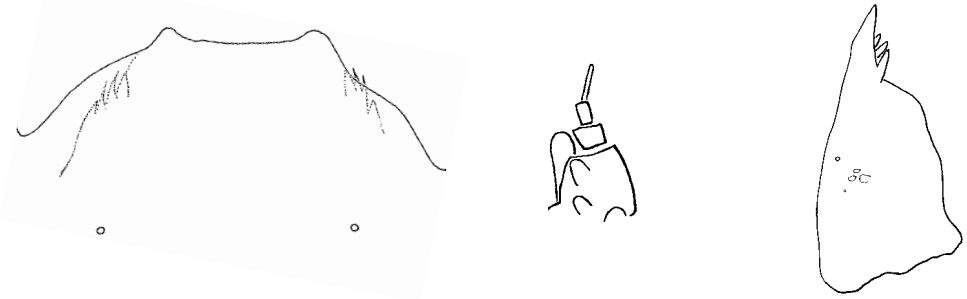
17(16’) Anal setae reduced; antenna with short 4th segment ..... ***Georthocladius*** (in part)



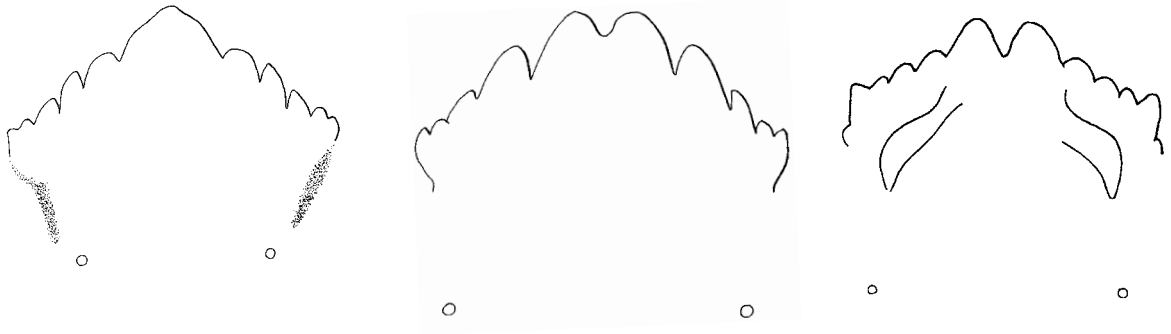
17’ Anal setae well developed; antenna with long 4th segment ..... ***Doithrix***



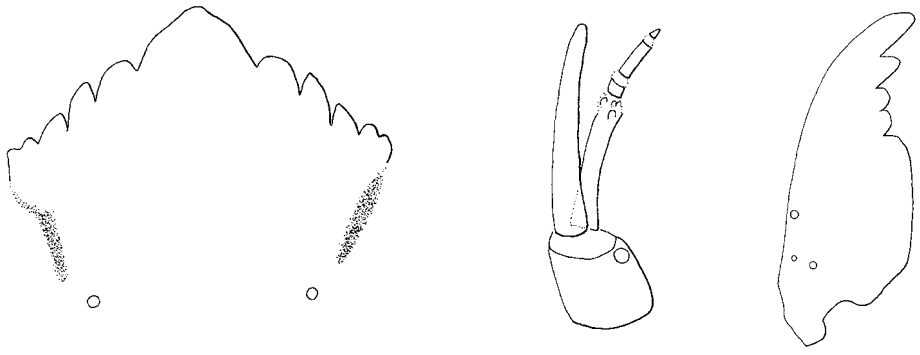
18(15’) Mentum without distinct median teeth, with 4-5 pairs of spine-like lateral teeth; antennae extremely reduced; mandible with a subapical cluster of sharply pointed teeth; ectoparasitic on mayflies ..... ***Symbiocladius***



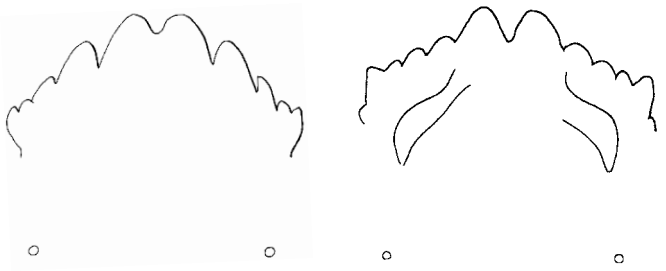
18’ Mentum with a distinct single or bifid median tooth, lateral teeth not spine-like; antennae not reduced as above; mandible with inner teeth not sharply pointed; free-living, semi-aquatic or terrestrial 19



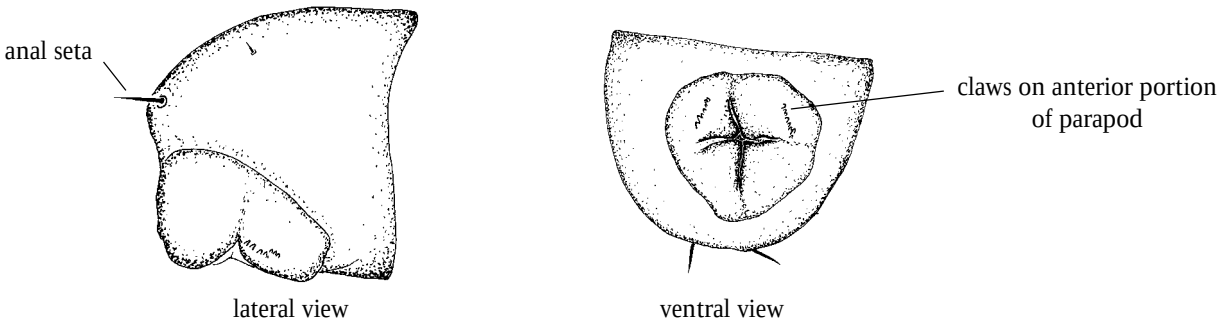
19(18’) Mentum with single median tooth ..... ***Mesosmittia***



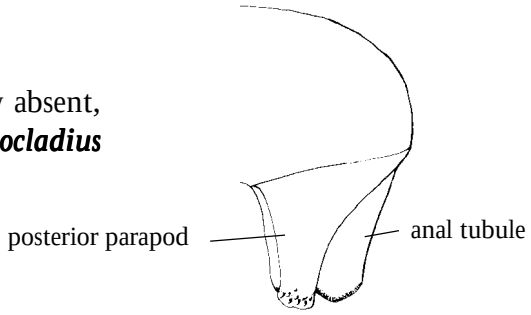
19' Mentum with bifid median tooth (or 2 median teeth) 20



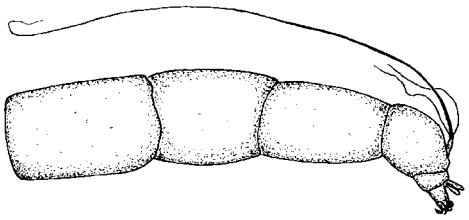
20(19') Posterior parapods appearing divided, anterior portion with claws, posterior portion bare; anal setae usually present and well developed ..... ***Gymnometriocnemus***



20' Posterior parapods not divided; anal setae usually absent, but may be present ..... ***Bryophaenocladius***

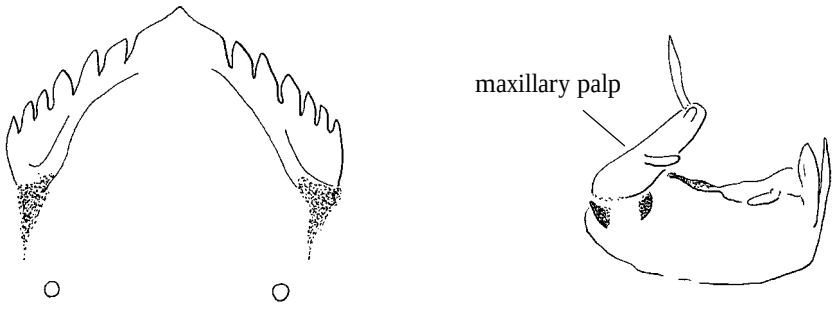


21(8') Procercus with one seta at least 1/4 as long as body 22



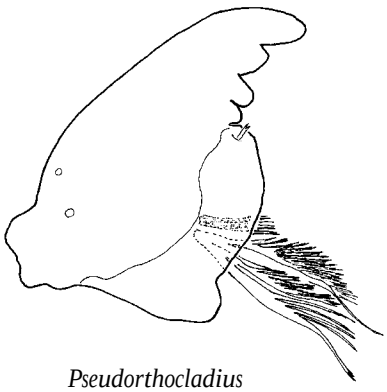
21' Procercus without such a long seta 24

22(21) Mentum with 6 pairs of sharply pointed lateral teeth and single median tooth with small median projection; premandible apically bifid; maxillary palp elongate ..... ***Krenosmittia***

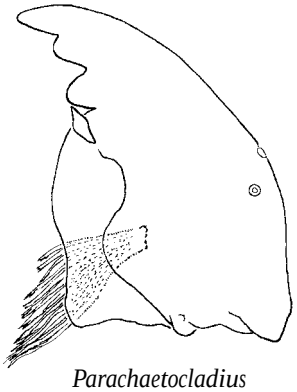


22' Mentum with 4 pairs of lateral teeth, median tooth bifid or single, broad and without median projection; premandible simple; maxillary palp not elongate 23

23(22') Mandible with 3 inner teeth ..... ***Pseudorthocladius***



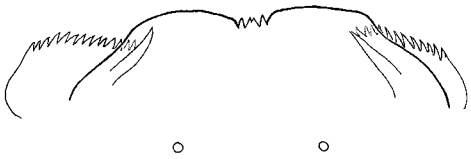
Pseudorthocladius

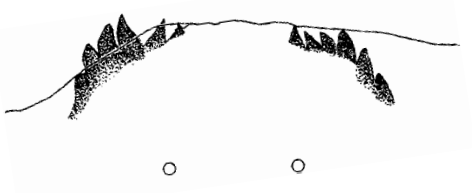


Parachaetocladius

23' Mandible with 1-2 inner teeth ..... ***Parachaetocladius***

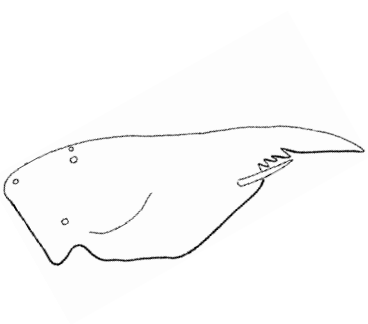
24(21') Lateral teeth of mentum appearing to be on plates separate from and usually covered by ventromentum 25

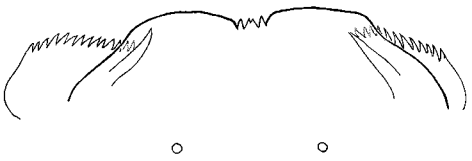




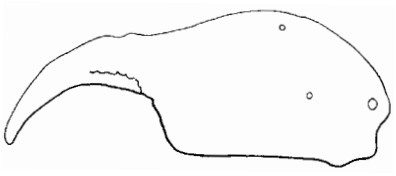
24' Lateral teeth appearing contiguous with median portion of mentum 26

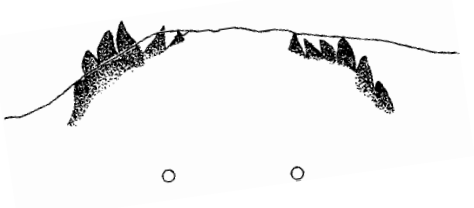
25(24) Mandible with small inner teeth; antennae more than 1/3 length of head capsule; mentum as figured; associated with blue-green algae or peat ..... ***Acamptocladius***



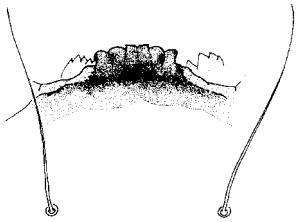
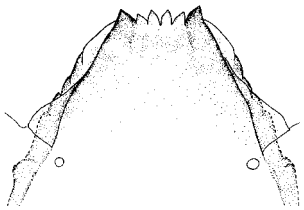
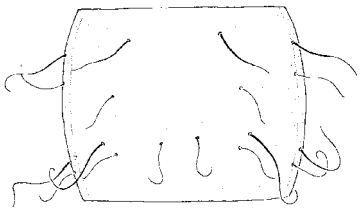


25' Mandible without inner teeth; antennae strongly reduced; mentum as figured; parasitic in unionid mussels ..... ***Trichochilus***



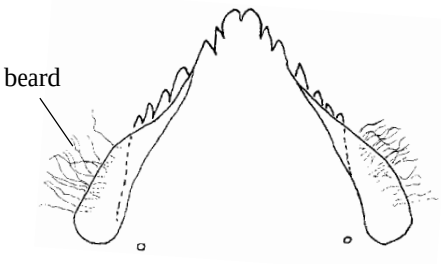


26(24') Mentum strongly arched, with 4-8 median teeth; body with numerous long, stout setae; phoretic or parasitic on ephemerid mayflies ..... ***Epoicocladius***

26' Mentum not as above; if body has long, strong setae, then mentum with only 1 or 2 median teeth; free-living, except for some *Nanocladius* (couplet 38) 27

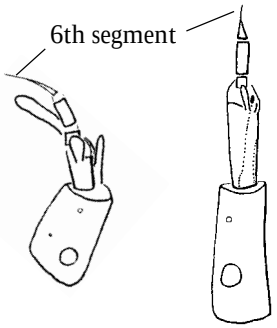
27(26') Beard (group of setae) present beneath or adjacent to ventromental plates (may be only a few setae and may require observation at 1000X) 28



27' Beard absent 37

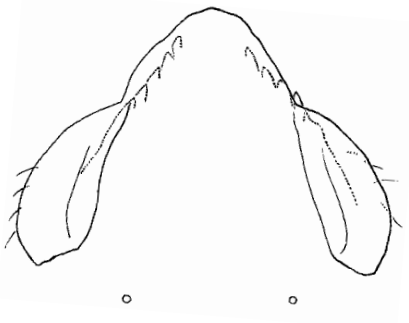
28(27) Vestigial, hair-like 6th antennal segment present and usually easily visible; mentum with single broad median tooth 29

28' Antennae with 5 apparent segments; if vestigial 6th segment visible (some *Zalutschia*), then mentum with 2-4 median teeth 30



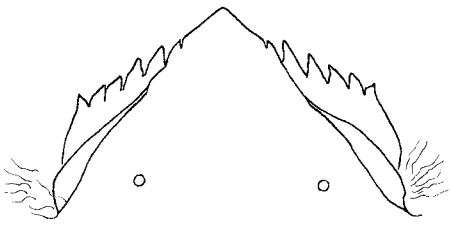
29(28) Ventromental plates elongate, covering most of lateral teeth; S I simple or apically toothed ..... ***Stilocladius***

apically toothed S I

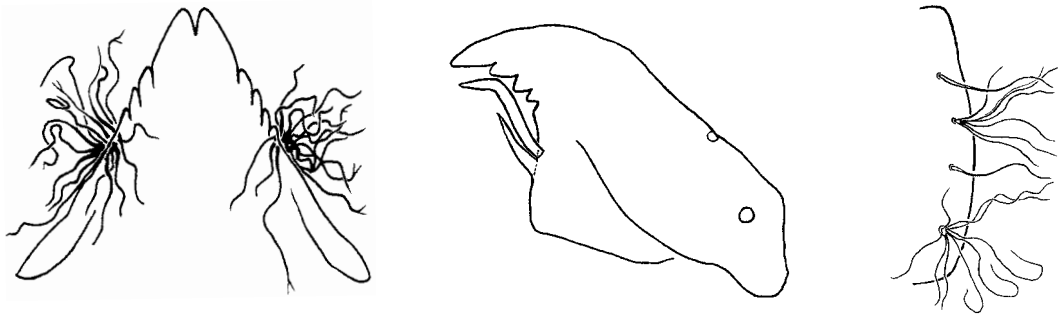


29' Ventromental plates smaller; S I bifid .... ***Parakiefferiella*** (in part)

bifid S I

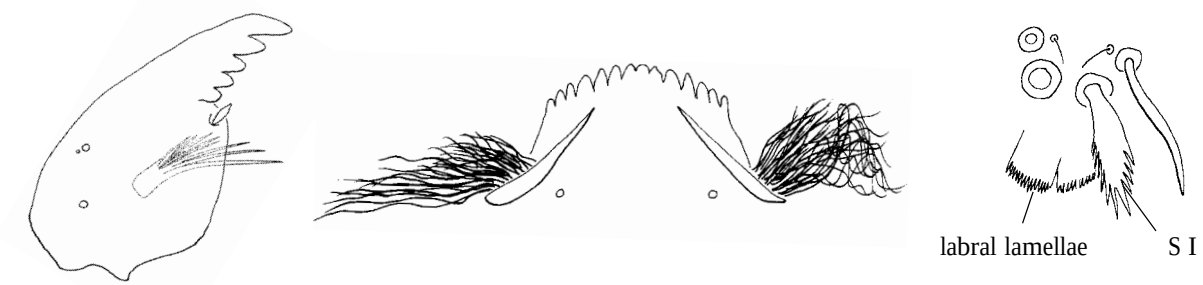


30(28') S I simple; median teeth of mentum elongate; beard well developed with apically branched filamaents; mandible with large seta subdentalis and inner spine; abdominal segments with alternating simple and plumose setae ..... ***Synorthocladius***



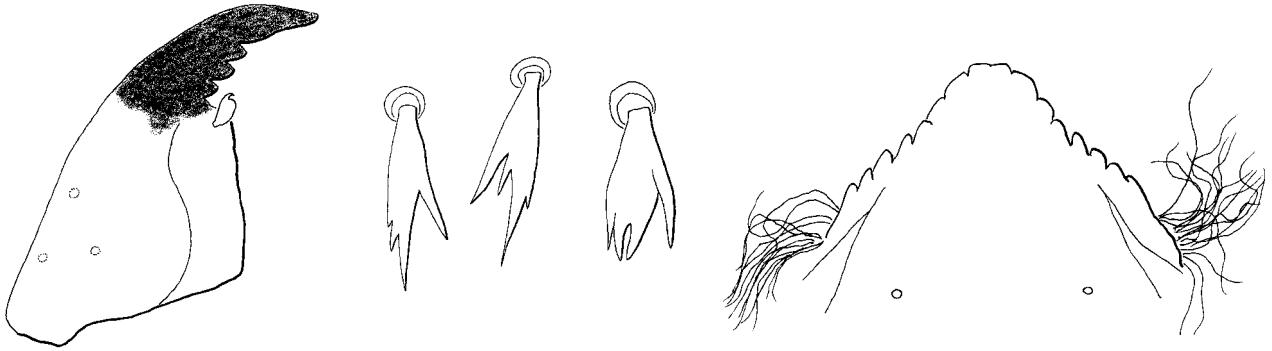
30' S I simple, bifid, coarsely pectinate, palmate or plumose; mentum, beard and mandible not as above; abdominal segments without alternating simple and plumose setae (a single pair of setal tufts may be present posterolaterally) 31

31(30') Mandible with 4 inner teeth; ventromental plates with dense beard; S I plumose; labral lamellae well developed, apically pectinate ..... ***Diplocladius***

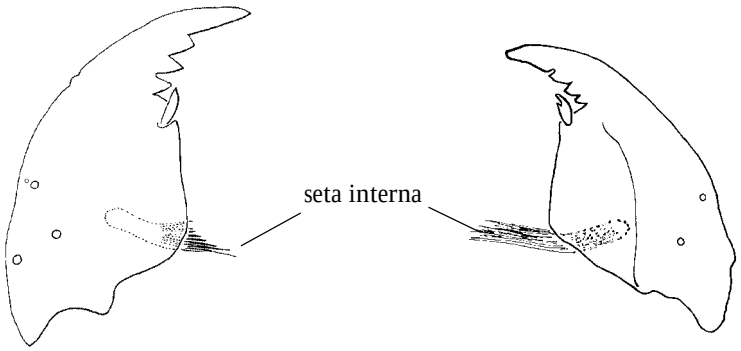


31' Mandible with 3 or fewer inner teeth (do not mistake darkened molar area for a 4th tooth!); mentum, beard and S I variable; if labral lamellae present, weakly developed and never apically pectinate 32

32(31') Mandible without seta interna; S I bifid (may be secondarily split into more teeth); mentum as figured ..... ***Acricotopus***

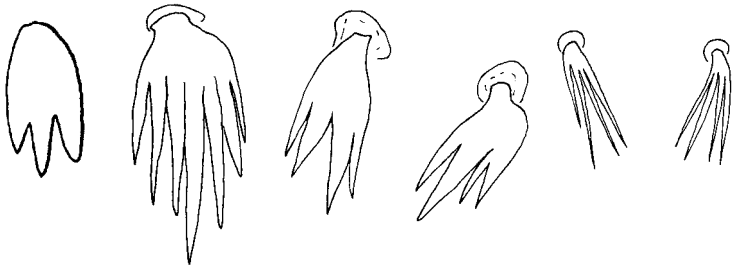


32’ Mandible with seta interna; ***IF*** mandible without seta interna, then S I broadly trifid 33

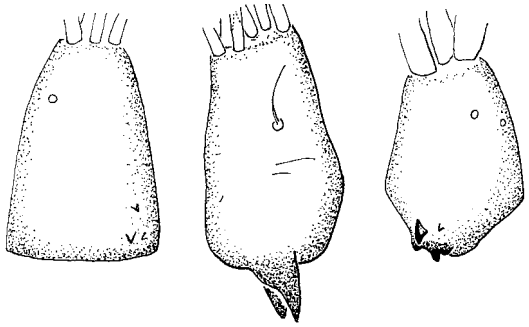


broadly trifid S I

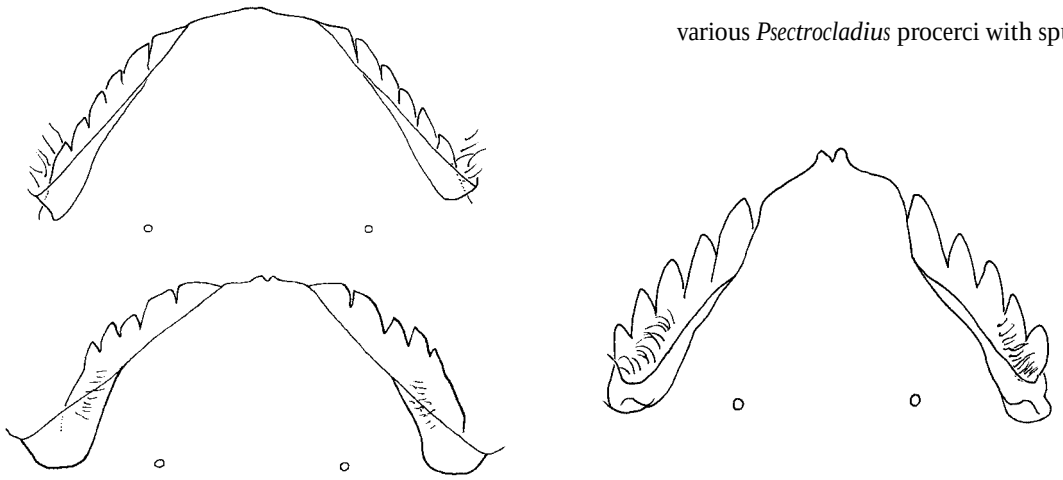
33(32’) S I broadly trifid, palmate or with about 4 long, narrow teeth; procercus with small to large spurs ..... ***Psectrocladius*** (in part)



various *Psectrocladius* S I’s



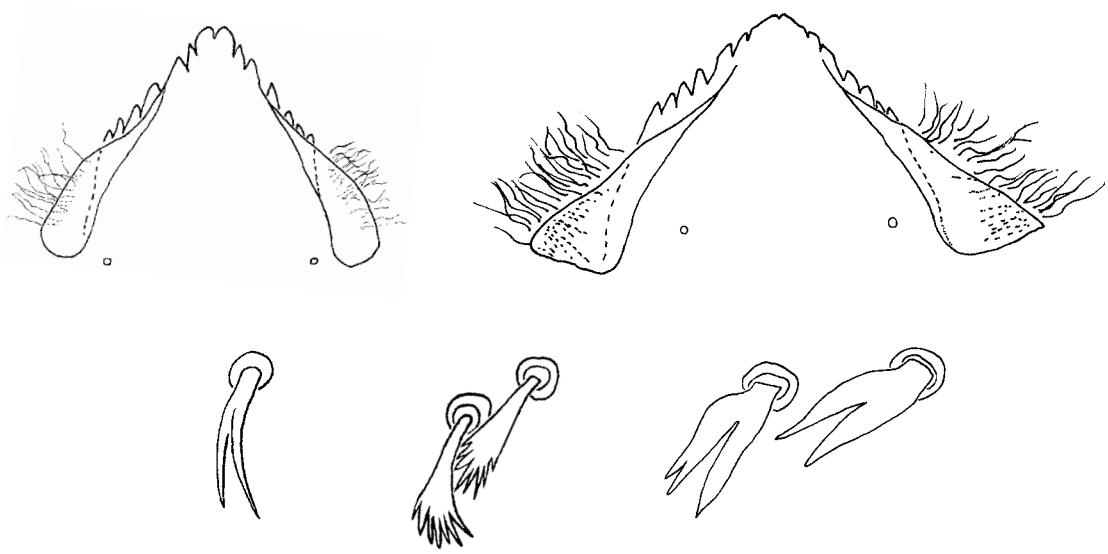
various *Psectrocladius* procerci with spurs



various *Psectrocladius* menta

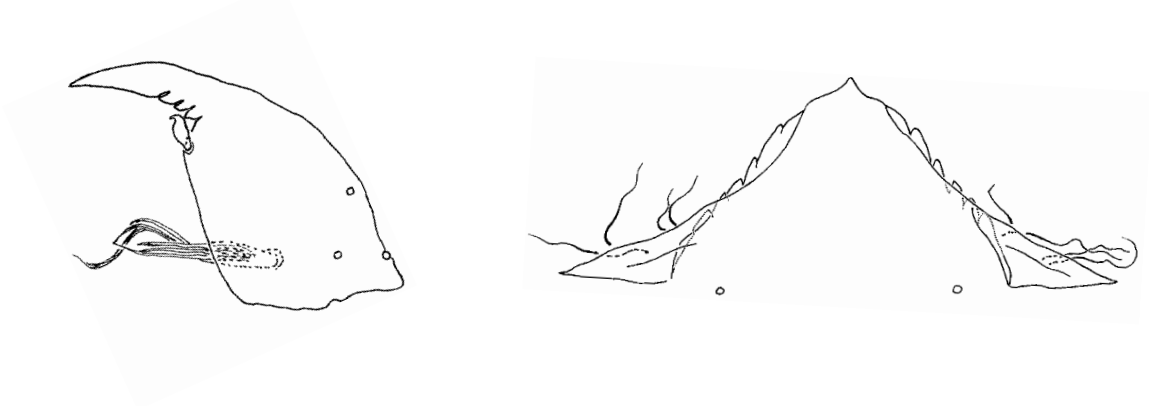
33’ S I simple, bifid, apically split into 4 or more short teeth, plumose or coarsely serrate; if procercus with spurs, S I bifid or apically split into 4 or more short teeth 34

34(33') Beard well developed; S I bifid or apically split into 4 or more short teeth; procercus usually with spurs 35

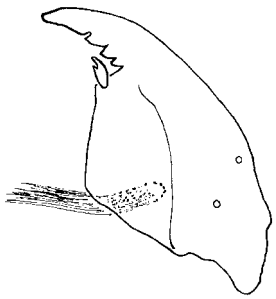


34' Beard weak to vestigial; S I simple, bifid, coarsely pectinate or plumose; procercus without spurs 36

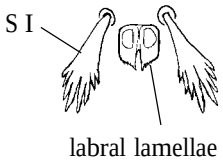
35(34) Apical tooth of mandible longer than width of 3 inner teeth; ventromental plates large and triangular; head capsule without ventral tubercules ..... ***Psectrocladius*** (in part) (some *Ps. (Monopsectrocladius)*)

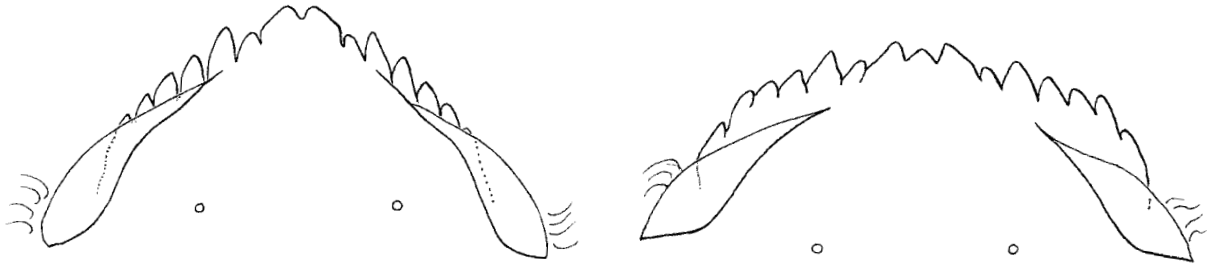


35' Apical tooth of mandible shorter than or subequal to width of 3 inner teeth; if ventromental plates large and triangular (as figured in couplet 34 above), then head capsule with pair of ventral tubercles .... ***Rheocricotopus***



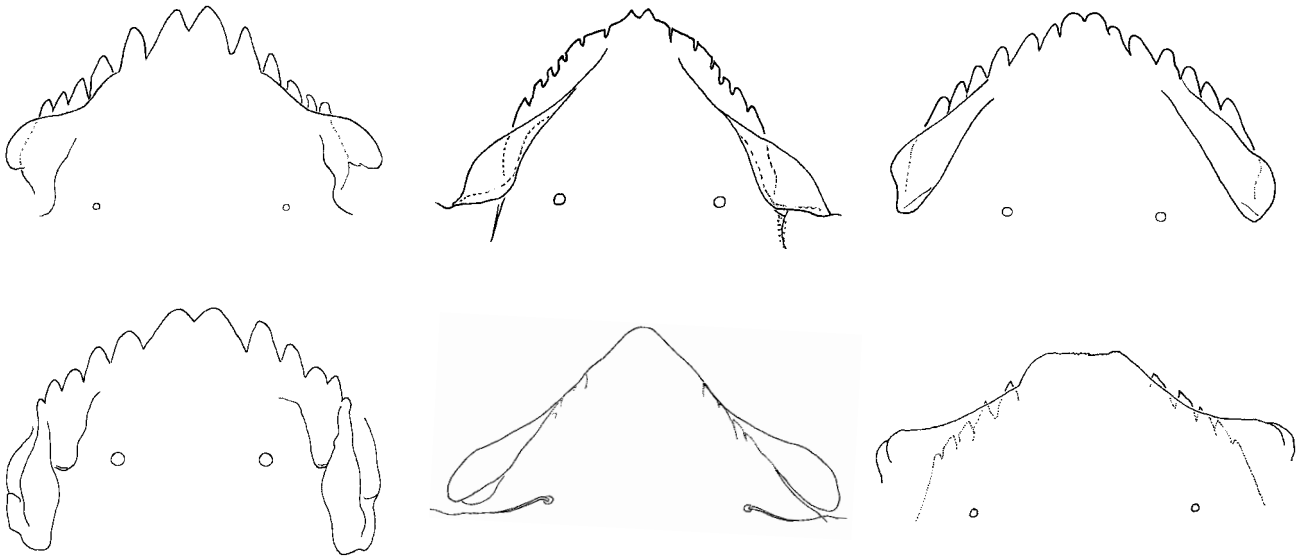
36(34') S I coarsely pectinate to plumose; weak labral lamellae present; mentum with 2-4 median teeth, which are usually lighter in color than lateral teeth ..... ***Zalutschia***



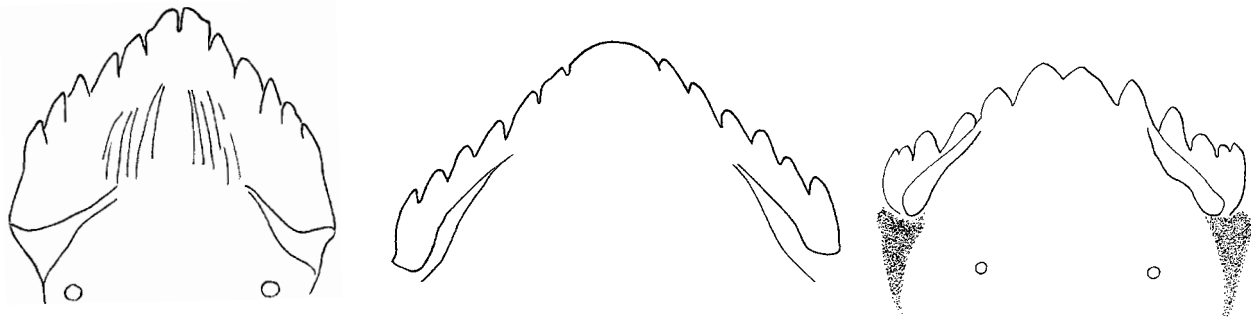


36' S I simple or bifid; mentum with single median tooth 37

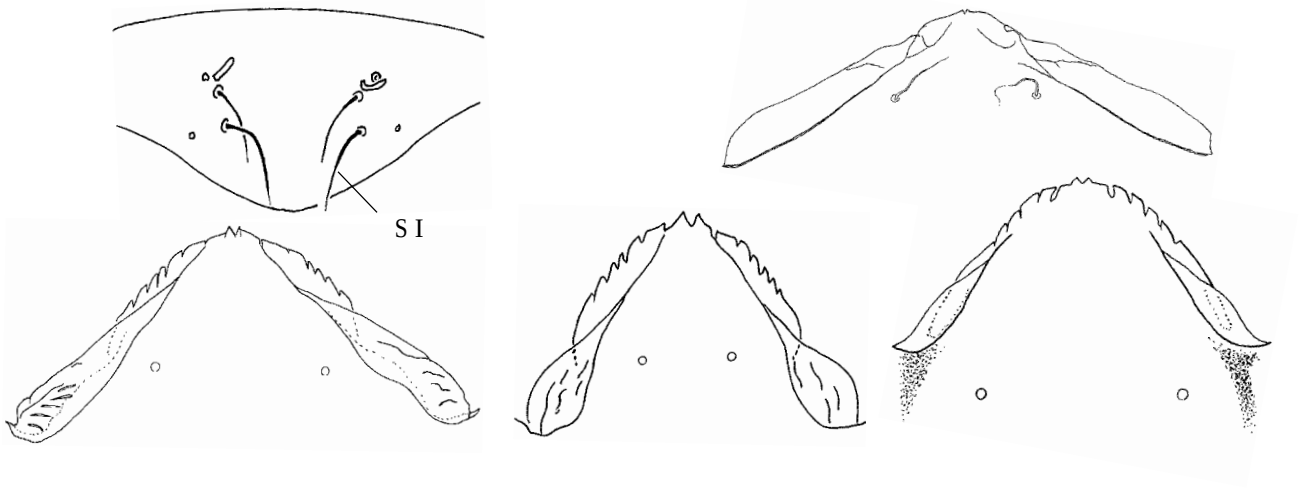
37(27', 36') Ventromental plates well developed, extending well beyond lateral margin of mentum 38



37' Ventromental plates absent/vestigial or, if present, do not extend beyond lateral margin of mentum (may extend to margin, but not far beyond, or plates very thin as in couplet 70) 47

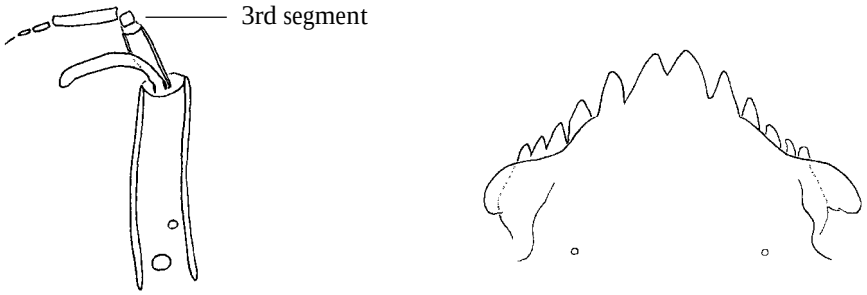


38(37) All S setae simple; mentum with a small pair of median teeth which are often well separated from the 0-6 pairs of lateral teeth (which may be small and fused or closely appressed to each other); ventromental plates elongate; some species phoretic or parasitic on a variety of aquatic insects ..... ***Nanocladius*** (in part)



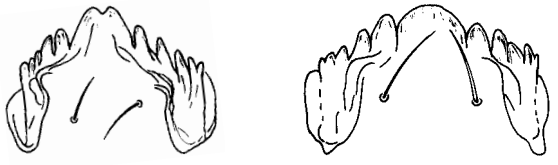
38' S I never simple; mentum not as above; not phoretic or parasitic on aquatic insects 39

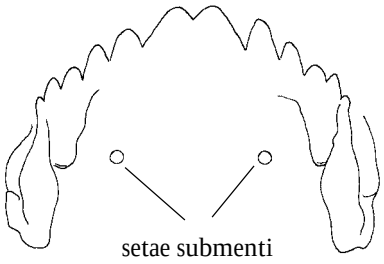
39(38') Antennae 7 segmented (7th segment hairlike, vestigial); 3rd antennal segment minute, < 1/3 length of 4th ..... ***Heterotrissocladius*** (in part)



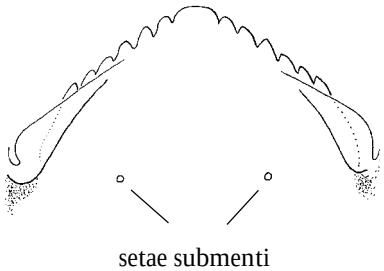
39' Antennae with 5-6 segments; 3rd segment never as small as <1/3 length of 4th 40

40(39') Ventromental plates appear double; setae submenti located well anterior to posterior margin of ventromental plates 41

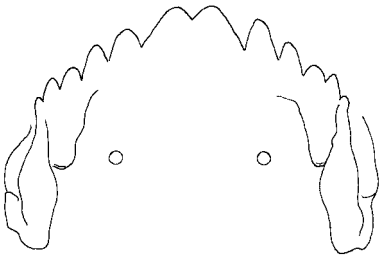


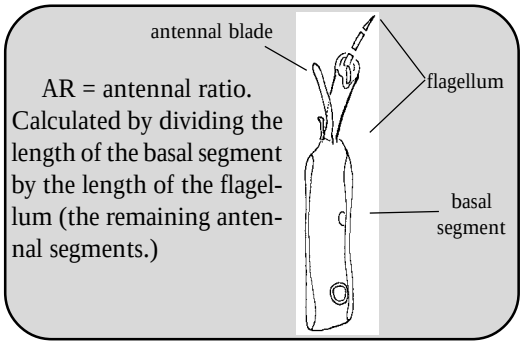


40' Ventromental plates single; setae submenti located near posterior margin of ventromental plates or more posteriad .. 42



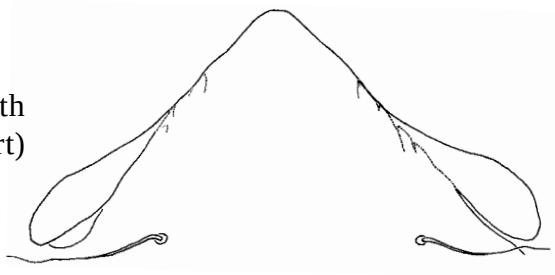
41(40) Mentum always with double median tooth; antenna with long basal segment, AR > 1.25; antennal blade shorter than flagellum ..... ***Parametriocnemus***





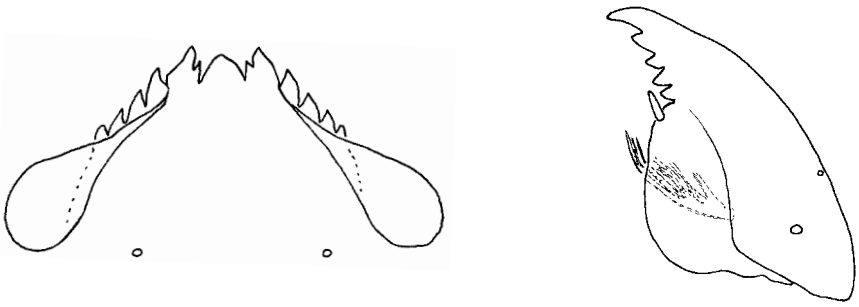
41' Mentum with single or double median tooth; basal antennal segment shorter, AR 0.5-1.0; antennal blade subequal to or longer than flagellum ..... ***Paraphaenocladius***

42(40') Mentum with large, pale, dome-shaped median tooth ..... ***Parakiefferiella*** (in part)



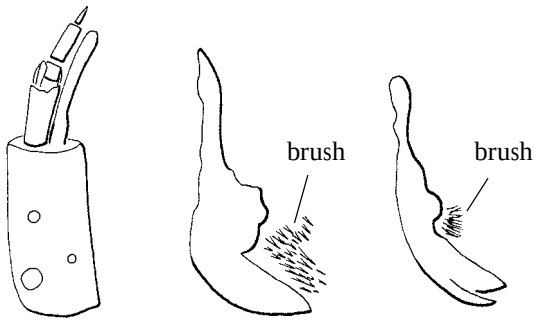
42' Median tooth of mentum not as above 43

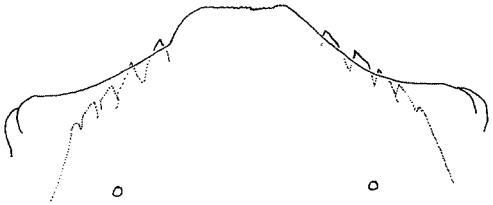
43(42') Median tooth of mentum lower than 2nd lateral teeth; 1st lateral tooth reduced and fused to 2nd lateral tooth; mandible with 4 distinct inner teeth ..... ***Unniella***



43' Mentum not as above; mandible with 3 inner teeth 44

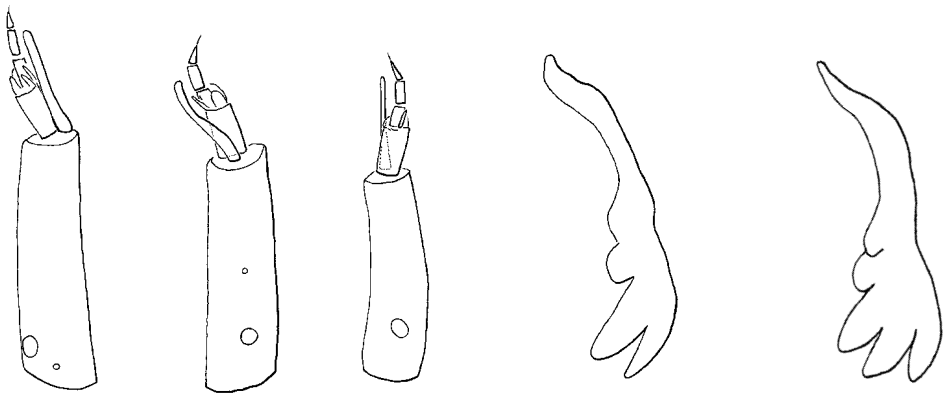
44(43') Antenna 5 segmented; premandible with brush (may be weak) ..... ***Chaetocladius*** (in part)



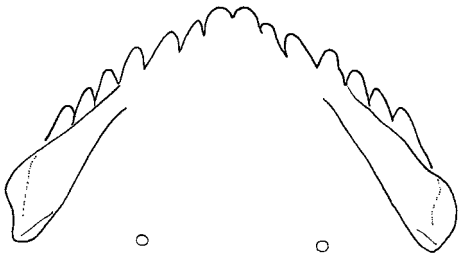


note that some larvae may have bifid median tooth

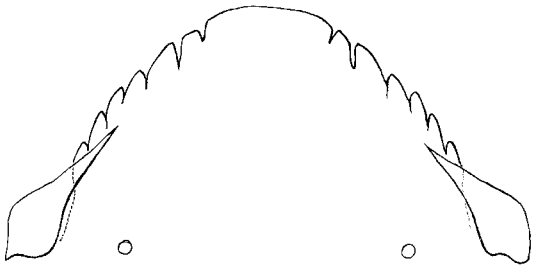
44' Antennae with 6 segments, 6th vestigial, hairlike; premandible without brush 45

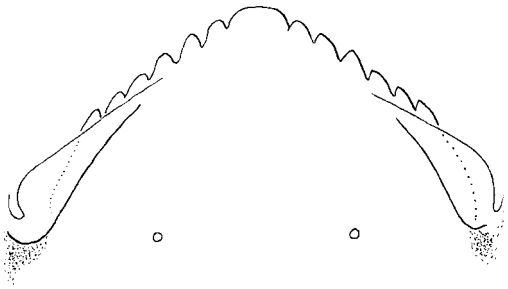


45(44) Mentum with bifid median tooth .... ***Hydrobaenus*** (in part)

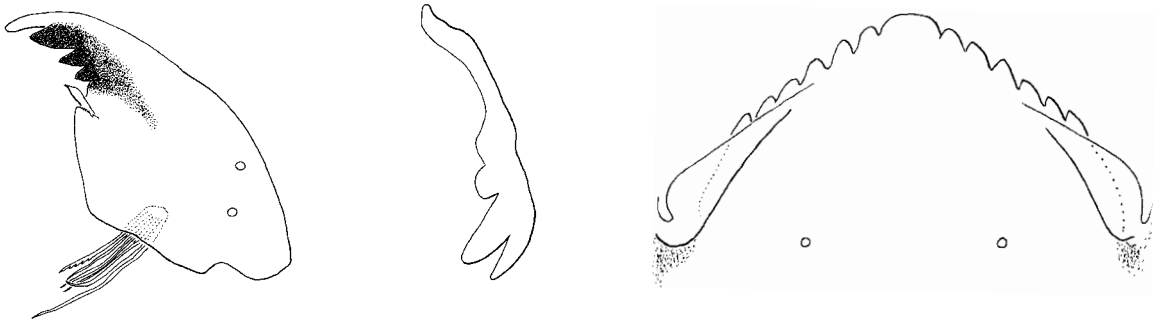


45' Mentum with single median tooth 46

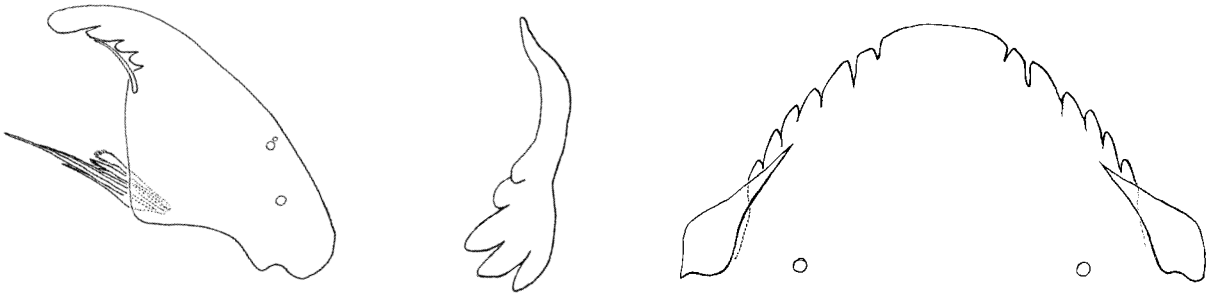




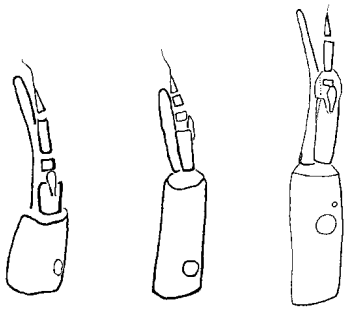
46(45') Apical tooth of mandible thin; premandible with 2 large apical teeth; mentum as figured ..... ***Hydrobaenus*** (in part)



46' Apical tooth of mandible inflated; premandible with 3 large apical teeth; mentum as figured ..... **Orthocladiinae genus I**

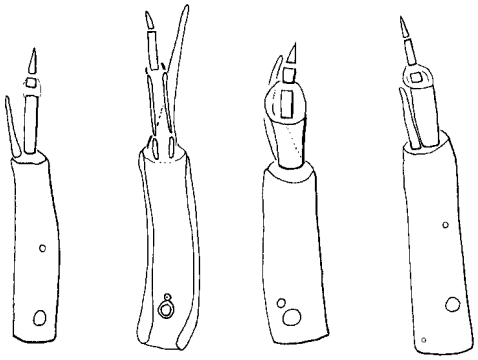


47(37') Antennae with 6 segments, 6th segment vestigial, hairlike 48

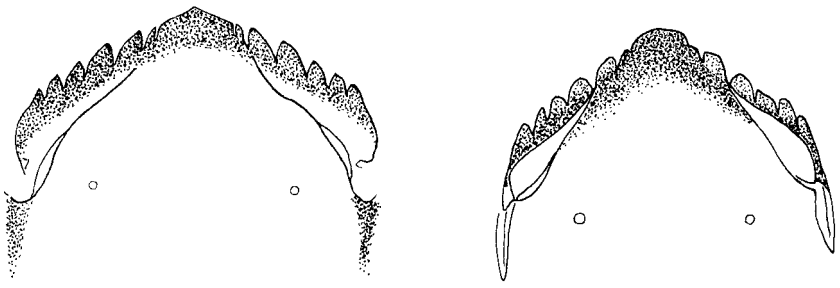


NOTE: Some *Cricotopus* may have an apparent hair-like 6th segment and may key to *Parakiefferiella* below. Note that the 6th segment of *Parakiefferiella* is about as long as the 5th and is easily seen at 400X while the vestigial segment of *Cricotopus* is much smaller and difficult to observe at that magnification; *Parakiefferiella* usually have larger ventromental plates than most *Cricotopus.*

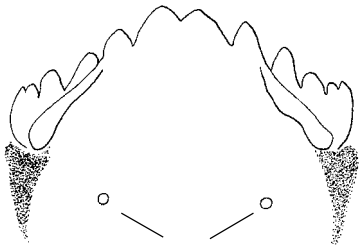
47' Antennae with 5 or fewer segments, last segment not hairlike 50

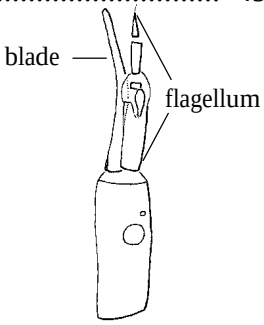


48(47) Mentum with single median tooth ..... ***Parakiefferiella*** (in part)

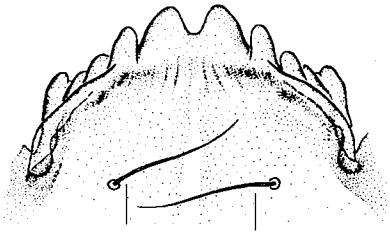


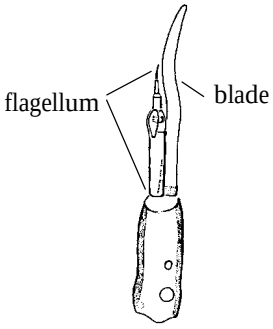
48’ Mentum with bifid median tooth (figures below) 49





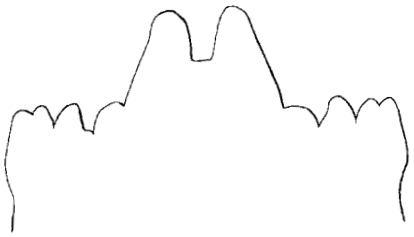
49(48’) Setae submenti well posterior to a line drawn between posterior margins of ventromental plates; antennal blade subequal to flagellum ..... ***Psilometriocnemus***

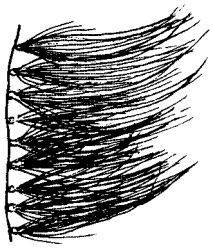




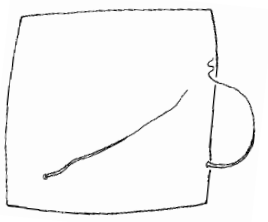
49’ Setae submenti just posterior to a line drawn between posterior margins of ventromental plates; antennal blade much longer than flagellum ..... ***Platysmittia***

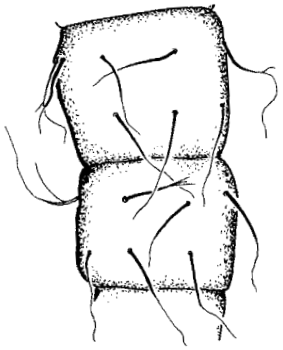
50(47’) Abdomen with a lateral fringe of setal tufts; mentum as figured; mining in submerged, partially decomposed wood .. ***Xylotopus***





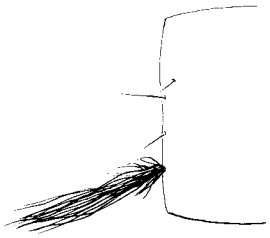
50’ Abdomen without fringe of setal tufts, although individual setal tufts or long setae may be present; mentum not as above 51

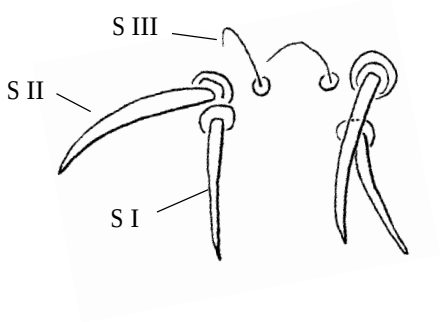




51(50’) Abdomen with long simple setae, at least ½ as long as the segment bearing them 52

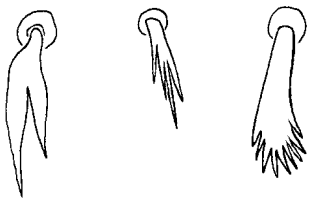
51’ Abdomen without long simple setae; ***OR*** if long setae present, they are arranged as a pair of single tufts, one on each side posterolaterally on body segments 56

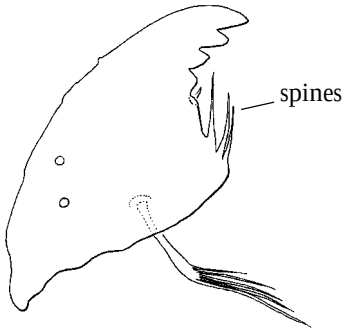




52(51) S I simple 53

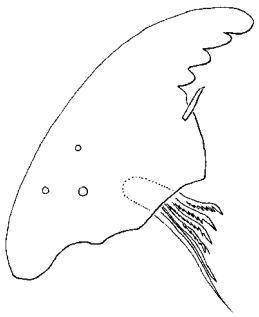
52’ S I bifid, or with several apical teeth, or plumose 54

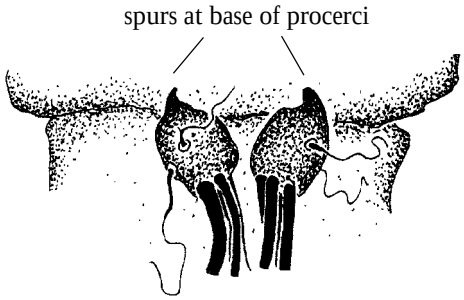




53(52) Inner margin of mandible with several spines; procerci without spurs ..... ***Eukiefferiella*** (in part)

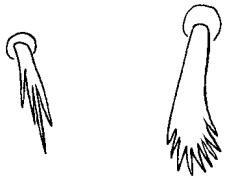
53’ Inner margin of mandible without spines; procerci with spurs ..... ***Paracricotopus***



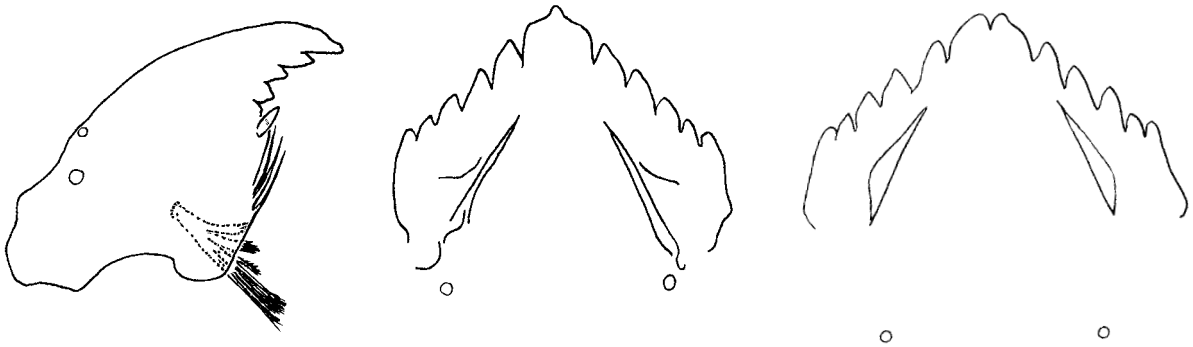


54(52’) S I bifid 68

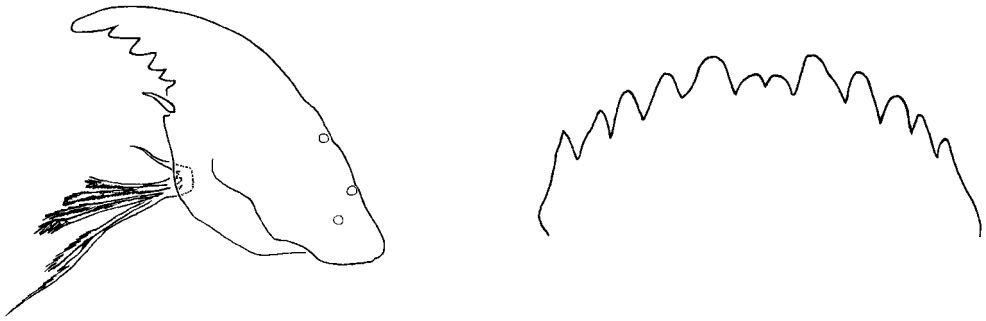
54’ S I with several apical teeth or plumose 55



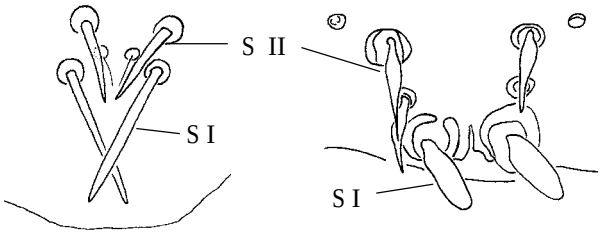
55(54') Mandible with 3 inner teeth and inner margin with several spines; common in streams and rivers ..... ***Tvetenia***



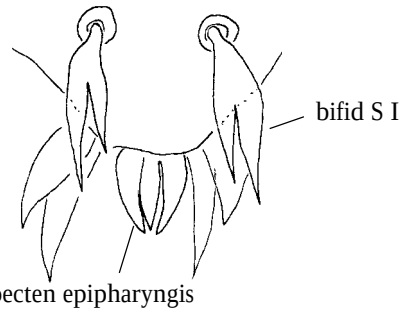
55' Mandible with 4 inner teeth and inner margin smooth; known only from bromeliads in peninsular Florida ..... ***Metriocnemus*** (in part)

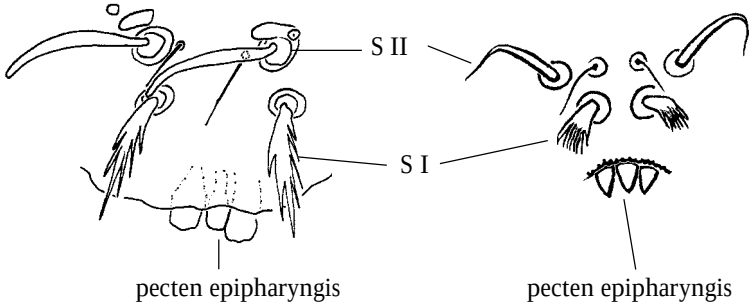


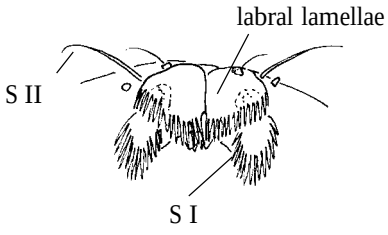
56(51') S I simple 57



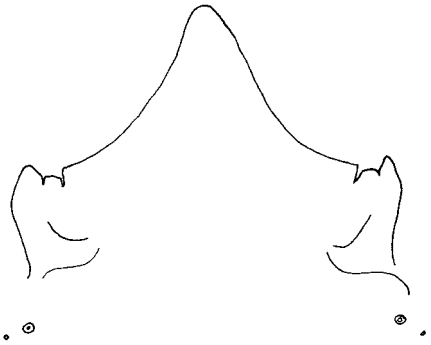
56' S I bifid, serrate, pectinate or plumose 68



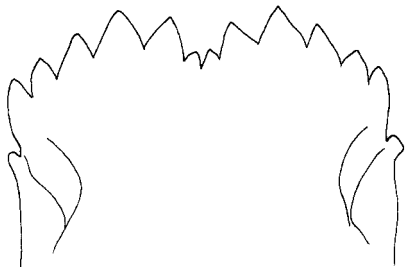




57(56) Mentum with huge median tooth and reduced lateral teeth ..... ***Orthocladius*** (in part)
(*O. (S.) lignicola*)



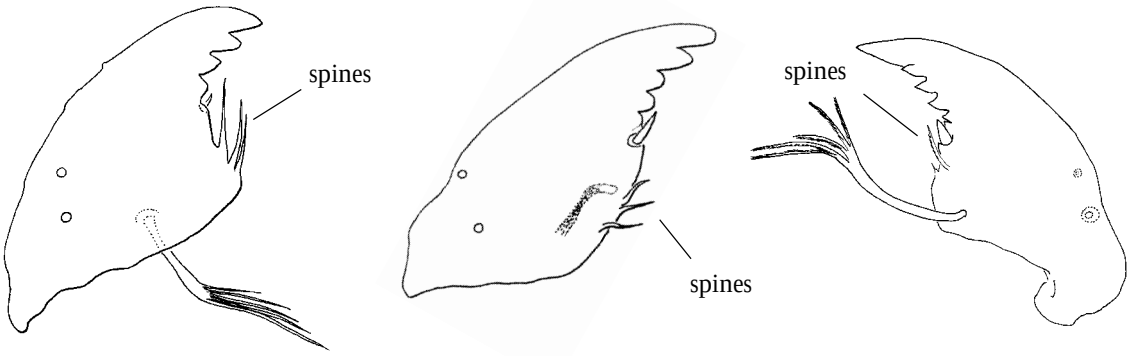
57' Median tooth of mentum not as above 58



58(57') Median teeth of mentum deeply recessed .... ***Metriocnemus*** (in part)
(*M. fuscipes*)

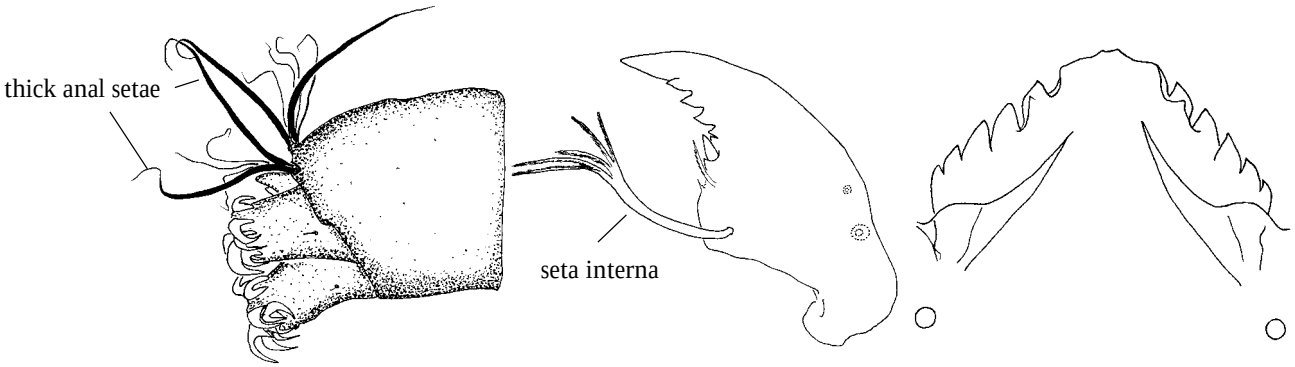
58' Median teeth of mentum not deeply recessed as above 59

59(58') Inner margin of mandible with spines (these may be small) 60

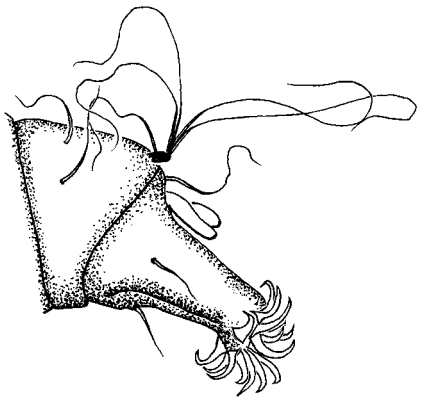


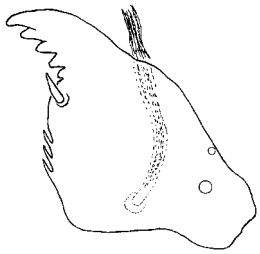
59' Inner margin of mandible smooth 66

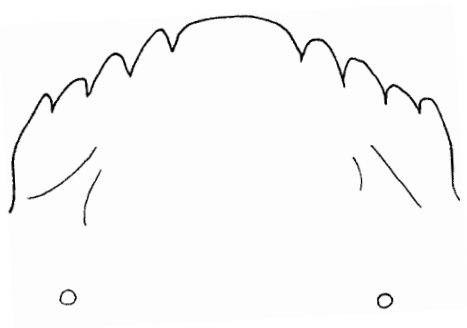
60(59) Procercus reduced, with 2 setae thicker than the rest on each procercus; seta interna of mandible with long stalk that branches near apex; mentum with 5 pairs of lateral teeth .... ***Cardiocladius*** (in part)



60’ Procercus at least as long as wide, setae about equally thick; seta interna usually divided to near base, but if divided near apex than mentum with 4 pairs of lateral teeth 61





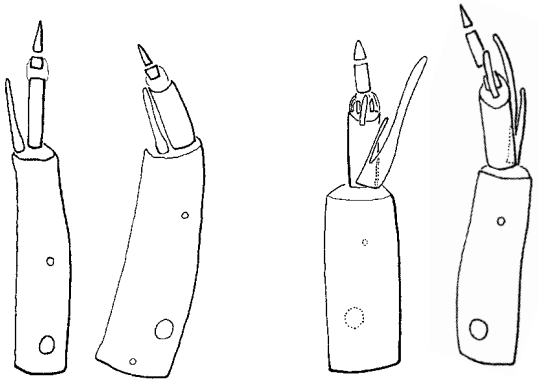


61(60’) Mentum with 4 pairs of lateral teeth .. .. ***Eukiefferiella*** (in part)

61’ Mentum with 5 pairs of lateral teeth .. 62

62(61’) Antenna with 4 segments .. ***Eukiefferiella*** (in part)

62’ Antenna with 5 segments 63

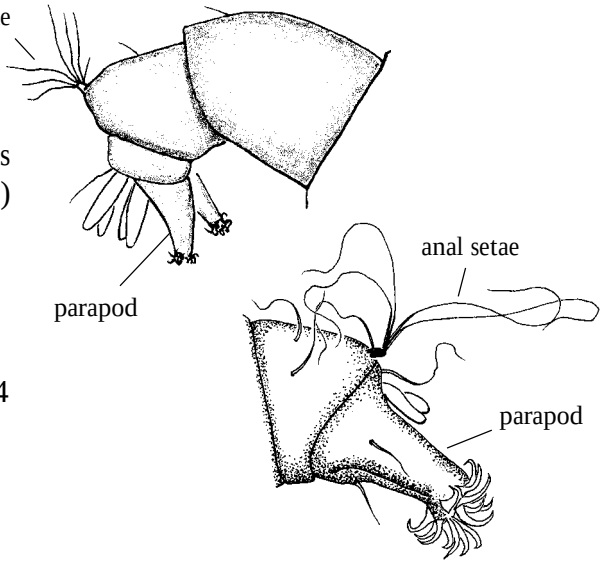


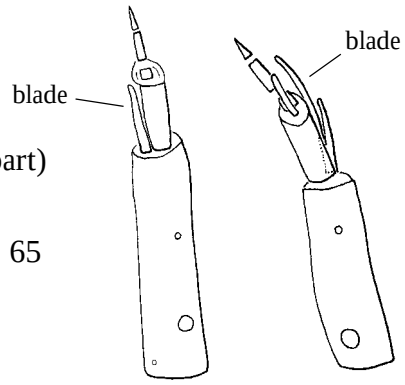
4 segments 5 segments

anal setae

63(62’) Anal setae much shorter than posterior parapods ..... ***Cardiocladius*** (in part)

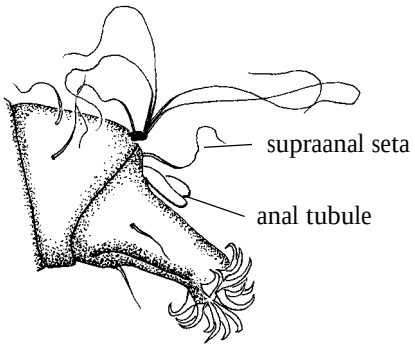
63’ Anal setae longer than posterior parapods 64





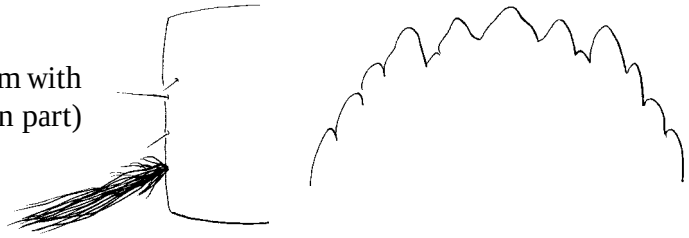
64(63') Antennal blade subequal to segment 2 ... ***Eukiefferiella*** (in part)

64' Antennal blade extends past segment 2 65



65(64') Supraanal setae much longer than anal tubules; abdomen with long setae, about 1/2 as long as segment bearing them ..... ***Eukiefferiella*** (in part)

65' Supraanal setae shorter than anal tubules; abdominal setae short ..... ***Tokunagaia***



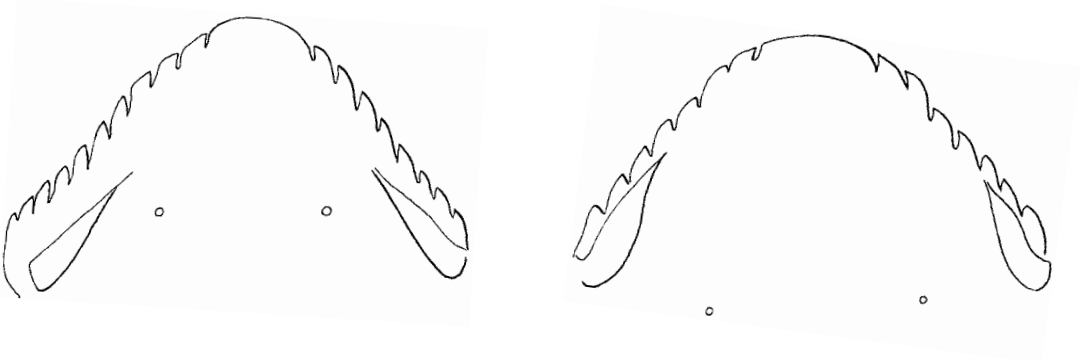
66(59') Body with posterolateral setal tufts; mentum with single median tooth ..... ***Cricotopus*** (in part)

66' Body without setal tufts; mentum with bifid median tooth (see below) 67

67(66') Premandible apically simple; mentum with median teeth strongly projecting anteriorly, without rounded ventromental plates posterolaterally ..... ***Chaetocladius*** (in part) (*Ch. ligni*)

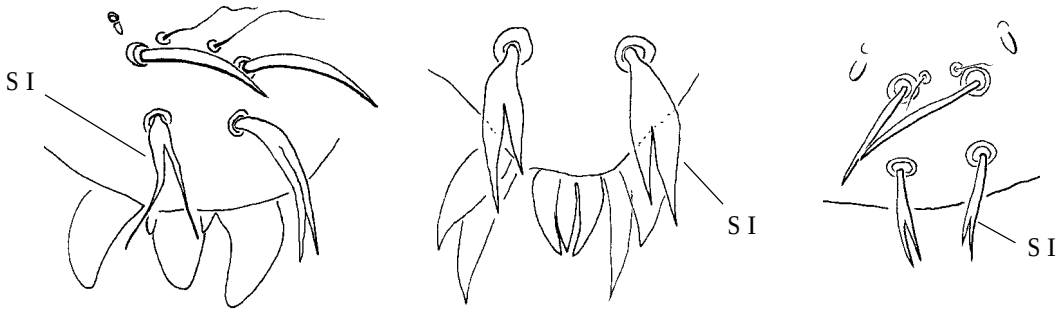
67' Premandible apically bifid; median teeth of mentum do not extend as far forward as above; mentum with rounded ventromental plates posterolaterally ..... ***Limnophyes*** (in part) (although the S I of *Limnophyes* is serrated, serrations may be weak and S I may appear simple; thus some specimens will key here)

68(54, 56') Mentum with 15 or more teeth ..... ***Orthocladius*** (in part)



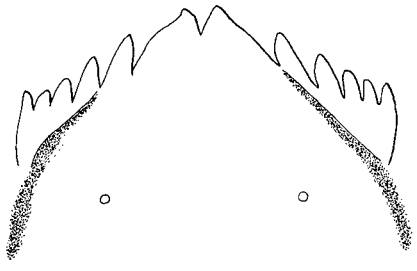
68' Mentum with at most 13 teeth 69

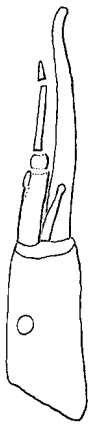
69(68') S I bifid 70



69' S I serrated, apically fringed/toothed, pectinate or plumose 86

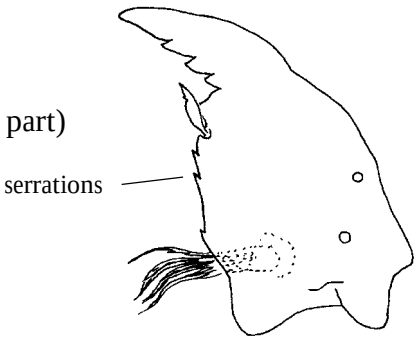
70(69) Mentum with 2 median teeth; antenna with long 4th segment and antennal blade much longer than flagellum ..... ***Mesocricotopus***





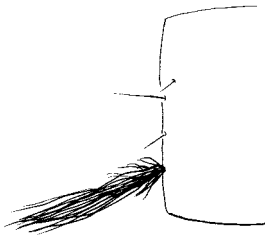
70' Mentum with single median tooth; 4th antennal segment subequal to 3rd and antennal blade at most subequal to flagellum 71

71(70') Inner margin of mandible with serrations ..... ***Cricotopus*** (in part)
(*C. (C.) bicinctus*)



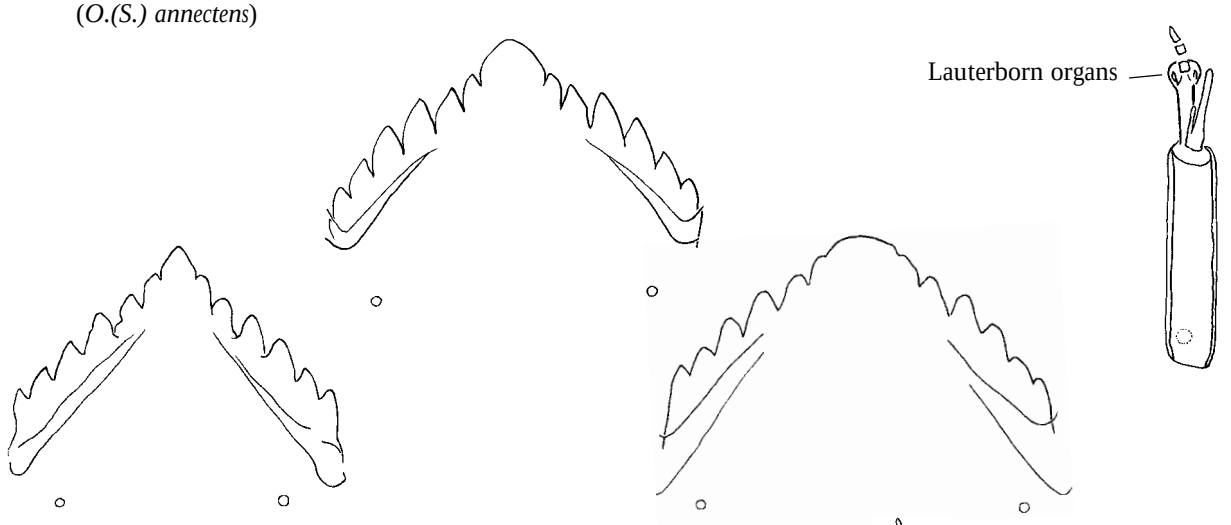
71' Inner margin of mandible smooth 72

72(71') Some abdominal segments with posterolateral setal tufts (may be quite small; most easily found on middle abdominal segments) 73

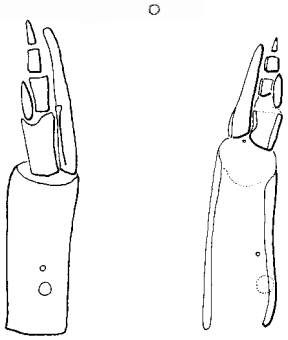


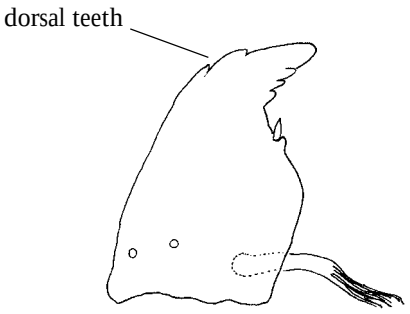
72' Abdominal segments without tufts of setae 74

73(72) Lauterborn organs well developed, appearing as moderately large circular organs at apex of antennal segment 2; mentum with median and appressed first lateral teeth projecting strongly forward from rest of mentum; setal tufts < 100 µm long ..... ***Orthocladius*** (in part)
(*O.(S.) annectens*)



73' Lauterborn organs not developed to appear as circles at apex of second segment; mentum without first lateral teeth appressed to median tooth; setal tufts variable in length, usually > 100µm in length ..... ***Cricotopus*** (in part)

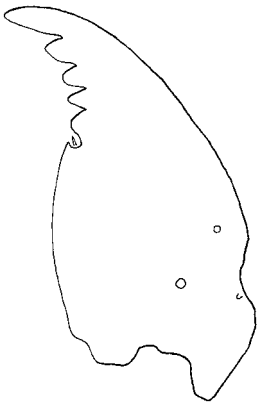


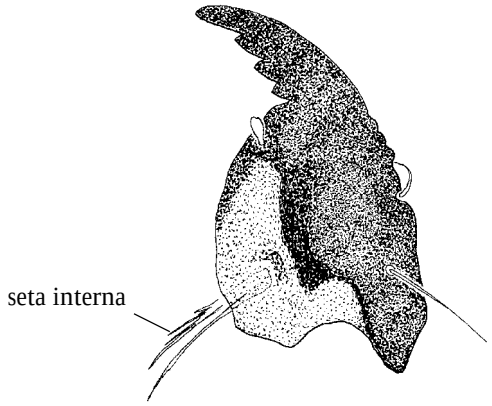


74(72') Head capsule dark brown; mandible with 2-3 dorsal teeth; restricted to colonies of blue-green alga *Nostoc* ..... ***Cricotopus*** (in part)
(*C. (N.) nostocicola*)

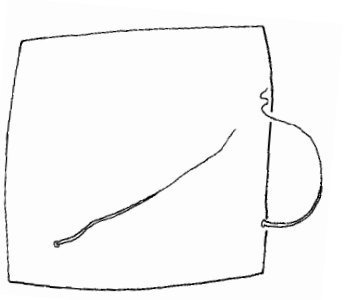
74' Head capsule yellowish to dark brown; mandible without dorsal teeth; not restricted to *Nostoc* 75

75(74') Mandible without seta interna ..... ***Orthocladius*** (in part)





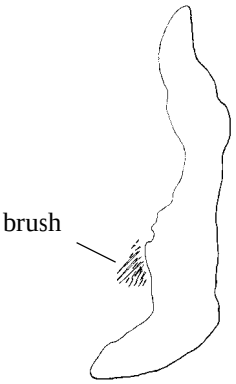
75' Mandible with seta interna 76



76(75') Some abdominal segments (usually middle segments) with long setae, at least ½ as long as the segment bearing them 77

76' Abdominal segments with setae < ½ as long as the segment bearing them 78

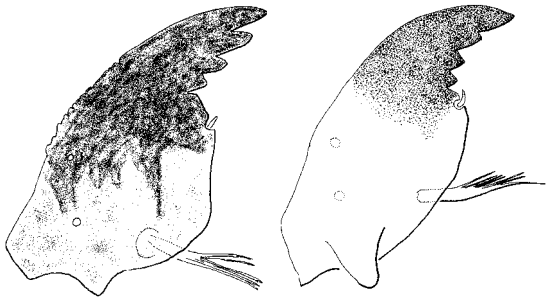
77(76') Premandible apically simple, with weak brush .... ***Cricotopus*** (in part)



77' Premandible simple or apically bifid, without brush ..... ***Orthocladius*** (in part)

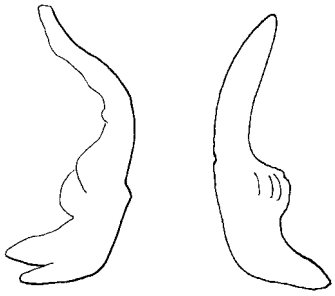
78(76') Head capsule light brown to dark brown or dark reddish-brown; mandibles usually darkly colored to base (base may be paler than apex, but overall the mandible is dark) .. ***Orthocladius*** (in part)

78' Head capsule yellow to light yellow-brown; mandibles with dark apex and inner teeth and light colored base, never darkly colored to base .. 79



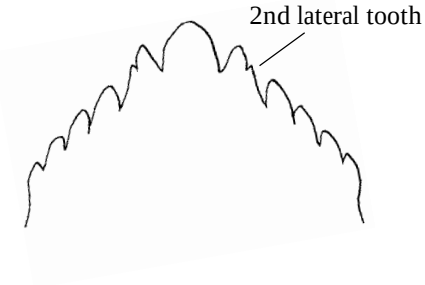
79(78') Premandible apically bifid ..... ***Orthocladius*** (in part) (*O.(O.) oliveri*)

79' Premandible simple 80



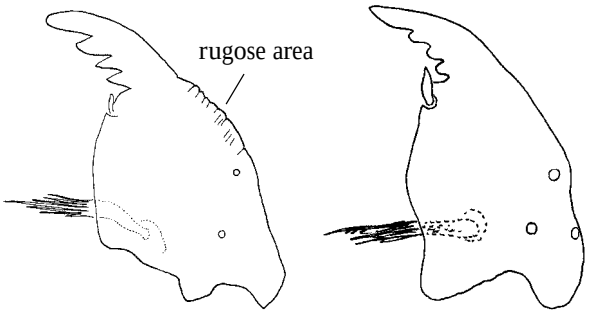
80(79') Mentum with second lateral tooth appressed to first lateral tooth ..... ***Cricotopus*** (in part)

80' Second lateral tooth of mentum not appressed to first .. 81

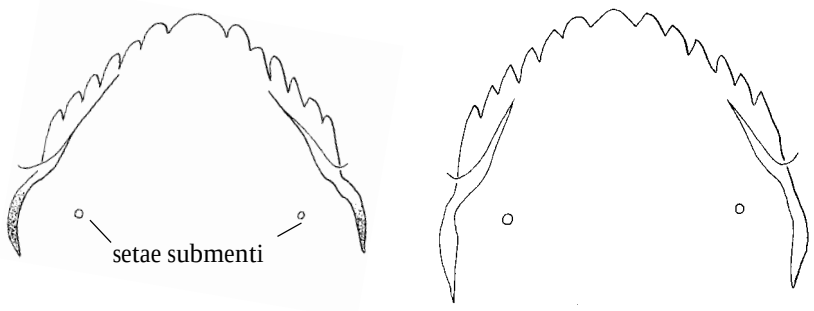


81(80') Outer margin of mandible rugose .... ***Orthocladius*** (in part)

81' Outer margin of mandible mostly smooth 82



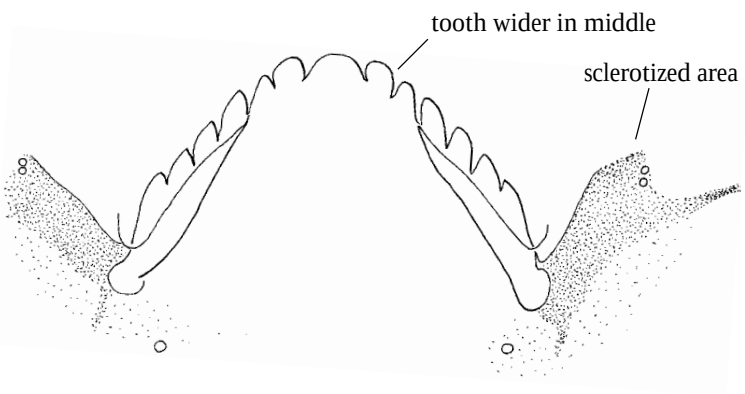
82(81') Ventromental plates appear to extend well past a line drawn between bases of setae submenti ..... ***Orthocladius*** (in part)

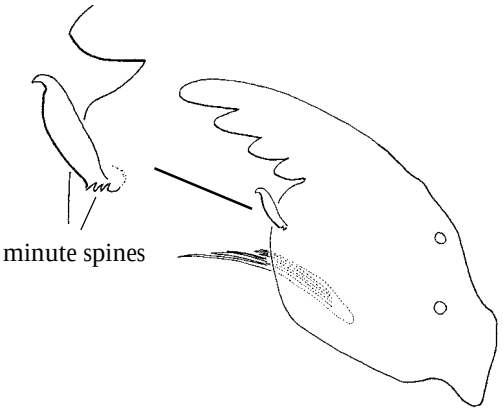


extending not extending

82' Ventromental plates not extending as far posteriorly 83

83(82') Mentum with first lateral teeth constricted at base so that they appear wider in the middle than at bottom; minute spines present at base of seta subdentalis (often difficult to observe); head caspule with slightly more heavily sclerotized area laterad to mentum ..... ***Paratrichocladius***

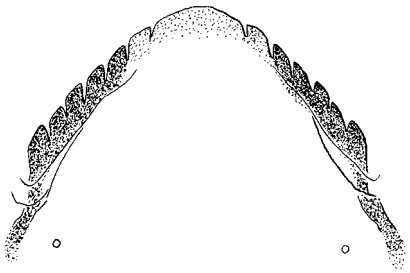




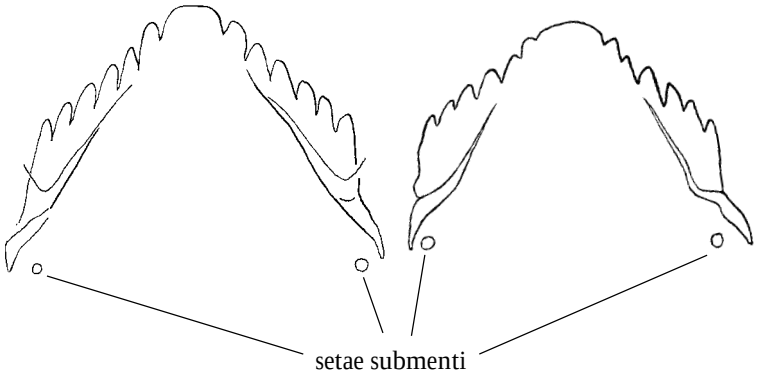
83' First lateral tooth of mentum usually as wide or wider at bottom than at middle; small spines not present at base of seta subdentalis; sclerotized area laterad to mentum variable 84

84(83') Median and first lateral teeth of mentum paler than remaining lateral teeth ..... ***Orthocladius*** (in part)

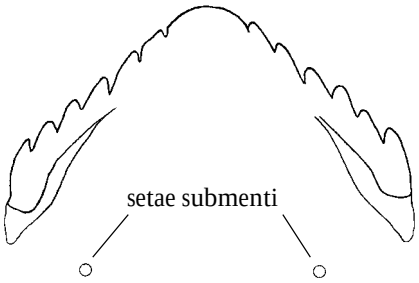
84' Teeth of mentum unicolored 85



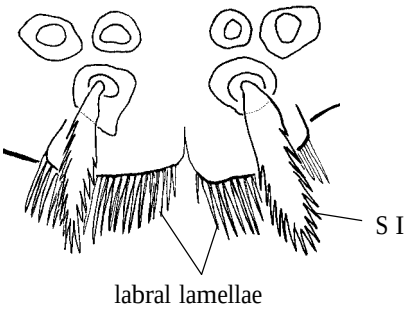
85(84') Mentum triangular in outline or with median and first lateral teeth projecting above remaining lateral teeth; setae submenti located below lateral margin of mentum; pharate pupa with chitinous rings posterolaterally on at least tergites I-III ..... ***Orthocladius*** (in part)

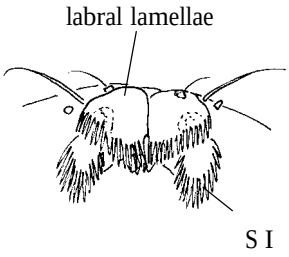


85' Mentum convexly arched, median and first lateral teeth not projecting above remaining lateral teeth; setae submenti located more towards center line of mentum; pharate pupa without chitinous rings on tergites ..... ***Cricotopus*** (in part)



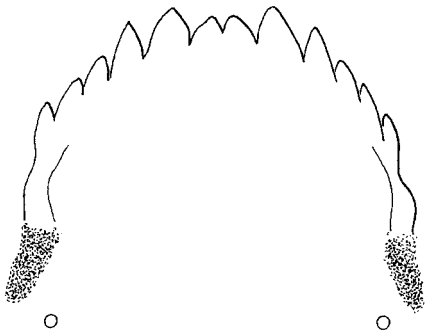
86(69') Well developed labral lamellae present 87



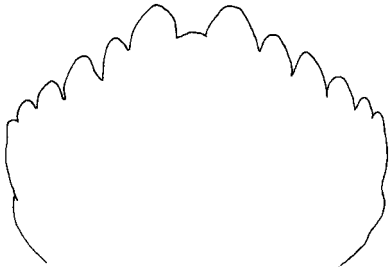


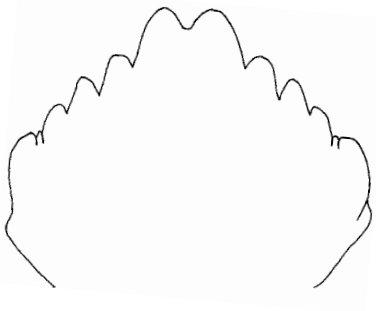
86' Labral lamellae absent or vestigial 90

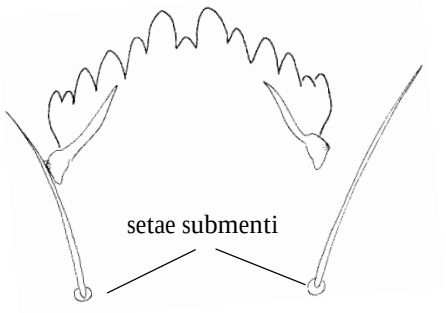
87(86) Mentum with 2-4 median teeth, none elongate; setae submenti located near base of mentum 88



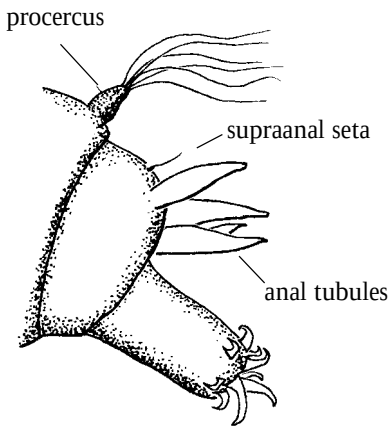
87' Mentum with 2 elongate median teeth (small central tooth sometimes present between median teeth); setae submenti displaced posteriorly, not near base of mentum 89







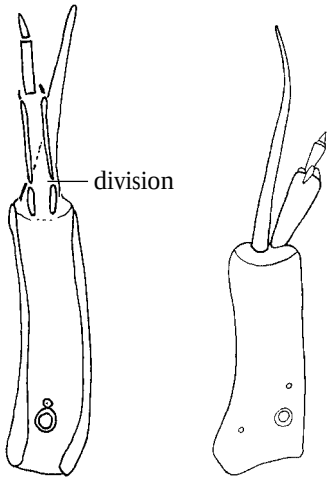
88(87) Procerci well developed, at least twice as long as wide; supranal setae shorter than anal tubules ..... ***Metriocnemus*** (in part)



88' Procerci weakly developed, about as wide as long; supraanal setae as long as or longer than anal tubules ..... ***Thienemannia***

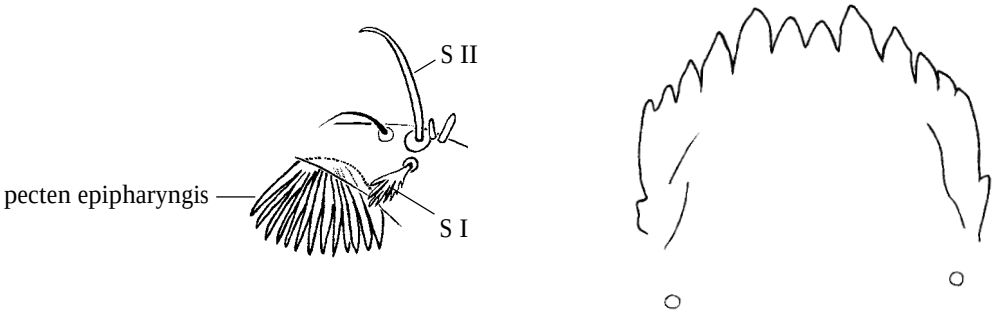
89(87') Antennal segment 2 divided by weakly sclerotized area near base ..... ***Brillia***

89' Antennal segment 2 not divided ..... ***Euryhapsis***

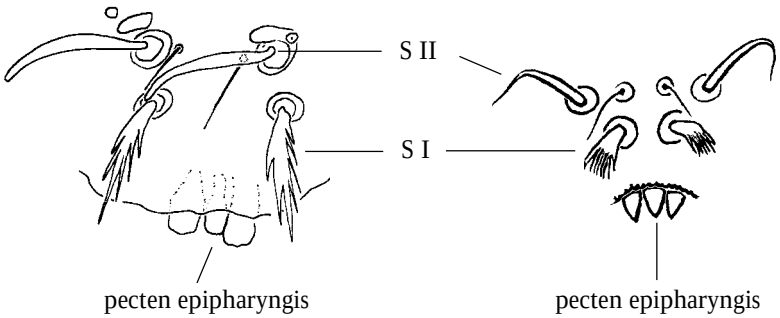


Brillia *Euryhapsis*

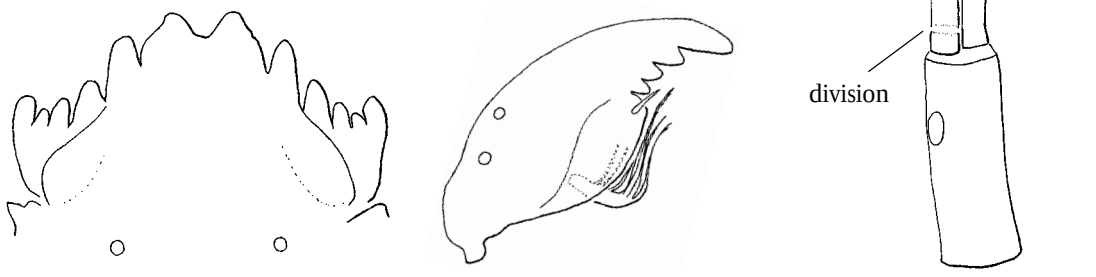
90(86') Pecten epipharyngis with 15-20 long narrow teeth ..... **Orthocladiinae genus E**



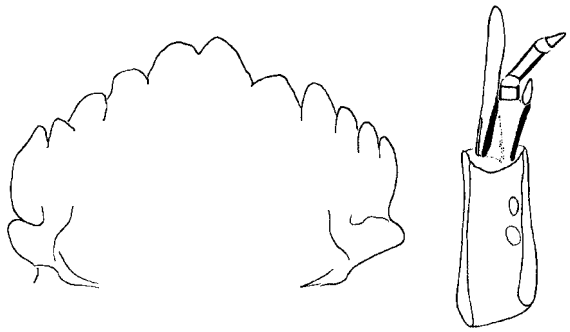
90' Pecten epipharyngis with 3 teeth 91



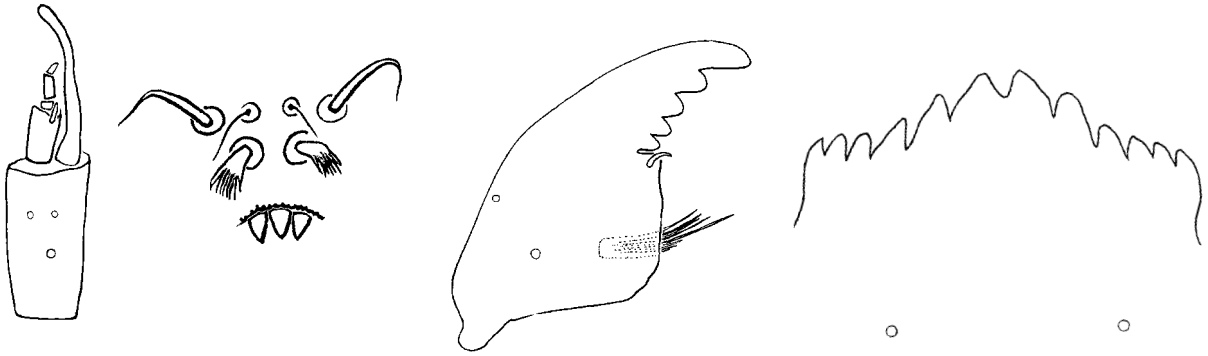
91(90') Mentum with 2 broad median teeth divided by U-shaped or wide V-shaped gap; second antennal segment weakly divided near base; antennal blade much longer than flagellum; mandible with 3 inner teeth ..... ***Heleniella***



91’ Median teeth of mentum not separated by U-shaped or broad V-shaped gap; second antennal segment not weakly divided near base; if antennal blade longer than flagellum, then mandible with 4 inner teeth 92

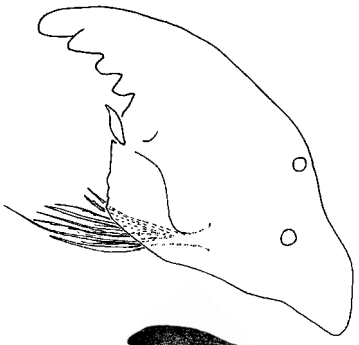


92(91’) Antennal blade longer than flagellum; S I apically pectinate/plumose; mandible with 4 inner teeth; found only in bromeliad phytotelmata in peninsular Florida ..... **Orthocladiinae genus H**



92’ Antennal blade subequal to flagellum; S I serrated; mandible with 3 or 4 inner teeth; not restricted to bromeliads in peninsular Florida 93

93(92’) Mandible with 3 inner teeth; supraanal setae about as long as anal setae ..... ***Limnophyes*** (in part)



93’ Mandible with 4 inner teeth; supranal setae about 1/3 length of anal setae ..... ***Compterosmittia***

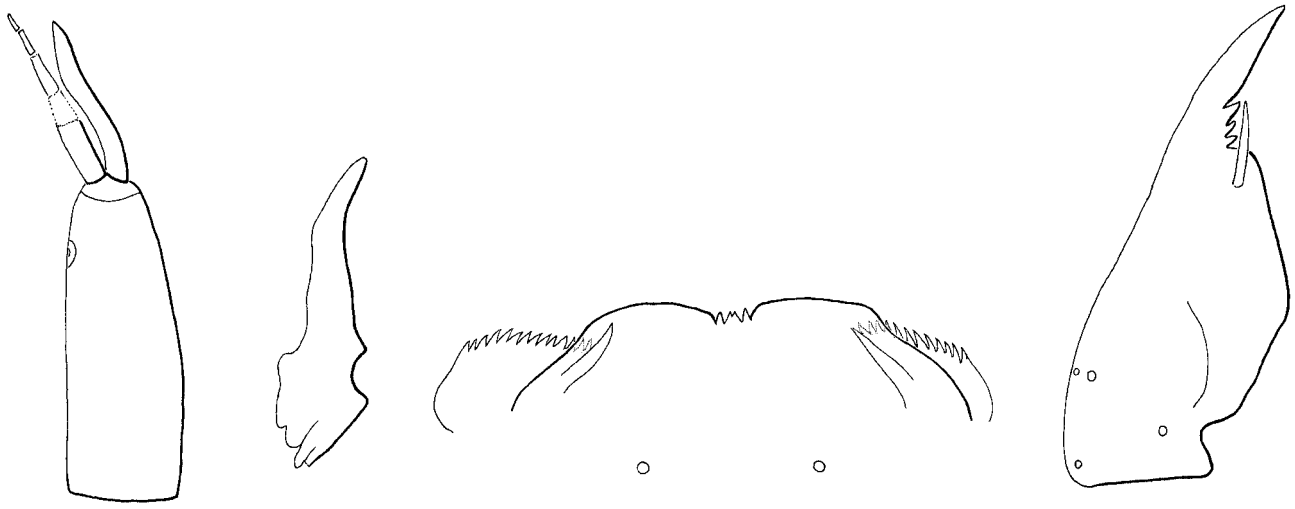
Genus *Acamptocladius*

DIAGNOSIS: This genus is diagnosed by the 5 segmented antennae, with 3rd and 4th segments difficult to distinguish; all S setae simple; ventromentum extended anteriorly to dorsomentum, with 3 central ventromental teeth (middle one may appear bifid) and with dorsomental teeth appearing to be arranged in two lateral lobes, each with about 12-18 teeth; and procerci and anal tubules present.

NOTES: This genus has not been recorded from North or South Carolina, but its presence in Canada and Florida indicates that it will eventually be found in the Carolinas. A single Nearctic species, *A. dentolatens* (Sæther) (originally described as a new genus, *Phycoidella*), has been described from larvae reared from blue-green algae (*Aphanocapsa* sp.) colonies in a lake in Canada; a Palaearctic species, *A. reissi* Cranston & Sæther, was collected from peat pools. One of the Florida *Acamptocladius* collecting sites (St. Lucie Co. in southeast central Florida) was a shallow water (0.4 m) savannah area, with gelatinous algae, *Eriocaulon*, *Nymphaea*, *Rhynchospora* and *Eleocharis* growing from a peaty bottom.

The Florida specimens do not appear to be conspecific with *A. dentolatens*. They will key to *A.* sp. (*submontanus* (Edwards)?) in Cranston & Sæther (1982), but it is very doubtful that they are that species.

ADDITIONAL REFERENCES: Cranston & Sæther 1982; Sæther 1971.



antenna premandible mentum mandible

Genus ***Acricotopus***

DIAGNOSIS: Distinguished by the bifid to coarsely pectinate/palmate S I setae; mandible without a seta interna; mentum with 6 pairs of lateral teeth, with its broad median tooth notched, dividing it weakly into 4 parts; moderate ventromental plates with well developed, long beard; procerci without spurs; and anal tubules present.

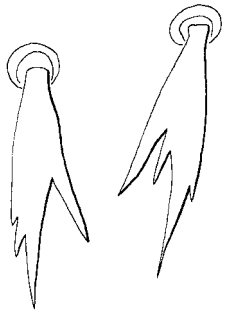
NOTES: Two species are described from North America; only one, *A. nitidellus* (Malloch) is known from the northeastern US. An *Acricotopus* pupa has been collected from South Carolina; a single larva has been found in North Carolina. These specimens probably represent *A. nitidellus*; reared material is necessary to confirm their identity.

Hirvenoja (1973: fig. 38.6) and Cranston, et al. (1983: fig. 9.3D) illustrate the SI setae as bifid with serrated margins. The SI of *A. nitidellus* is more coarsely pectinate as illustrated by Johannsen (1937a: fig. 198; as *Spaniotoma senex*); the SI setae of North Carolina and Ohio specimens are similar.

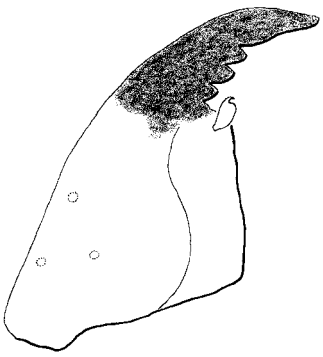
Acricotopus larvae are found in small streams, temporary pools, bog pools and the littoral zone of lakes. The single North Carolina larva examined came from a stream impacted by toxic and organic wastes.

ADDITIONAL REFERENCES: Cranston & Oliver 1988a; Hirvenoja 1973; Johannsen 1937a.

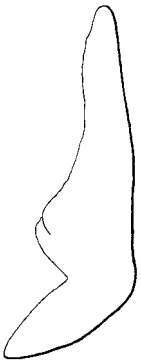
SI, NC specimen



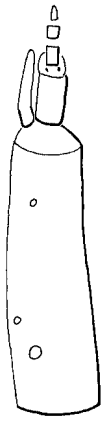
SI, OH specimen



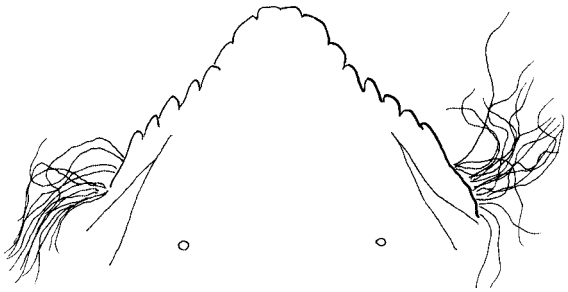
mandible



premandible



antenna



mentum

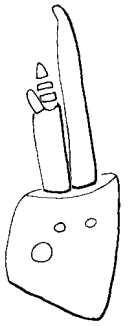
Genus *Antillocladius*

DIAGNOSIS: The coarsely palmate SI; pecten epipharyngis appearing plate-like with numerous small rounded teeth; 5 segmented antennae with blade much longer than flagellum; apically bifid premandible; mandible with seta interna; well developed posterior parapods; and the lack of procerci and anal tubules will distinguish this genus.

NOTES: Two species of *Antillocladius* occur in the Southeast; only the immature stages of *A. pluspilalus* have been described (Sæther 1984). Larvae occur in seeps and around small streams, or are completely terrestrial; the Florida specimens figured below came from hardwood leaf litter.

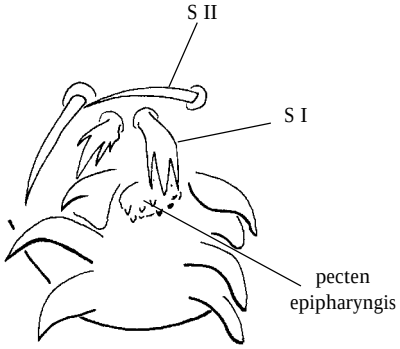
The larva of *A. pluspilalus* was described from a single exuviae; its mentum differs slightly from the unassociated Florida material figured here. Note the unusual pecten epipharyngis, which is similar to the type found in some Chironominae.

ADDITIONAL REFERENCES: Sæther 1981b, 1982, 1984.

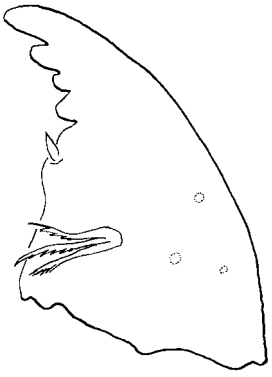


antenna

premandible

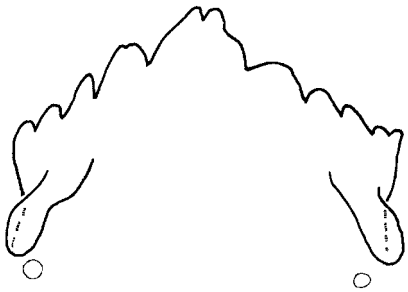


labral area

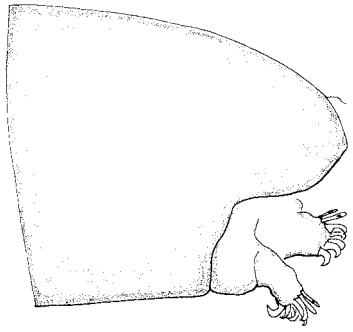


mandible

mentum, FL specimen



A. pluspilalus mentum
(adapted from Sæther 1984)



posterior end

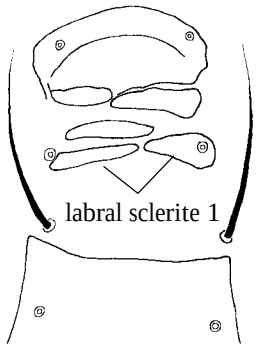
Genus ***Brillia***

DIAGNOSIS: Distinguished by the well developed pectinate labral lamellae; plumose S I; 4 segmented antenna with segment 2 divided in basal third by a weakly sclerotized area; antennal blade subequal to flagellum; distinctive mentum; posteriorly displaced setae submenti (near posterior margin of head capsule); and procerci and anal tubules present.

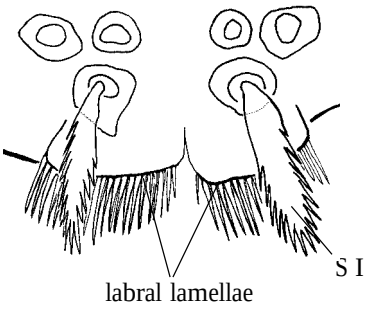
NOTES: Three species are described from eastern North America; all three occur in the Carolinas. The species formerly known as "*Brillia par*" is now placed in *Xylotopus*.

Brillia larvae are almost always associated with submerged allochthonous wood and leaves, and may be found in springs, streams, rivers and the littoral margins of lakes.

ADDITIONAL REFERENCES: Oliver & Roussel 1983.

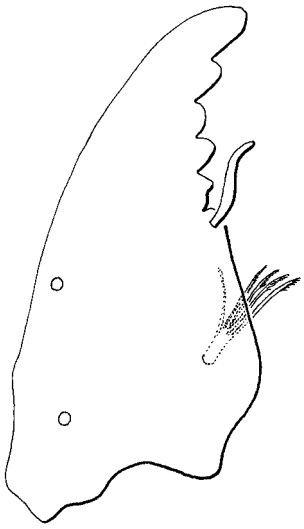


B. flavifrons
apotome and labral sclerites

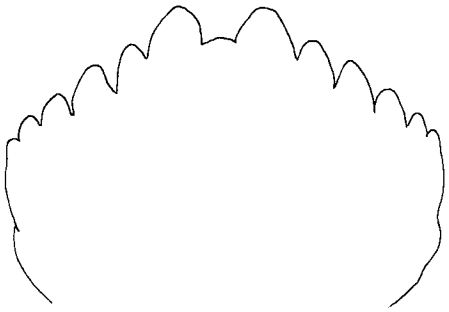


B. flavifrons
palatal surface of labrum

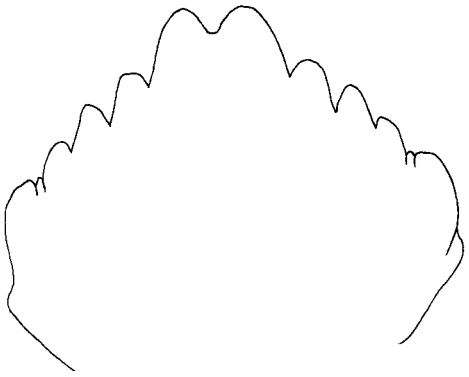
B. parva antenna



B. flavifrons mandible



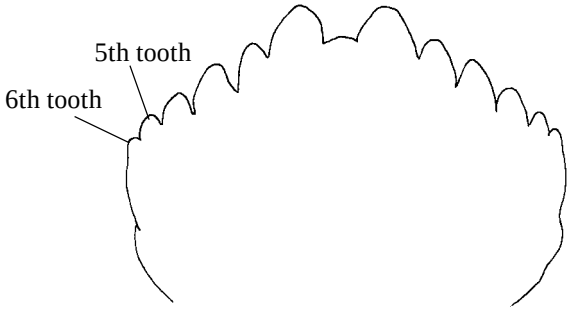
B. flavifrons mentum



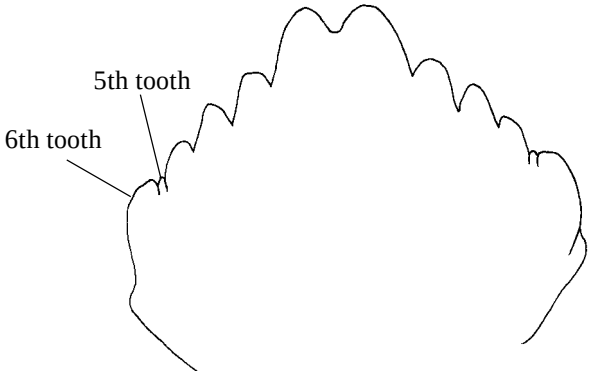
B. parva, mentum

Key to *Brillia* larvae of the southeastern United States

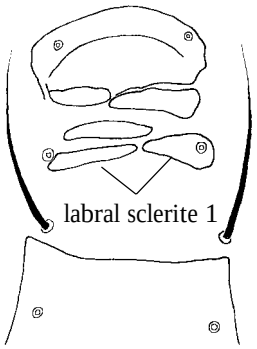
1 6th lateral tooth of mentum placed posterior to 5th lateral tooth 2



1' 6th lateral tooth of mentum even with or anterior to 5th lateral tooth ..... ***B. parva***



2(1) Labral sclerite 1 entire or narrowly separated medially, separation < 8 µm ..... ***B. flavifrons***



2' Labral sclerite 1 widely separated medially, separation > 10 µm ..... ***B. sera***

Genus *Bryophaenocladius*

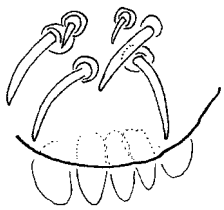
DIAGNOSIS: The five segmented antenna; simple, stout S setae; mandible without seta interna; lack of procerci and anal setae; and posterior end bent downward at a 90° angle, with posterior parapods undivided, will distinguish this genus.

NOTES: Based on adult specimens, five species are recorded from the Carolinas; it is not possible to identify larvae to species. Larvae are very similar to those of *Gymnometriocnemus*; apparently only the divided posterior parapods of *Gymnometriocnemus* larvae will separate them from *Bryophaenocladius*, which lack the division. The larva illustrated as "*Mesosmittia* sp." in Epler (1995:6.51) is most likely a *Bryophaenocladius*.

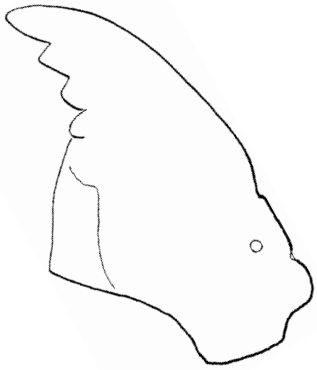
Larvae are mostly terrestrial but several species are aquatic, inhabiting lake shorelines. Some terrestrial larvae may be pests of greenhouse plants and some crops (lettuce, potatoes and tomatoes).

ADDITIONAL REFERENCES: Cranston 1987; Sæther 1973a; Tuiskunen & Lindeberg 1986.

antenna

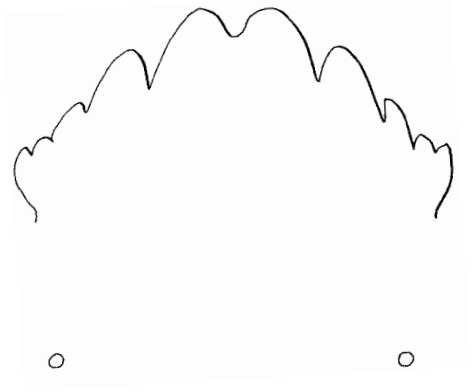


labrum

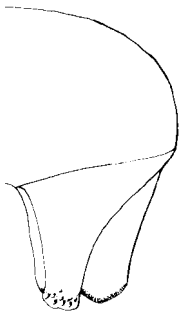


mandible

premandible



mentum



B. furcatus, posterior end
(adapted from Cranston 1987)

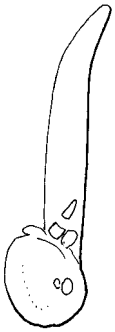
Genus *Camptocladius*

DIAGNOSIS: Distinguished by the bifid S I and S II; reduced, three segmented antennae, with 3rd segment subequal to or shorter than 2nd and blade much longer than flagellum; apically bifid premandible without brush; and the absence of procerci and posterior parapods.

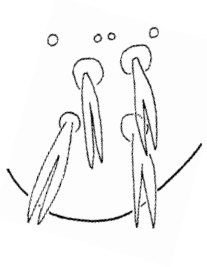
NOTES: Apparently a monotypic genus, *C. stercorarius* has not been recorded from the Carolinas. However, this species is widely distributed throughout the Holarctic and no doubt occurs in the Carolinas; I've examined unassociated specimens from north Florida (illustrated below).

Larvae are terrestrial and are usually found in cow dung and rotting vegetable matter.

ADDITIONAL REFERENCES: Strenzke 1940, 1950a.

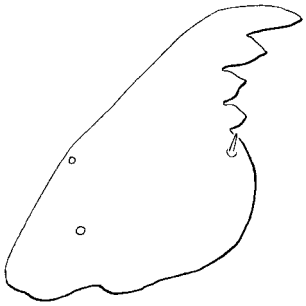


antenna

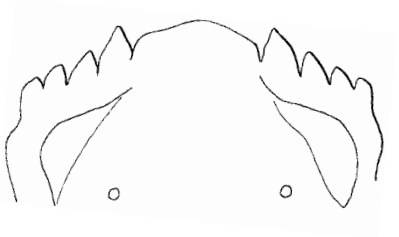


labrum

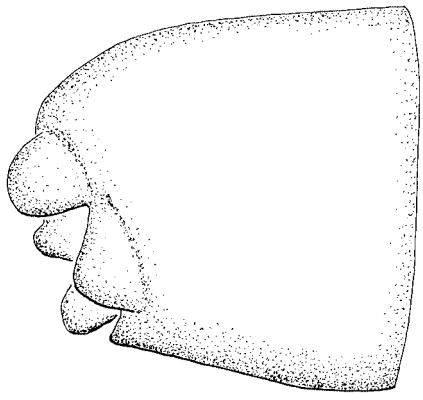
premandible



mandible



mentum



posterior end

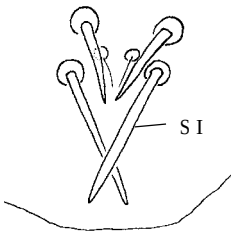
Genus *Cardiocladius*

DIAGNOSIS: Distinguished by the brown to dark brown head capsule; simple S setae, with S I long, thick and heavily sclerotized; short basal sclerite; heavily sclerotized premandible with a broad, usually simple apex; mandible with inner serrations/spines; seta interna of mandible with long simple basal stalk that branches apically; body with short setae; and reduced procerci.

NOTES: Two species of *Cardiocladius* are recorded from the Carolinas. Both species are lotic and appear to be more common in fast flowing water; Hudson et al. (1990) stated that larvae may be "fairly tolerant of toxic pollution".

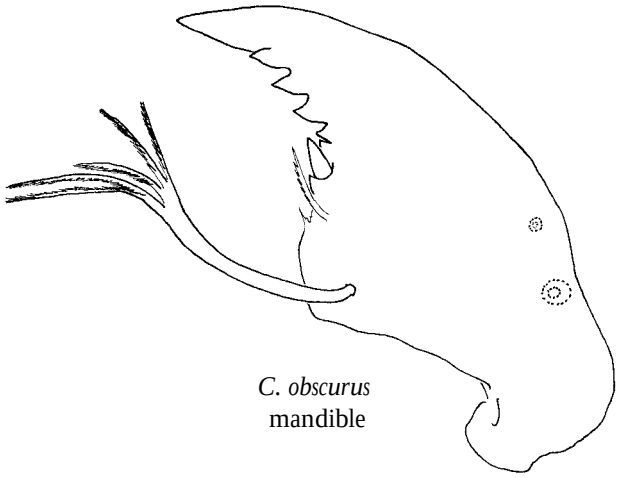
Cardiocladius larvae have been reported to be associated with or even predacious on simuliid larvae. Since many simuliid larvae prefer fast running water, as do *Cardiocladius* larvae, the association makes sense. However, there is (to my knowledge) no published evidence of *Cardiocladius* predation on simuliid larvae; all guts of *C. obscurus* larvae I've examined were filled with detritus, apparently algae. Note that *C. albiplumus* can be ectoparasitic on hydropsychid caddisfly pupae (see Notes on species)

ADDITIONAL REFERENCES: Bode 1983; Oliver & Bode 1985; Parker & Voshell 1979.



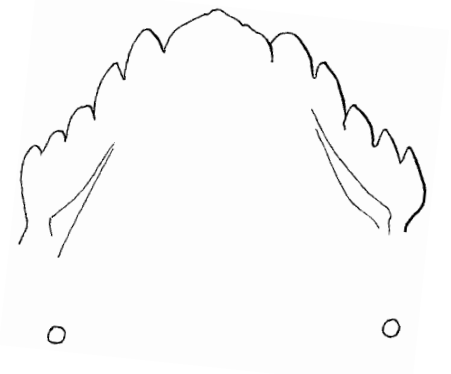
C. albiplumus
S setae

premandible



C. obscurus
mandible

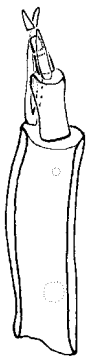
C. obscurus mentum

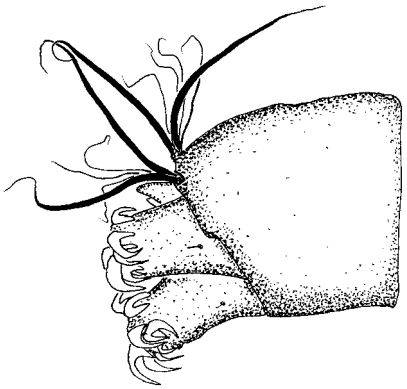


C. albiplumus mentum

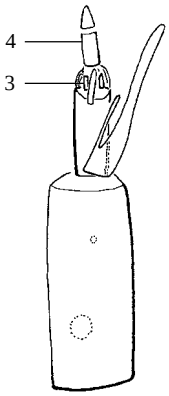
Key to *Cardiocladius* larvae of the southeastern United States

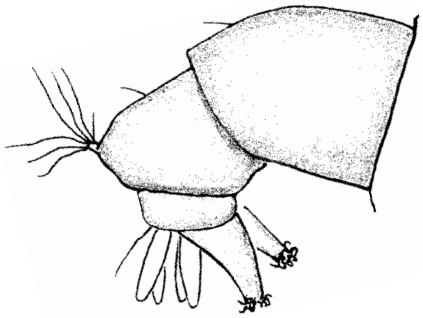
1 Antennal segments 3 and 4 subequal; each procercus with 2 setae that are thicker and longer than others; anal end not deflexed ventrally ..... ***C. obscurus***





1' Antennal segment 4 about twice as long as segment 3; procerci without thicker, longer setae as above; anal end deflexed ventrally ..... ***C. albiplumus***





Notes on species

C. albiplumus - Bode (1983) initially described the larva of this species as "*Eukiefferiella similis* group". Oliver & Bode (1985) associated the immature stages with the adult (previously described by Sæther (1969)) and noted that the species should be placed in *Cardiocladius,* although the immature stages appeared more closely aligned with *Eukiefferiella*. The inclusion of *C. albiplumus* in *Cardiocladius* confuses the limits of *Eukiefferiella* and related genera; on-going revisionary work will hopefully clarify the status of the species. Larvae have been reported as ectoparasites on hydropsychid caddisfly pupae (Parker & Voshell 1979); such larvae grow to a much larger size than other *C. albiplumus* larvae that have fed on algae. Note that the median tooth has a central nipple-like projection which is often worn off. *Cardiocladius albiplumus* also has supraanal setae; these setae are noted as absent in other species of *Cardiocladius* (Cranston et al. 1983). Note also that the deflexed posterior of *C. albiplumus* is similar to that of *Paraphaenocladius* and will cause it to key to *Paraphaenocladius* in Cranston et al. (1983).

C. obscurus - Larvae of this species are far more commonly encountered than those of *C. albiplumus*.

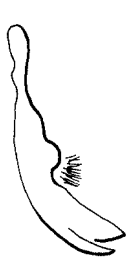
Genus *Chaetocladius*

DIAGNOSIS: In contrast to the adults and pupae, larvae of *Chaetocladius* can be difficult to diagnose due to considerable variation in some larval structures. Larvae may be diagnosed by the following: S I simple (one species, *Ch. ligni*), serrate, branched or plumose; labral lamellae present near bases of S I (sometimes absent/vestigial, as in *Ch. ligni*); antennae 5 segmented, with segment 3 shorter than or subequal to 4; premandible apically simple or bifid, with weak to moderate brush; mentum with 1 or 2 median teeth; and ventromental plates small to large, when large may extend beyond lateral margin of mentum.

NOTES: Caldwell et al. (1997) report two species of *Chaetocladius* from the Carolinas based on adult specimens; I've seen two species from the Smoky Mountains based on pupae. There are probably several more species present in the Southeast, but with the exception of *Ch. ligni* (with its distinctive mentum and labral setae), it is not possible to identify larvae to species. *Chaetocladius stamfordi* has been shown to be a junior synonym of *Ch. piger* (Caldwell 1997); *Chaetocladius* requires revision in the Nearctic. The preanal segment of *Ch. ligni* is curved over the posterior segments, similar to *Cardiocladius albiplumus* and *Paraphaenocladius* species; I've seen larvae of *Ch. ligni* from Great Smoky Mountains National Park in North Carolina.

Chaetocladius larvae may be semi-terrestrial or aquatic, being found in wet leaves, springs, ditches, streams, ponds and permanent and temporary pools, as well as in wells and sewage treatment plants; one species, *Ch. ligni*, mines in immersed wood.

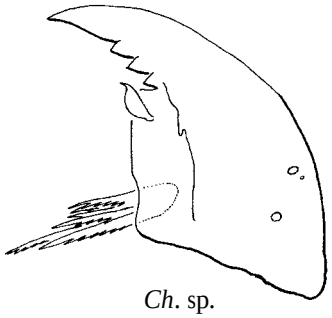
ADDITIONAL REFERENCES: Caldwell 1997; Cranston & Oliver 1988b.



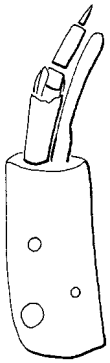
Ch. sp.
bifid premandible

Ch. sp.
simple premandible

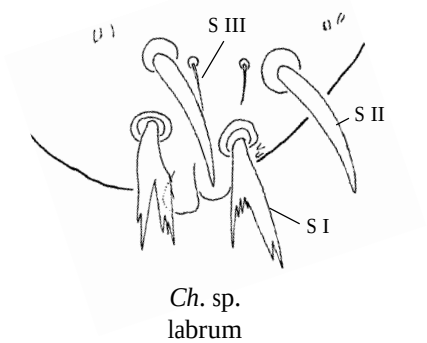
Ch. ligni premandible



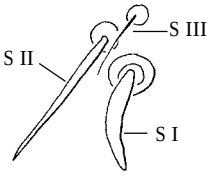
Ch. sp.
mandible



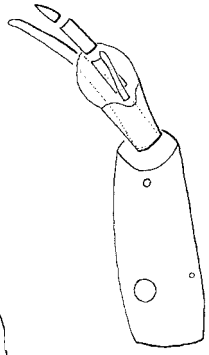
Ch. sp.
antenna



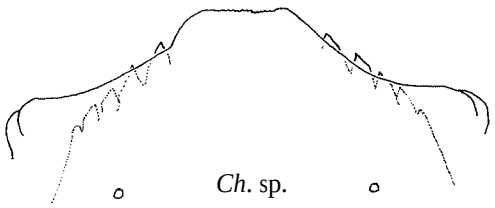
Ch. sp.
labrum



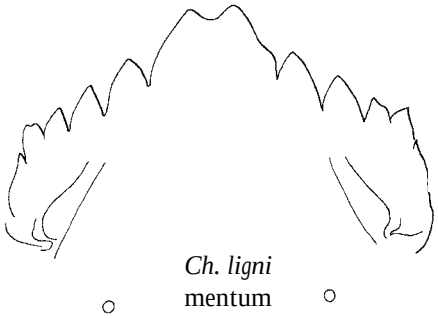
Ch. ligni
labral setae



Ch. ligni
antenna



Ch. sp.
mentum



Ch. ligni
mentum

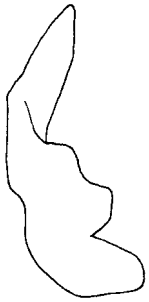
Genus ***Clunio***

DIAGNOSIS: This genus is easily identified by its plumose S I and S II; premandible with simple apex; lack of procerci and anal tubules; and its marine/brackish water habitat.

NOTES: One species, *C. marshalli*, is known from the southeastern United States. Specimens from near Wilmington, NC, are the northernmost examples I've examined.

I've collected larvae and pupae from algae covered rocks in the Intracoastal Waterway in Florida, where they co-existed with *Thalassomya* larvae.

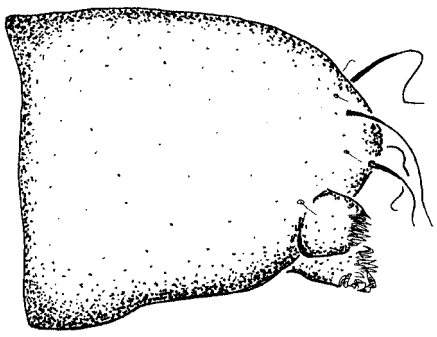
ADDITIONAL REFERENCES: Hashimoto 1976; Stone & Wirth 1947; Strenzke 1960; Wirth 1949.



premandible

labrum

mentum



posterior end

Genus *Compterosmittia*

DIAGNOSIS: Distinguished by the absence of labral lamellae; serrated S I; 5 segmented antenna, with blade shorter than to subequal to flagellum; apically bifid premandible, without brush; mentum with 2 median teeth and 5 pairs of lateral teeth; ventromental plates weak, with posterolateral portion appearing as a rounded tooth; mandible with 4 inner teeth, proximal tooth distinctly separate from mola; body setae shorter than 1/2 length of segment; and supraanal setae 1/3 length of anal setae.

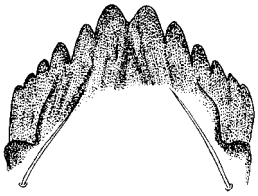
NOTES: One species, *C. nerius*, is known from the eastern United States, where it is recorded from New York and both Carolinas. The immature stages are undescribed; the diagnosis above and figures below are based on larvae from Hong Kong and Tasmania. Larvae are very similar to *Limnophyes* and *Paralimnophyes*; pupae of *Compterosmittia* are inseparable from those of *Limnophyes*.

Larvae from the Australian and Oriental regions were collected from phytotelmata (plant held waters); the habitat of immature *C. nerius* is unknown.

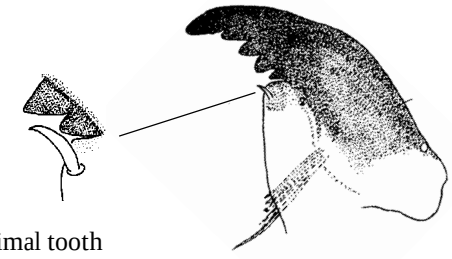
ADDITIONAL REFERENCES: Cranston & Kitching 1995; Sæther 1981b.

labrum and premandible

antenna



mentum



proximal tooth

mandible

(figures above adapted from Cranston & Kitching 1995)

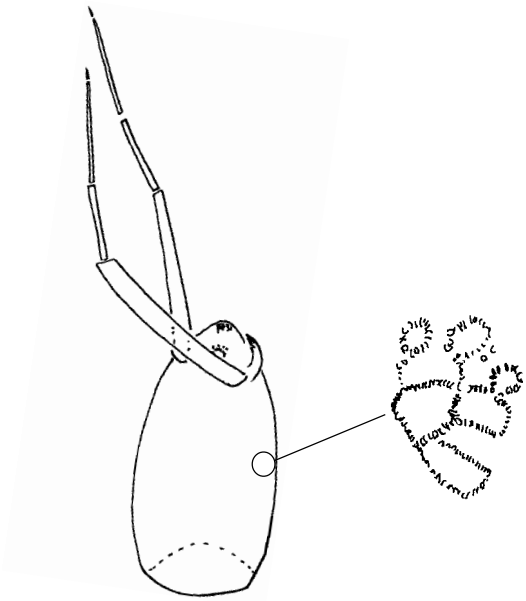
Genus ***Corynoneura***

DIAGNOSIS: Distinguished by the small size (less than 4 mm) and long, 4 segmented antennae that are subequal to or longer than head capsule length.

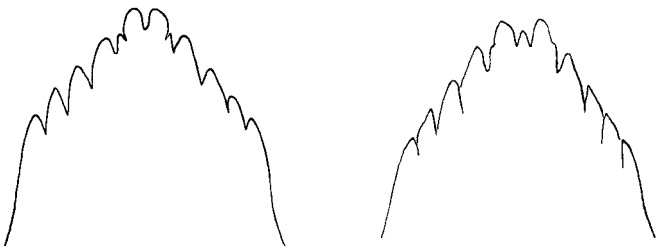
NOTES: Four named species are recorded from the Carolinas. However, it is uncertain whether these named species, three of which are Palaearctic, have been correctly identified, although I have seen pupal and adult material that is most certainly *C. lobata* (see Notes on species for *C. taris*). Seasonal variation in the number of adult antennal flagellomeres can cause confusion, perhaps leading to misidentification of adults (see Schlee (1968) and Hirvenoja & Hirvenoja (1988)). Larval keys written for European species will not work correctly in the Nearctic; matching a specimen's mentum with an illustration from the literature (mostly based on Palaearctic species) does not mean that a correct identification has been achieved. All Nearctic records of *Corynoneura* species based on larvae must be treated with extreme skepticism. Because of the difficulties in identifying *Corynoneura* species, some due to vague descriptions or misunderstandings by earlier workers who did not examine type material, it appears that the names *C. scutellata*, *C. celeripes* and *C. taris* have been grossly misused; see Schlee (1968) and Hirvenoja & Hirvenoja (1988). Note that the species keyed and illustrated as *C. scutellata* in Pinder (1978) is *C. gratias* Schlee (Hirvenoja & Hirvenoja (1988)). Needless to say, the Nearctic species of *Corynoneura* are in great need of revision!

Corynoneura are found in a wide variety of habitats, and it is not unusual to find two or more species in one sample. The key that follows must be considered preliminary; there may be other species in the Southeast whose larvae I have not seen and can not include in the key. Note especially that 4th instar larvae are necessary for correct use of much of the key; Hirvenoja & Hirvenoja (1988) found that antennae lengthened from the first to the last instars. Also note that relative lengths of antennal segments may vary within a species from instar to instar.

ADDITIONAL REFERENCES: Boesel & Winner 1980; Hirvenoja & Hirvenoja 1988; Schlee 1968; Sublette & Sasa 1994.



C. lobata head capsule with close-up of reticulate sculpturing



C. sp. B mentum

C. sp. G mentum

C. sp. B *C.* sp. C *C.* sp. D

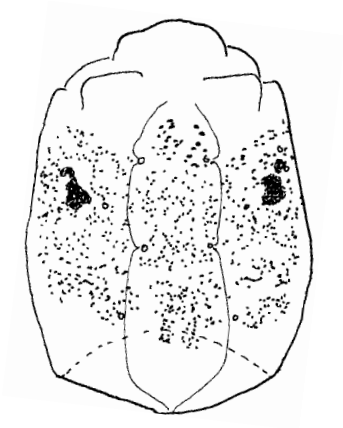
subbasal setae of posterior parapod

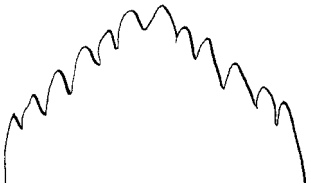
Key to *Corynoneura* larvae of the southeastern United States

1 Head capsule integument with pustules/granules or sculpturing consisting of fine scratches, often in a reticulate pattern (sculpturing usually strongest dorsally, but may be faint in some specimens) (see figures in couplet 2) 2

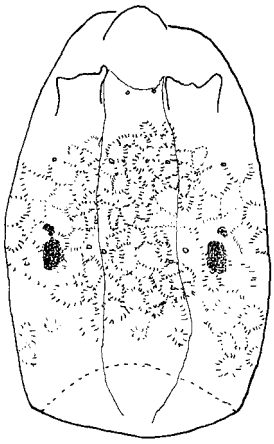
1' Head capsule integument smooth, unsculptured 5

2(1) Head capsule integument pustulate/granulate; mentum with 2 median teeth; known only from southern Florida ..... ***C.* sp F**

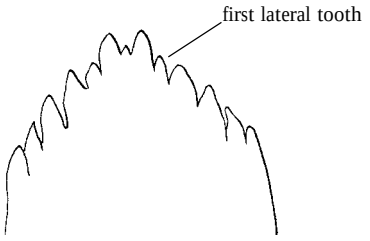




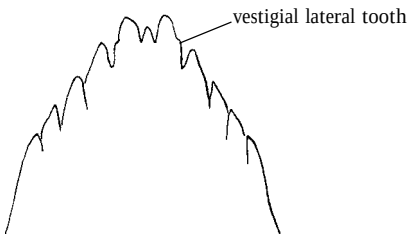
2' Head capsule integument with sculpturing that usually forms a reticulate pattern; mentum with 3 median teeth (see couplet 3 below); widespread 3



3(2') First lateral tooth of mentum well defined, rising to about the same level as second lateral tooth, mentum with 5 well defined lateral teeth on each side ..... ***C.* sp. C**

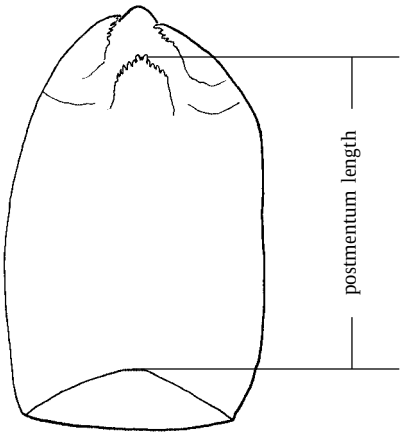


3' First lateral tooth of mentum vestigial or appressed closely to outer median tooth so that mentum may appear to have only 4 lateral teeth per side 4



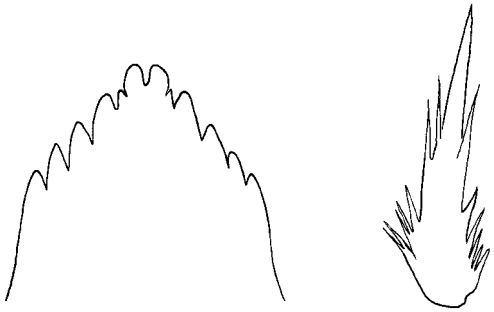
4(3') Basal antennal segment shorter, less than to slightly greater than postmentum length ..... ***C. lobata***

NOTE: 4th instar larvae are necessary for accurate measurements!!

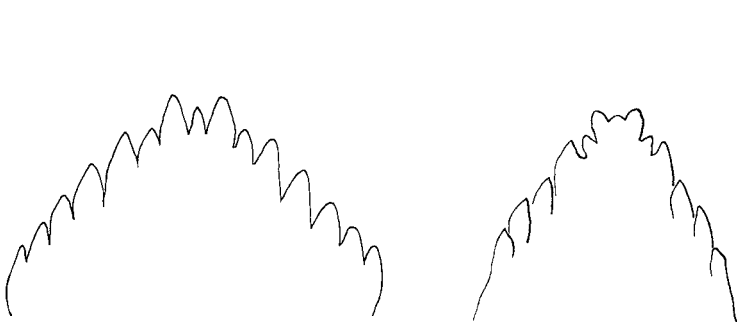


4' Basal antennal segment longer; much longer (at least 10 µm) than postmentum length ..... ***C.* sp. G**

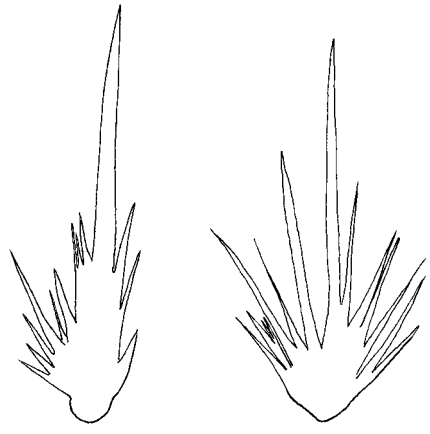
5(1') Mentum with 2 median teeth; posterior parapod subbasal setae with lateral spinules running along almost entire side of main shaft, not confined to basal half or less ..... ***C.* sp. B**



5' Mentum with 3 median teeth; posterior parapod subbasal seta with lateral spinules of main shaft confined to basal half or less 6

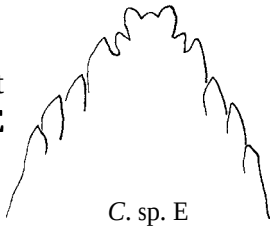


C. sp. E



C. sp. D

6(5') Total length of antennae subequal to head capsule length, basal segment about 80-100 µm (4th instar only!) ..... ***C.* sp. E**



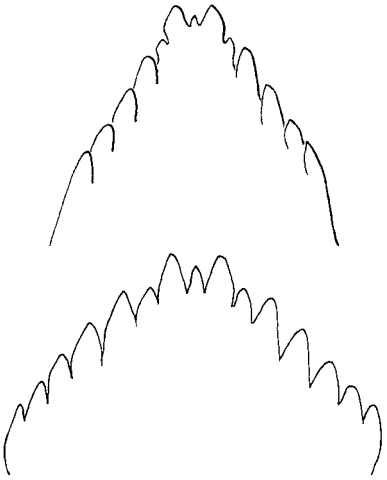
C. sp. E

6' Total antennal length much longer than head capsule length; basal segment 190-325 µm 7

7(6') Mentum with 5 pairs of lateral teeth; basal antennal segment 190-210 µm long (4th instar only!) ..... ***C.* sp. H**

NOTE: 4th instar larvae are necessary for accurate measurements!!

7' Mentum with 6 pairs of lateral teeth; basal antennal segment 300-325 µm long (4th instar only!) ..... ***C.* sp. D**



Notes on species

C. lobata - In the Nearctic this species was formerly referred to as *C. taris*. I have re-examined the holotype male of *C. taris*; contrary to Roback's (1957) description, the gonocoxite does bear a small medial lobe and is basically identical to *C. lobata* Edwards. Both species have antennae with 10 flagellomeres; however, in adult males of Palaearctic *C. lobata* the last antennal segment is as long as the preceding 4-6 flagellomeres while in the holotype *C. taris* it is slightly shorter than the preceding 3 flagellomeres. Given the propensity for variation known in the genus *Corynoneura* (see Schlee (1968) and Hirvenoja & Hirvenoja (1988)), this difference appears insignificant. I have measured the *C. taris* holotype's AR as 0.36; this falls within the range of ARs (0.20-0.64) for this species given by Schlee (1968). Both taxa have an S-shaped setae at the enlarged apex of the hind tibia. Associated pupae from north Florida will key to *C. lobata* in Langton (1991) and in a manuscript key to North American pupal exuviae. Under a different coverslip on the same slide as the holotype of *C. taris* is a whole mounted larva; it is not an exuviae and thus can not be directly associated as the larval exuviae of the holotype (which, according to Roback (1957), was reared.) It is this larva that Epler (1995) used as a basis for *C. taris* in his larval key. Its basal antennal segment is as long as the postmentum length (163 µm). Cranston's (1982) key stated that the first antennal segment length of *C. lobata* was less than 200 µm but greater than 130 µm. I've also examined reared specimens of *C. lobata* from England and have compared them to reared Nearctic material (mostly from Florida). I can see no differences that would suggest that the two taxa are not the same entity and thus I consider the two synonymous; *lobata* is the older name and has priority. A single reared male *C. lobata* from Ohio is slightly different in that the pupa differs slightly in bearing very light tergal shagreen in contrast to the moderate to heavy shagreen of *C. lobata*.

Note that the ovoid darker area on the mid-dorsum of the head mentioned by Epler (1995) can also be observed on *C.* sp. C and *C.* sp. G. *Corynoneura* sp. G may be a variant of *C. lobata* with longer antennae; reared material is necessary to confirm whether the two taxa are different species.

C. sp. B - This is apparently the same taxon called "*C. celeripes*" by Simpson & Bode (1980); the mentum and subbasal setae of the posterior parapods are similar. However, I have reared *C*. sp. B from the Suwannee and Withlacoochee Rivers in northern Florida; this species does not appear to be *C celeripes*. Male genitalia of *C*. sp. B are somewhat similar to *C. lobata*, but differ in having a truncate transverse sternapodeme; that of *C. lobata* is sharply arched and directed anteriorly. The larva of *C. coronata* Edwards as illustrated by Cranston (1982) and Cranston et al. (1983) also has a mentum similar to *C*. sp. B, but *C*. sp. B is **not** that species either; *C. coronata* has sculpturing on the head capsule. This taxon appears to be an undescribed species and is apparently common throughout the Southeast (and perhaps the entire eastern U.S.). Hirvenoja & Hirvenoja (1988) separated some species as larvae by antennal length. Using such criteria, *C*. sp. B may consist of more than one species: in Florida and South Carolina material examined, there were two size classes based on basal antennal length/postmentum length. In specimens with basal antennal segment lengths of 150 µm or more, basal segment length was greater than postmentum length; in specimens with basal antennal lengths 125 µm or less, basal segment length was less than or subequal to postmentum length. Whether this is due to allometry, seasonal, or species differences will remain uncertain until adults of both varieties are associated with larvae (I have reared only the "short" antennal variety).

C. sp. C - Very similar to *C. lobata* and *C*. sp. G, but with a well developed first lateral tooth on the mentum. This species has long antennae; the basal segment is much longer than postmentum length. This taxon may be *C. lacustris* or *C. scutellata* but reared material is needed for confirmation.

C. sp. D - This taxon is unique in that most specimens have a mentum with 6 pairs of lateral teeth (plus three median teeth); Cranston et al. (1983) stated that *Corynoneura* has 5 pairs of lateral teeth plus 2 or 3 median teeth. The outermost 6th tooth may appear as only a notch on some specimens; the figure accompanying couplet 6' is of a considerably flattened mentum. Note also the smooth head capsule integument and the very long antennae. I have not yet seen this taxon from the Carolinas.

C. sp. E - A species with short antennae for a *Corynoneura*; total antennal length is subequal to the length of the head capsule. I have seen specimens from as far north as the Blue Ridge Parkway in North Carolina.

C. sp. F - Known only from marshes in south Florida, this species is unique among North American *Corynoneura* known to me in that the head capsule integument bears tiny pustules or granules. Its head capsule is rather squat for a *Corynoneura*; the basal antennal segment is longer than the postmentum length.

C. sp. G - I have set aside larvae with longer antennae than *C. lobata* as a separate taxon. If the basal antennal length is more than 10 µm greater than the postmentum length, I have called such larvae *C*. sp. G. There does seem to be a "natural" gap here, but, as usual, more material is needed! I have seen material of this taxon from South Carolina and northern Florida.

C. sp. H - A smooth head capsuled species with moderately long antennae, I have seen this taxon only from the Santa Fe River in northern Florida. Since much of northern Florida's chironomid fauna is found throughout the southeastern Coastal Plain, it should probably occur in that region of the Carolinas.

In addition to the described species listed by Caldwell et al. (1997), I have examined male specimens of what is probably *C. oxfordana* Boesel, described from Ohio, from the Savannah River Plant area in South Carolina and Coweeta Hydrologic Lab in North Carolina; the immature stages are undescribed.

Genus *Cricotopus*

DIAGNOSIS: A difficult genus to diagnose precisely because of variation in many key characters; many larvae are difficult or impossible to separate from *Orthocladius (Orthocladius)* and *Paratrichocladius* larvae. S I most often bifid, but sometimes simple or with one branch considerably larger than the other; pecten epipharyngis a simple scale ([*C. (Isocladius)*] or with 3 scales [*C. (Cricotopus)* and *C. (Nostococladius)*]; simple (usually) or bifid premandible; weakly developed ventromental plates; beard very weak or vestigial; mentum with an odd number of teeth; and abdominal segments with or without a pair of posterolateral setal tufts.

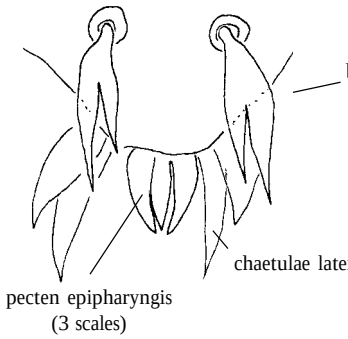
NOTES: About 16 species of *Cricotopus*, representing three subgenera (*Cricotopus*, *Isocladius* and *Nostococladius*), are recorded for the Carolinas. Many of these records are based on pupae or adults, because reliable identifications are often not possible with Nearctic *Cricotopus* larvae that have not been associated with a pupa or an adult. As noted above, some *Cricotopus* larvae are very difficult to separate from those of *O. (Orthocladius)* and *Paratrichocladius*. It may be necessary to run specimens through both the *Cricotopus* and *Orthocladius* keys; in many instances it will be necessary to have associated pupae or adults for accurate identifications. Quite often, the best you may be able to do is an identification of "*Cricotopus/Orthocladius* sp.". Hirvenoja (1973) revised *Cricotopus* for the western Palaearctic; his keys to adults, pupae and larvae have been translated and modified in Simpson et al. (1983). Note that in the Southeast there are several species that will not fit in Hirvenoja's keys or species groups, and the conspecificity of many Nearctic forms with Palaearctic species has not been conclusively demonstrated - a revision of the Nearctic species is greatly needed!

Contrary to the diagnosis in Cranston et al. (1983), most *Cricotopus* larvae do have a weak cardinal "beard" near the lateral margin of the mentum (Hirvenoja (1973) gives beard length measurements). Also note that the presence of posterolateral setal tufts on the abdominal segments will not distinguish larvae as *Cricotopus* - at least two species of *Orthocladius* (*O. annectens* and *O. lignicola*) possess setal tufts. However, note that the extremely long setal tufts of *C. sylvestris* group larvae easily identify them, visible even in alcohol. Larvae with both a simple S I and setal tufts (except for *O. lignicola*) are *Cricotopus*.

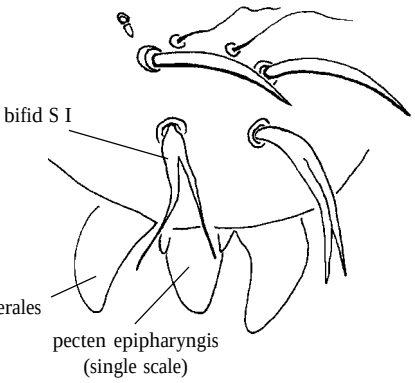
Larvae are found in a variety of aquatic habitats, where they are often associated with plants. *C. (Isocladius)* species tend to be more common in lentic conditions; *C. (Cricotopus)* species are more common in lotic situations; *C. (Nostococladius)* is associated with the blue-green alga *Nostoc*. Some *Cricotopus* larvae may be economically important as pests in rice fields (members of the *C. (I.) sylvestris* group) and as biocontrol agents for nuisance aquatic plants (*C. (I.) lebetis* for hydrilla). *Cricotopus bicinctus* and *C. infuscatus* are tolerant of many types of water pollution.

The key that follows must be used with caution; our knowledge of Nearctic *Cricotopus* larvae is still relatively poor. You should have an associated pupa or adult that indicates that your specimen is a *Cricotopus* (you may have to run your specimen through the *Orthocladius* key as well); and before applying a species-level name to a larva, it should be verified by an associated pupa or adult.

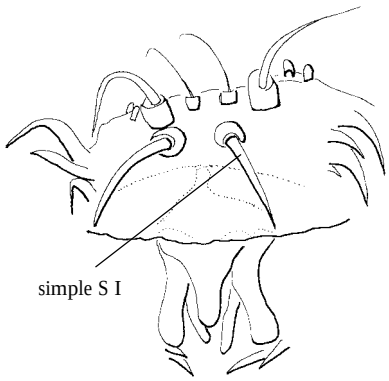
ADDITIONAL REFERENCES: Boesel 1983; Epler et al. 2000; Hirvenoja 1973; LeSage & Harrison 1980; Oliver 1977, 1984; Simpson & Bode 1980; Simpson et al. 1983 (translation of keys of Hirvenoja 1973).



C. (C.) politus
labrum



C. (I.) trifasciatus
labrum

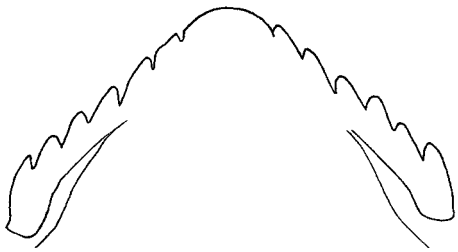


C. (I.) lebetis
labrum

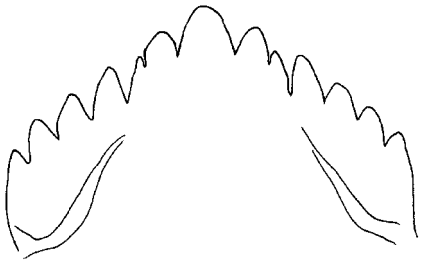
C. politus
simple premandible

C. sylvestris apically
bifid premandible

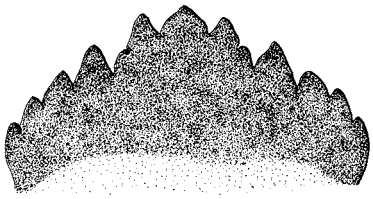
C. lebetis antenna



C. politus mentum



C. trifasciatus mentum



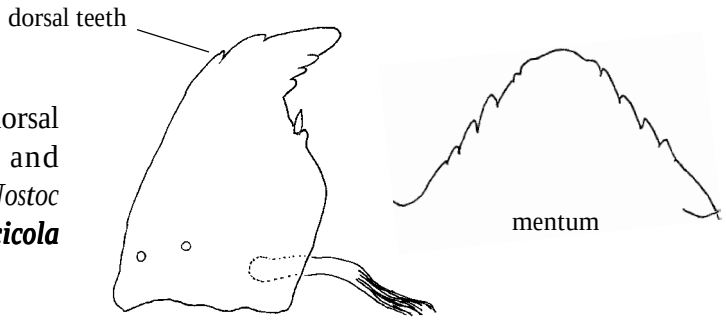
C. lebetis mentum

Key to *Cricotopus* larvae of the southeastern United States

(For best results you should have at least a pupal association that confirms that your specimen is indeed a *Cricotopus* before using this key. Most identifications should be considered tentative unless backed by a pupal or adult association.)

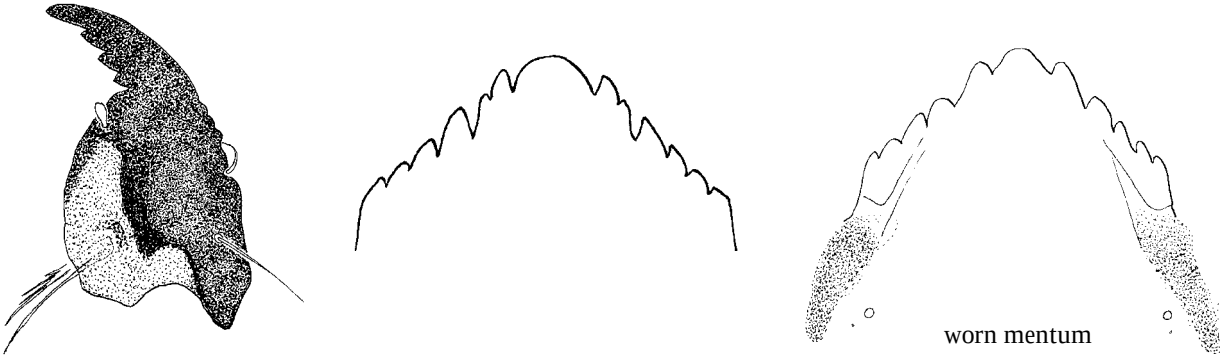
1 Head capsule dark brown to almost black 2

1' Head capsule light yellow brown to light brown 3



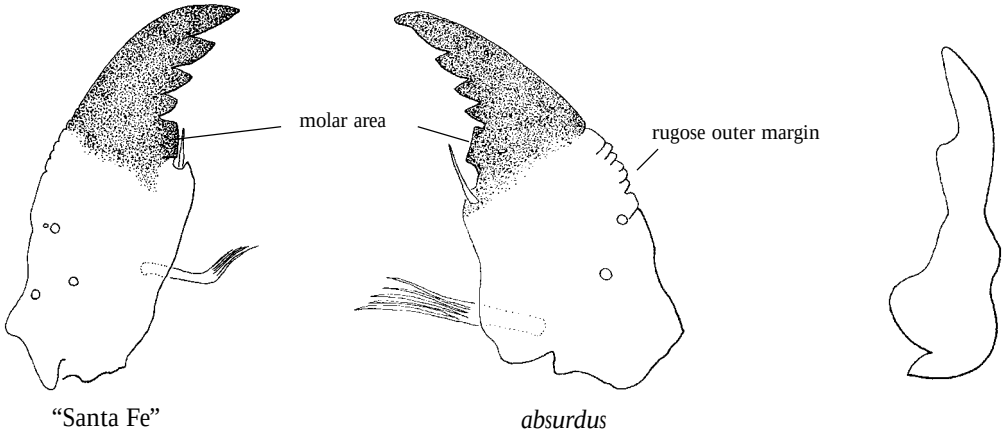
2(1) Outer margin of mandible with 2-3 dorsal teeth; mentum distinctly elongate and arched; restricted to blue-green alga *Nostoc* ..... ***C. (N.) nostocicola***

2' Outer margin of mandible without teeth; mentum as figured; not found in *Nostoc* .... ***C.(C.) fugax***



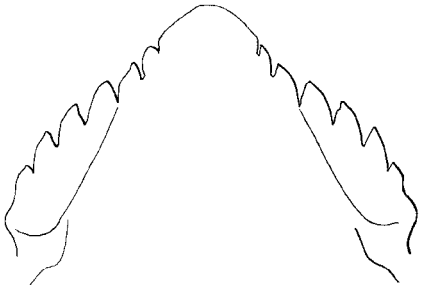
If your dark-headed specimen is not one of the above species, it probably is not a *Cricotopus*. See *Cardiocladius*, *Eukiefferiella*, *Orthocladius* and *Tokunagaia*.

3(1') Mandible with truncate molar area and rugose outer margin; premandible with large rounded inner tooth 4

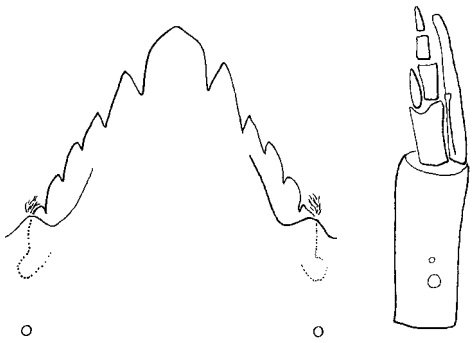


3' Mandible without truncate molar area, outer margin smooth or rugose; premandible not as above 6

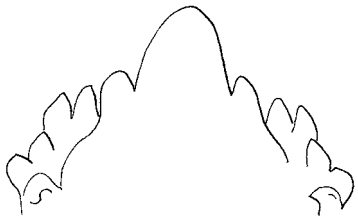
4(3) Mentum with 6 pairs of lateral teeth, first lateral tooth reduced ..... ***C.(I.) absurdus***



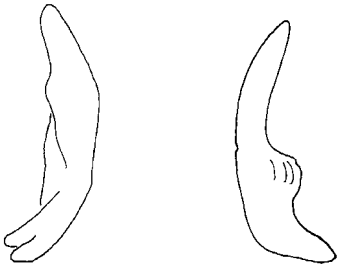
4’ Mentum with 5 pairs of lateral teeth, first lateral tooth not reduced (figures below) 5



5(4’) Mentum with first pair of lateral teeth much higher than remainder of mentum ..... ***C.(I.)*** **sp. “Santa Fe”**

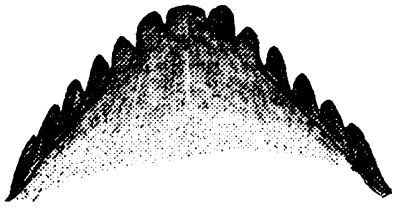


5’ Mentum with first pair of lateral teeth lower, more level with remaining lateral teeth ..... ***C. (I.)*** **sp. “Ozarks”**



6(3’) Premandible apically bifid 7

6’ Premandible simple 12

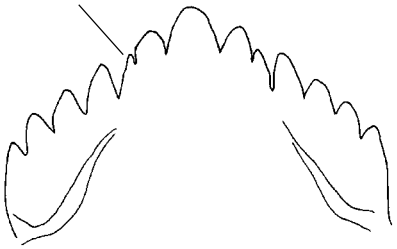


7(6) Second lateral tooth of mentum not reduced and apressed to first lateral tooth; setal tufts of abdominal segments short, at most 1/3 length of segment bearing them 8

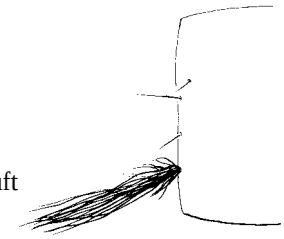
(adapted from Hirvenoja 1973)

7’ Second lateral tooth of mentum reduced and apressed to first lateral tooth abdominal setal tufts very long, as long as or longer than segment bearing them ..... ***C. (I.) sylvestris*** **group** 9
(members of this group are very difficult to separate; your best identification may be “*Cricotopus sylvestris* group sp.”)

2nd lateral tooth

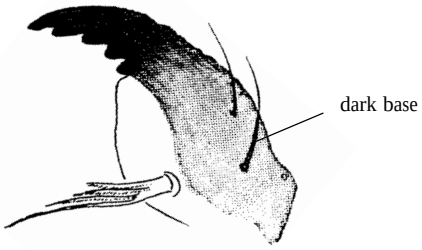


setal tuft



8(7) Mandible with light base; premandible with very weak brush ..... ***C. (C.) tibialis***
(not recorded from the SE US)

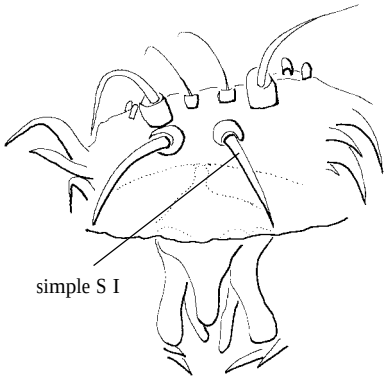
mandible with light base

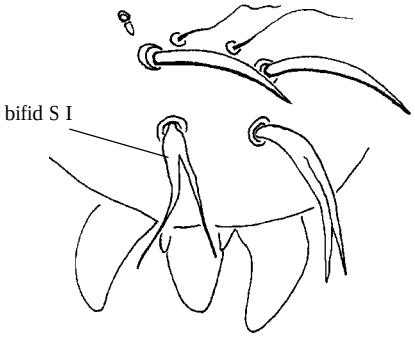


C. fuscus mandible with dark base
(adapted from Hirvenoja 1973)

8' Mandible with dark base; premandible without brush ..... ***C. (C.) fuscus***

9(7') Abdominal segments I-VII with setal tufts; S I simple; thorax with bright blue coloration in life; lives exclusively (?) within stems of the aquatic weed hydrilla ..... ***C. (I.) lebetis***



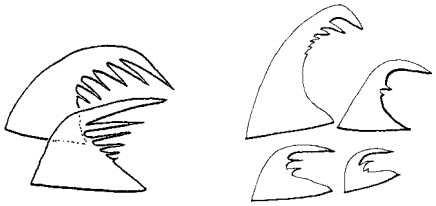


9' Abdominal segments I-VI with setal tufts; S I bifid (although may be unevenly bifid, with one branch much larger than the other); thorax not blue in life; not restricted to hydrilla stems 10

10(9') Apical tooth of small claws of anterior parapods slightly larger than subapical teeth ..... ***C. (I.) sylvestris***

Note - you will have to examine several claws; the differences can be very slight!

10' Apical tooth of small claws of anterior parapods much larger than subapical teeth 11



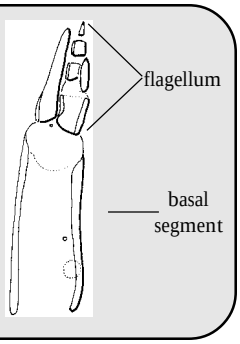
longer inner spines shorter inner spines

11(10') AR of 4th instar larva 1.4-1.7 ... ***C. (I.) tricinctus***

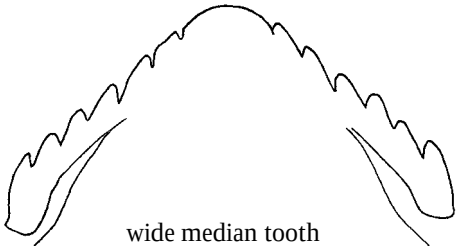
11' AR of 4th instar larva 1.7-2.0 . ***C. (I.) trifasciatus***

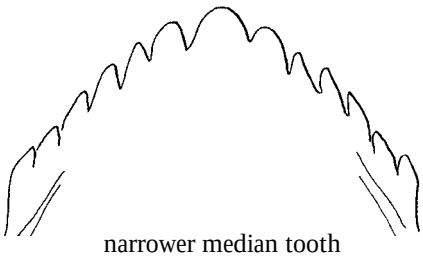
NOTE: 4th instar larvae are necessary for accurate measurements!!

AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)



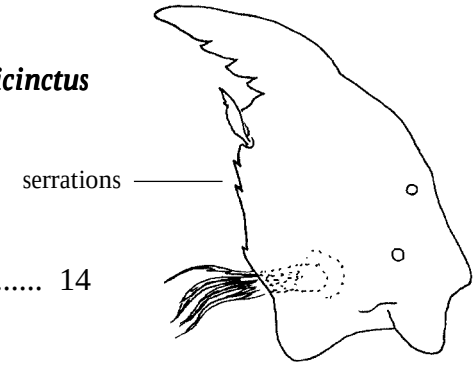
12(6') Median tooth of mentum about 3 times (or more) as wide as first lateral tooth 13


wide median tooth


narrower median tooth

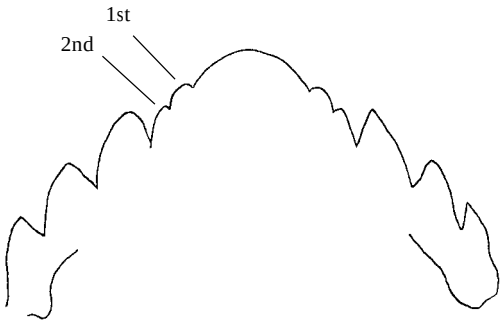
12' Median tooth of mentum at most 2.5 times width of first lateral tooth 19

13(12) Inner margin of mandible with serrations ..... ***C. (C.) bicinctus***



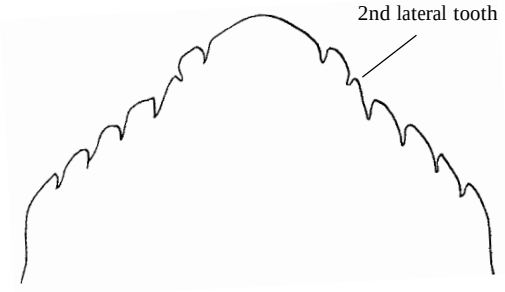
13' Inner margin of mandible smooth 14

14(13') 1st, 2nd and 6th lateral teeth of mentum reduced (6th tooth may be absent) ..... ***C. (C.) trifascia***

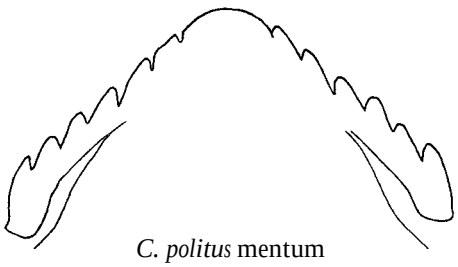


14' Mentum not as above; 6th lateral tooth well developed 15

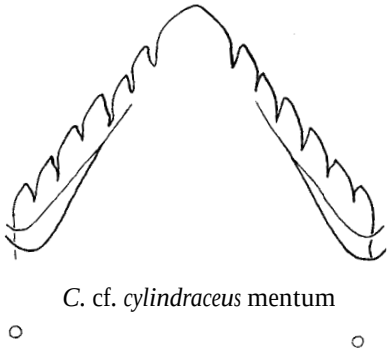
15(14') 2nd lateral tooth of mentum reduced, setting off central 5 teeth from remainder of mentum ..... ***C. (C.)* cf. *patens***



15' 2nd lateral tooth not reduced, mentum not as above 16

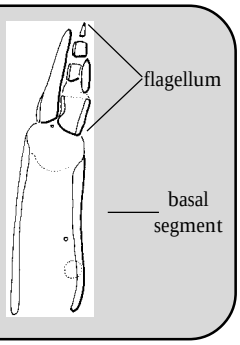

C. politus mentum

16(15') AR around 2.0-2.5; median tooth of mentum projects strongly forward ..... ***C.(C.)* cf. *cylindraceus***



C. cf. *cylindraceus* mentum

AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)



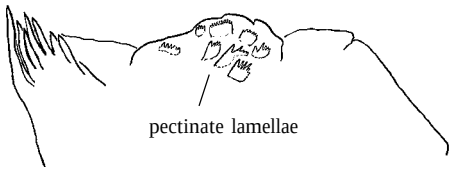
16' AR around 1.5; median tooth not projecting forward as above 17

The following 3 species are very difficult to separate as isolated larvae; associated pupae or adult males are necessary for accurate identification.

17(16') Setal tufts on abdominal segments absent or reduced, < 50 µm in length ..... ***C. (C.) politus***

17' Setal tufts on abdominal segments better developed, about 80-100 µm in length 18

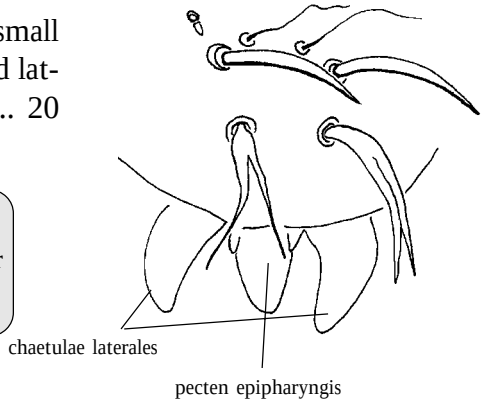
18(17') Dorsal anterior margin of galea of maxilla with numerous pectinate lamellae .. ***C. (C.) albiforceps***



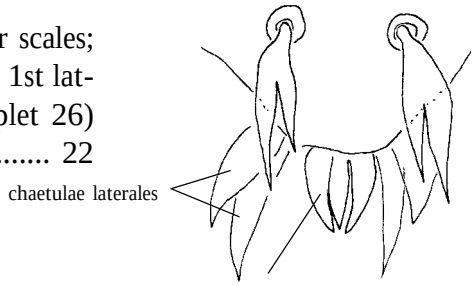
18' Dorsal anterior margin of galea without or with <2 rows of pectinate lamellae .. ***C. (C.) vierriensis***

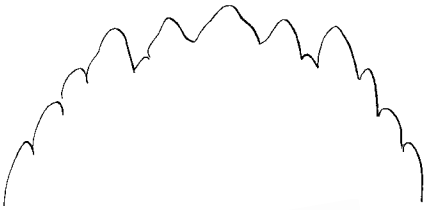
19(12') Pecten epipharyngis a single lobe (or scale) with at most a small notch or lobe near the base of each side; mentum with 2nd lateral tooth small and partially fused to 1st lateral tooth 20

CAUTION: Do not mistake the adjacent chaetulae laterales for outer lobes of the pecten epipharyngis!

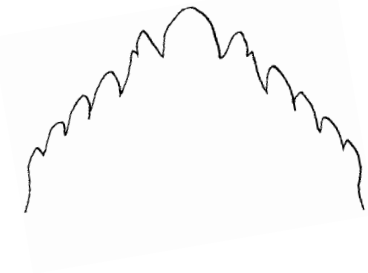


19' Pecten epipharyngis with 3 nearly equal sized lobes or scales; mentum with 2nd lateral not as small and not fused to 1st lateral tooth (except in *C. luciae* and *C. tremulus*, couplet 26) 22





20(19) Antennae short; S I simple; mentum as figured ..... ***C. (I.) elegans***



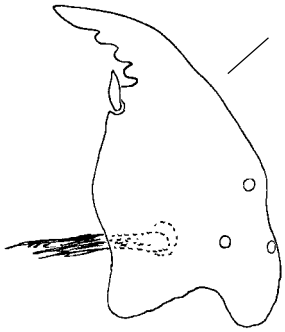
20' Antennae normal; S I bifid; mentum not as above .. 21

21(20) Setal tuft on abdominal segment VII with 20-50 setae ..... ***C. (I.) reversus* group**

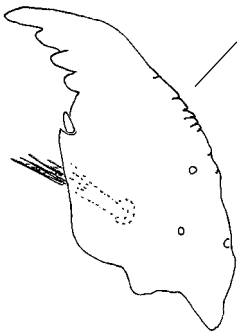
21' Setal tuft on abdominal segment VII with < 10 setae or absent ..... ***C. (I.) intersectus***

22(19') Outer margin of mandible smooth or indistinctly rugose 23

22' Outer margin of mandible distinctly rugose 24

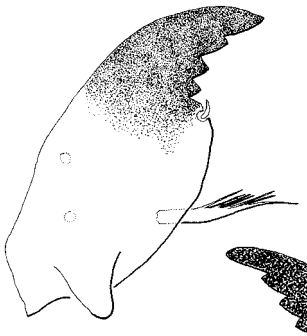


smooth outer margin



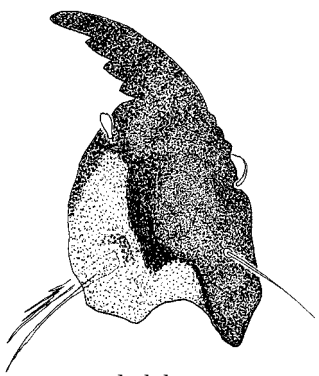
rugose outer margin

23(22) Mandible with light base ... ***C. (C.) annulator complex ..... (C. (C.) annulator*** (in part)***, C. (C.) slossonae, C. (C.) varipes)***
(these 3 species can not be distinguished as larvae; see Notes)

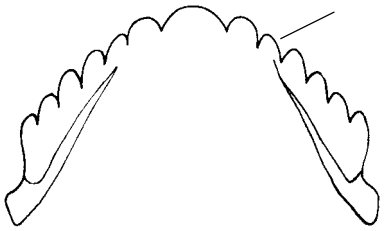


light base

23' Mandible dark to base ..... ***C. (C.) annulator*** (in part)

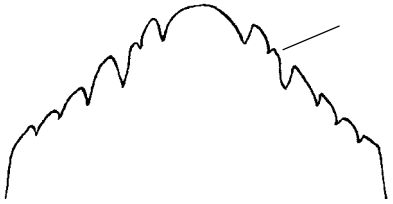


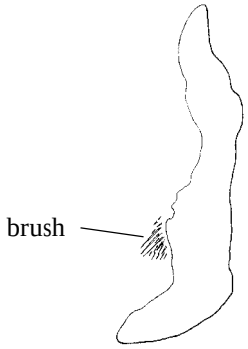
dark base



24(22') Mentum with 2nd lateral tooth about as large as other lateral teeth; premandible without brush 25

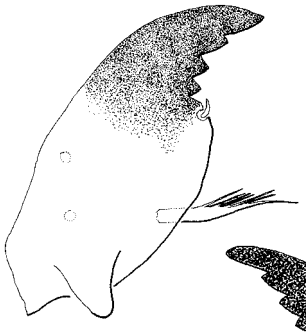
24' Mentum with 2nd lateral tooth small and appressed to 1st lateral tooth; premandible with weak brush (may require observation at 1000X) 26





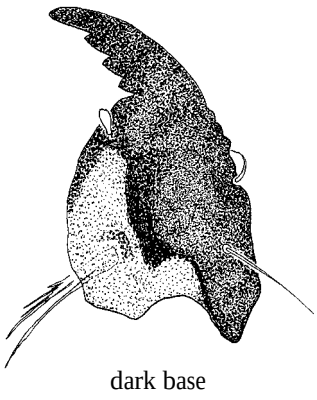
25(24) Mandible with light base .... ***C. (C.) triannulatus, C. (C.) infuscatus*** (in part) (see Notes)

25' Mandible dark to base ..... ***C. (C.) infuscatus*** (in part)



26(24') Mandible with light base ..... ***C. (C.) luciae***

26' Mandible dark to base ..... ***C. (C.) tremulus***



Notes on Species

Species level (and even accurate generic level) identifications of *Cricotopus* larvae are difficult. Perceived differences in larvae are often only variants of the same species; associated pupae and/or adults are usually needed for accurate species level identification - as with *Orthocladius*, pupae usually provide the best means of species identification. Dave Lenat (NC DENR) has written a laboratory key for combined *Cricotopus* and *Orthocladius* species; the taxa were given C/O numbers, some of which were also used in Lenat (1993b). I have attempted to reconcile his system of numbers with the names listed below; his number is listed in brackets at the end of each species summary when applicable. Note that some of the numbers may apply to several species and that some species may have several numbers associated with them. Again, unless larval material is somehow associated with a pupa or adult (often through pharate pupae within very late 4th instar larvae, or pupae with attached larval exuviae – sometimes such pupae may have almost completely

developed adults within, thus giving a complete larval-pupal-adult association), species level identifications can only be considered tentative!

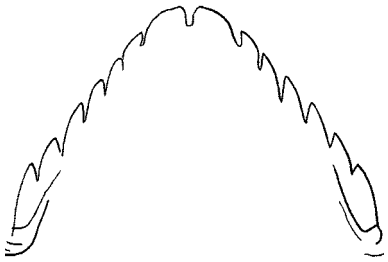
C. (I.) absurdus - This species is not known from the Carolinas but I have seen associated material from Ohio, as well as larvae from the Ozarks (where it occurred with *C.* sp. "Ozarks"), northern Florida and Georgia. The cone-like pecten epipharyngis indicates that the species should be placed in *Isocladius*. In addition to the characters noted in the key, this species has long (80-100 µm), well developed setal tufts and a long, thin seta subdentalis.

C. (C.) albiforceps - I have seen adults from Lake Norman, NC, that closely conform to the description of this species as described by Hirvenoja (1973). The specimens differ from the description in having the first two abdominal tergites infuscate rather than white as in typical *albiforceps*. However, Hirvenoja (1973: 233) noted that some northern individuals had tergite IV or the first two tergites more or less dark. Larvae I've examined from NC identified as *C. albiforceps* do not key to that species in Hirvenoja (1973) but key to *C. vierriensis* (which they are not); and key to *C. pulchripes* in Cranston (1982), but the antennae are shorter; the larva lacks well developed setal tufts on the abdominal segments. Hirvenoja (1973) noted that the surface of the galea of the maxilla of *C. albiforceps* (a member of Hirvenoja's *festivellus* group) bears many small pectinate lamellae; that of *C. vierriensis* bears only a few such lamellae. The galea of *C. politus* bears numerous such pectinate lamellae. I have not seen genuine larval or pupal material of *C. albiforceps* from the Carolinas.

C. (C.) annulator - I've examined larvae identified as *C. annulator* from NC but they do not fit the description in Hirvenoja (1973) in that the base of the mandible is not dark. Hirvenoja's (1973) description of the larva of *C. annulator* was based on the larva of *C. bituberculatus* Goetghebuer, a species he placed as a probable junior synonym of *C. annulator*; the base of the mandible is dark in *C. bituberculatus*. Hirvenoja (1973: 203) stated that it was possible that *C. bituberculatus* was a local variation of *C. annulator*; this probable synonymy has been accepted as a synonymy by subsequent authors. I've examined the larval material Hirvenoja (1973) described, collected by Thienemann in Garmisch-Partenkirchen, Germany. This material consists of whole mounted larvae, not larval exuviae; the material is not reared and thus not directly associated with pupae or adults. There appears to be more than one species on these slides; most slides have several larvae with moderately rugose, dark-based mandibles, but one slide also has one larva with a smoothly margined, light-based mandible. Hirvenoja's (1973: 206) description of the mandible stated that the "back" of the mandible had small grooves and was almost smooth. I've also examined reared material of *C. annulator* from Scotland; in this material the larval mandibles are not dark at the base and possess mostly smooth outer margins. Schmid (1993) also described the larva of *C. annulator* without a darkened base on the mandible. *Cricotopus annulator* may occur in the SE US; it is recorded from Ontario, Canada by LeSage & Harrison (1980), who based their records on adult males and females; they were not successful in obtaining immature stages and did not include them in their keys. Sublette et al. (1998) recorded *C. annulator* from the Grand Canyon and redescribed the adult male and pupa; in assigning their specimens to *C. annulator* they recognized some variation in the pupa and adults. Most adult males of *C. slossonae* and *C. varipes* possess a minute anal point, absent in *C. annulator*. Separating *C. annulator* larvae from those of *C. slossonae* and *C. varipes* without associated adult males is not possible; larvae of all three species should be referred to as "*C. annulator* complex sp.". [C/O sp. 6]

C. (C.) bicinctus - The most common and widespread species of *Cricotopus* in the SE US, perhaps in the entire US. Larvae are usually easily identified by the serrate inner margin of the mandible, but these serrations (or thin spines) are sometimes worn off or can not be seen if the mandible is not oriented correctly; such specimens can be confused with *C. vierriensis* (q.v.) However, the abdomi-

nal setal tufts of *C. bicinctus* are very small (< 30 µm). *Cricotopus bicinctus* larvae are tolerant of organic and other forms of pollution. Note that a closely related species, *C. mackenziensis* Oliver, has been described from western Canada (Oliver 1977); it probably does not occur in the SE US. I have seen apparently aberrant *C. bicinctus* larvae from Louisiana and the Suwannee River in northern Florida that possess a narrow u-shaped notch in the middle of the median tooth. [C/O sp. 1]



aberrant mentum of *C. bicinctus* group larva from Louisiana

C. (C.) coronatus Hirvenoja - This species was recorded for the Carolinas by Hudson et al. (1990) and Caldwell et al. (1997), apparently based on a single specimen from NC. I have examined this specimen and believe it to be *C. politus*. *Cricotopus coronatus* is otherwise only known from Finland (Hirvenoja 1973) and northern Canada (Oliver et al. 1990). I have not included it on the check list for the Carolinas.

C. (C.) cf. *cylindraceus* - I've examined larvae from North Carolina that appear to be this species, but without associated pupae or adults, identification remains tentative. [C/O sp. 14]

C. (I.) elegans - A distinctive larva with reduced antennae. Hirvenoja (1973) suspected that this species was a junior synonym of the Palaearctic *C. obnixus* (Walker), but had insufficient material. [C/O sp. 42]

C. (C.) festivellus - The larva of *C. festivellus* was not described by Hirvenoja (1973); Schmid (1993) figured the larva and gave a brief diagnosis for a taxon he called "*C.* cf. *festivellus* grp.". I've seen adults that closely match *C. festivellus* from the Carolinas and Alabama; larvae remain unknown for this taxon in North America.

C. (C.) fugax - The head capsule of *C. fugax* is usually very dark; the larva lacks setal tufts and may be mistaken for *Orthocladius (Eudactylocladius) dubitatus*. The two species can be separated by the simple premandible of *C. fugax*; the premandible of *O. dubitatus* has a simple apex but also bears a broad inner tooth; and by the 3rd and 4th antennal segments: in *C. fugax* these segments are about twice as long as wide, in *O. dubitatus* they are about as long as wide. In addition, the molar area of *O. dubitatus* is usually truncate; that of *C. fugax* is usually more rounded (the mandible must be oriented correctly to observe this) but ***may*** appear truncate. See figures under *O. (Eud.) dubitatus*. Also, *C. fugax* has long (at least 1/2 length of the segment) setae on the abdominal segments; *O. dubitatus* has only short setae on the abdomen. Larvae of *C. fugax* were reared from water flowing over rock surfaces at the Coweeta Hydrologic Laboratory, North Carolina. This material was originally misdetermined as *C. luciae* and erroneously reported in Caldwell et al. (1997). Note that *C. tremulus* and *C. luciae* are also very similar to *C. fugax*, but bear a weak brush on the premandible. [C/O sp. 20]

C. (C.) fuscus - I've examined an adult from Great Smoky Mountains National Park that appears to be this species; I have not seen larvae from the SE US.

C. (C.) infuscatus - This species was collected in Ontario and the immature stages described by LeSage & Harrison (1980); they described the larva with a dark base to the mandible. However, I have examined a single reared male from Ohio in which the larval mandible is not darkened at the base. Such larvae are apparently inseparable from *C. triannulatus*; pupal or adult characters must be used to identify the species. If you're fortunate enough to have a larva with a well developed pupa within, note that the median spine patches on abdominal tergites III-VI of *C. triannulatus* are somewhat bean-shaped and about twice as wide as long; in *C. infuscatus* these patches are more transverse and about 3X as wide as long. I've seen larvae that appear to be *C. infuscatus* from NC.[some C/O sp. 5]

C. (I.) intersectus (Staeger) - I've examined reared larvae of this species from NY and have seen larvae that fit this species from Jackson and Stokes Counties in NC. It appears as C/O sp. 44 in Lenat's key;

however specimens from his collection I've examined from NC identified as C/O sp. 44 are not *C. intersectus* because they possess an apically bifid premandible and appear to be typical *C. sylvestris* group members; the premandible of *C. intersectus* is apically simple.

C. (I.) lebetis - Not recorded from the Carolinas, but known from Louisiana and Florida. In Florida, larvae have been found living within the stems of the aquatic nuisance weed hydrilla. The species had been considered a synonym of *C. tricinctus*, but recent work in which the larva and pupa were described for the first time (Epler et al. 2000) demonstrated that the taxon is a valid species. Larvae and pupae appear to only occur within the stems of hydrilla, where the larvae can cause sufficient damage to preclude further growth of the plant, thus preventing it from reaching the water surface. A major complaint against hydrilla in the South is that the plant forms large mats on the surface, impeding the passage of boats and thus making it a nuisance. This may be the first instance of a chironomid being a potential biological control agent (some African *Polypedilum* species may also be potential biocontrol agents for hydrilla). Close examination of hydrilla in other parts of the US may give a better idea of the range of *C. lebetis*.

C. (C.) luciae - *Cricotopus luciae*, originally described from Ontario, was recorded for North and South Carolina by Hudson et al. (1990) and Caldwell et al. (1997). However, my examination of North Carolina specimens identifed as *C. luciae* showed them to be *C. fugax* (q.v.). Other adult male specimens of *C. luciae* reported in Hudson et al. (1990) could not be located for verification; those records should be disregarded at this time. I have seen adult specimens and reared material from Alabama and Ohio of true *C. luciae*. Note that although LeSage & Harrison (1980) described the inferior volsella of *C. luciae* as bare, the volsellae actually have a series of 4-6 sensillae ventrally and may bear a strong seta on the "neck" or near the base. I have examined the holotype and two paratypes of *C. luciae* to confirm this. See also *C. tremulus*.

C. (N.) nostocicola - This distinctive larva is restricted to living within colonies of the blue-green alga *Nostoc*. [C/O sp. 55]

C. (C.) cf. *patens* - I've seen larvae from NC and SC that fit this species, but without associated pupae or adults the identification remains tentative. A member of Hirvenoja's *cylindraceus* group, it strongly resembles *C. (C.) flavocinctus* (Kieffer), a member of the *festivellus* group. The two can apparently only be separated as larvae by the number of rows of pectinate lamellae on the galea: three in *flavocinctus* and at most two in *patens*. Reared material is necessary to elucidate the true identity of these larvae. [C/O sp. 31]

C. (C.) politus - A relatively common but often overlooked or misidentified species, difficult to identify without an associated pupa or adult. It is easily confused with *O. carlatus* or *O. rubucundus* but is usually separable by the more medial position of the setae submenti in *C. politus*. It can also be confused with *O. nigritus;* identifications of *C. politus* larvae must be confirmed with pupae or adults! I've seen no associated material of *C. politus* from the Carolinas (only pupal exuviae from NC, adults from NC and SC). Given its distribution in northern Florida (where it is the second most common *Cricotopus* species in the Suwannee River basin), it is probably most common on the Piedmont and Coastal Plain. The abdominal setal tufts of *C. politus* may be very small (LeSage & Harrison (1980) give a 23-45 µm size range), but in associated material from northern Florida and Ohio, setal tufts are absent; in their place are single, long setae. [some C/O spp. 8, 54]

C. (I.) reversus group - Larvae that fit this group have been found in NC; accurate identification is not possible without associated pupae and/or adults. [C/O sp. 45]

C. (C.) slossonae - As a larva, not separable from *C. varipes* and some *C. annulator* (q.v.); the species may be the same, but variable as adults. See LeSage & Harrison (1980). Unassociated larvae should be referred to as "*C. annulator* complex sp." [C/O sp. 6]

C. (I.) sylvestris - Common and widespread throughout the eastern US, but difficult to separate from other members of what can be called the "*C. sylvestris* group" (*C. lebetis, C. sylvestris, C. tricinctus, C.*

trifasciatus); pupae may provide the best characters for species level separation. See Hirvenoja (1973), Simpson et al. (1983) and Epler et al. (2000) for pupal identification. In most cases with isolated larvae of all these species (except perhaps *C. lebetis*), an identification of "*C. sylvestris* group sp." will be the best one can do. Most *C. sylvestris* group members are found in lakes and ponds; some mine in aquatic vegetation. [C/O spp. 9, 41, 44?]

C. (C.) tibialis (Meigen) - Not recorded from the Carolinas or the SE US; included only because of its similarity to *C. fuscus.*

C. (C.) tremulus - I've examined an adult from Great Smoky Mountains National Park and several larvae from North Carolina that appear to be this species. Hirvenoja's (1973) *tremulus* group would include the following North American species: *C. annulator, C. luciae, C. infuscatus, C. slossonae, C. tremulus, C. triannulatus* and *C. varipes*. Larvae of *C. tremulus* may be most easily confused with those of *C. luciae,* but note that the larva of *C. tremulus* has a darker base to the mandible. This difference may be difficult to discern; adults must be used to confirm identity! The body setae of *C. tremulus* and *C. luciae* are long (sometimes as long as the segment bearing them) and sometimes forked. [some C/O 20]

C. (C.) triannulatus - This species is apparently more abundant in the mountains and piedmont, but has been found on the coastal plain. Listed as "*C. infuscatus* group" in Lenat (1993b), it is considered tolerant. [C/O sp. 5]

C. (I.) tricinctus - A member of the *C. sylvestris* group, not recorded from the Carolinas. See *C. sylvestris.*

C. (C.) trifascia - A species with a very distinctive mentum, apparently most common in the mountains. [C/O sp. 36]

C. (I.) trifasciatus - A member of the *C. sylvestris* group, not recorded from the Carolinas. See *C. sylvestris.*

C. (C.) varipes - As a larva, not separable from *C. slossonae* and some *C. annulator* (q.v.); the species may be the same, but variable as adults. See LeSage & Harrison (1980) for more information. Unassociated larvae should be referred to as "*C. annulator* complex sp." [C/O sp. 6]

C. (C.) vierriensis - Very similar to *C. albiforceps, C. politus* and *C. bicinctus*; see the key for characters to separate them. Adults strongly resemble *C. bicinctus*, but have a longer, thinner inferior volsella. Larvae can be confused with *C. bicinctus* if the distinctive serrations of the mandible of *C. bicinctus* are not visible. However, the abdominal setal tufts of *C. vierriensis* are very long (about 80-100 µm) compared to the very short ones of *C. bicinctus* (< 30 µm). I have seen samples from the Suwannee River in northern Florida in which larvae and pupae of *C. bicinctus*, *C. politus* and *C. vierriensis* were all present on one Hester-Dendy sampler. [C/O sp. 46]

C. (I.) sp. "Ozarks" - I first saw material of this taxon from the Ozarks, hence the name. I have since examined more material from the Kentucky River in Kentucky; this taxon has not yet been found in the Carolinas, but might be expected to occur there. It shares the characteristic premandible and mandible with *C. absurdus* and *C.* sp. "Santa Fe", and has long (125-160 µm) setal tufts. Two prepupae of *C.* sp. "Ozarks", one from the Ozarks, the other from Kentucky, were also examined. Unusual for *Cricotopus*, the pupa has two long, thick, spine-like macrosetae on each anal lobe. The pupal thoracic horn is similar to some other *Isocladius* species: long, club-like and smooth; it resembles a baseball bat. I have examined larvae from Ohio that have a mentum that is intermediate between *C.* sp. "Ozarks" and *C.* sp. "Santa Fe". In the Ohio specimens the median tooth and first three pairs of lateral teeth are similar to those of *C.* sp. "Santa Fe", but the 4th and 5th pairs of lateral teeth are low and rounded. This might indicate that three species are present or that *C.* sp. "Ozarks" and *C.* sp. "Santa Fe" represent the extreme ends of a single variable species.

C. (I.) sp. "Santa Fe" - This taxon is based upon several unassociated larvae from the Santa Fe River in north Florida; I have not seen material from the Carolinas. This larva has a premandible and mandible similar to those of *C.* sp. "Flint" and *C.* sp. "Ozarks", and also has long (up to 200 µm) setal tufts. A similar premandible is found in the European species *C. (I.) brevipalpis* Kieffer.

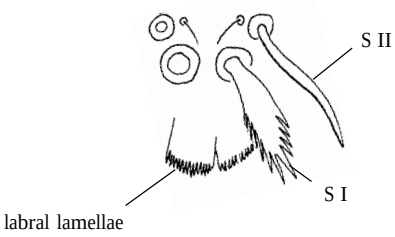
Genus *Diplocladius*

DIAGNOSIS: Distinguished by the plumose SI; apically pectinate labral lamellae; apically bifid premandible; 5 segmented antennae; well developed ventromental beard; and mandible with 4 inner teeth.

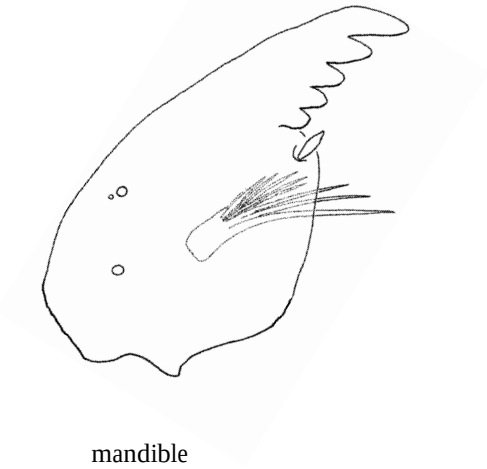
NOTES: One Holarctic species, *D. cultriger*, is known from the eastern United States. Cranston et al. (1983) noted that there is variation in Nearctic larvae that may indicate that more than one species is present, but to date no such variation or new species have been described.

Diplocladius larvae are usually found in springs and cool streams; in North Carolina they are found mainly in winter.

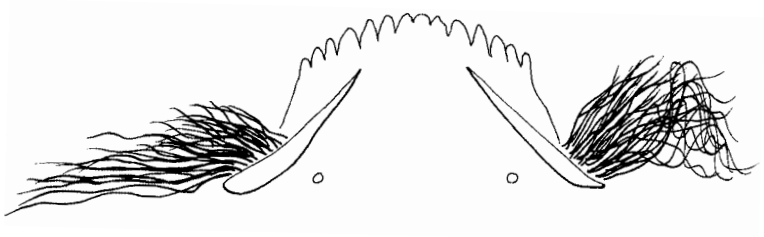
ADDITIONAL REFERENCES: Johannsen 1937a; Schmid 1993.



labrum



mandible



mentum

Genus ***Doithrix***

DIAGNOSIS: Distinguished by the SI with weak lateral serrations; apically bifid premandible; mandible with seta interna and 3 inner teeth; vestigial procerci,; long anal tubules with several constrictions; and normal sized anal setae.

NOTES: Three species are recorded from the mountain and piedmont areas of the Carolinas (Caldwell et al. 1997). The presence of a third species in the Carolinas renders the key to *Doithrix* larvae in Sæther & Sublette (1983) obsolete. In that key, *D. parcivillosa* has a distinctly bifid median tooth on the mentum, postmentum length of 90-94 µm and supranal/anal seta ratio of about 0.43; *D. villosa* has indistinctly bifid median tooth, postmentum length of 105-113 µm and supranal/anal seta ratio of about 0.30. The larva of the third species, *D. dilloni*, is undescribed. Larvae can not realistically be identified to species without associated pupae or adults.

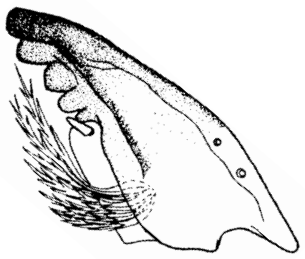
The mandible may appear to have 4 inner teeth.

Larvae may be considered semi-terrestrial; the larvae described by Sæther & Sublette (1983) were reared from the vicinity of small streams and seeps.

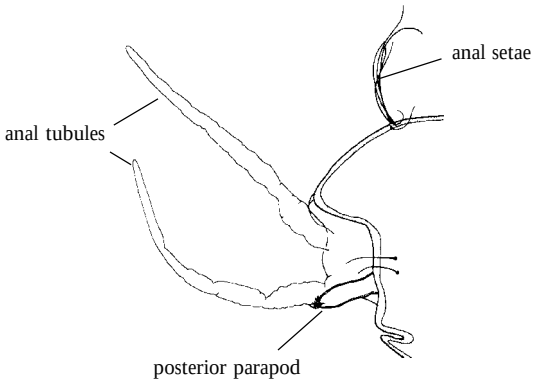
ADDITIONAL REFERENCES: Cranston & Oliver 1998a; Sæther & Sublette 1983.

D. villosa antenna

D. villosa mentum



D. villosa mandible



D. parcivillosa
posterior portion of body
(all figs. adapted from Sæther & Sublette 1983)

Genus ***Epoicocladius***

DIAGNOSIS: The distinctive mentum and mandible; long, thick body setae; single pair of anal tubules and symphoretic or parasitic life style will identify this genus.

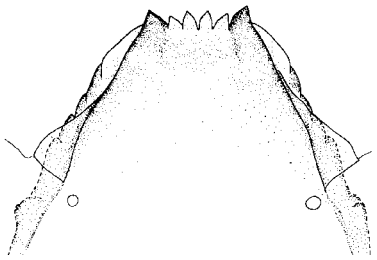
NOTES: Only one named species, *E. flavens*, is recorded from the Southeast. Jacobsen (1992) described the larvae of three other species from the eastern US. At least one of them, *E.* sp. #3, occurs in the Carolinas. His *E.* sp. #4 is *E. flavens*, which is also found in the Carolinas.

Contrary to the diagnosis in Cranston et al. (1983), the S I setae may be simple or coarsely plumose and the S II may be simple. Note that the S II setae are mounted on tubercles.

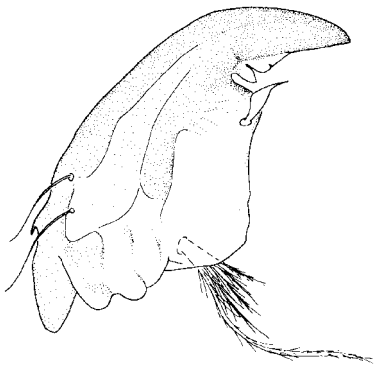
Epoicocladius larvae live commensally or as parasites on larvae of the mayfly family Ephemeridae.

The key and the excellent figures below are adapted from Jacobsen (1992)

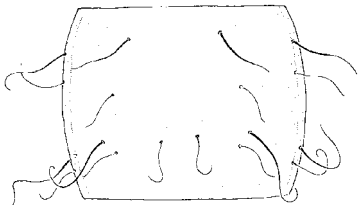
ADDITIONAL REFERENCES: Jacobsen 1992.



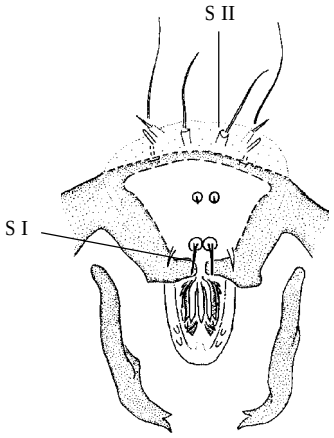
E. sp. #3 mentum



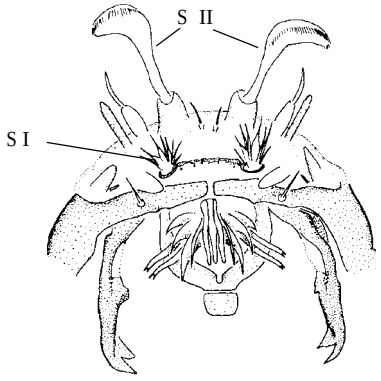
E. sp. #3 mandible



E. flavens middle abdominal segment



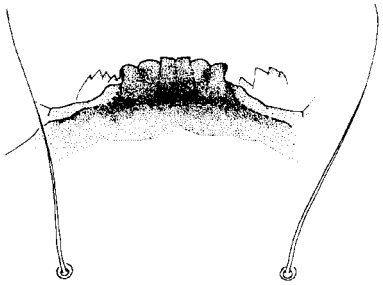
E. sp. #1 labrum

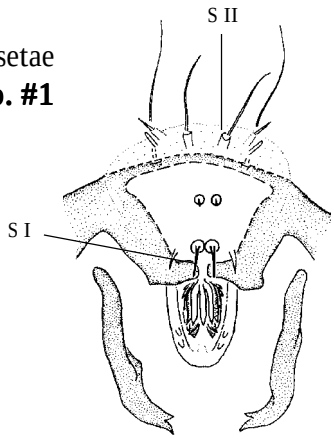


E. sp. #3 labrum

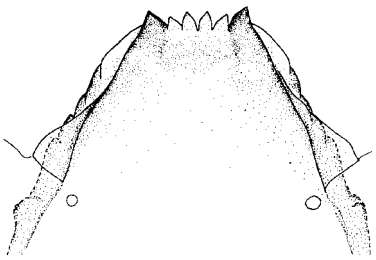
Key to *Epoicocladius* larvae of the eastern United States

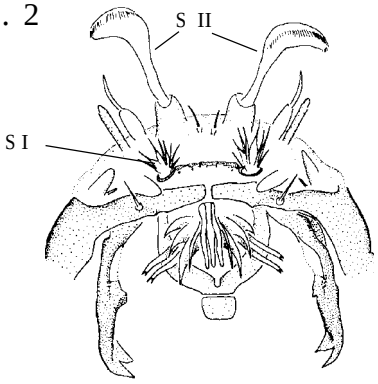
1 Mentum reduced, with median group of teeth dark; S I and S II setae of labrum simple ..... ***E.* sp. #1**



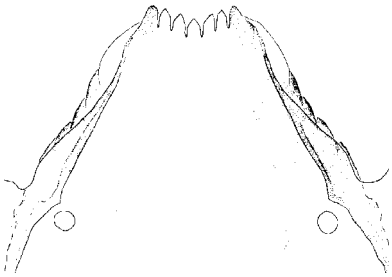


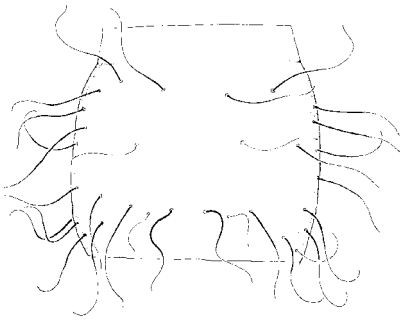
1' Mentum normal, with median teeth paler than lateral teeth; S I coarsely plumose; S II spatulate, apically pectinate 2



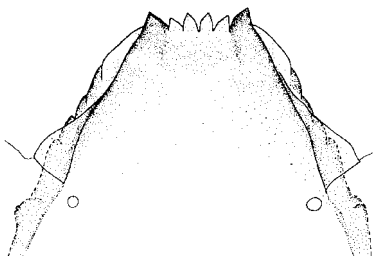


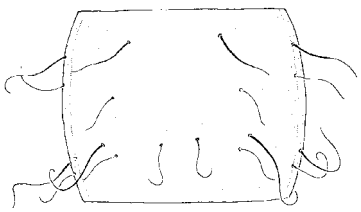
2(1') Mentum with 7-8 median teeth, middle 5-6 pale; middle abdominal segments each with about 40-45 setae ..... ***E.* sp. #2**



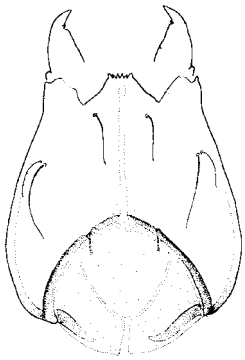


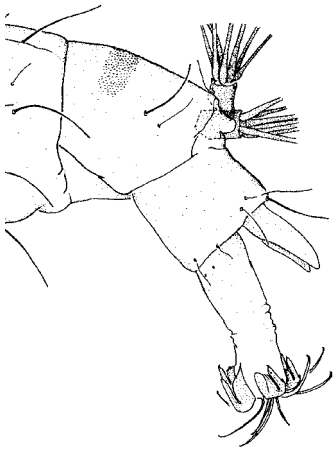
2' Mentum with 6 median teeth, middle 4 pale or light brown; middle abdominal segments each with < 30 setae 3



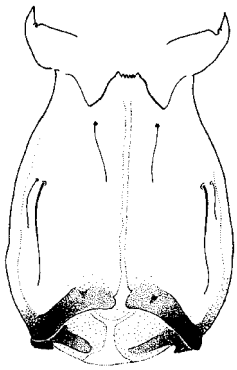


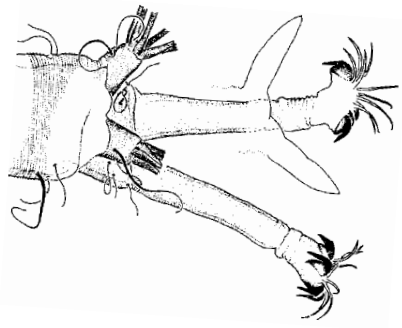
3(2') Posteroventral margin of head capsule strongly arched; posterior parapods < 300 µm long, with stout claws amber colored ..... ***E.* sp. #3**





3' Posteroventral margin of head capsule not strongly arched; posterior parapods > 300 µm long, with stout claws dark ..... ***E. flavens***





Notes on species

E. flavens - Larvae of this species live among the gills of the ephemerid mayfly *Hexagenia* where they apparently graze on fine particulates. Known from the Carolinas; Jacobsen (1992) referred to this taxon as *E*. sp. #4. Note that Sæther's (1969) synonymy of this species with *E. ephemerae* (Kieffer) is incorrect; both are distinct species (Jacobsen 1992). The mentum of *E. flavens* is similar to that of *E*. sp.#3, but the 4 median teeth are paler; this color difference is sometimes difficult to discern; rely on the shape of the posteroventral margin of the head capsule.

E. sp. #1 Jacobsen - Recorded from Pennsylvania and West Virginia, where larvae are parasitic on larvae of *Ephemera guttulata* Pictet.

E. sp. #2 Jacobsen - Recorded from Massachusetts, Pennsylvania and Vermont, where larvae are commensal on larvae of *Litobrancha recurvata* (Morgen).

E. sp. #3 Jacobsen - Recorded from Maryland, Pennsylvania and West Virginia. Jacobsen (1992) found larvae living symphoretically on larvae of *Ephemera guttulata*, *E. simulans* Walker and *E. varia* Eaton. I've also examined larvae from Great Smoky Mountains National Park and other areas in North Carolina.

Genus *Eukiefferiella*

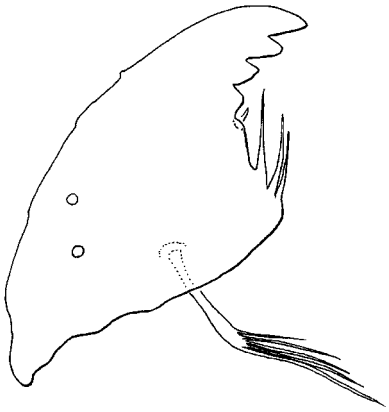
DIAGNOSIS: The simple, thin S I; distinctly serrate labral chaetae; weak/vestigial ventromental plates; seta interna of mandible divided almost to base (except in *E. devonica* group); inner margin of mandible with spines/serrations; 4 or 5 segmented antennae; well developed procerci; and body with simple setae that are usually < 1/2 the length of the body segment bearing them (exception: *E. devonica* group sp. B) will distinguish this genus.

NOTES: The taxonomy of *Eukiefferiella* in North America remains unclear. Because relationships between Nearctic and Palaearctic taxa are uncertain, Bode (1983) used species groups for larval taxa; these species groups are used in the key that follows. Some of these groups may consist of several species. Note that these species group names are based on European species; some of these taxa maybe the same as their Palaearctic counterparts, but until a revision is completed for the Nearctic, with all larval forms associated with pupae and adults and compared with European taxa, most identifications of *Eukiefferiella* larvae will have to remain at the species group level.

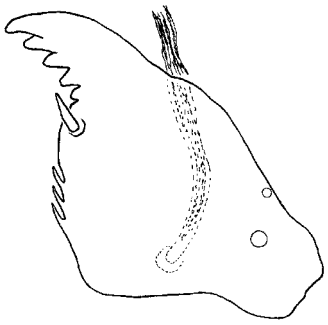
Some earlier records of *Eukiefferiella* may pertain to *Cardiocladius*, *Tvetenia* or *Tokunagaia*.

Eukiefferiella larvae are usually found in running water, where they are often encountered in moss and algae; some taxa are pollution tolerant. Preserved larvae may be green, blue or red.

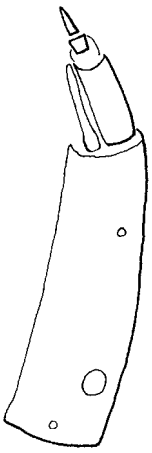
ADDITIONAL REFERENCES: Bode 1983; Lehmann 1972; Sæther & Halvorsen 1981; Sublette et al. 1998.



E. devonica group mandible

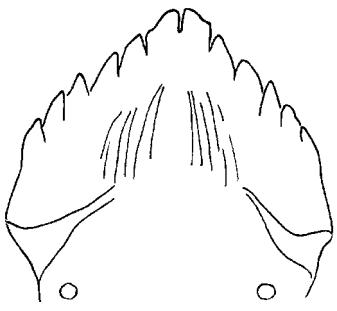


E. claripennis group mandible

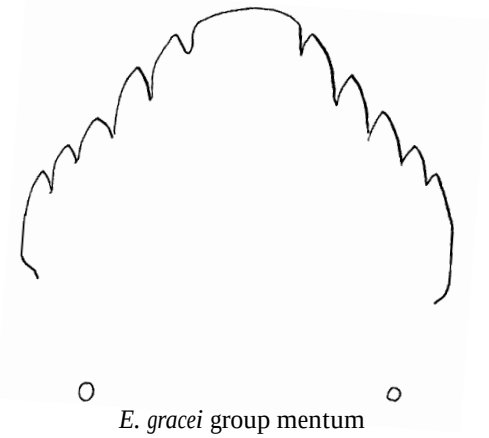


E. brevicalcar group sp. A antenna

E. brevicalcar group sp. B antenna



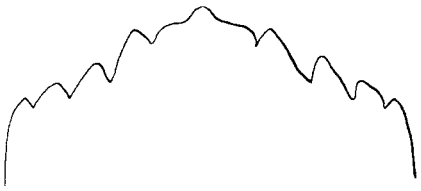
E. claripennis group mentum

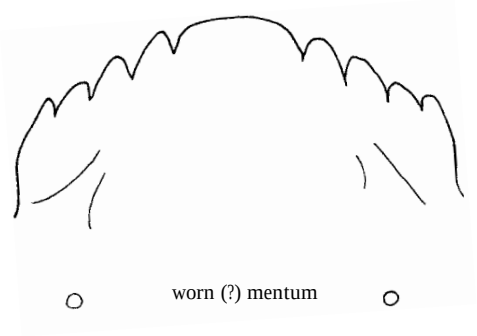


E. gracei group mentum

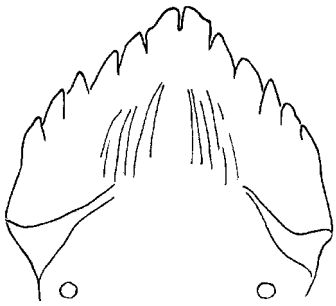
Key to *Eukiefferiella* larvae of the southeastern United States

1 Mentum with 4 pairs of lateral teeth ..... ***E. devonica* group** 2





1' Mentum with 5 pairs of lateral teeth 3

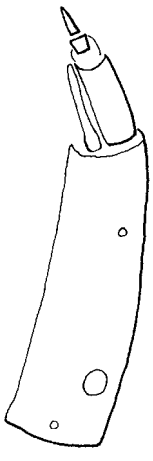


2(1) Head capsule yellow-brown to light brown; middle body segments with setae less than half as long as segment length ..... ***E. devonica* group sp. A**

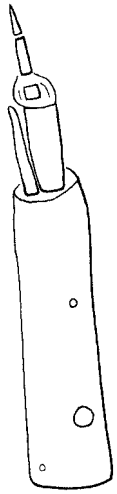
2' Head capsule dark brown to reddish brown; middle body segments with setae more than half as long as segment length ..... ***E. devonica* group sp. B**

3(1') Antenna with 4 segments 4

3' Antenna with 5 segments 7

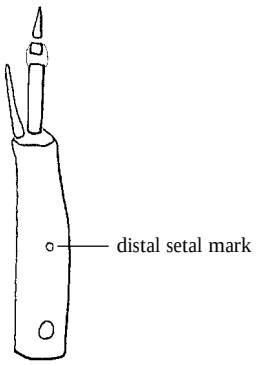


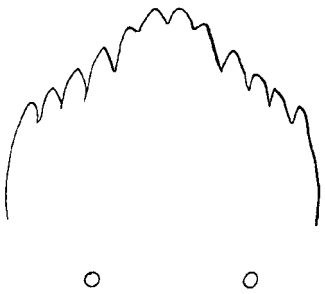
4 segments



5 segments

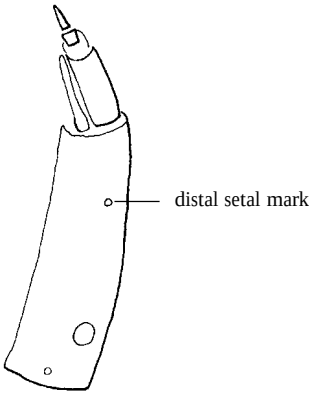
4(3) Distal setal mark of basal antennal segment located at mid point or closer to base; mentum as figured ..... ***E. coerulescens* group**



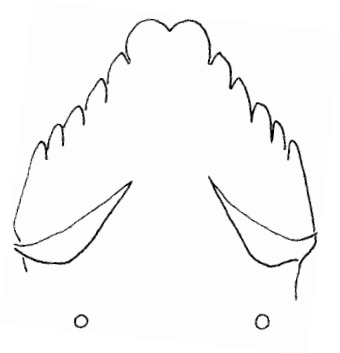


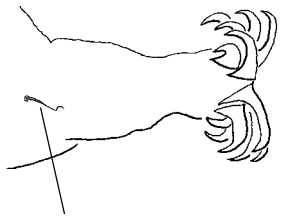
E. coerulescens group

4' Distal setal mark of basal antennal segment located distal to mid point 5



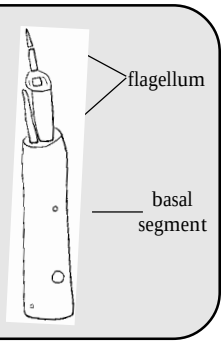
5(4') Median teeth of mentum large, barely divided medially; subbasal seta of posterior parapod weak, < 25 µm long; AR 1.40-1.80; ventromental plates relatively large ..... ***E. pseudomontana* group**



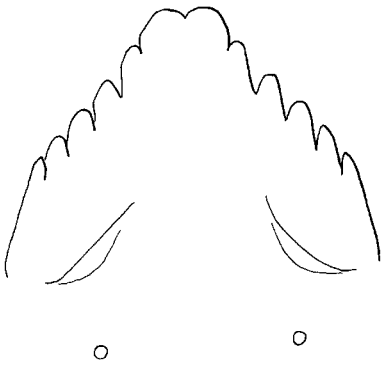


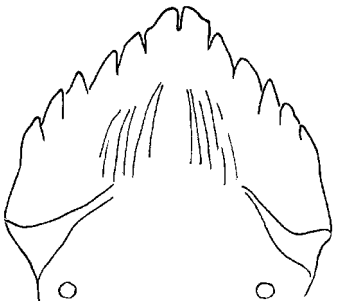
subbasal seta of posterior parapod

AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)



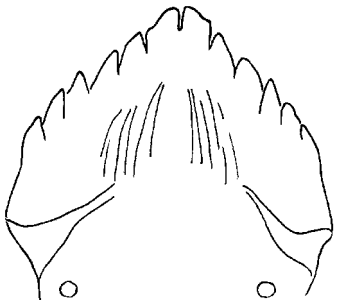
5' Median teeth not as wide (if wide then ventromental plates small); subbasal seta usually > 40 µm long; AR usually > 1.80; ventromental plates smaller (if larger then median teeth well divided) 6



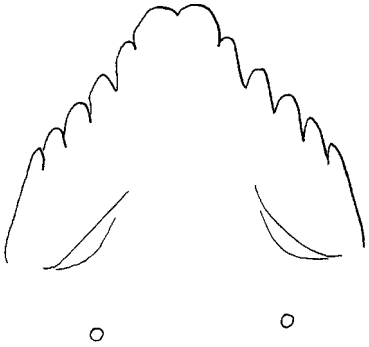


subbasal seta of posterior parapod

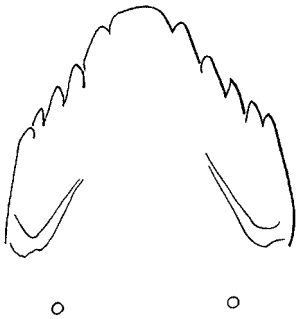
6(5') 1st lateral tooth of mentum subequal in width to either of median teeth ..... ***E. claripennis* group**



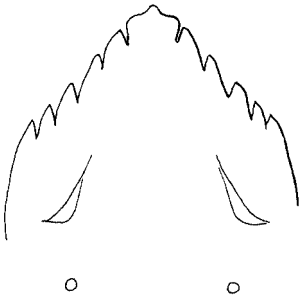
6' 1st lateral tooth about 1/2 as wide as either median tooth ..... ***E. brevicalcar* group sp. A**



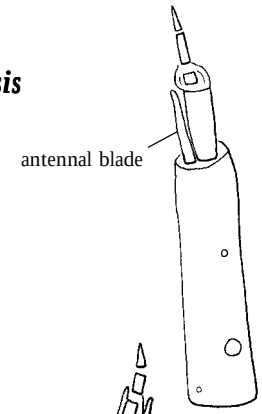
7(3') Antennal blade subequal to segment 2 ..... ***E. tirolensis***



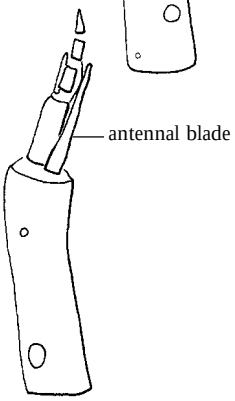
worn mentum



E. tirolensis menta

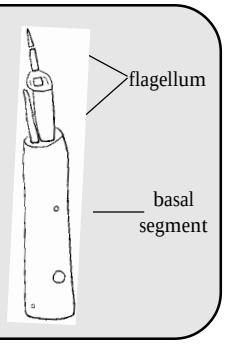


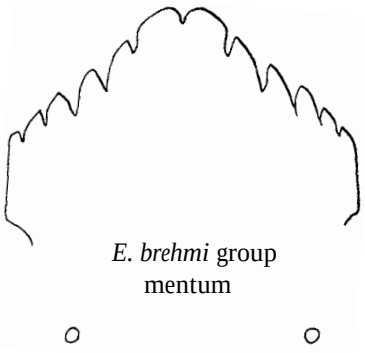
7' Antennal blade extends past segment 2 to segment 4 or beyond 8



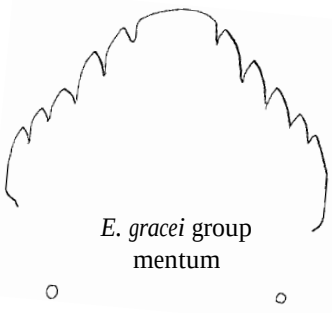
8(7') Mentum with 2 median teeth; AR 1.14-1.50 ..... ***E. brehmi* group**

AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)





E. brehmi group mentum



E. gracei group mentum

8' Mentum with single median tooth; AR 1.50 or higher ..... ***E. gracei* group**

Notes on species

E. brehmi group - Note the long body setae of this taxon, approaching 1/2 the length of the segment bearing them. The mentum has angulate "shoulders" posterolaterally. In specimens with a worn mentum (so that the bifid median tooth is not apparent), the lower AR of this taxon will separate it from *E. gracei* group specimens.

E. brevicalcar group - There are at least two species in this group in the Carolinas; *E. brevicalcar* group sp. A has four segmented antennae and two median teeth. Also see *E. tirolensis* below.

E. claripennis group - Members of this group appear to be the most commonly encountered species of the genus in the Southeast. Bode (1983) noted that this group includes the most tolerant *Eukiefferiella* in North America.

E. coerulescens group - I have not seen larval material of this group from the Southeast, but it is recorded from SC by Caldwell et al. (1997). I've also seen a male from Pen Branch in the Savannah River Plant area in SC that apparently belongs in this group; it has pubescent eyes but has 2 setae on the squama. It is very difficult to separate larvae from the similar *E. brevicalcar* group sp. A. Although illustrated by Bode (1983) and Schmid (1993) with two median teeth, Cranston et al. (1983) figure a mentum with a single median tooth.

E. devonica group - There are apparently at least two species in this group in the Carolinas. In Europe, the group consists of *E. devonica* and *E. ilkleyensis*; both species have been recorded as adults or pupae from the Carolinas, but larvae have not yet been associated for them. Note the longer inner "spines" of the mandible in members of this group, and that the seta interna is not deeply divided, thus resembling that of *Cardiocladius*. Also note that *E. devonica* group sp. B has the longest body setae of the genus in the Southeast, with some equaling the length of the segment which bears them. This may cause them to be keyed as *Tvetenia* in some keys, but note that the S I of *Tvetenia* is weakly branched to plumose, not simple as in *Eukiefferiella*.

E. gracei group - Like the *E. brehmi* group, the mentum is angulate posteriorly and body setae are relatively long. ARs are higher, >1.50, than in the *brehmi* group (AR 1.14-1.50); use caution because *E. brehmi* group specimens with a worn mentum can be easily confused with *E. gracei* group larvae.

E. pseudomontana group - Larvae resemble the European species *E. clypeata*, but associated pupae from NY indicate that this species is *E. pseudomontana* or an undescribed species closely related to it. This species group appears to be uncommon in the Southeast.

E. tirolensis - A member of the *brevicalcar* group. Identification of this species is based on reared material, in particular the distinctive pupa, from a creek in SC. The single adult male examined differs slightly from Lehmann's (1972) description in having an AR of 0.51 (0.30-0.40 in Lehmann) and wing length of 1.35 µm (about 1.50 in Lehmann). The larvae has five segmented antennae and a single median tooth. This may be the same taxon recorded as *E. lobifera*, another European species, from SC by Caldwell et al. (1997).

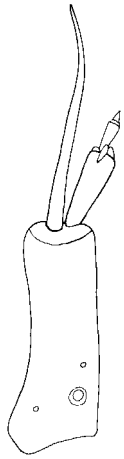
Genus ***Euryhapsis***

DIAGNOSIS: The broad, pectinate labral lamellae; plumose S I; 4 segmented antennae (with 2nd segment entire) with antennal blade longer than flagellum; very short ventromental beard; posteriorly displaced setae submenti; and well developed procerci and anal tubules will distinguish this genus.

NOTES: Three species of *Euryhapsis* are described from western North America; only the immature stages of one species, *E. cilium* Oliver, are described. The larval diagnosis above is based on this species; additional material of other species may alter the diagnosis. I have examined adult males of an apparently undescribed species from the Great Smoky Mountains National Park; I have not seen any immature *Euryhapsis* material from the Southeast. Larvae are very similar to those of *Brillia*, except the second antennal segment is entire, not subdivided as in *Brillia*, and a minute beard is present in *Euryhapsis*.

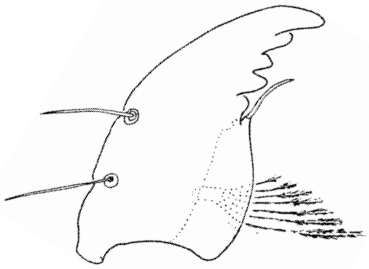
Little is known of the ecology of the immature stages except that they inhabit medium sized bodies of flowing water.

ADDITIONAL REFERENCES: Oliver 1981c.

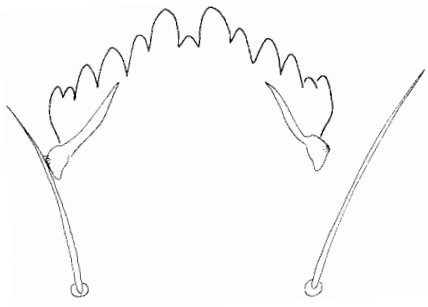


antenna

labrum



mandible



mentum

larval structures of *E. cilium*
(adapted from Oliver 1981c)

Genus *Georthocladius*

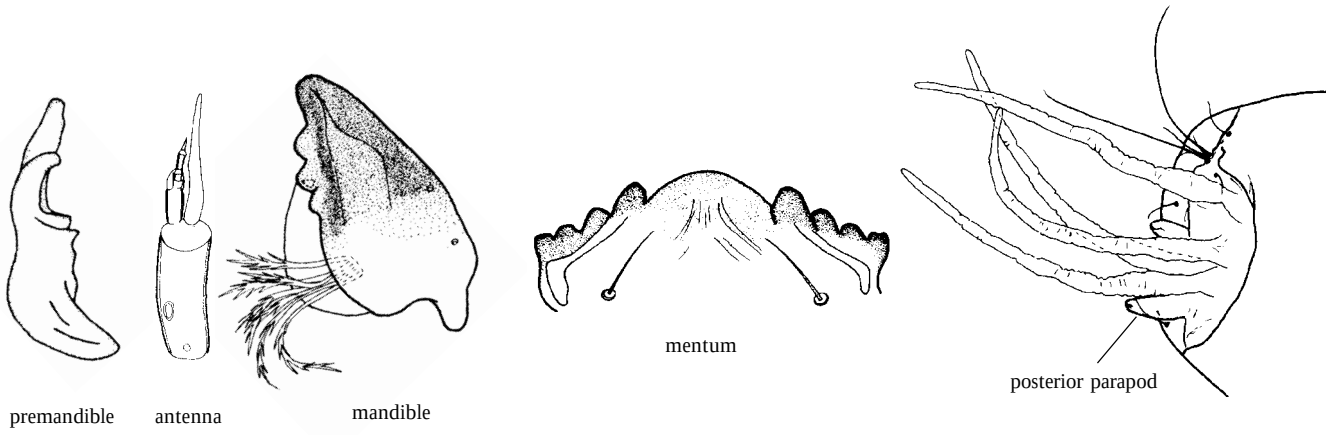
DIAGNOSIS: The weakly serrate S I (may appear simple); mandible with seta interna; procerci absent or vestigial; and long anal tubules with numerous constrictions identify this genus. The mentum may have 1 or 2 median teeth, the mandible 2 or 3 inner teeth.

NOTES: Sæther (1982) established a new subgenus, *G. (Atelopodella)*, which is distinguished in the larval stage from the nominate subgenus by its double median tooth; 3 inner mandibular teeth; normal seta subdentalis; lack of posterior parapods and the presence of 2 small dorsal plates (which are probably vestigial procerci) bearing small setae. In *G. (Georthocladius)* the mentum has a single median tooth, there are only 2 inner teeth on the mandible, the seta subdentalis is broad, small posterior parapods with small or vestigial claws are present and at least 1 large anal seta is present (there are no procerci).

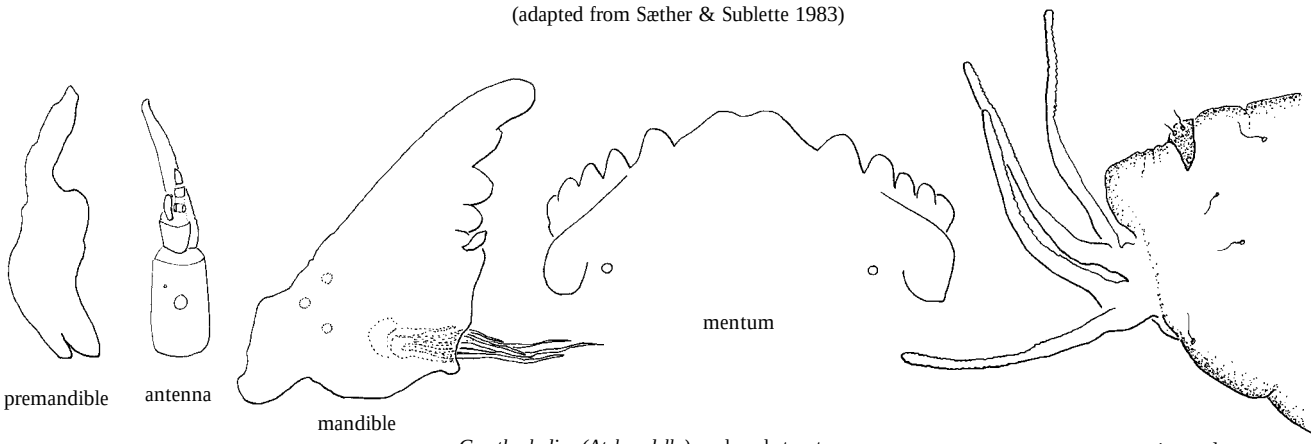
I've examined specimens referable to *G. (Atelopodella)* from the Carolinas and Tennessee (figured below) that have an apically bifid premandible, not mentioned in the description of the only known larva of the subgenus, *G. (A.) curticornus.* I have also examined a Florida larva that apparently fits the subgenus *Atelopodella* except that its mentum bears a single median tooth. None of these larvae were associated with pupae or adults and their identity remains tentative; they do not appear to be *G. (A.) curticornus.*

Larvae are recorded from bogs, seeps and lotic habitats.

ADDITIONAL REFERENCES: Sæther 1982; Sæther & Sublette 1983.



Georthocladius (Georthocladius) fimbriatus larval structures
(adapted from Sæther & Sublette 1983)



Georthocladius (Atelopodella) sp. larval structures

Genus ***Gymnometriocnemus***

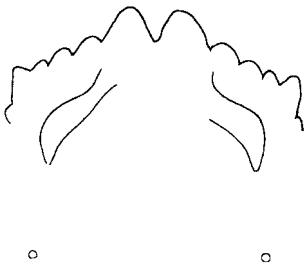
DIAGNOSIS: Distinguished by the simple S I; mandible without seta interna; posterior parapods at right angle to body axis and divided, with claws on the anterior portion; and lack of procerci.

NOTES: Both of the described species known from North America (*G. (G.) subnudus* and *G. (Raphidocladius) brumalis*) occur in the Carolinas. However, no larvae have been positively associated with adults; larvae are thus not identifiable to species. I've also seen adults of an apparently undescribed species from the North Carolina portion of Great Smoky Mountains National Park.

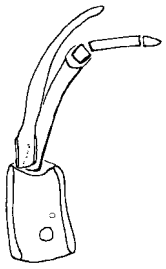
Gymnometriocnemus larvae are difficult to separate from those of *Bryophaenocladius*, differing only in the weakly divided posterior parapods of *Gymnometriocnemus*; those of *Bryophaenocladius* are undivided.

Pupae and adults of the subgenus *G. (Raphidocladius)* have been collected from seeps and springs; larvae may be aquatic or semi-aquatic. Larvae of *G. (Gymnometriocnemus)* may be exclusively terrestrial.

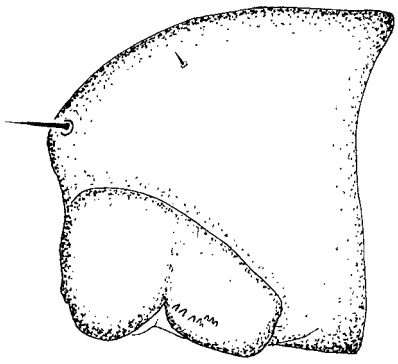
ADDITIONAL REFERENCES: Sæther 1983d.



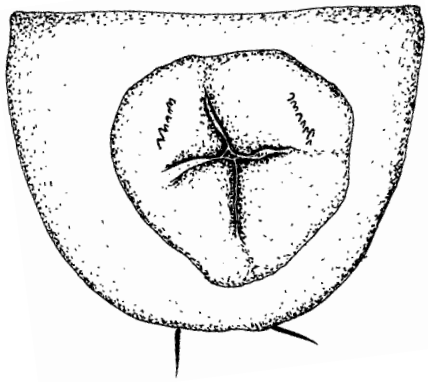
mentum



antenna



anal end, lateral



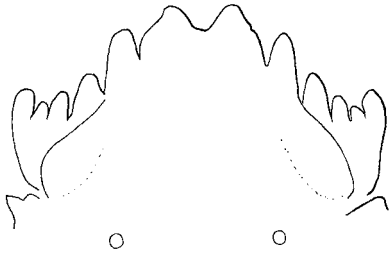
anal end, ventral

Genus ***Heleniella***

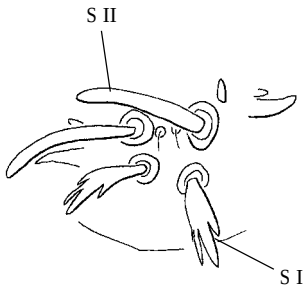
DIAGNOSIS: Distinguished by the coarsely serrate S I; stout S II; apically bifid premandible; 5 segmented antennae with the second segment divided near its base and third segment very small; long antennal blade; mentum with 2 broad median teeth separated by a U-shaped or broad V-shaped gap and with a distinct tooth or notch near the base of the mentum.

NOTES: Two species of *Heleniella* occur in the Carolinas, where they are found mainly in mountain streams. Larvae have not been associated with adults and can not be identified to species.

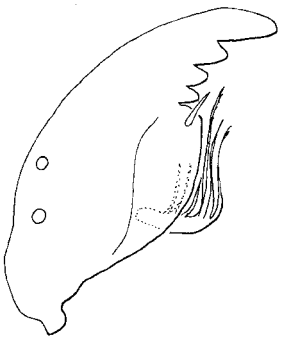
ADDITIONAL REFERENCES: Sæther 1969, 1985g.



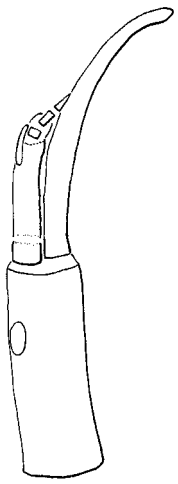
mentum



labrum



mandible



antenna

Genus ***Heterotrissocladius***

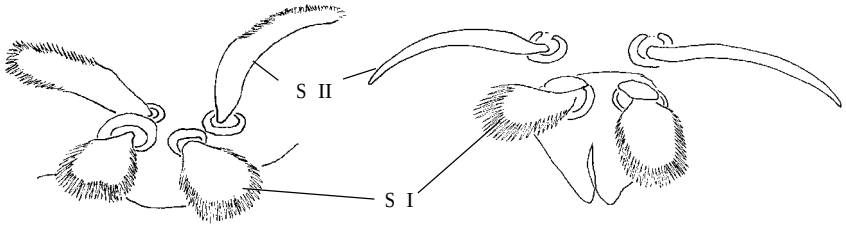
DIAGNOSIS: Larvae are distinguished by the plumose S I; pecten epipharyngis of 3 serrated spines; 7 segmented antenna with the 3rd segment 1/3 or less the length of the 4th and with the 7th segment hairlike; and well developed ventromental plates that extend beyond the lateral margin of the mentum.

NOTES: Two described species are known from the Southeast, although one, *H*. sp. C Sæther, known only as a larva, does not have a formal name. At least one additional undescribed species has been found in Georgia.

The following key includes an Ohio species, *H. boltoni*, that may eventually be found in the Carolinas. At least two other species (*H. changi* and *H*. sp. E Sæther) are known from the northeastern and north central United States; see Sæther (1975a).

In the Southeast, most larvae are found in rivers, streams, seeps and pools. The majority of other northern species are found most often in lakes.

ADDITIONAL REFERENCES: Sæther 1975a, 1992b.

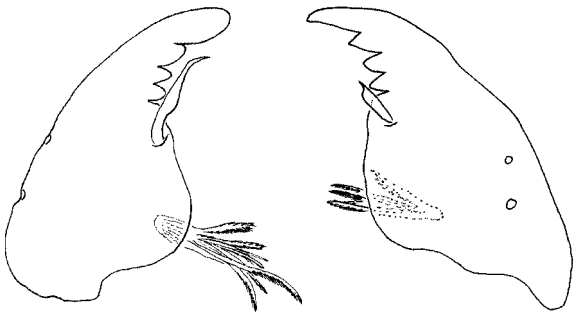


H. sp. C labrum

H. marcidus labrum

H. sp. C mentum

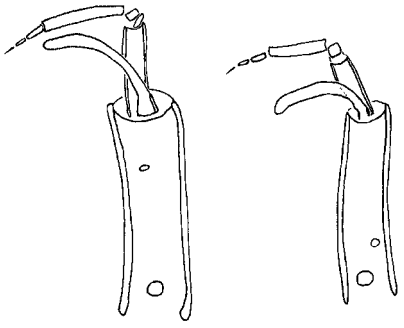
H. marcidus mentum



H. sp. C

H. marcidus

mandibles



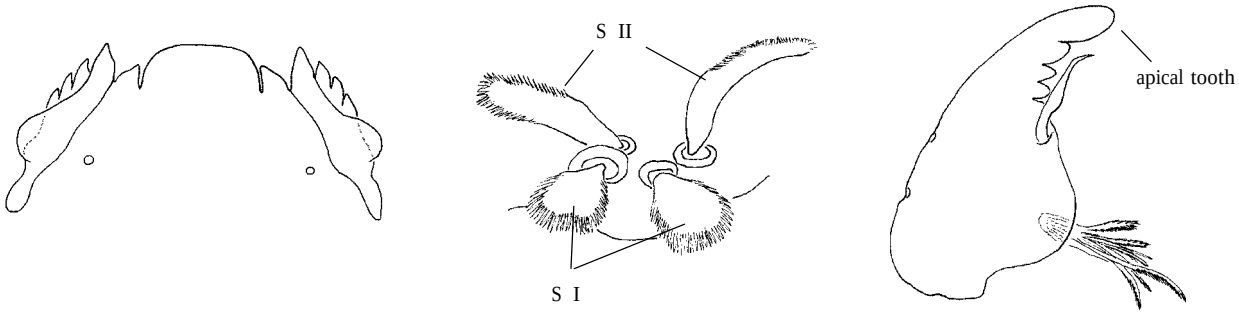
H. sp. C

H. marcidus

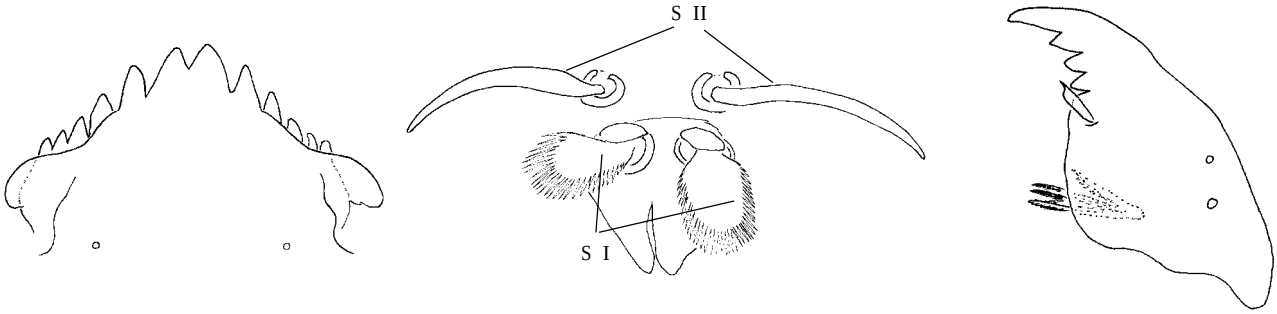
antennae

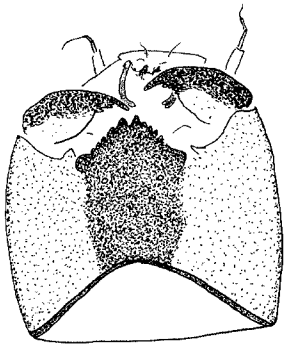
Key to *Heterotrissocladius* larvae of the southeastern United States

1 Mentum with single median tooth; S II broad, plumose; apical tooth of mandible broad .... ***H.* sp. C**



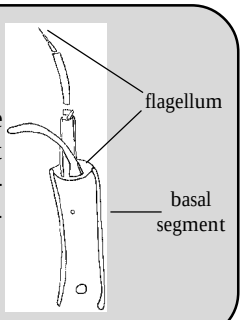
1' Mentum with 2 median teeth; S II thinner, simple; mandible with smaller apical tooth 2





2(1') Postmentum darker than remainder of head capsule; 1st antennal segment 75-95 µm long; AR 1.05-1.14 ..... ***H. marcidus***

AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)



NOTE: 4th instar larvae are necessary for accurate measurements!!

2' Postmentum as most slightly darker than remainder of head capsule; 1st antennal segment 43-58 µm long; AR 0.80-1.00 ..... ***H.* sp. "Caldwell"** and ***H. boltoni***

Notes on species

H. boltoni - Not known from the Carolinas, *H. boltoni* was recently (Sæther 1992b) described from vernal pools and streams in Ohio. To date it has been found only in Ohio, but could possibly occur elsewhere in the eastern US. The larva is indistinguishable from *H*. sp. "Caldwell" (see below); adult males are needed for identification of both species.

H. marcidus - The only named species of *Heterotrissocladius* found in the Southeast and the most commonly encountered. Generally recognized by its darkened postmentum and longer basal antennal segment. Newly molted individuals may not have the darkened postmentum.

H. sp. C Sæther - The larva's distinctive mentum, broad apical tooth of the mandible, long seta subdentalis (the figure in Epler (1995) was of a mandible with a broken seta subdentalis), broad plumose S II, and a premandibular brush, make *H*. sp. C unusual for a *Heterotrissocladius*; this taxon may deserve a separate genus but until the larva is associated with an adult it is best kept in *Heterotrissocladius*. Known from North Carolina and Florida.

H. sp. "Caldwell" - This undescribed taxon has been reared from Georgia by B.A. Caldwell; it is not known from the Carolinas. I have been unable to find characters to separate the larva of this species from *H. boltoni*. The larvae of both species have a lightly pigmented postmental area, different from the normally darkly pigmented postmentum of *H. marcidus*. The adult male of *H*. sp. "Caldwell" is unlike that of any other described Holarctic *Heterotrissocladius*; the gonostylus is broadly triangular.

I have also seen a single larva from North Carolina with a pale postmentum that is similar to *H*. sp. "Caldwell" and *H. boltoni*, but appears to have a pecten epipharyngis composed of flattened, smooth scales instead of the finely serrated scales of other southeastern *Heterotrissocladius* species. However, it is not possible to accurately observe the pecten epipharyngis of this specimen; the apparent pecten epipharyngis may be displaced chaetulae laterales.

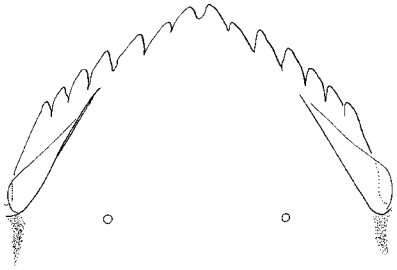
Genus ***Hydrobaenus***

DIAGNOSIS: Distinguished by the smooth outer margins of the chaetulae laterales; mentum with single or double median tooth; well developed ventromental plates; absence of a beard; apically bifid premandible, without brush; maxilla with well developed pecten galearis; and 6 segmented antenna, with 6th segment vestigial, threadlike.

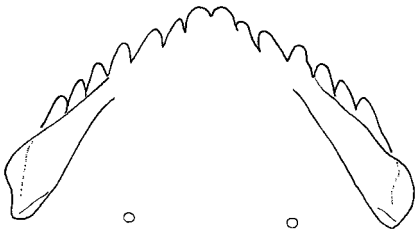
NOTES: At least five species of *Hydrobaenus* occur in the Southeast; two described species, *H. johannseni* and *H. pilipes*, are recorded from the Carolinas. An undescribed species (*H.* sp. "Georgia") is known from several streams in Georgia and *H. pilipodex* is recorded from Alabama; either two may eventually be found in the Carolinas. A more unusual undescribed species, *H.* sp. O, is known from streams of the mountains and Piedmont of North Carolina and from Ohio; this species is unusual in having a single median tooth instead of the normal double median tooth of *Hydrobaenus*. *Hydrobaenus* sp. O was referred to as "*Oliveridia*" in Caldwell et al. (1997). It appears that *H. pilipes* may be the most common species in the Southeast. Although Sæther (1976) offered a key to larvae, in reality it is impossible to separate most larvae to species without an associated pupa or adult; there is considerable variation and overlap in characters. Note that *H.* sp. "Georgia" will key to *H. johannseni* or *H. pilipes* in Sæther's (1976) key.

Hydrobaenus larvae are most common in streams in the Southeast, occurring most often in the winter or early spring.

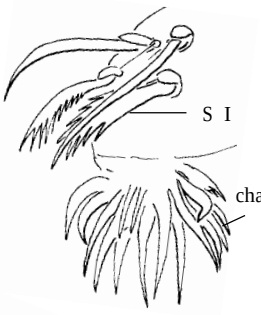
ADDITIONAL REFERENCES: Sæther 1976, 1989b; Tuiskunen & Lindeberg 1986.



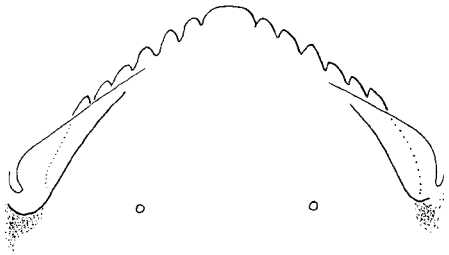
H. sp. "Georgia" mentum



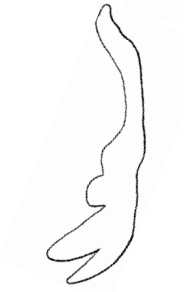
H. pilipes ? mentum



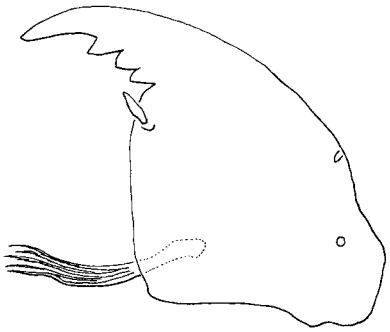
H. sp. O labrum



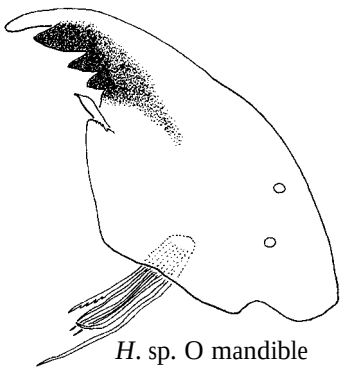
H. sp. O mentum



H. sp. O premandible

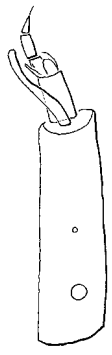


H. sp. "Georgia" mandible



H. sp. O mandible

H. sp. "Georgia" antenna



H. sp. O antenna

Genus ***Krenosmittia***

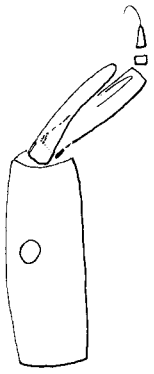
DIAGNOSIS: The small size (body < 3.5 mm); apically bifid premandible; distinctive mentum; elongate maxillary palp; and the very elongate anal setae will distinguish this genus.

NOTES: No named species are known from the Southeast; although Hudson et al. (1990) and Caldwell et al. (1997) list two "undescribed species", I have seen larval material of only one apparent taxon. *Krenosmittia* is know to occur at least as far south as northwestern Florida.

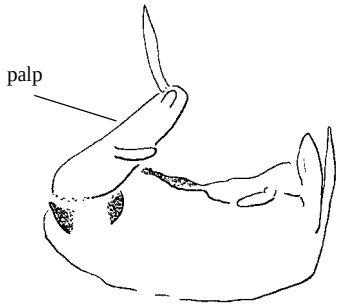
Cranston et al. (1983) stated that the antenna of *Krenosmittia* was 4 segmented. However, material from the Southeast appears to be 5 segmented, with the apical segment a thread-like extension. In addition the second antennal segment appears to be weakly divided near the base, somewhat similar to the antennae of *Brillia* and *Heleniella*. *Krenosmittia* antennae are difficult to observe clearly because of their small size and they usually have detritus stuck to them.

Larvae are found in sandy substrata of springs and streams; they are apparently hyporheic.

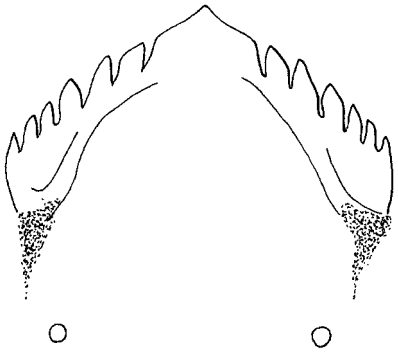
ADDITIONAL REFERENCES: Ferrington 1984; Sæther 1969; Tuiskunen & Lindeberg 1986.



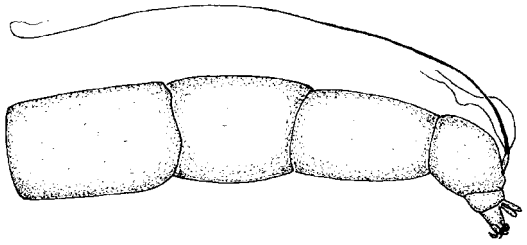
antenna



maxilla



mentum



posterior body segments

Genus *Limnophyes*

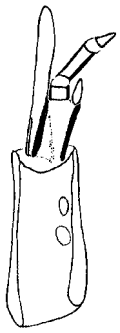
DIAGNOSIS: Larvae are distinguished by the absence of labral lamellae; serrate SI (but serrations sometimes reduced); 5 segmented antennae with antennal blade as long as or slightly longer than the flagellum; mentum with 2 median teeth and 5 lateral teeth; ventromental plates weak, with posterolateral portion appearing as a rounded basal tooth; mandible with 3 inner teeth, with mola not tooth-like; body setae shorter than 1/2 length of segment, simple (occasionally bifid); and supraanal setae about as long as anal setae.

NOTES: Based on adult males, nine species of *Limnophyes* are known from the Carolinas. Although Sæther (1990) offered a key to some larvae, only a few are associated with adults; it is not realistically possible to identify *Limnophyes* larvae to species without associated adult males.

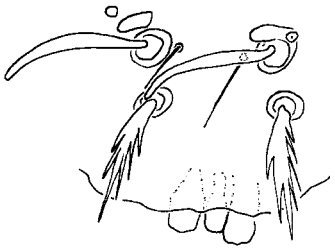
The only described larvae of the genus *Compterosmittia,* described from Hong Kong and Tasmanian larvae (see Cranston & Kitching (1995)), are very similar to those of *Limnophyes,* differing only in the tooth-like mola and the shorter supraanal setae of *Compterosmittia* (and perhaps the shorter antennal blade of *Compterosmittia*). Note that *C. nerius* occurs in the Carolinas and that its larva is undescribed; it may very well be masquerading as a *Limnophyes* in some samples.

Limnophyes larvae are found in rivers, streams, springs, seeps, in moss on rock surfaces, stream margins and other semi-aquatic habitats, as well as in terrestrial habitats.

ADDITIONAL REFERENCES: Cranston & Oliver 1988a; Sæther 1975d, 1990; Sublette & Sasa 1994.

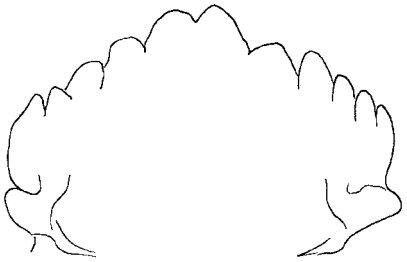


antenna

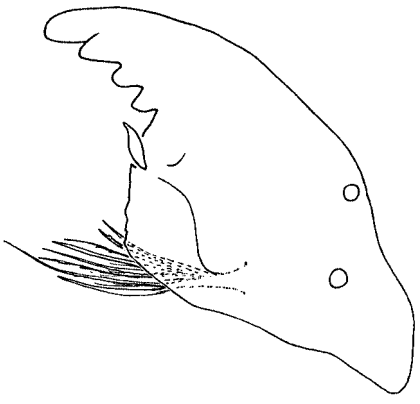


labrum

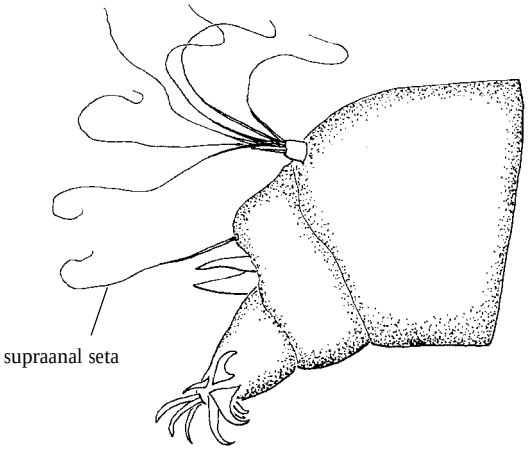
premandible



mentum



mandible



posterior body segments

Genus ***Lopescladius***

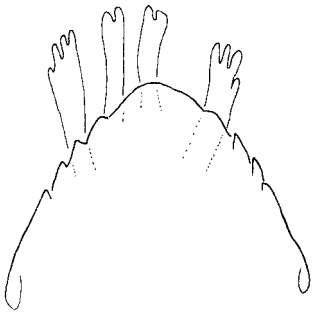
DIAGNOSIS: The small size (< 4 mm long); simple, apically pointed premandible; antennae longer than head capsule; 2nd antennal segment with median weakly sclerotized area and minute Lauterborn organs at apex; and last antennal segment (4th) long and whip-like will distinguish this genus.

NOTES: One described, named species, *L. hyporheicus*, is recorded from South Carolina by Hudson et al. (1990) and Caldwell et al. (1997); I have not seen material of this taxon from the Southeast. *Lopescladius* sp. 1, another species, described but unnamed by Coffman & Roback (1984), is known from South Carolina. All larvae I've examined from the Southeast appear to be *L*. sp. 1; I've also examined Roback's *L*. sp. 1 material from the Savannah River Plant area in South Carolina. It is possible that *L*. sp. 1 is based on smaller specimens of *L. hyporheicus* with an unworn mentum, but until *L*. sp. 1 is associated with an adult male it is best to retain the two as separate taxa. Two additional species, based on adults, are known from Kansas and Illinois (Sæther 1983b).

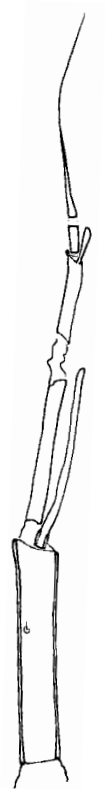
Lopescladius larvae are found in sandy substrata of streams and rivers.

ADDITIONAL REFERENCES: Coffman & Roback 1984; Sæther 1983b.

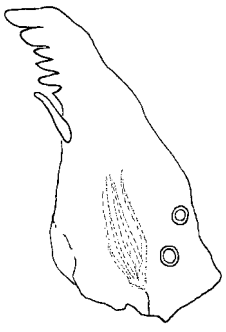
L. hyporheicus mentum



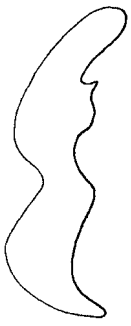
L. sp 1 mentum with hypopharyngeal scales



L. sp. 1 antenna



L. sp. 1 mandible



L. sp. 1 premandible

Genus *Mesocricotopus*

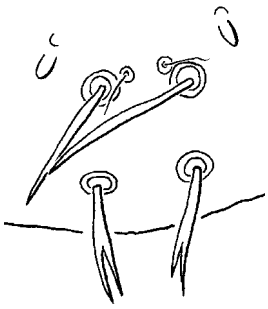
DIAGNOSIS: Distinguished by the bifid S I; antennal blade longer than the flagellum; absence of labral lamellae; two median teeth of the mentum; maxilla with pecten galearis; and mandible with 4 inner teeth (proximal 4th tooth sometimes difficult to observe).

NOTES: One described Nearctic species, *M. loticus*, is known from Georgia and Ohio (Caldwell 1996). I have also seen an adult male of an undescribed species from Great Smoky Mountains National Park in North Carolina.

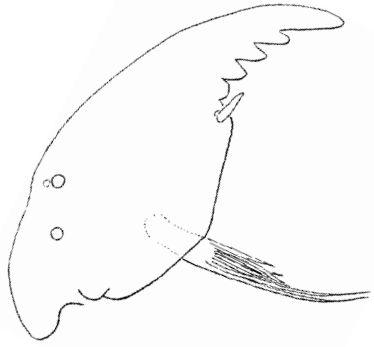
Larvae of *M. loticus* were found in 2nd and 3rd order streams. The undescribed male from North Carolina was collected at a light trap near a mountain stream. This contrasts with the littoral to profundal lake zones known as habitats for the Holarctic species *M. thienemanni.*

Although Cranston et al. (1983) described the S setae of the labrum as "normal", their illustration (Fig. 9.40E) shows the S III as large and displaced laterad to S I. In *M. loticus*, the S III are small and located between the S I setae.

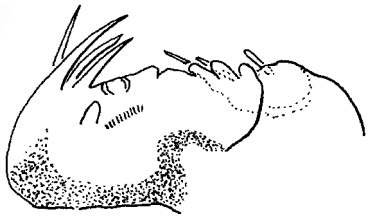
ADDITIONAL REFERENCES: Caldwell 1996.



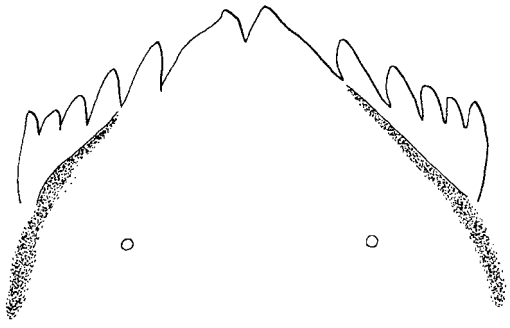
labrum



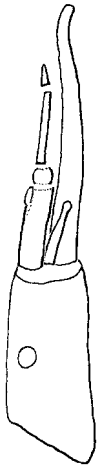
mandible



maxilla, dorsal



mentum



antenna

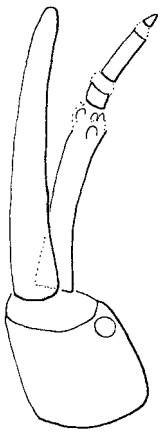
Genus ***Mesosmittia***

DIAGNOSIS: The simple labral setae; lack of seta interna on the mandible, distinctive mentum; and lack of procerci, anal setae and anal tubules will distinguish this genus.

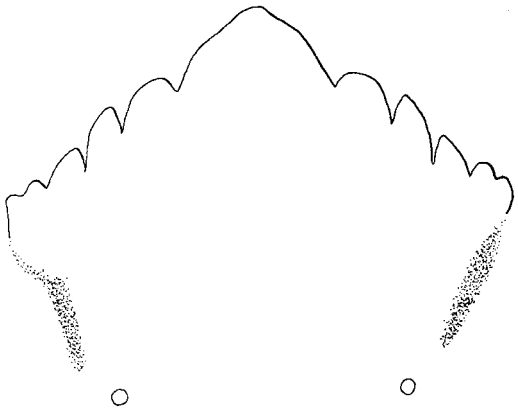
NOTES: Earlier texts (e.g., Cranston et al. (1983)) referred to Nearctic *Mesosmittia* as *M. flexuella*. However, Sæther (1985c) showed that *M. flexuella* is apparently not present in the Nearctic and described several new Nearctic species, three of which are recorded from the Southeast (Caldwell et al. 1997). Judging by adult specimens I've seen, *M. patrihortae* appears to be the most common species in the Southeast.

Mesosmittia larvae appear to be mostly terrestrial, although they may be found in aquatic habitats. The larvae illustrated by Epler (1995: 6.51) as "*Mesosmittia* sp." is probably a *Bryophaenocladius* (or *Gymnometriocnemus*); its identity will remain a mystery until it is reared and adults are examined.

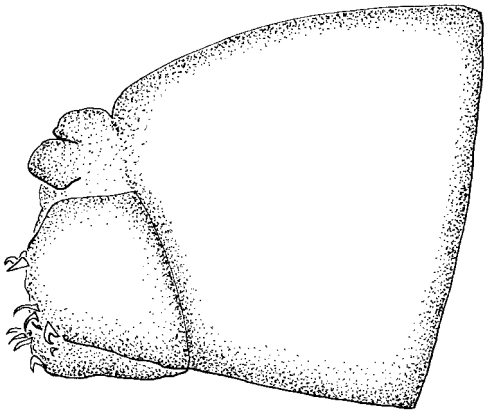
ADDITIONAL REFERENCES: Sæther 1985c; Strenzke 1950b.



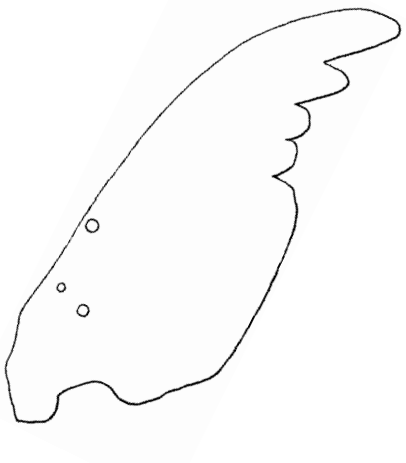
antenna



mentum



posterior body segments



mandible

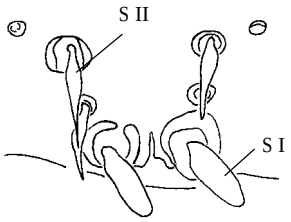
Genus *Metriocnemus*

DIAGNOSIS: Distinguished by the usually plumose S I (simple in *M. fuscipes*); well developed labral lamellae (reduced in *M. fuscipes*); lack of ventromental beard; well developed procerci; and short anal and supraanal setae.

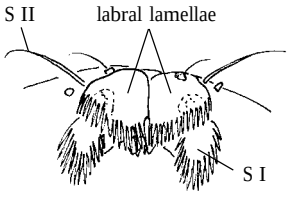
NOTES: Three species are known from the Carolinas, all identifiable to species as larvae. The larvae identified by Epler (1995: 6.52-6.54) as *M*. sp. B do not belong with *Metriocnemus.* Newly reared material indicates that they probably represent a new genus, Orthocladiinae genus H Epler, perhaps closely related to *Compterosmittia*.

Larvae are known from a variety of aquatic habitats, including water held by the pitcher plant *Sarracenia*, marine intertidal pools, sewage treatment beds, moss, tree holes, in damp soil, madicolous habitats (water flowing in a thin film), and in seeps, springs, streams, rivers and lakes.

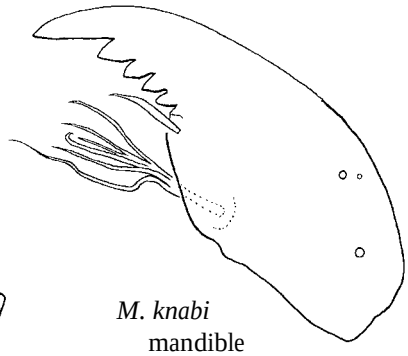
ADDITIONAL REFERENCES: Cranston & Judd 1987; Oliver & Sinclair 1989; Sæther 1989a.



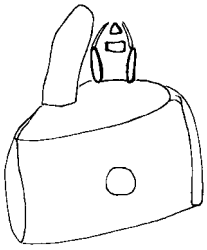
M. fuscipes labrum



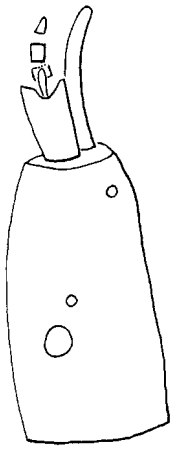
M. knabi labrum



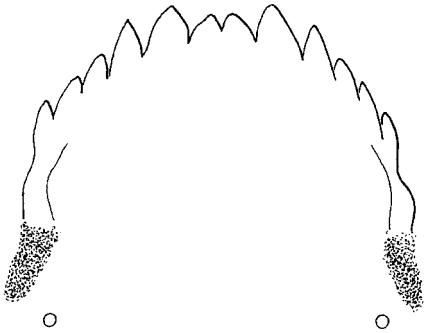
M. knabi mandible



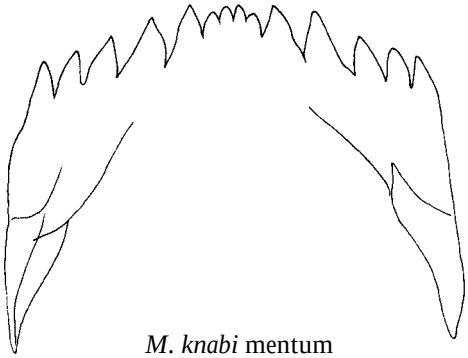
M. fuscipes antenna



M. eurynotus antenna



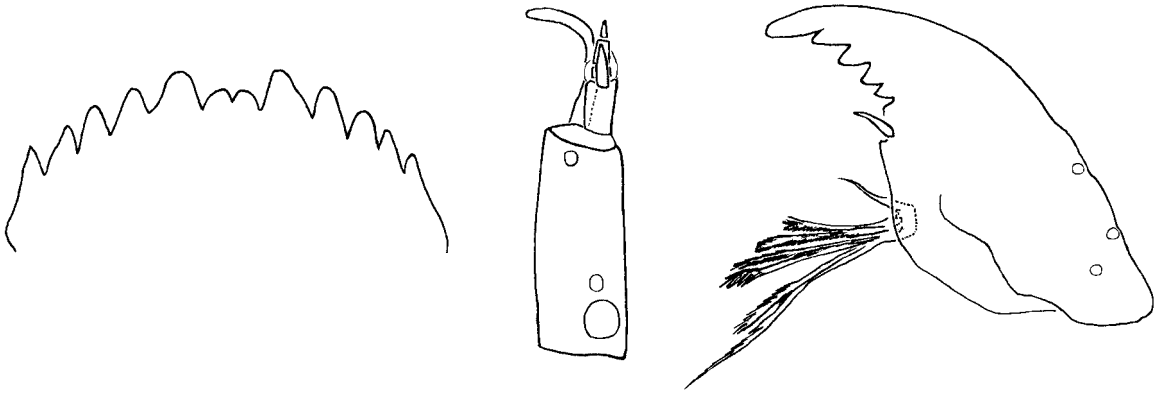
M. eurynotus mentum



M. knabi mentum

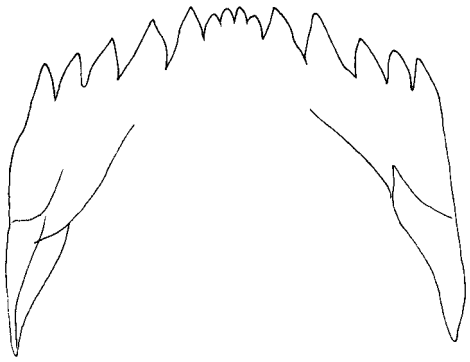
Key to *Metriocnemus* larvae of the southeastern United States

1 Abdominal segments with long setae (at least 1/2 as long as segment bearing them); known only from bromeliads in southern Florida ..... ***M.* sp. A**



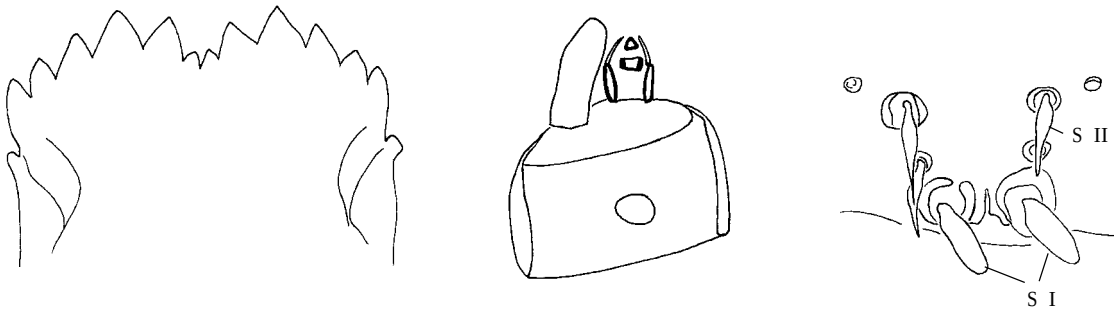
1' Abdominal segments with short setae; widespread 2

2(1') Mentum with 4 median teeth; restricted to water held by pitcher plant *Sarracenia* ..... ***M. knabi***

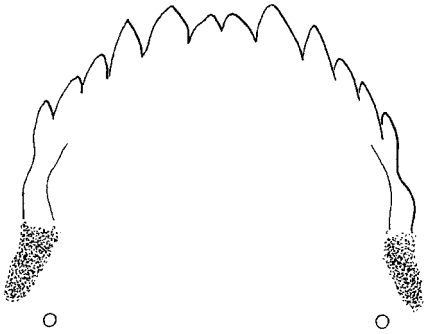


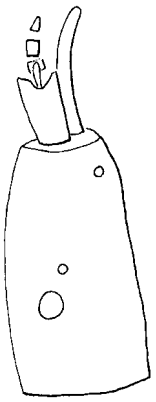
2' Mentum with 2 median teeth; not restricted to *Sarracenia* phytotelmata 3

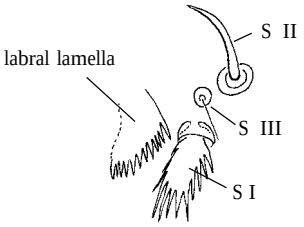
3(2') Median teeth of mentum deeply sunken; antenna squat; S I simple ..... ***M. fuscipes***



3' Median teeth of mentum slightly lower than first lateral teeth; antenna normal; S I plumose .... ***M. eurynotus***







labral setae

Notes on species

M. eurynotus - Formerly known as *M. hygropetricus* and *M. obscuripes*. The two median teeth of the mentum may be worn down to appear as one rounded tooth or as a semicircular depression. Larvae are usually found in madicolous habitats, such as water flowing in thin sheets over rocks. They may occur in organically enriched habitats, especially sewage treatment beds.

M. fuscipes - According to Sæther (1989a) the second most common and widespread species of *Metriocnemus*, following *M. eurynotus*. Most of the larva's body segments are banded with purple; Bill Beck used to call this larva "Bungarus" (a genus of banded snakes, the kraits). Larvae occur in springs, seeps and streams; de la Rosa and Nastase (1987) reported a "small larva of *Metriocnemus* cf. *fuscipes*" found among larvae of *M. knabi* in the pitcher plant *Sarracenia purpurea* L.

M. knabi - Larvae are restricted to the water held by the pitcher plant *Sarracenia*, most often (exclusively?) *S. purpurea*. Note that the larval procerci are huge, as large as the posterior parapods.

M. sp. A - This species is known only from bromeliad phytotelmata (water held by plants) in south-central Florida; it is not expected to occur in the Carolinas. The procerci are more than twice as long as wide. An unusual larva for a *Metriocnemus* (if indeed it belongs here), for it has long abdominal setae. These setae should easily separate this species from *M. eurynotus*, which has a similar mentum, S I and labral lamellae. All characters other than the long body setae seem to place it in *Metriocnemus*; until pupae and adults are discovered, I am keeping it in *Metriocnemus*. Another phytotelmatic species placed as *Metriocnemus* sp. B in Epler (1995) has been moved to Orthocladiinae genus H (q.v.).

Metriocnemus abdominoflavatus Picado has been reported from North Carolina and Florida by Caldwell et al. (1997). It is very doubtful that this poorly described Costa Rican species (see Picado (1913)) occurs in the United States; these records may refer to *M. fuscipes*.

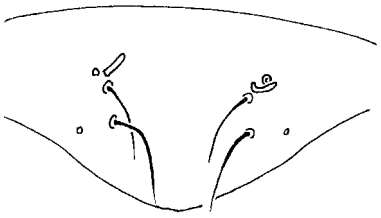
Genus ***Nanocladius***

DIAGNOSIS: The simple labral setae (a single Japanese species with apically pectinate S II); large ventromental plates which extend past the lateral margin of the mentum; lack of cardinal beard; and distinctive mentum with wide median area, usually with two small central teeth, distinguish the genus in our area.

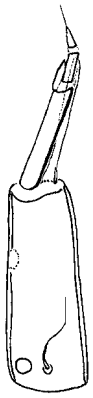
NOTES: A common and widespread genus, *Nanocladius* is divided into two subgenera: *Nanocladius (Plecopteracoluthus)* is phoretic or parasitic on aquatic insects; *Nanocladius (Nanocladius)* species are free-living. Larvae are found in lakes, rivers and streams; at least one species, *N. distinctus*, is tolerant of high levels of organic nutrients.

Identification of some *Nanocladius* species is difficult; many determinations based on larvae alone are suspect. A pupal association is often necessary for accurate identification. I have seen numerous misidentifications, especially of early instar larvae, in which the ventromental plates are not developed as in the 4th instar; this is especially true for larvae identifed as species of *N. (Plecopteracoluthus)*. Sæther (1977a) provided keys for larvae, pupae and adults, but the keys and descriptions are ambiguous and contain numerous errors; some species descriptions include measurements, etc., from more than one species. There are several undescribed species in the eastern United States.

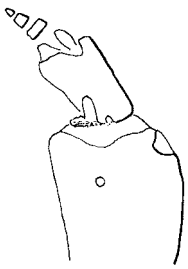
ADDITIONAL REFERENCES: Dendy 1973; Dendy & Sublette 1959; Dosdall & Mason 1981; Fittkau & Lehman 1970; Epler 1986; Sæther 1977a; Simpson & Bode 1980; Steffan 1965.



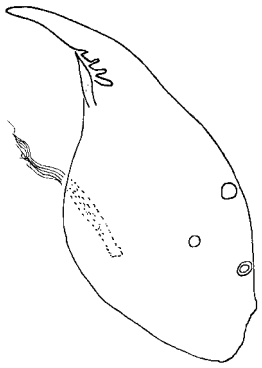
N. crassicornus labrum



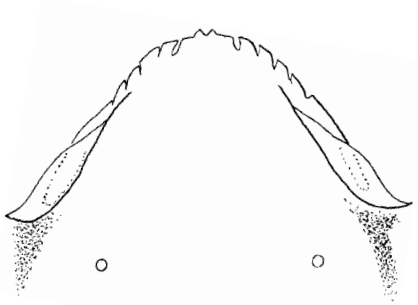
N. crassicornus antenna



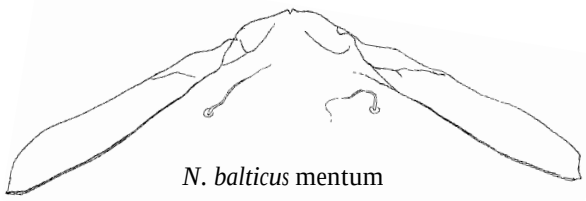
N. sp. 1 antenna



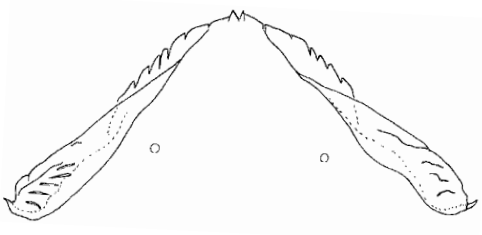
N. crassicornus mandible



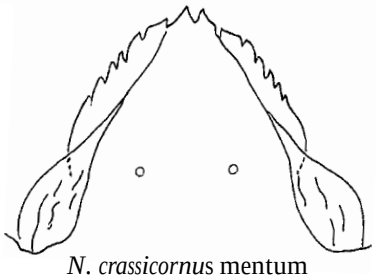
N. branchicolus mentum



N. balticus mentum



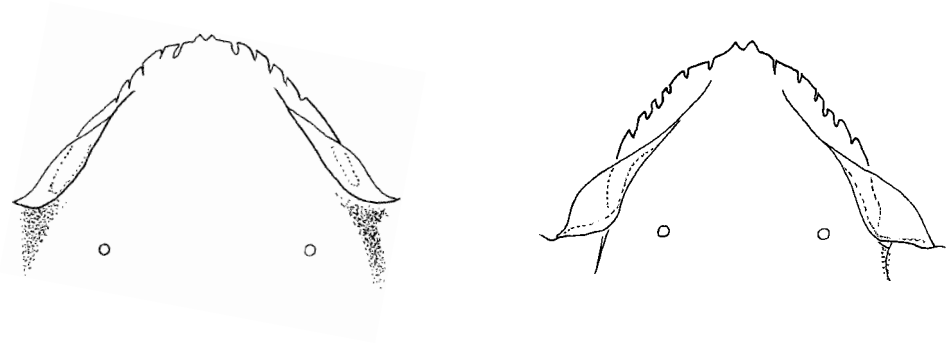
N. distinctus mentum



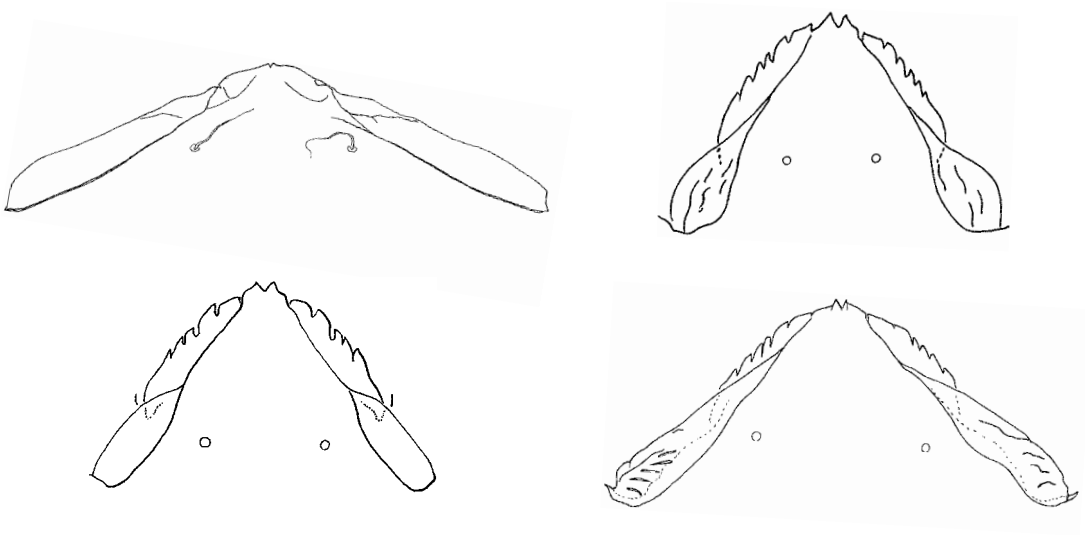
N. crassicornus mentum

Key to *Nanocladius* larvae of the southeastern United States

1 Ventromental plates short, scarcely extending past the posterolateral margin of the mentum .. 2

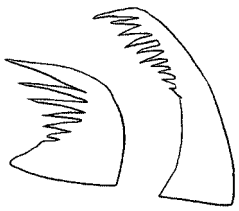


1' Ventromental plates long, extending at least more than 1/2 their length beyond the posterolateral margin of the mentum 7

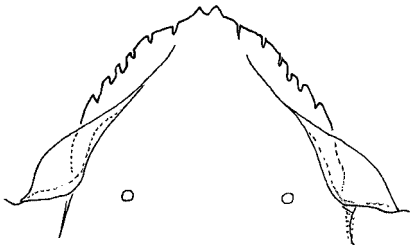


2(1) Anterior parapods with most claws smooth, although some present with internal teeth; free-living, usually on aquatic macrophytes, usually in lentic habitats ..... ***N. (N.) alternantherae***

anterior parapod claws of *N. alternantherae*



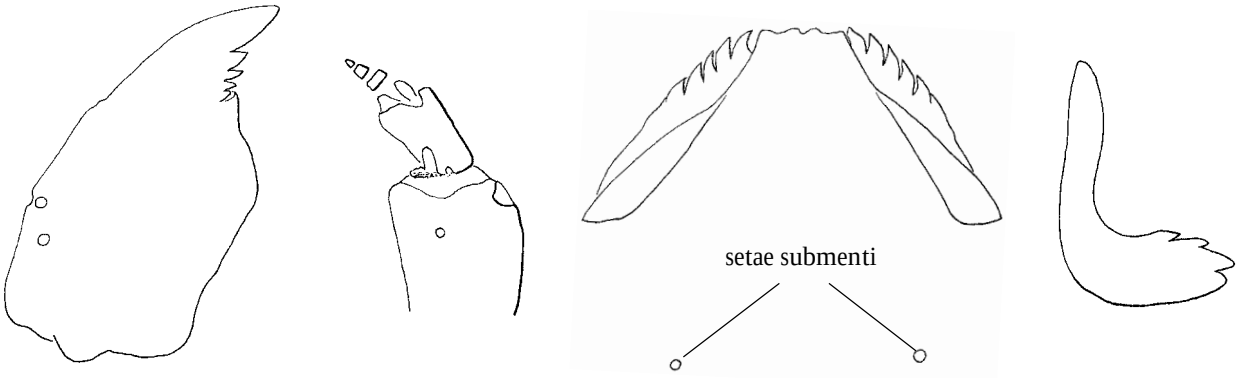
strongly pectinate claws



mentum of *N. alternantherae*

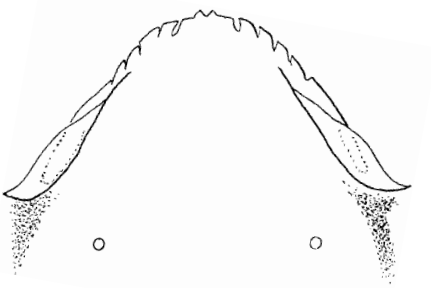
2' Anterior parapods with most medium-sized claws strongly pectinate/serrated; phoretic or parasitic on aquatic macroinvertebrates, usually in lotic habitats 3

3(2') Apical tooth of mandible stout; antennae reduced; premandible with 4-5 apical teeth; setae submenti displaced posteriad; obligate parasite on *Ephemera guttulata* ..... ***N. (P.)* sp. # 1**

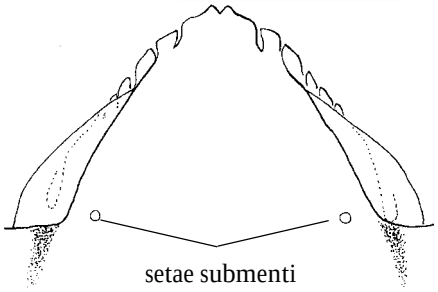


3' Apical tooth of mandible longer, thinner; antennae not as reduced; premandible simple or at most weakly bifid; setae submenti not displaced as far posteriad; not parasitic on *E. guttulata* 4

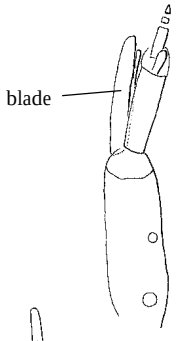
4(3') Setae submenti just posterior to ventromental plates .. 5



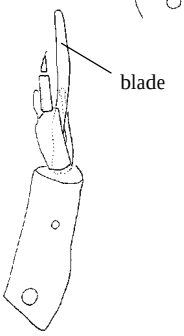
4' Setae submenti even with ventromental plates 6



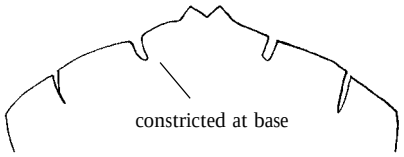
5(4) Antennal blade shorter than flagellum; central cusps of mentum sharp, distinct .... ***N. (P.) branchicolus***



5' Antennal blade longer than flagellum; central cusps of mentum weaker, lower .... ***N. (P.)* sp. #3**

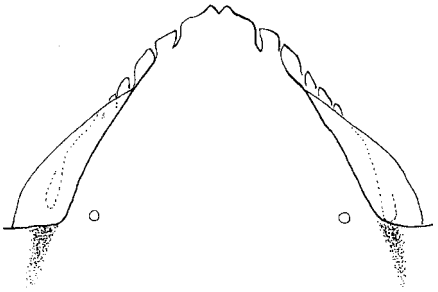


6(4') Median tooth of mentum constricted at base; postmentum usually dark near posterior margin of head capsule ..... ***N. (P.) downesi***



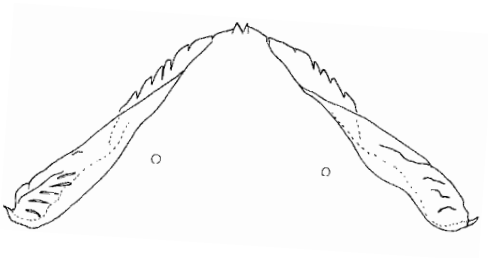
central teeth of *N. downesi* mentum

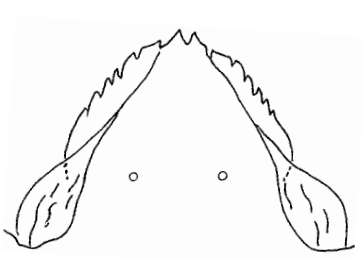
6' Median tooth of mentum not constricted basally; postmentum not darkened ..... ***N. (P.)* sp. # 5**

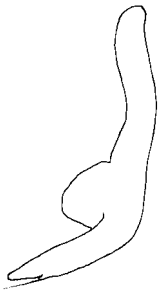


7(1') Ventromental plates extremely wide; teeth of mentum not distinct; premandible with 3-5 apical teeth 8

7' Ventromental plates not as wide; lateral teeth of mentum usually distinct; premandible simple or apically bifid 10

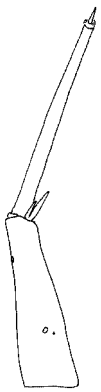




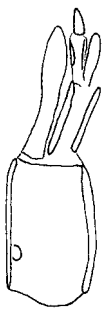


8(7) Antennae elongate, with 2nd segment longer than basal segment ..... ***N. (N.)* sp. D**

8' Antennae reduced, with 2nd segment at most subequal to basal segment 9

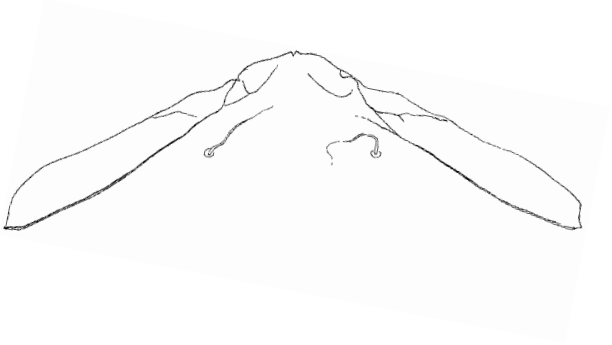


N. sp. D



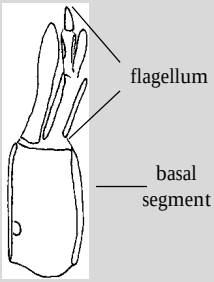
N. balticus

9(8') AR ≤ 1.00; postmentum length > 130 µm; ventromental plates with horizontal ridges near anterior margin; some anterior parapod claws pectinate ..... ***N. (N.) balticus***



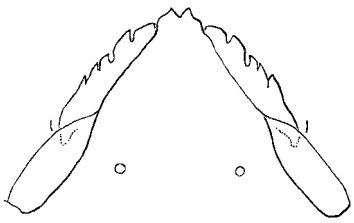
NOTE: 4th instar larvae are necessary for accurate measurements!!

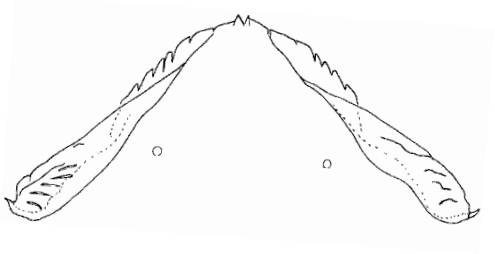
AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)



9' AR 1.00-1.12; postmentum length < 120 µm; ventromental plates apparently smooth; most anterior parapod claws smooth ..... ***N. (N.) incomptus***

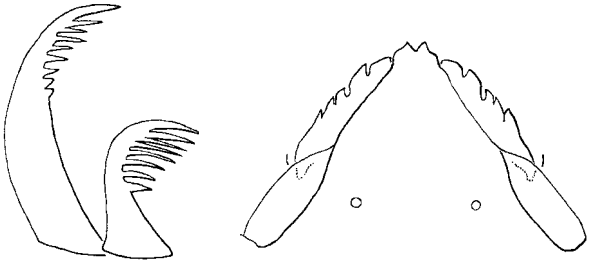
10(7') Ventromental plates elongate, without ridges or with horizontal ridges 11



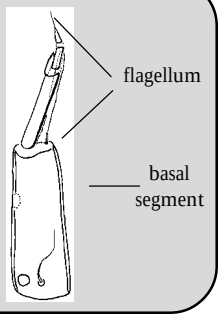


10' Ventromental plates tear-drop shaped, with vertical ridges ..... ***N. (N.) crassicornus***, ***N. (N.)*** **cf.** ***rectinervis*** 13

11(10) Anterior parapod claws strongly pectinate; AR 1.2-1.5; ventromental plates smooth .... ***N. (N.) spiniplenus***

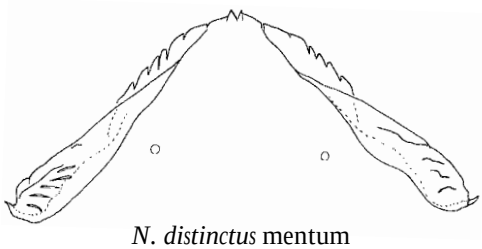


AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)



NOTE: 4th instar larvae are necessary for accurate measurements!!

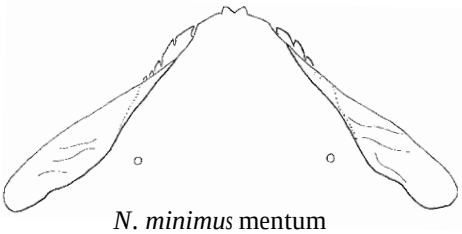
11' Anterior parapod claws smooth; AR ≥ 1.5; ventromental plates with horizontal ridges 12



N. distinctus mentum

12(11') Ventromental plates with strong, distinct horizontal ridges; AR 1.7-2.0; basal antennal segment length 53-60 µm .... ***N. (N.) distinctus***

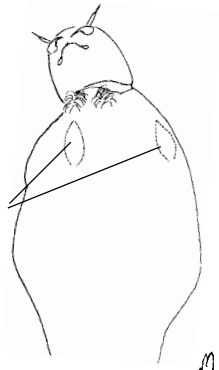
NOTE: 4th instar larvae are necessary for accurate measurements!!



N. minimus mentum

12' Ventromental plates with weak horizontal ridges; AR 1.5-1.8; basal antennal segment length 40-53 µm ..... ***N. (N.) minimus***

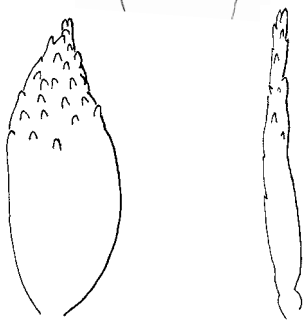
The larvae of the following two species are inseparable. However, if you have a late 4th instar larva, the developing pupal thoracic horns may be visible. If they are, the larvae may be identified to species by the following:



developing thoracic horns in late 4th instar larva

13(10') Pupal thoracic horn ovoid ..... ***N. (N.) crassicornus***

13' Pupal thoracic horn elongate ..... ***N. (N.)* cf. *rectinervis***



N. crassicornus *N.* cf. *rectinervis*

Notes on species

Larvae of many *Nanocladius* are difficult to identify to species; pupae often provide the best characters for species separation. Larvae of the subgenus *Plecopteracoluthus* have been the most misidentified members of the genus; this has led to numerous papers with misinformation concerning macroinvertebrate hosts of *Nanocladius.* Note that *N*. (*Plecopteracoluthus)* species may be phoretic or parasitic. Much of the information in this manual concerning *N*. *(Plecopteracoluthus)* species has been graciously provided by Dr. Rick Jacobsen.

N. *(N.) alternantherae* - A common species usually associated with plants in lentic conditions. The short ventromental plates easily confuse this taxon with members of the subgenus *Plecopteracoluthus*. However, *N*. *alternantherae* is free-living; all known members of *Plecopteracoluthus* are phoretic or parasitic on aquatic macroinvertebrates, and most of the claws of the anterior parapods of *N*. *alternantherae* are simple; those of *Plecopteracoluthus* species are strongly pectinate. Note that some of the parapod claws of *N*. *alternantherae* will have inner teeth, but the majority of the medium-sized claws will be smooth. This species can be easily confused with *N*. cf. *rectinervis* (as used in this manual); *N*. *alternantherae* is usually found associated with plants in lentic conditions; *N*. cf. *rectinervis* is usually lotic. Pupae of *alternantherae* strongly resemble those of *N*. cf. *rectinervis* but differ in having one of the dorsal antepronotal setae much thinner and shorter than the other; these setae are subequal in *N*. cf. *rectinervis.* Note that the original description (Dendy & Sublette 1959) of *N*. *alternantherae* is in error; the pupal thoracic horn does have small spines.

N. *(N.) balticus* - I have examined a reared specimen from Florida that appears to be this species. It occurs in both the Carolinas and has been found as far south as the Orlando, Florida, area. This species is difficult to separate from *N*. *incomptus*; unless 4th instar larvae are present and can provide accurate measurements, larvae should be identified as "*N*. *balticus* group sp.".

N. *(P.) branchicolus* - A parasitic species found on the perlid stoneflies *Acroneuria* spp., *Paragnetina media* (Walker) and *P. immarginata* (Say). *Nanocladius branchicolus* and *N*. *downesi* have been frequently misidentified and confused in the literature. Jacobsen (pers. comm.) notes that *N*. *branchicolus* is not found on the coenagrionid damselfly *Argia* as reported by Dosdall & Parker (1998); these specimens were *N*. *downesi*. Known from Michigan, New York, North Carolina (Great Smoky Mountains National Park), Pennsylvania, Wisconsin, Wyoming, Ontario and Saskatchewan.

N. *(N.) crassicornus* - A common species in northern Florida, where I have been able to confirm its identity with associated pupae. At this time, characters have not been found that will separate larvae of *N*. *crassicornus* from those of *N*. cf. *rectinervis* . Although Simpson & Bode (1980) used antennal characters to separate the two species, these characters do not hold up when a larger range of material is examined.

N. *(N.) distinctus* - A species with large ventromental plates bearing distinct horizontal ridges, *N*. *distinctus* often occurs in water with high organic loading, such as below pulp mill discharges. It can be confused with *N*. *minimus*, which usually has weaker ridges on the ventromental plates and is smaller.

N. *(P.) downsei* - A phoretic (not parasitic) species found on a wide variety of aquatic macroinvertebrates: Plecoptera: Perlidae; Megaloptera: Corydalidae: *Corydalus, Chauliodes, Nigronia*; Hemiptera: Belostomatidae: *Belostoma*; Odonata: Coenagrionidae: *Argia*. It has been found in Georgia, Maryland, Michigan, Missouri, New Hampshire, North Carolina, Pennsylvania, Tennessee, Vermont, Wisconsin and Quebec. Although recorded from the Carolinas by Hudson et al. (1990) and Caldwell et al. (1997), with the exception of one specimen from North Carolina, their specimens have not been reexamined for positive identification. Almost without exception, all records of this species and *N*. *branchicolus* in the "gray literature" must be viewed with considerable skepticism.

N. (N.) incomptus - A member of the *balticus* group; in general, only 4th instar larvae are identifiable because of the similarity between this species and *N. balticus*.

N. (N.) minimus - As a larva and adult male, very difficult to identify; according to Sæther (1977a) only the female and pupa are easily identified. This species may be a variant of *N. anderseni* (Sæther 1977a). Records of this species from throughout the Southeast, such as those in Hudson et al. (1990) and Caldwell et al. (1997), must be viewed with skepticism. Originally described from South Carolina.

N. (N.) cf. *rectinervis* - Note that what has been called *N. rectinervis* in North America may not be that species, originally described from the Palaearctic. See figures of *N. rectinervis* in Cranston et al. (1983: fig. 9.44B); the ventromental plates are apparently much longer than those of specimens identified as *N. rectinervis* from the Nearctic. The material described by Sæther (1977a) as *N. rectinervis* and *N. alternantherae* was mixed (Sæther, in ms.). I have not examined any associated material of this taxon from the Palaearctic. For the time being, it would be best to call this taxon *N.* cf. *rectinervis* until its identity can be settled through examination of reared material from both sides of the Atlantic. This species is apparently inseparable from *N. crassicornus* as a larva. Although Simpson & Bode (1980) suggested that lengths of the first antennal segment might separate the two species, these measurements overlap and are unusable. Epler (1995) confused *N. rectinervis* with *N. alternantherae*; most of what he called *rectinervis* was actually *alternantherae* (also see *alternantherae* above). Records of *N. rectinervis* as a phoretic organism on North American macroinvertebrates are in error and in most cases refer to species, some undescribed, of *N. (Plecopteracoluthus)* (R. Jacobsen, pers. comm.). These include the record of *N. rectinervis* on *Nigronia serricornis* (Say) in Gotceitas & Mackay (1980) (referable to *N. (P.)* sp. # 5) and probably those of Dosdall et al. (1986) on the stonefly *Pteronarcys dorsata*.

N. (N.) spiniplenus - Records of this species by Dosdall et al. (1986) as a phoretic organism on the stonefly *Pteronarcys dorsata* are probably in error. Fourth instar larvae and pupae are necessary for accurate identification.

N. (N.) sp. D - Epler (1992, 1995) called this taxon "Orthocladiinae genus D" and suggested that it was a *Nanocladius*. Several colleagues (Caldwell, Cranston, Sæther, all pers. comm.) agree that it is best placed in *Nanocladius*. It is not known to me from the Carolinas; it is known from Georgia (Caldwell et al. 1997) and western Florida.

N. (P.) sp. #1 Jacobsen - This distinctive species is an obligate parasite on the mayfly *Ephemera guttulata* Pictet. No other species of *N. (Plecopteracoluthus)* has such short antennae, a stout apical tooth of the mandible and the short, stout, apically dissected body setae. This *Nanocladius* has not been found in the Carolinas but its host has been recorded from North and South Carolina (Pescador et al. 1999), leading one to believe that it will probably be found in the Carolinas. Known from Kentucky, Maryland, Pennsylvania, Virginia and West Virginia.

N. (P.) sp. #3 Jacobsen - Larvae are parasitic on the stoneflies *Pteronarcys biloba* Newman, *Pt. proteus* Newman and *Pt. scotti* Ricker. B. A. Caldwell has collected *N. (P.)* sp. #3 from *Pt. scotti* in Georgia. It is the species reported from *Pt. biloba* as "*Nanocladius (Plecopteracoluthus)* undescribed sp., nr. *branchicolus*" in Giberson et al. (1996). It is also probably the species referred to as *N. branchicolus* on *Pt. dorsata* (Say) by Dosdall et al (1986), but no material exists (R. Jacobsen, pers. comm.). Distributed from New Brunswick to Georgia, but not yet recorded from the Carolinas.

N. (P.) sp. #5 Jacobsen - Larvae are phoretic on *Nigronia serricornis* (Say) and the damselfly *Argia*. Larvae of *N. (P.)* sp #5 were referred to as *N. rectinervis* in Gotceitas & Mackay (1986); some of Hilsenhoff's (1968) *N. downesi* on *Nigronia serricornis* were also this species, and it is the *N. (P.)* sp. of Pennuto (1997, 1998). Known from Connecticut, Maine, Maryland, North Carolina, Pennsylvania and Wisconsin.

Genus ***Orthocladius***

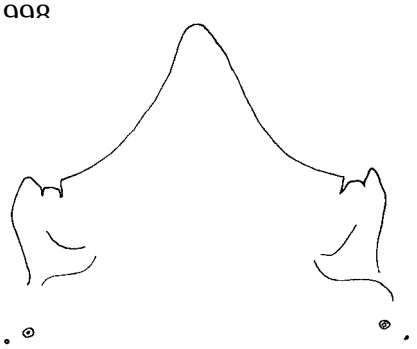
DIAGNOSIS: Difficult to diagnose because of the wide range of character variation; some larvae are difficult to distinguish from *Cricotopus (Cricotopus)* and *Paratrichocladius* larvae. Most *Orthocladius* possess a bifid SI (secondarily split in one undescribed species) or, less commonly, the SI is simple; pecten epipharyngis always of three scales; premandible simple or apically bifid; weak to moderately developed ventromental plates; weak or vestigial beard; mentum with odd number of teeth (ranging from 5 to 21); and body usually without setal tufts (but tufts present in at least 3 species in the United States).

NOTES: Four of the five subgenera of *Orthocladius* occur in the Carolinas: *Eudactylocladius, Euorthocladius, Orthocladius* and *Symposiocladius*. Although the various subgenera have recently been revised, it is still very difficult to identify larvae, making associations with pupae or adult males imperative for accurate species level identification; pupae are often the best stage for species identification. The discovery of setal tufts on *O. annectens* (Fagnani & Soponis 1988) negates the use of that character in separating some *Orthocladius* larvae from those of *Cricotopus* that also bear setal tufts.

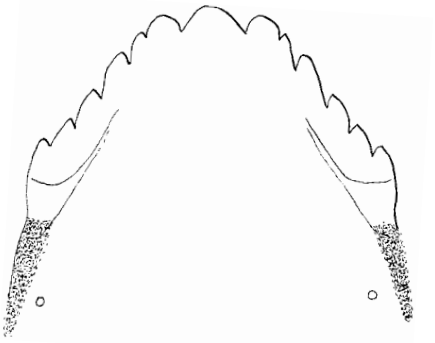
The distinction between some *O. (Orthocladius)* species (*frigidus, vaillanti* and sp. "Jacobsen") and *O. (Euorthocladius)* is unclear; much more work is necessary. A worldwide revision of *Orthocladius* (including all its subgenera) and *Cricotopus* are needed. Note that several Nearctic *Orthocladius* species are probably synonyms of Palaearctic taxa (See Notes on species)

Orthocladius larvae inhabit a wide variety of habitats, although most are usually found in running water. It is not unusual to find more than one species at a single site. *Orthocladius (S.) lignicola* larvae mine in submerged soft or decomposing hardwoods. The larvae and pupae of many (all?) *O. (Euorthocladius)* live in gelatinous tubes.

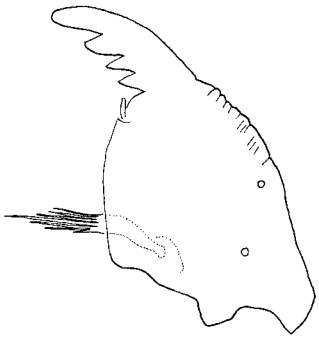
ADDITIONAL REFERENCES: Caldwell 1999; Cranston 1999; Cranston & Oliver 1988b; Fagnani & Soponis 1988; Langton & Cranston 1991; Sæther 1969; Soponis 1977, 1987, 1990; Sublette et al. 1998



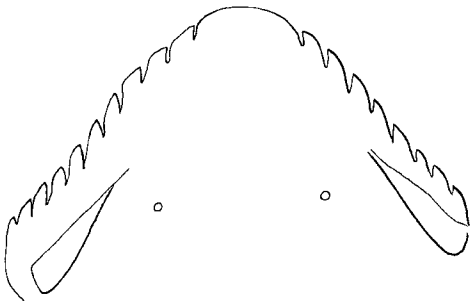
O. (S.) lignicola mentum



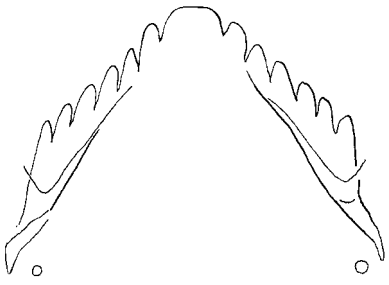
O. (Eud.) dubitatus mentum



O. (O.) dorenus mandible



O. (Euo.) rivulorum mentum



O. (O.) rubicundus mentum

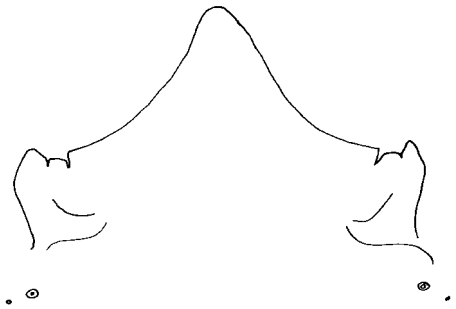
O. (S.) annectens antenna

O. (O.) nigritus antenna

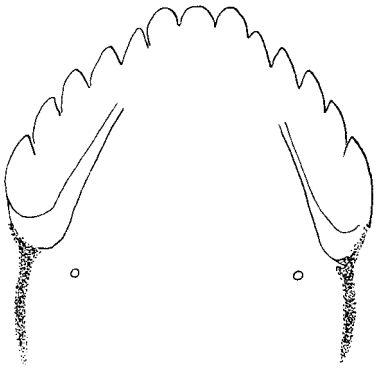
Key to *Orthocladius* larvae of the southeastern United States

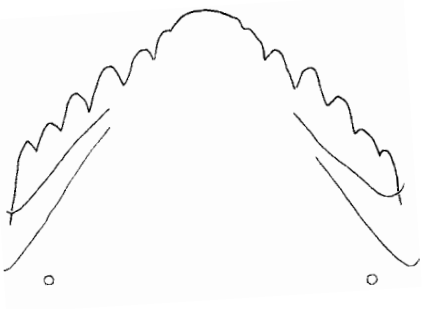
(You should have a pupal association that confirms that your specimen is an *Orthocladius* before attempting this key. Most identifications should be considered tentative unless backed by a pupal or adult association)

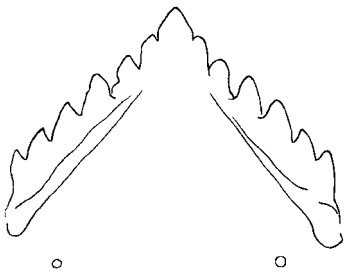
1 Mentum with huge median tooth and < 11 lateral teeth (caution – a worn mentum may have less than the usual number of teeth visible!); abdominal segments with posterolateral setal tufts .....…… ..... ***O. (S.) lignicola***

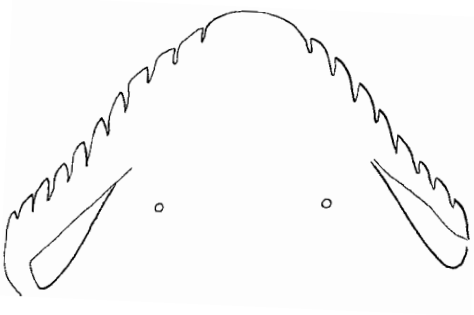


1' Mentum with more normal median tooth and 11 or more lateral teeth; abdominal segments usually without posterolateral setal tufts (present in one species, couplet 12) ……..……. 2

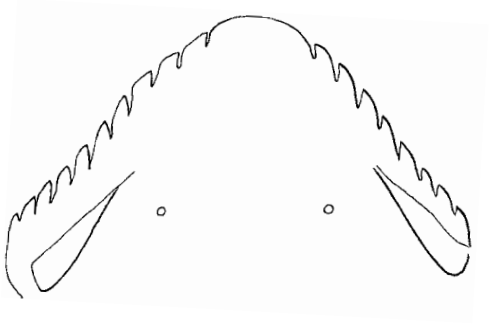




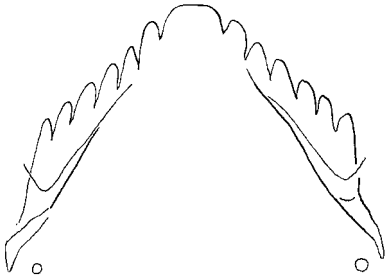




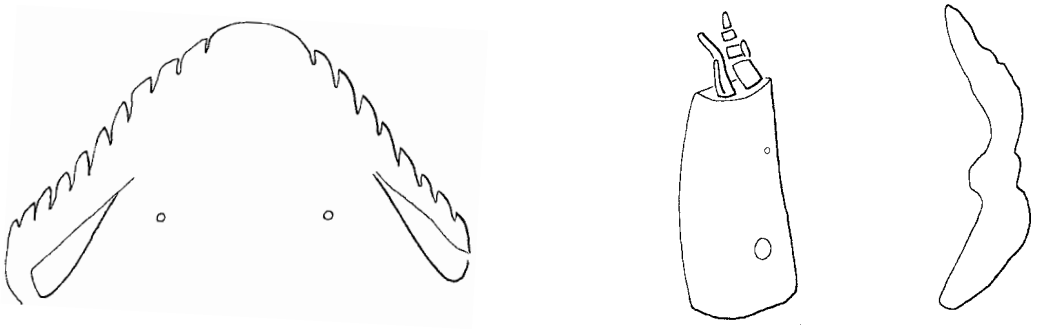
2(1') Mentum with more than 13 teeth ……..…….. 3



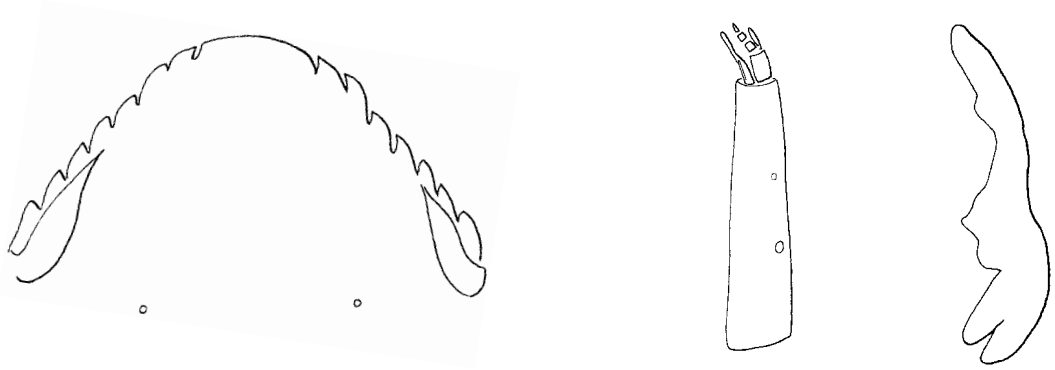
2' Mentum with 13 teeth ……...……. 4



3(2) Mentum with 17-21 teeth; basal segment of antenna short; premandible simple …..... ..... ***O. (Euo.) rivulorum***

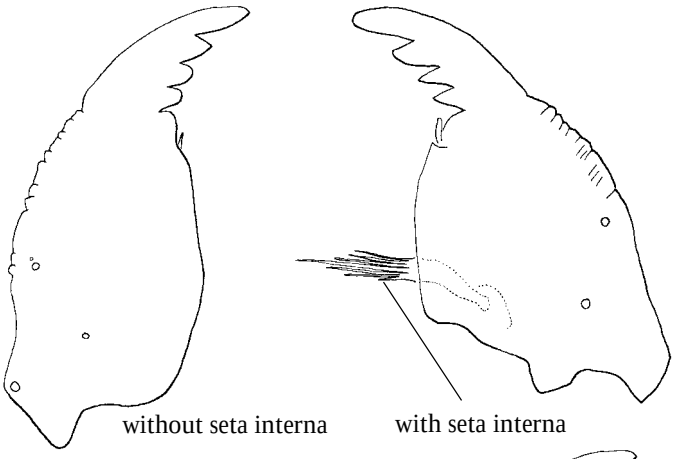


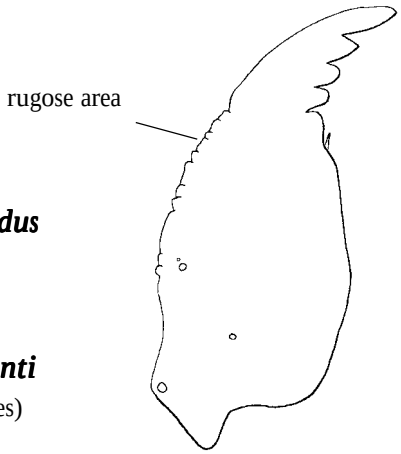
3' Mentum with 15 teeth; basal segment of antenna long; premandible apically bifid ..... ***O. (O.)* sp. "Jacobsen"**



4(2') Mandible without seta interna 5

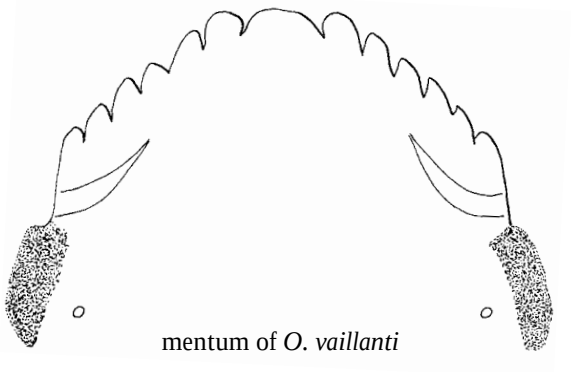
4' Mandible with seta interna ….....….. 6

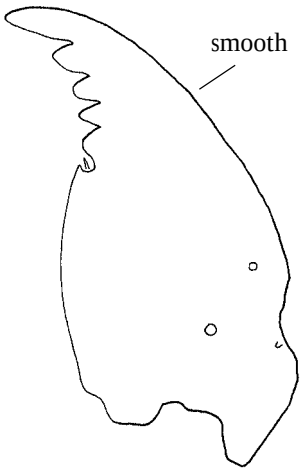




5(4) Outer margin of mandible rugose ..... ***O. (O.) frigidus***

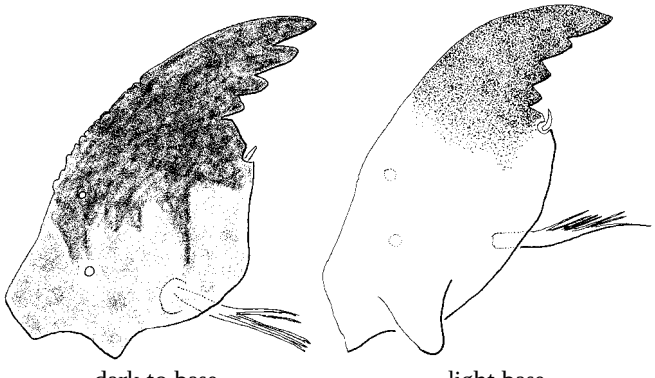
5' Outer margin of mandible mostly smooth .. ***O. (O.) vaillanti***
(see Notes; if premandible bifid represents a different, undescribed, species)



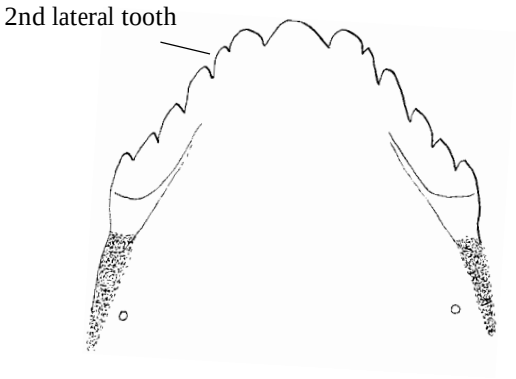


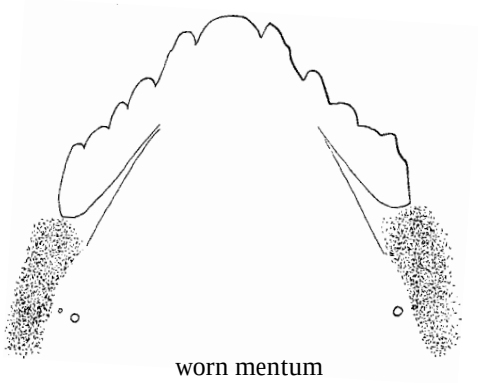
6(4') Head capsule light brown to dark brown or dark reddish-brown; mandibles usually darkly colored to base (base may be paler than apex, but overall the mandible is dark) …..... 7

6' Head capsule yellow to light yellow-brown; mandibles with dark apex and teeth and light colored base, never darkly colored to base ….....…… 11

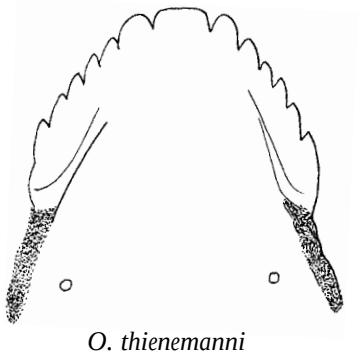


7(6) 2nd lateral tooth of mentum reduced and partially fused to 1st lateral tooth .. ***O. (Eud.) dubitatus***



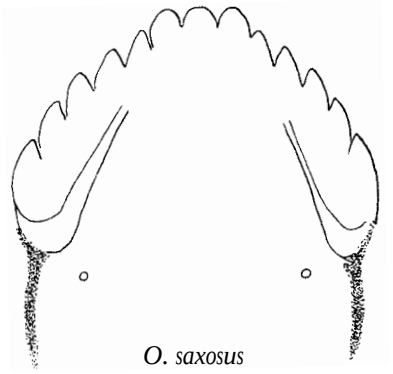

worn mentum

7' 2nd lateral tooth not reduced or fused to 1st lateral tooth …..... 8


O. thienemanni

8(7') Mentum with median tooth > 1.5X width of 1st lateral tooth 9

8' Mentum with median tooth < 1.5X width of 1st lateral tooth 10


O. saxosus

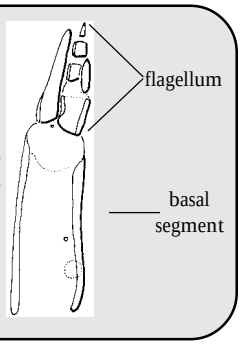
9(8) AR > 1.85 ..... ***O. (Euo.) thienemanni***

9' AR < 1.85 ..... ***O. (Euo.) luteipes***

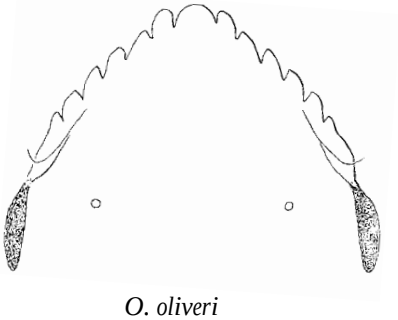
10(8') AR < 1.80 …..... ***O. (Euo.) rivicola***

10' AR > 1.80 …..... ***O. (Euo.) saxosus***

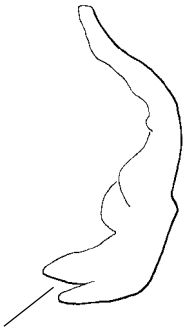
AR = antennal ratio. Calculated by dividing the length of the basal segment by the length of the flagellum (the remaining antennal segments.)



11(6') Premandible apically bifid ..... ***O. (O.) oliveri***



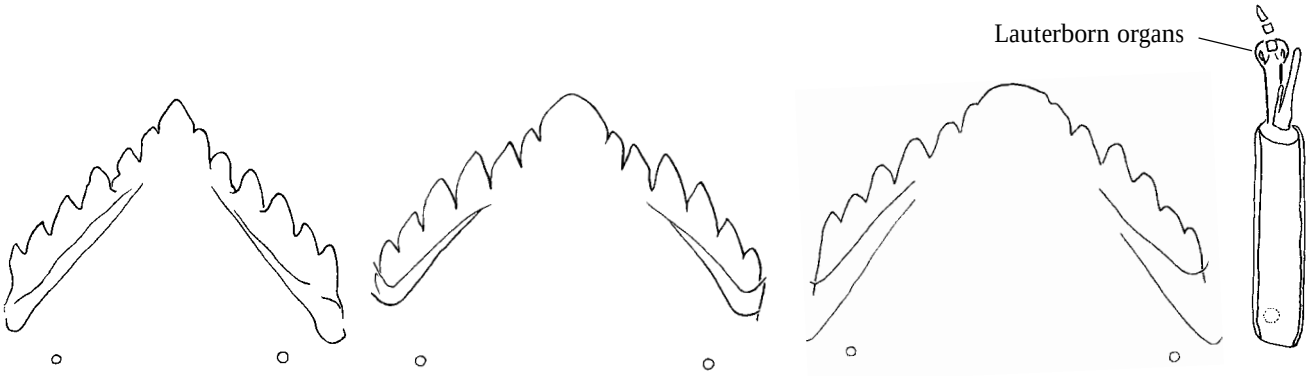
O. oliveri



apically bifid premandible

11' Premandible apically simple (may be slightly notched apically) .. 12

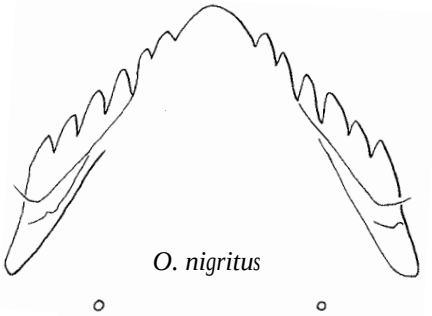
12(11') Mentum with 1st lateral teeth small and partially fused to median tooth, median tooth and 1st lateral teeth projecting far beyond remaining mental teeth; Lauterborn organs large, appearing circular; abdominal segments with posterolateral setal tufts ..... ***O. (S.) annectens***



variation in menta due to wear

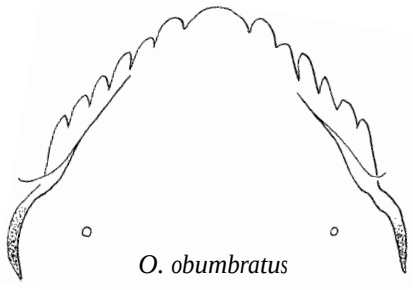
12' 1st lateral teeth of mentum not small and partially fused to median tooth; Lauterborn organs not as above (may be large but rarely appear circular); abdomen without setal tufts …..... 13

13(12') Mentum more triangular in outline; median tooth, 1st and 2nd lateral teeth often project above remaining lateral teeth …….....…… 14



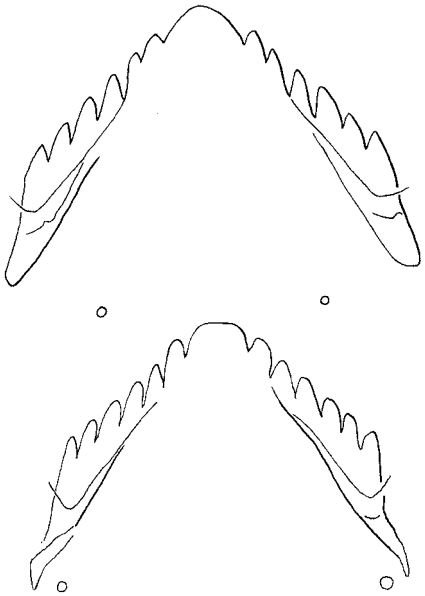
O. nigritus

13' Mentum more convex in outline, without teeth projecting far beyond their neighbors 17



O. obumbratus

14(13) Median tooth of mentum about 3X width of 1st lateral tooth 15

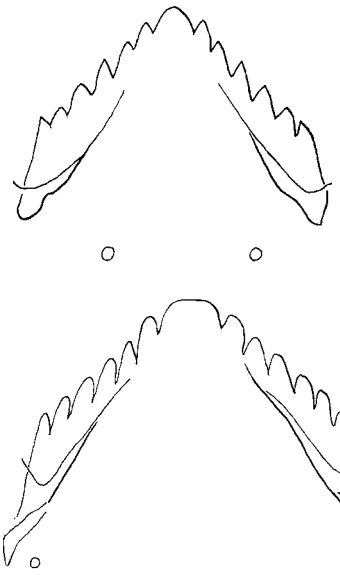


14' Median tooth of mentum at most about 2x width of 1st lateral tooth 16

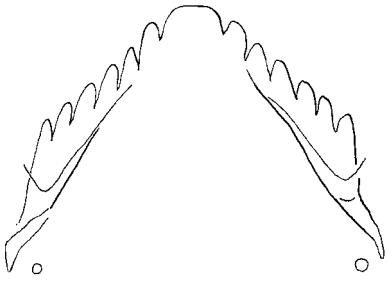
15(14) Mandible moderately rugose on outer margin ..... ***O. (O.) nigritus***

15' Mandible smooth on outer margin …..... ***O.(O.) carlatus***
(and perhaps some *O. (O.) rubicundus*)

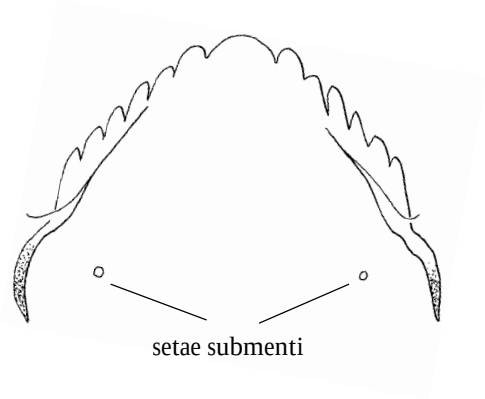
16(14') Mandible with outer margin rugose (see 15 above); mentum as figured ..... ***O.(O.) dentifer***

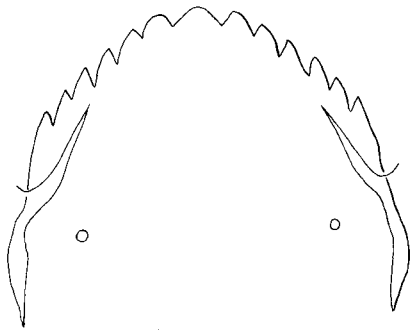


16' Mandible with outer margin smooth (see 15' above); mentum as figured ..... ***O. (O.) rubicundus***

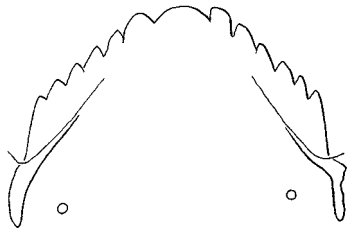


17(13') Ventromental plates apparently extended posteriorly, far exceeding line drawn through setae submenti 18

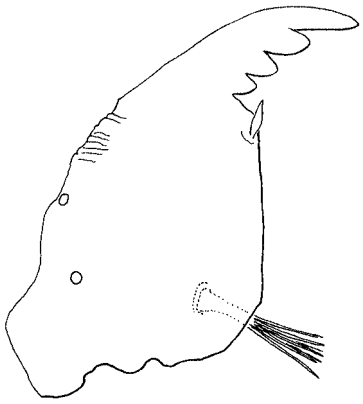


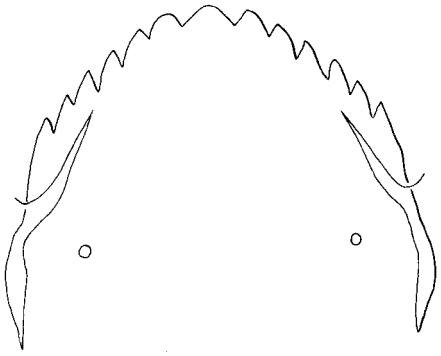


17' Ventromental plates not extended as far posteriorly, barely exceeding line drawn through setae submenti 20

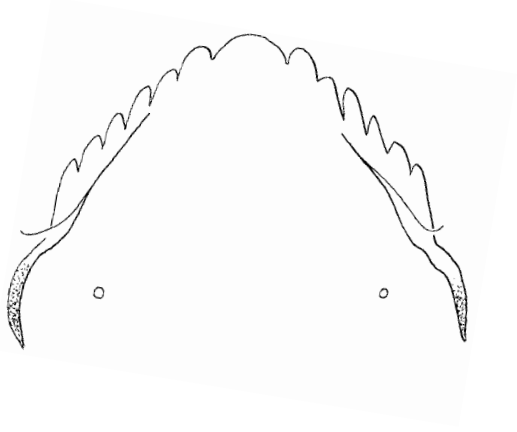


18(17) Mandible rugose on outer margin; median tooth of mentum <1.5 X width of 1st lateral tooth .. .. ***O. (O.) mallochi***

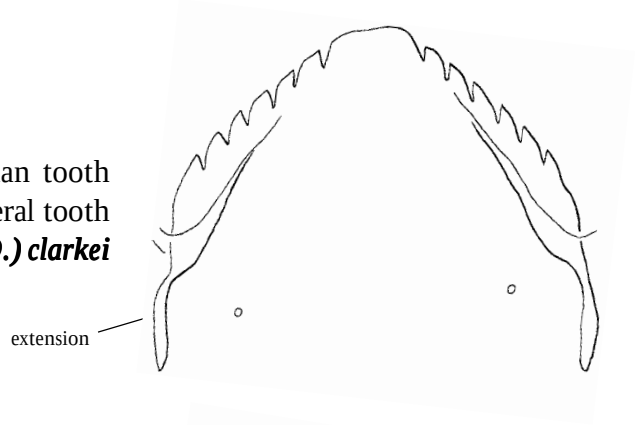




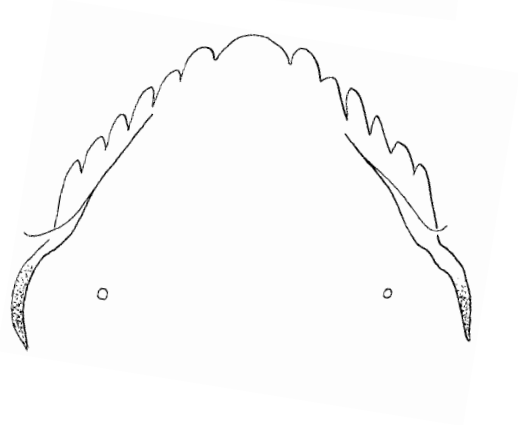
18' Mandible smooth to slightly rugose on outer margin; median tooth of mentum about 2-3X width of 1st lateral tooth 19



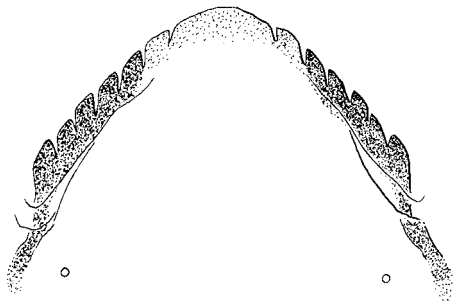
19(18') Ventromental "plate" extension longer; median tooth of mentum more than 3.3X as wide as 1st lateral tooth …..... ***O. (O.) clarkei***



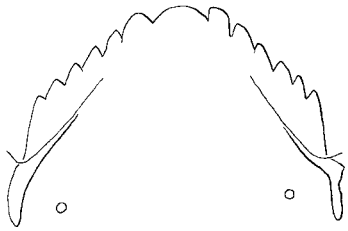
19' Ventromental "plate" extension shorter; median tooth of mentum about 2.5-3.3X as wide as 1st lateral tooth …..... ***O. (O.) obumbratus***

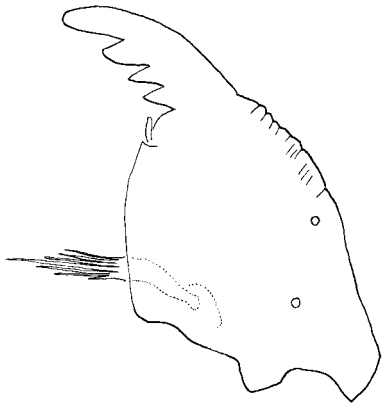


20(17') Median tooth and 1st lateral tooth of mentum lighter in color than remaining lateral teeth; outer margin of mandible smooth to weakly rugose .. ***O. (O.) robacki*** (and perhaps some ***O. (O.) obumbratus***)



20' Median tooth similar in color to lateral teeth; outer margin of mandible strongly rugose .... ***O. (O.) dorenus***





Notes on Species

Species level (and even accurate generic level) identifications of *Orthocladius* larvae are difficult. Perceived differences in larvae are often only variants of the same species; associated pupae and/or adults are usually needed for accurate species level identification - as with *Cricotopus*, pupae usually provide the best means of species identification. Dave Lenat (NC DENR) has written a laboratory key for combined *Cricotopus* and *Orthocladius* species; the taxa were given C/O numbers, some of which were also used in Lenat (1993b). I have attempted to reconcile his system of numbers with the names listed below; his number is listed in brackets at the end of each species summary when applicable. Note that some of the numbers may apply to several species and that some species may have several numbers associated with them.

Many *Orthocladius* larvae have sclerotized extensions at the posterior corner of the mentum, which appear as elongated, posteriorly directed ventromental plates. However, these extensions appear to be more heavily sclerotized areas of the cuticle that are extensions of the mentum and not true ventromental plates. They may prove to be useful in separating some species, but more reared material is needed to realistically assess their utility. Note that the ability to observe the rugosity (or amount of wrinkles) on the outer margin of the mandible is dependent upon the orientation of the mandible. If the outer edge is not lined up correctly, rugosity may only appear as a series of thin lines on the surface of the mandible. And to further confuse matters, it appears that mandibular rugosity may vary within a species - some specimens may be smooth when most other specimens of that species ordinarily have rugose mandibles.

Again, unless larval material is somehow associated with a pupa or adult (often through pharate pupae within very late 4th instar larvae, or pupae with attached larval exuviae – sometimes such pupae may have almost completely developed adults within, thus giving a complete larval-pupal-adult association), species level identifications can only be considered tentative! If you are serious about species-level identification of *Orthocladius* larvae, you ***must*** use the keys and descriptions found in Soponis (1977, 1987, 1990), Langton & Cranston (1991), Cranston (1999) and Caldwell (1999) to identify associated pupae and/or adults.

O. (S.) annectens - A common species of the coastal plain; mature larvae are most abundant during late Winter/early Spring. The distinctive mentum, with the median tooth projecting forward and small first lateral tooth placed well forward of the second lateral tooth, well developed Lauterborn organs that usually appear as circles at the apex of the second antennal segment, and the abdominal setal tufts distinguish this taxon. The median teeth of the mentum are often worn down; rely on the circular appearance of the Lauterborn organs and the setal tufts to identify such specimens. Recently transferred from *O. (Orthocladius)* to *O. (Symposiocladius)*. [C/O sp. 52]

O. (O.) carlatus - The smooth outer edge of the mandible and perhaps smaller size (Soponis (1977) gives a mentum width of less than 125 µm for *carlatus*; note that this is for 4th instar larvae) separate this species from *O. nigritus*. However, some uncertainty exists about the characters of the larva of *O. carlatus*. In Roback's material at the Academy of Natural Sciences of Philadelphia are two slides from 1953 (from the time period and area when the type material of *O. carlatus* was collected); each has apparently associated pupal and larval exuviae of *O. carlatus*. On one, the mandible is smooth; on the other it is rugose. Also, Roback's original description (1957: 77) stated that the Lauterborn organs were weak; Soponis' (1977: 32) redescription stated the same. However, below her description she wrote "Roback (1957a) described and figured (fig. 161) the Lauterborn organs of the larva of *carlatus* as weak. However, I find them to be robust (Fig. 110a)." On the two above mentioned Roback specimens, one has antennae with weak Lauterborn organs; the other is missing the apical segments of the antennae. Larvae with pharate pupae from North Carolina that appear to be *O. carlatus* have smooth mandibles and moderately developed Lauterborn organs. Associ-

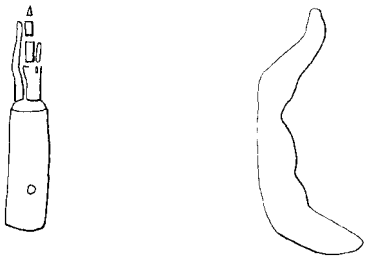
ated material is needed for more positive identification; the pupa is the only stage that will definitely confirm the identify of this species. [some C/O sp. 8?, many C/O sp. 54]

O. (O.) clarkei Soponis - Not definitely known from the Southeast. I have seen some larvae from NC that may fit this species. However it is more likely that they are *O.(O.) obumbratus*, whose ventromental plates may also appear to be extended posteriorly. Associated material is needed before *O. clarkei* can be said to occur in the southeastern US. [some C/O sp. 54?]

O. (O.) dentifer - In the Southeast, recorded from SC; I've also examined material from the NC portion of Great Smoky Mountains National Park. There is also a reared specimen from extreme western FL in the collection at Florida A&M University. Larvae of this species (especially those with a worn mentum) may resemble *O. annectens* but lack the large Lauterborn organs and abdominal setal tufts of that species.

O. (O.) dorenus - Possibly the same species as the Palaearctic *O. (O.) pedestris* Kieffer. [C/O sp. 7]

O. (Eud.) dubitatus - Head capsule color of this relatively common species is variable, running from medium to dark brown to dark reddish-brown. Cranston (1999) noted that *O. dubitatus* was one of the most variable species in the subgenus *Eudactylocladius*, in all life stages. This species is easily confused with *Cricotopus fugax*. The two species can be separated by the simple premandible of *C. fugax*; the premandible of *O. dubitatus* has a simple apex but also bears a broad inner tooth; by the 3rd and 4th antennal segments: in *C. fugax* these segments are about twice as long as wide, in *O. dubitatus* they are about as long as wide; the molar area of *O. dubitatus* is usually truncate, that of *C. fugax* is usually more rounded (the mandible must be oriented correctly to observe this); and the abdominal setae of *O. dubitatus* are short; those of *C. fugax* are long (at least 1/2 length of the segment). I have seen specimens of *O. dubitatus* from North Carolina misidentified as *O. carlatus* and *O. wiensi* and from South Carolina misidentified as *O. nigritus*. [C/O spp. 3, 29, 40]



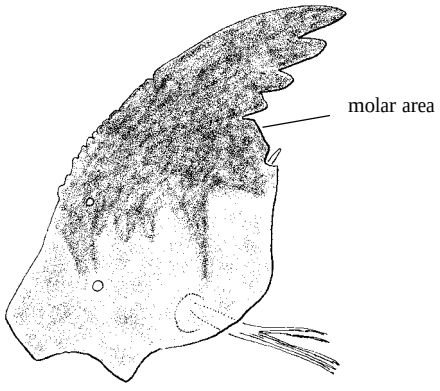
C. fugax antenna

C. fugax premandible

O. dubitatus antenna

O. dubitatus premandible

C. fugax mandible



O. dubitatus mandible

O. (O.) frigidus - This species and *O. vaillanti* are the only *Orthocladius* species in the SE US that lack a seta interna on the mandible. *Orthocladius (Eou.) roussellae* Soponis, known only from Alaska,

Wyoming, the Yukon and Northwest Territories, also lacks a seta interna; *O. roussellae* has 15 teeth on the mentum. *Orthocladius frigidus* had been placed in the subgenus *Euorthocladius*, but Soponis (1987) redescribed the species and placed it in *O. (Orthocladius)*. *Orthocladius frigidus* larvae are difficult to separate from those of *O. vaillanti*; it appears the only separating character is the rugose outer margin of the mandible of *frigidus* (which is smooth in *vaillanti*). Soponis (1990: fig. 13) shows the S I of *frigidus* as being unevenly bifid; Schmid (1993: fig. 87D) illustrates them as evenly bifid. The S I of *vaillanti* are evenly bifid. Both species have a similar mentum, although that of *frigidus* may be more convex; more material is needed. As with so many species of *Orthocladius*, associated pupae are needed for accurate identification. [C/O sp. 2, some C/O sp. 60]

O. (O.) hellanthali - I've seen a single adult male of this species from the Tennessee portion of Great Smoky Mountains National Park; the immature stages are unknown.

O. (S.) lignicola - The distinctive mentum of this wood-mining species distinguishes it from all other *Orthocladius*. This species was referred to as *O. tryoni* in Soponis (1977); she did not have associated larvae available. *Orthocladius lignicola* was later (Cranston 1982) elevated to generic status as *Symposiocladius*, but *Symposiocladius* was eventually relegated to subgeneric status under *Orthocladius*. [C/O 48]

O. (Euo.) luteipes - Difficult to distinguish from *O. thienemanni* as a larva; only the AR will separate most specimens. Both species have very large Lauterborn organs. These two species have been confused often in the literature (see Soponis 1990); pupae are needed for accurate identification. [some C/O sp. 13]

O. (O.) mallochi - The larva of this species is usually easily recognized by the posteriorly extended ventromental plates and relatively narrow median tooth of the mentum. It is recorded for SC by Caldwell et al. (1990) but I have not seen material of this species from the SE US. Note that *O. (O.) wiensi* Soponis, known from Minnesota and Manitoba, will also key to this species in the key above; see Soponis (1977).

O. (O.) nigritus - Somewhat similar to *O. carlatus*, but *O. nigritus* has a rugose outer edge to its mandible (but see the notes under *O. carlatus*). Also similar to *O. dorenus*, but the median tooth of the mentum of *nigritus* extends farther ahead of the lateral teeth than that of *dorenus*. [C/O sp. 8]

O. (O.) obumbratus - A common, widespread but variable species, best identified in the pupal or adult stage. The color of the mentum is apparently variable, as is the width of the median tooth and the amount of rugosity on the outer edge of the mandible. Note that contrary to Soponis (1977), the ventromental plates appear to be extended posteriorly, but not as far or as well developed, as in *O. clarkei*, *O. mallochi* and *O. oliveri*. Most *O. obumbratus* larvae have a pair of single, simple setae that are about 70 µm long, located caudolaterally on the abdominal segments; note that this may not be a specific character because I have been unable to examine associated larvae of many other *Orthocladius* species. Some *O. obumbratus* larvae can be easily mistaken for *Paratrichocladius*. [C/O spp. 10, some 54; some C/O sp. 10 larvae are *Paratrichocladius*]

O. (O.) oliveri - The only *O. (Orthocladius)* in the Southeast with an apically bifid premandible except for the distinctive *O.* sp. "Jacobsen", an undescribed species with a 15-toothed mentum (q.v.; see also *O. vaillanti*). Note that some *O. (Euorthocladius)* may have a bifid premandible, and that many *Orthocladius* may have premandibles that are apically notched. The outer margin of the mandible of *O. oliveri* is weakly to moderately rugose. Note also the posteriorly directed, narrow sclerotized area posterior to the ventromental plates, similar to that of *O. clarkei* and *O. mallochi* (but not as well developed), and to a lesser extent, that of *O. obumbratus*. [C/O sp. 35]

O. (Euo.) rivicola - Soponis (1990: 28, 30) noted considerable variation in larval material of *O. (Euo.) rivicola*, which can easily be confused with *O. (Euo.) saxosus*. Associated pupae are needed for

accurate identification. [C/O sp. 13, 13A]

O. (Euo.) rivulorum - The distinctive mentum, which may bear from 17-21 teeth, simple premandibles and the short basal segment of the antenna will identify this species. Note that the mentum is not always symmetrical; sometimes there are more teeth on one side of the mentum than the other. A rare species of clean mountain streams and rivers; also recorded from the sandhills region. [C/O sp. 37, 61]

O. (O.) robacki - This may be the same as the Palaearctic species *O.(O.) oblidens* (Walker). Soponis (1977) could not find characters to separate the larvae of *O. robacki* from *O. obumbratus*. However, on material I've examined, the ventromental plates of *obumbratus* appear to extend farther posteriorly than those of *robacki*. It is possible that both species may have the median tooth of the mentum lighter in color than the lateral teeth, so caution must be used (although I have not seen any associated *obumbratus* larvae with a lighter median tooth). Larval material should be associated with a pupa or an adult male for accurate identification! [C/O sp. 12]

O. (O.) rubicundus - Formerly known as *O. curtiseta* in North America; known from as far south as northern FL. [some C/O sp. 54?]

O. (Euo.) saxosus - This species is apparently rare in the mountain and piedmont regions. Note the narrower median tooth of the mentum, the large Lauterborn organs, higher AR (>1.85) and perhaps the long body setae (greater than ½ length of segment on the more posterior body segments). However, Soponis (1990) described *O. rivicola*, *O. saxosus*, and *O. thienemanni* all with some long body setae. Soponis (1990: 28, 30) noted considerable variation in larval material of *O. (Euo.) rivicola*, some of which may key to this species. She also noted (1990: 38) that in *O. saxosus* larvae may have 4 or 5 inner teeth on the mandible and that the usually simple premandible may be bifid. [some C/O sp. 60]

O. (O.) subletti - Recorded from SC by Caldwell et al. (1990); I have not seen material of this species from the Carolinas. The record might be considered doubtful considering that *O. subletti* was described from the western US. However, *O. hellanthali* was also described from the western Nearctic (Alaska, California, Northwest Territories) but has been found in the Smoky Mountains. The immature stages of both species are undescribed.

O. (Euo.) thienemanni - As a larva, difficult to separate from *O. luteipes* (q.v.) or sometimes *O. saxosus*, due to variation in the width of the median tooth of the mentum (see Soponis 1990: 42); pupae provide the best means of identification. [C/O sp. 51?]

O. (O.) vaillanti - Caldwell (1999) recently described the larva and adult male of this species, known previously only from the Palaearctic as a pupa (Langton & Cranston 1991). Very similar to *O. frigidus*, but apparently separable by the more rugose outer margin of the mandible of *O. frigidus* (smooth in *vaillanti*). See also *O. frigidus* above. I have also examined associations of an undescribed *Orthocladius* species from Ohio that will run to *O. vallainti* in the key above; however, this larva has bifid premandibles and the pupa has a "normal" *Orthocladius* thoracic horn, not the type seen in *O. vaillanti* or *O. frigidus*. Refer to this undescribed species as *O.* sp. "Ohio". [C/O sp. 64]

O. (O.) sp. "Jacobsen" - Larvae of this undescribed species resemble *O. (Euo.) rivulorum* because of the 7 pairs of lateral teeth on the mentum; *O. rivulorum* usually has at least 8 pairs of lateral teeth. However, this taxon has been reared and is being described by Rick Jacobsen; the pupa and adult are typical *O. (Orthocladius)* (my examination of Ohio material and Jacobsen, pers. comm.) Note that this new species has bifid S I setae that are secondarily split, the premandibles are apically bifid and the basal antennal segment is much longer than that of *O. rivulorum*. I've seen associated material from Ohio and larvae from Indiana and North Carolina.

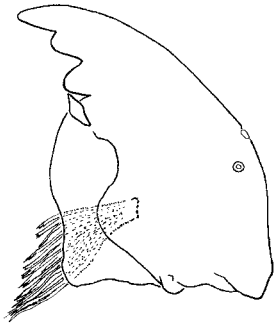
Genus *Parachaetocladius*

DIAGNOSIS: Larvae are distinguished by the distinctive mentum, with broad median tooth (sometimes weakly divided or notched medially); simple premandible without brush; mandible with 1-2 inner teeth; and each procercus with one very long seta, at least 1/4 as long as the body length.

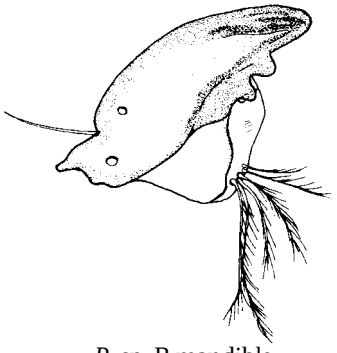
NOTES: One named species, *P. abnobaeus*, is known from the Southeast; it occurs as far south as northern Florida. In addition, Sæther & Sublette (1983) illustrated the larva of an apparently different taxon, *P.* sp. B. This taxon differs in having only one inner tooth on the mandible (figure below). This "species" is only known from one stream, Howard Creek, in Oconee County, South Carolina; it may be an aberrant or deformed *P. abnobaeus*. Note: do not mistake the darkened molar area (proximal to the inner teeth) of the mandible of *Parachaetocladius* species for an additional inner tooth.

Parachaetocladius larvae are found in lotic conditions and are often associated with spring-fed streams.

ADDITIONAL REFERENCES: Cranston & Oliver 1988a; Sæther & Sublette 1983.

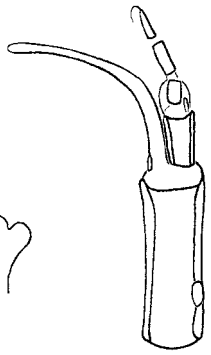


P. abnobaeus mandible

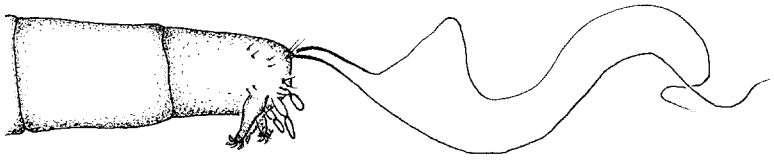


P. sp. B mandible
(adapted from Sæther & Sublette 1983)

P. abnobaeus mentum



P. abnobaeus antenna



posterior segments

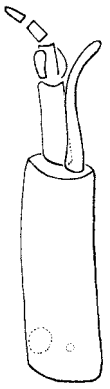
Genus ***Paracricotopus***

DIAGNOSIS: Distinguished by the S I with weak apical serrations or S I appears to be simple; smooth inner margin of the mandible (proximal to inner teeth); reduced ventromental plates, without a beard; long (at least 1/2 as long as segment), simple abdominal setae; and well developed procerci with spurs.

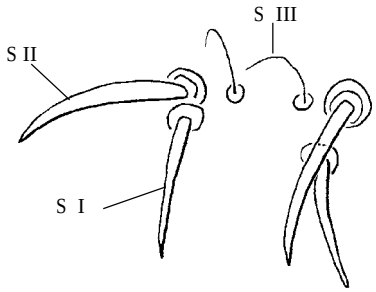
NOTES: Three species are recorded from the Southeast; all but *P. mozleyi* (known only from Georgia) have been found in the Carolinas. It is probable that *P. mozleyi* is a junior synonym of *P. glaber*, but *P. millrockensis* appears to be a distinct species. Because of the paucity of associated material and uncertain variation in larval characters, it is not possible to reliably separate *Paracricotopus* larvae to species.

Larvae are denizens of mosses, liverworts and algae in seeps, bogs, springs and low order streams.

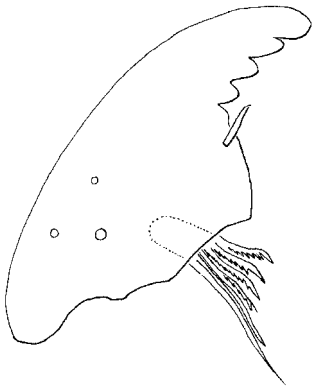
ADDITIONAL REFERENCES: Caldwell 1985; Sæther 1980b; Steiner 1983.



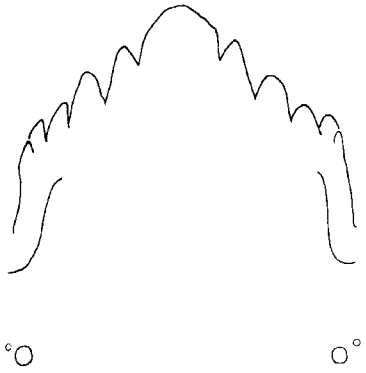
P. sp. antenna



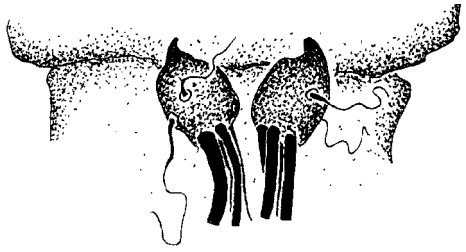
P. sp. labrum



P. sp. mandible



P. millrockensis mentum



P. millrockensis procerci
(anal setae abbreviated)

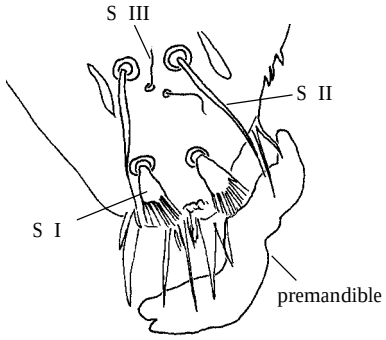
Genus *Parakiefferiella*

DIAGNOSIS: Larvae may be distinguished by the 6 (7 in some?) segmented antennae, with the last segment hairlike; S I most often pectinate-plumose, but may be bifid (simple to bifid in one species tentatively assigned to the genus); premandible simple, apically notched or weakly bifid; mentum with an odd number of teeth in known southeastern US taxa; ventromental plates usually well developed and may extend beyond lateral margin of the mentum, usually without a beard (but a weak beard present in one species tentatively assigned to this genus)

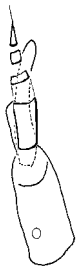
NOTES: Based on larvae, at least five species, perhaps seven, of *Parakiefferiella* are found in the Southeast. A problem is that most of the larvae have not been associated with adults; thus no names can be placed on them, with the exception of *P. coronata*. I have tentatively assigned two enigmatic taxa to *Parakiefferiella*: *P.* sp. D and *P.* sp. F; see Notes on species. The genus requires revision in North America; the paper by Tuiskunen (1986b) is the best source available, but does not cover larvae.

Parakiefferiella larvae are commonly encountered in lentic and lotic habitats.

ADDITIONAL REFERENCES: Sæther 1969; Sublette et al. 1998; Tuiskunen 1986b; Walker et al. 1992.



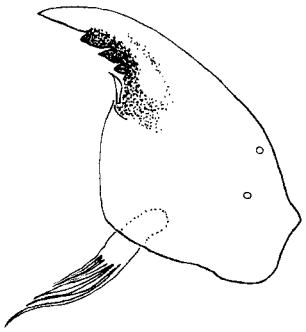
P. sp. A labrum



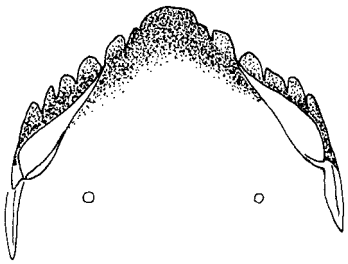
P. sp. A antenna

P. sp. B antenna

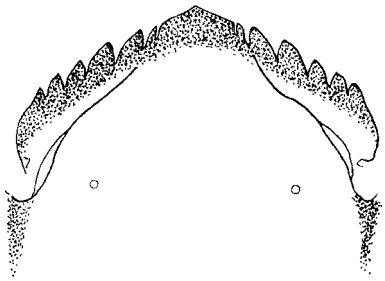
P. coronata antenna



P. sp. E mandible



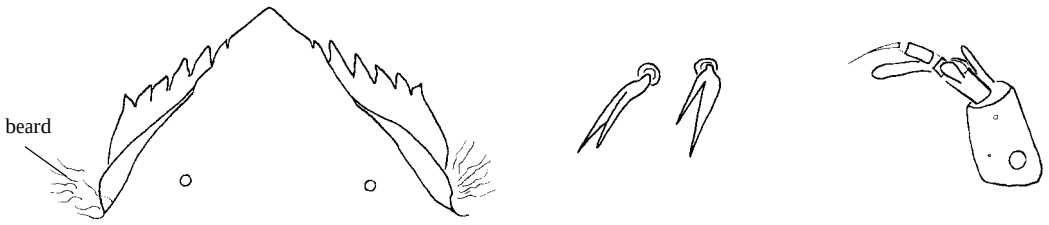
P. sp. B mentum



P. coronata mentum

Key to *Parakiefferiella* larvae of the southeastern United States

1 A weak beard present near ventromental plates; S I bifid ..... ***P.* sp. F**

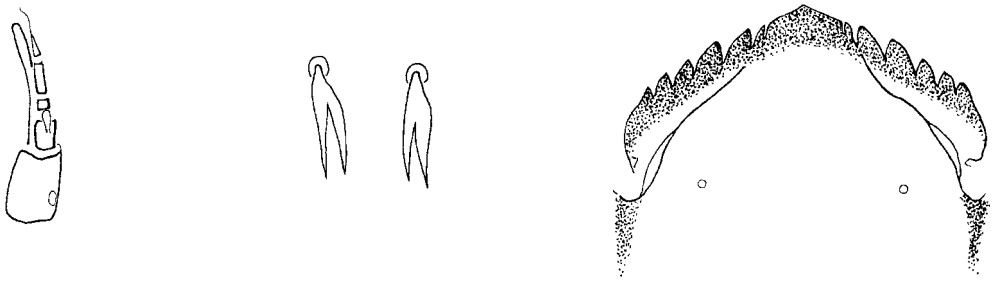


1' Beard not present near ventromental plates; S I bifid, simple or pectinate/plumose 2

2(1) Mentum with large, pale dome-shaped median tooth; ventromental plates cover most of lateral teeth of mentum; S I apically plumose ..... ***P.* sp. A**

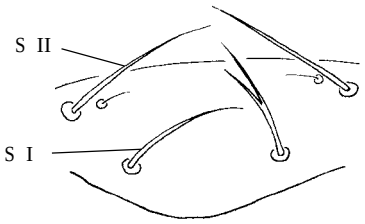
2' Median tooth of mentum dark, if pale then not as large and not dome-shaped; ventromental plates usually smaller, not covering all of lateral teeth; S I variable 3

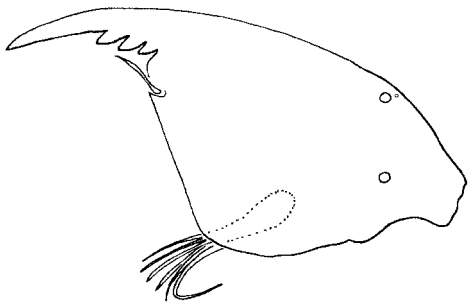
3(2') 4th antennal segment two or more times the length of segment 3; S I bifid ..... ***P. coronata***

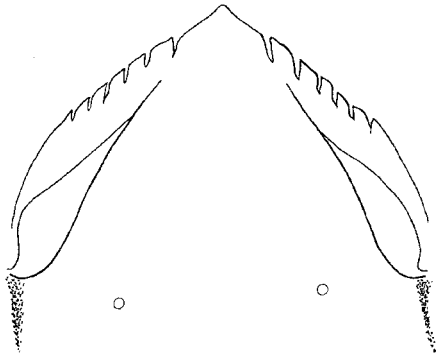


3' 4th antennal segment subequal to 3rd; if S I bifid, then thinner, longer 4

4(3') S I simple or bifid; 2nd antennal segment shorter than to slightly longer than 3rd; apical tooth of mandible very long; procerci darkly sclerotized ..... ***P. sp.*** **D**

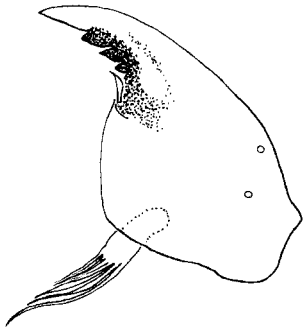




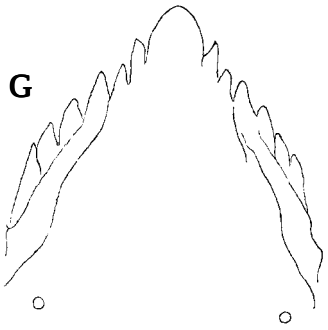


4' S I pectinate; 2nd antennal segment 2 or more times longer than 3rd; apical tooth of mandible not as long and thin; procerci not darkly scelrotized 5

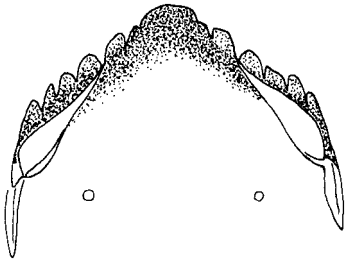
pectinate S I

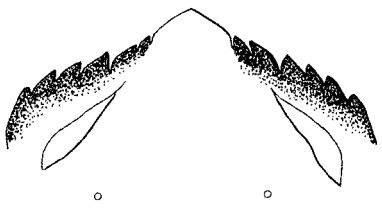


5(4') Median tooth of mentum projects far anterior to lateral teeth .. ***P.*** **sp. G**



5' Median tooth not projecting as far 6

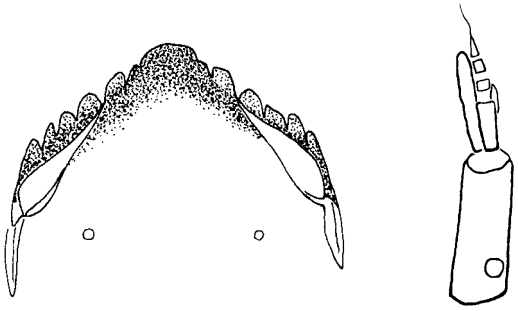




6(5') Median tooth of mentum paler than first lateral tooth ..... ***P.* sp. E**

6' Median tooth of mentum approximately same color as first lateral tooth ..... ***P.* sp. B**

central teeth of unworn mentum



Notes on species

P. coronata - This species' identity is confirmed with associated pupae and adults. It occurs as far south as the northern Everglades in Florida. This taxon was called "*Parakiefferiella* sp. C" in Epler (1995). The S I's are bifid.

P. sp. A - This species has a distinctive mentum with large ventromental plates. I've seen material from Florida and the Carolinas. This taxon is very similar to *P. triquetra* (Pankratova). Note that Chernovskij's (1949) "description" of this taxon as "Orthocladiinae gen. ? *triquetra*" was not valid; Pankratova (1970) validated the name.

P. sp. B - A common species in the Southeast; this is probably *P. bathophila*, but there is insufficient reared material available to be certain. It is possible that *P. subaterrima* is the same species as *P. bathophila*; again, there is insufficient reared material available; *bathophila* would have priority over *subaterrima*.

P. sp. D - I've examined larvae of this taxon with developing pupae within them; the anal lobes indicate it can be placed in *Parakiefferiella* although there are some peculiarities in the spine patch on tergite II. The S I's are long and simple, although two specimens examined, one from Florida, the other from North Carolina, had one S I that was bifid (see figure in key). In addition, the procerci are darkly sclerotized. This is the taxon called "genus nr. *Nanocladius* B" by Mozley (1980) and Caldwell et al. (1997).

P. sp. E - The pale median tooth is distinctive for this species. Also, in ***most*** larvae the apical tooth of the mandible is lighter than the inner teeth; this may help separate some larvae from the similar *P.* sp. B, in which the entire apex of the mandible is usually darkened. I've seen material from North and South Carolina. This is apparently the larva called "*Parakiefferiella* sp." in Simpson & Bode (1980).

P. sp. F - This taxon may not belong in *Parakiefferiella* because it has a cardinal beard; however, Cranston et al. (1983) note that some unreared larvae tentatively assigned to *Parakiefferiella* have a beard. This is the taxon called "*Stilocladius* ? sp." in Epler (1995). The S I is bifid. I've seen material from northern Florida; it probably also occurs on at least the Coastal Plain in the Carolinas.

P. sp. G - This taxon was figured by Dr. S.C. Mozley in an unpublished, undated manuscript; the figure in the key is adapted from his illustration. I have not seen material of this species, recorded by Mozley from Wake County, NC. The S I is pectinate.

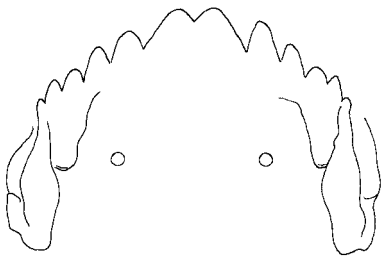
Genus *Parametriocnemus*

DIAGNOSIS: Distinguished by the plumose S I; antenna 5 or 6 segmented (if 6, last segment vestigial, hairlike); antennal blade shorter than flagellum; AR more than 1.25; mentum with double median tooth; ventromental plates extending beyond lateral margin of mentum; setae submenti located high on mentum, about 1/2 distance of length of ventromental plates; maxilla with or without pecten galearis; and procerci well sclerotized, with long anal setae (> 300 µm).

NOTES: Based on adult males, 3 described species are known from the Carolinas. At least one tentatively new species is known from Florida and North Carolina, and I have reared another undescribed species from northern Georgia. At present it is not possible to construct a larval key for species identification; larvae should be identified as "*Parametriocnemus* sp.". The larva of *P*. sp. F is unique in the Nearctic fauna for its vestigial 6th antennal segment and presence of pecten galearis (see Notes on species); note that Schmid (1993) described and figured the larvae of the Palaearctic species *P. boreoalpinus* (Gowin & Thienemann) and *P. stylatus* (Kieffer) with a pecten galearis on the maxilla, contrary to the diagnosis in Cranston et al. (1983).

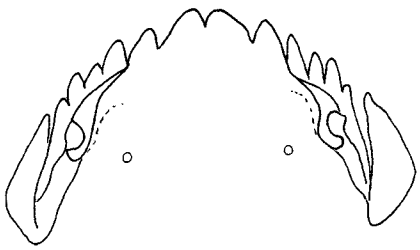
Parametriocnemus larvae are often misidentified as *Paraphaenocladius*, but note the longer basal antennal segment (and corresponding higher AR of more than 1.25) and anal setae of *Parametriocnemus*. *Parametriocnemus* larvae are found in springs and lotic habitats.

ADDITIONAL REFERENCES: Sæther 1969.



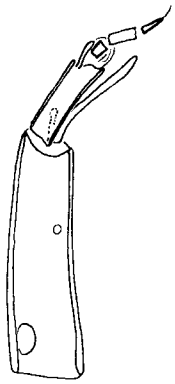
P. sp. mentum

P. sp. antenna

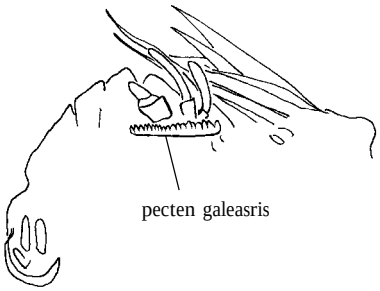


P. sp. F mentum

P. sp. F S I



P. sp. F antenna



P. sp. F maxilla

Notes on species

P. eoclivus - B.A. Caldwell (pers. comm.) has identified an adult of this species, originally described from Quebec, from the Tennessee portion of Great Smoky Mountains National Park; it probably also occurs in North Carolina. Sæther (1969) described the larva, but not in enough detail to allow consistent separation from other species.

P. hamatus - I've seen adults from the North Carolina portion of Great Smoky Mountains National Park; the immature stages are unknown.

P. lundbeckii - Based on adult male specimens, the most common and ubiquitous member of the genus in the eastern US. However, larvae of other *Parametriocnemus* species are insufficiently known to allow identification of any species as a larva without an associated pupa or male. Unassociated larvae should be identified as "*Parametriocnemus* sp. ".

P. cf. *vespertinus* - Recorded from North Carolina by Caldwell et al. (1997); the immature stages are unknown.

P. sp. F - An unusual species in that the larva has a 6 segmented antenna and a pecten galearis on the maxilla. However, I have associated material from Costa Rica of two undescribed *Parametriocnemus* species that have larvae with similar 6 segmented antennae. One of these species, *P*. sp. CR-1 Epler, has adult male genitalia very similar to *P. lundbeckii* but the adult male has a low AR (0.72-0.78); the AR of *P. lundbeckii* is usually above 1.00. It is probable that *P*. sp. F is the larva of my adult species *P.* sp. 1 that I have identified from Great Smoky Mountains National Park; this species has genitalia similar to those of *P. lundbeckii* but has an AR of about 0.40.

Genus *Paraphaenocladius*

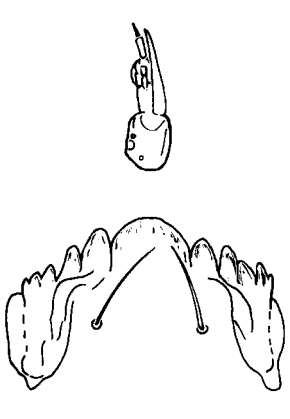
DIAGNOSIS: Distinguished by the plumose S I; 5 segmented antennae; antennal blade usually subequal to or longer than flagellum; AR 0.5-1.0; mentum with single or weakly divided median tooth; ventromental plates large and extending beyond lateral margin of mentum; setae submenti located high on mentum, about 1/2 distance of length of ventromental plates; maxilla without pecten galearis; and weakly sclerotized procerci with short anal setae (< 200 µm).

NOTES: Sæther & Wang (1995) recently revised the genus and recorded 5 species from the Carolinas; the key below is adapted from that work. NOTE that larvae ***must*** be 4th instar to key correctly and you should confirm your identifications with associated pupae or adults (see Sæther & Wang (1995) for pupal and adult keys). Because of considerable variation, Sæther and Wang (1995) established subspecies for several species. Southeastern US subspecies are: *P. exagitans exagitans*, *P. irritus longiocostatus* and *P. pseudirritus nearcticus*.

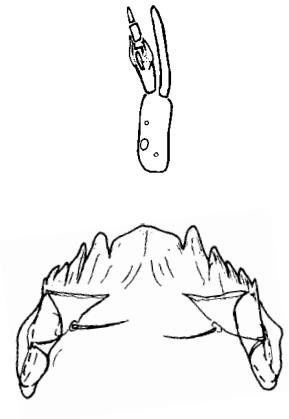
Many larvae that I've examined from the Southeast identified as *Paraphaenocladius* have been *Parametriocnemus* or *Chaetocladius*. Much of the problem with identifying *Paraphaenocladius* larvae has probably been the body characters used in keys such as Cranston et al. (1983) - the preanal segment being extended over the anal segment so that the anal setae are directed posteriorly. Unfortunately, when slide mounted many larvae are distorted enough that almost any specimen will fit such a diagnosis. In addition, several other taxa also fit this diagnosis (some *Cardiocladius* and *Chaetocladius*). All known *Paraphaenocladius* larvae have a short basal antennal segment, resulting in a low AR of < 1.0; the antennae of *Parametriocnemus* have longer basal segments and higher ARs, > 1.25. *Paraphaenocladius* larvae have weakly sclerotized procerci bearing short anal setae (< 200 µm); those of *Parametriocnemus* are more sclerotized and have long anal setae (> 300 µm) (4th instar measurements!). The setae submenti of *Chaetocladius* are near the posterior margin of the ventromental plates, not about half way down along the mentum as in *Paraphaenocladius* and *Parametriocnemus*.

Larvae occur in semi-terrestrial or semiaquatic habitats (moss lined banks of springs and streams, moist soil in seeps, periphyton at the margin of water bodies) or in true aquatic habitats such as springs, streams and standing water bodies.

ADDITIONAL REFERENCES: Sæther & Wang 1995.



P. exagitans mentum and antenna



P. pseudirritus mentum and antenna

P. pusillus mentum and antenna

(all figures adapted from Sæther & Wang 1995)

Key to *Paraphaenocladius* larvae of the southeastern United States

(the larva of *P. irritus* is unknown)

NOTE: 4th instar larvae are necessary for accurate measurements!!

NOTE: 4th instar larvae are necessary for accurate measurements!!

1 Median tooth of mentum single; procercus 19-32 µm long, 15-17 µm wide; basal antennal segment 26-31 µm long ..... ***P. pseudirritus***

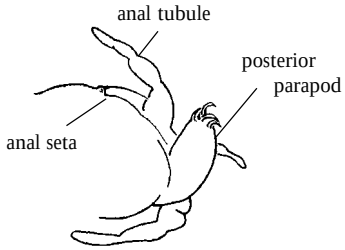
1' Median tooth of mentum double (may be worn to appear as single tooth); procercus 9-15 µm long, 8-11 µm wide; basal antennal segment 12-20 µm long 2

2(1') Postmentum (distance from mentum to posterior margin of head capsule) and mandible about 79 µm long ..... ***P. pusillus***

2' Postmentum 86-124 µm long; mandible 86-109 µm long 3

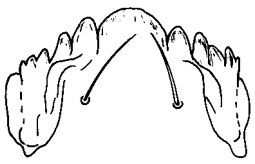
P. pusillus mentum

3(2') Longer anal tubules much longer than posterior parapods; median teeth of mentum weakly divided, often appearing single when worn; postmentum 86-111 µm long ..... ***P. exagitans***



posterior end

P. exagitans mentum with "fresh" median teeth



P. exagitans mentum with worn median tooth

3' Longer anal tubules at most slightly longer than posterior parapods; median teeth of mentum always appear divided; postmentum > 113 µm long ..... ***P. innasus***

(all figures adapted from Sæther & Wang 1995)

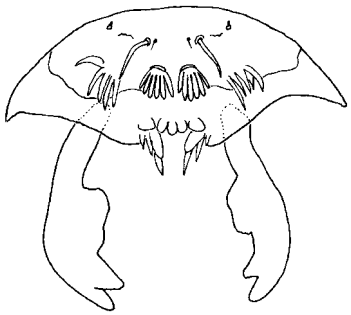
Genus *Parasmittia*

DIAGNOSIS: The multilobed S I; pecten epipharyngis of 3 small scales; short, 4 segmented antennae with blade much longer than the flagellum; lack of procerci and posterior parpaods; and the terrestrial habitat distinguish this genus.

NOTES: The genus appears to be monotypic, with the species *P. carinata* having a Holarctic distribution. I've seen adults from Great Smoky Mountains National Park that appear to be this species, previously known only from Nova Scotia in North America.

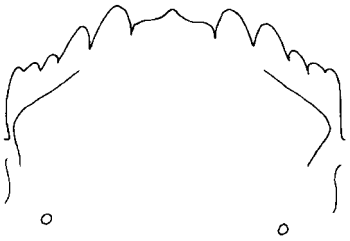
Larvae are terrestrial.

ADDITIONAL REFERENCES: Strenzke 1950a.



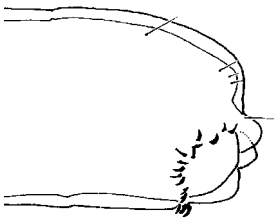
labrum and premandibles

antenna



mentum

mandible



posterior end

(all figures adapted from Cranston et al. 1983)

Genus *Paratrichocladius*

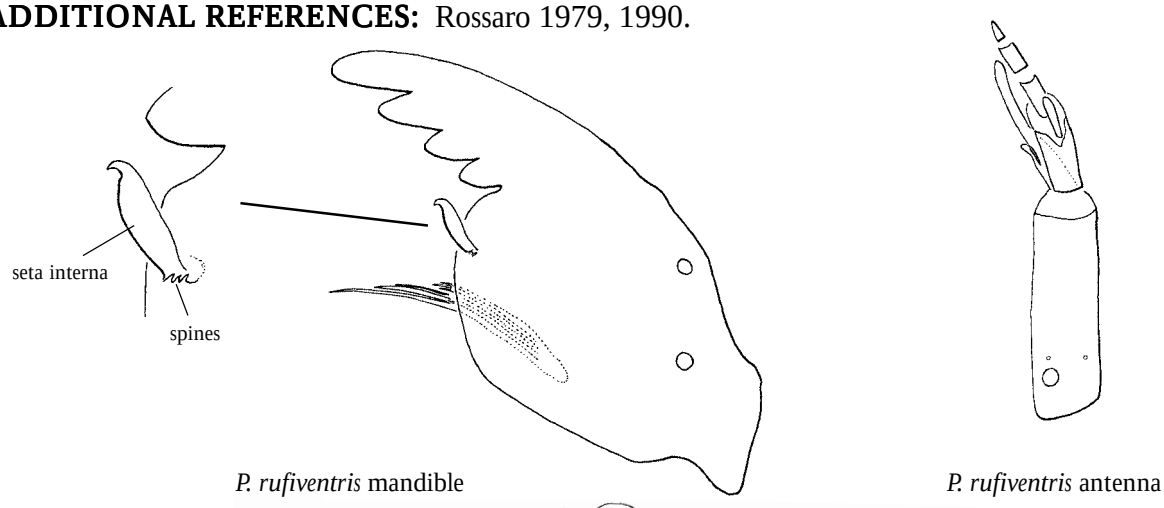
DIAGNOSIS: Difficult to distinguish from some *Cricotopus* and *Orthocladius*, but larvae can usually be identified by the bifid S I; pecten epipharyngis of 3 subequal scales; premandible simple or apically bifid, without brush; 1st lateral teeth of mentum constricted at base so that broader in the middle than at the bottom; lack of cardinal beard; small rounded posterolateral margin of the mentum; mostly smooth outer margin of the mandible; seta interna with minute spines at base (sometimes very difficult to observe); and simple, moderately short (< 1/2 length of segment) abdominal setae.

NOTES: One species, *P. rufiventris*, is known from the Southeast (North and South Carolina); other species may occur also. Oliver et al. (1990) recorded 3 species for North America; *P. nitidus* (Malloch), known from Manitoba, Illinois, Iowa, New York and Utah, may the same species as *P. skirwithensis* (Edwards), recorded from New Brunswick, Nova Scotia. However, the larva of *P. nitidus* is undescribed. The larva of *P. skirwithensis* has dark brown to black mentum, mandible and hind margin of the head capsule, compared to the light to medium brown color of those structures in *P. rufiventris*, and its setae submenti are not displaced posteriad.

This genus can be very difficult to identify - it may appear very similar to some *Cricotopus* and *Orthocladius* species, especially *C. triannulatus* and *O. obumbratus*. Larvae of *P. rufiventris* can usually be "easily" identified by the setae submenti that are displaced posteriad to the ventromental plates; however, note that several *Cricotopus* species have setae submenti that are displaced posteriad. Note also the small rounded posterolateral margin of the mentum and an area of slightly more heavily sclerotized cuticle that runs along the anterior margin of the head capsule lateral to the mentum (see figure below).

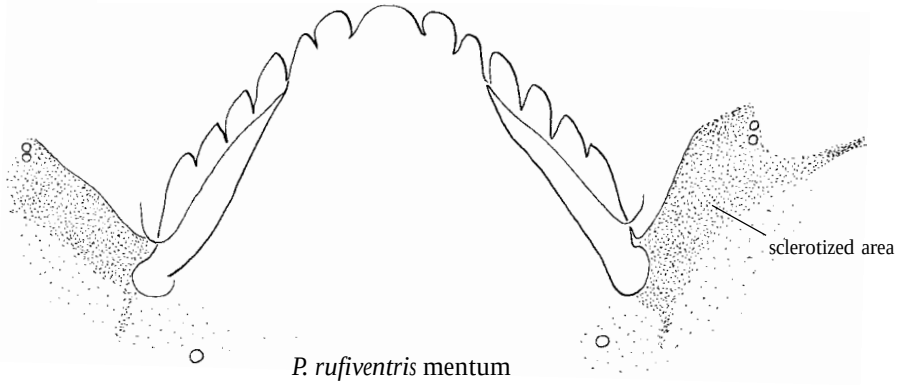
Larvae are recorded from many aquatic habitats, including brackish water.

ADDITIONAL REFERENCES: Rossaro 1979, 1990.



P. rufiventris mandible

P. rufiventris antenna



P. rufiventris mentum

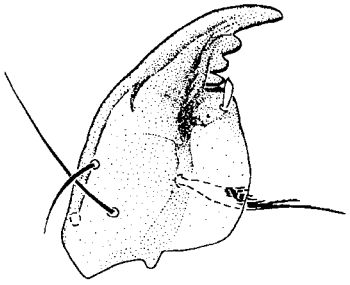
Genus *Platysmittia*

DIAGNOSIS: Distinguished by the bifid-serrated S I; pecten epipharyngis of 3 slender scales; 6 segmented antennae, with 6th segment hairlike and blade longer than flagellum; maxilla with pecten galearis; mentum with 2 median teeth and 5 pairs of lateral teeth, 4th smaller than 5th; and setae submenti located just posterior to a line drawn between the bases of the ventromental plates.

NOTES: Two species are known from the Nearctic; one, *P. fimbriata*, is recorded from the Southeast (Tennessee and North Carolina). The second species, P. *bilyji*, is known from Pennsylvania and Maryland in addition to Manitoba; it may eventually be found in the Carolinas. Larvae of the two species can be separated by the longer 4th antennal segment of *P. bilyji*.

Platysmittia larvae have been collected from small intermittent streams.

ADDITIONAL REFERENCES: Jacobsen 1998; Sæther 1982, 1985j.

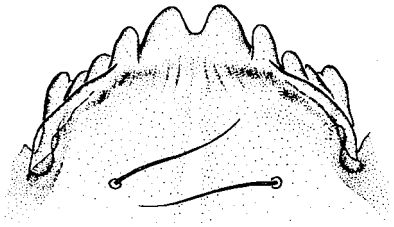


P. bilyji mandible

P. bilyji labrum

P. bilyji antenna

P. fimbriata antenna



P. fimbriata mentum

(figures adapted from Jacobsen 1998)

Genus ***Psectrocladius***

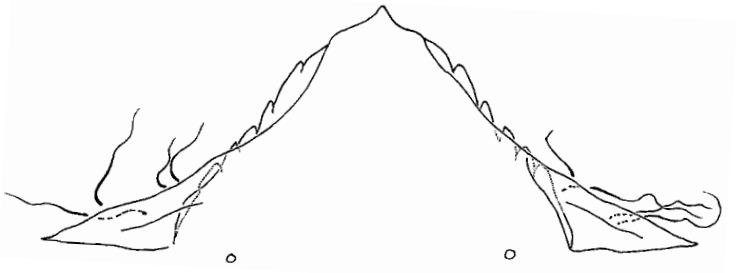
DIAGNOSIS: The bifid/trifid (uncommon) to palmate (typical) S I; apically simple premandible without a brush; well developed ventromental plates and cardinal beard; and procercus with 1 to several spurs, which may vary from minute to large, will distinguish the genus.

NOTES: *Psectrocladius* is divided into four subgenera, all of which have been recorded from the Southeast. Caldwell et al. (1997) record *Ps. (Mesopsectrocladius)* from Georgia, but I have not seen any material of this subgenus and none are included in the key below. The taxonomy of the genus in the Nearctic is confused and is in need of revision on a Holarctic basis; several Nearctic species are probably synonyms of Palaearctic species.

The S I is usually large and palmate in most *Psectrocladius* species, but differs from that in at least three taxa in the Southeast; most different is a *Ps. (Monopsectrocladius)* species commonly found in the Southeast in which the S I is trifid or occasionally bifid.

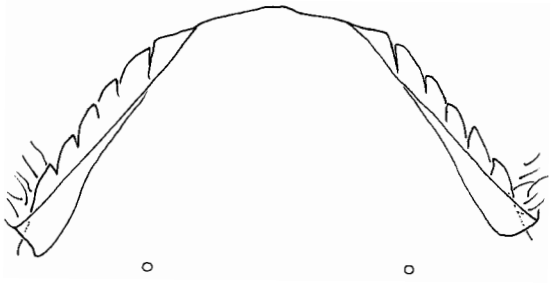
Larvae are found in lentic and lotic habitats and seem to prefer acidic conditions.

ADDITIONAL REFERENCES: Cranston 1982; Langton 1980, 1985; Sæther 1969; Sublette 1967.

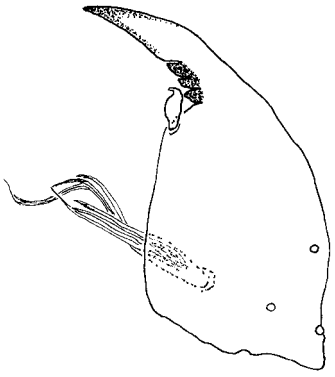


Ps. (Monopsectrocladius) sp. mentum

Ps. (Monopsectrocladius) sp. S I's of two specimens

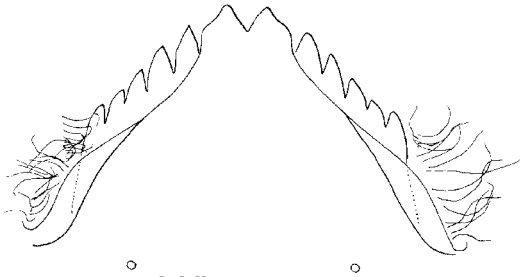


Ps. elatus mentum

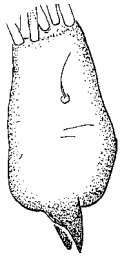


Ps. elatus mandible

Ps. elatus S I



Ps. sordidellus grp. sp. mentum

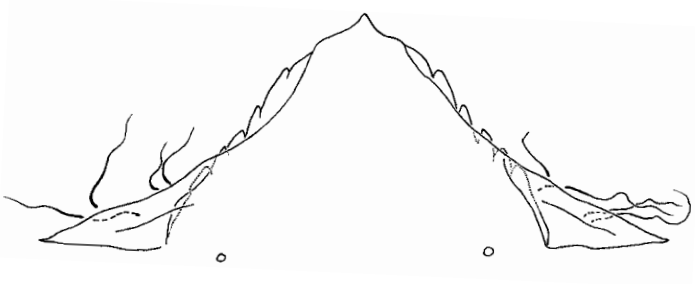


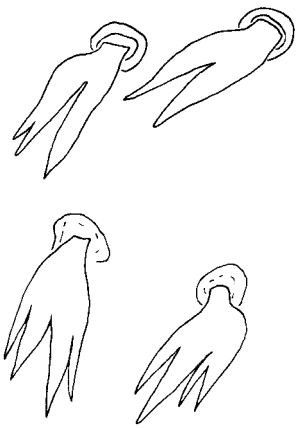
Ps. flavus procercus

Ps. psilopterus grp. antenna

Key to *Psectrocladius* larvae of the southeastern United States

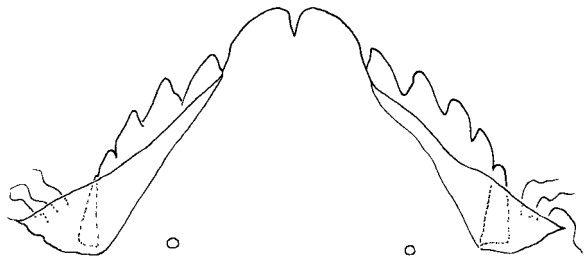
1 Mentum with single nipple-like median tooth; S I with ≤ 5 teeth, may be deeply bifid or trifid .... ***Ps. (Monopsectrocladius)* sp.**

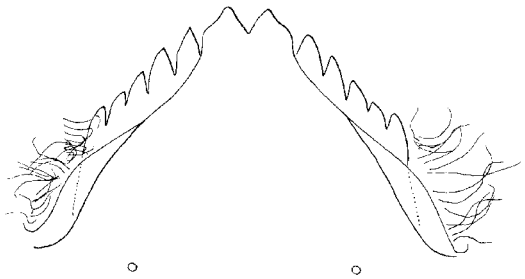




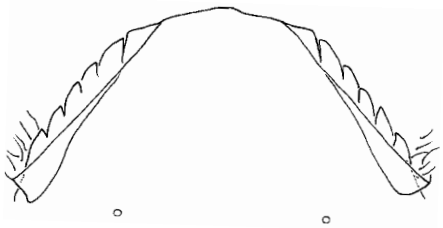
1' Mentum with single broad tooth or 2 median teeth (see all figures below); S I variable, with 3 or more teeth 2

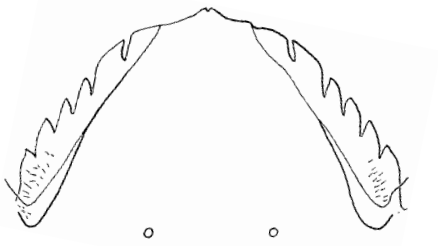
2(1') Mentum with 2 median teeth, each at least as wide as lateral teeth 3

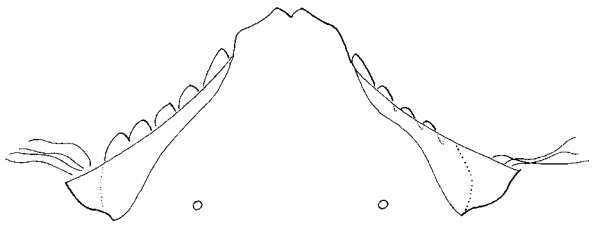


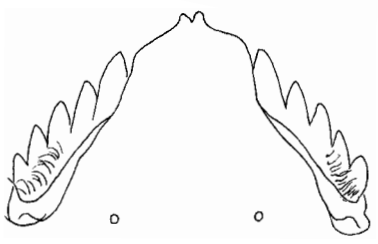


2' Mentum with single broad tooth or 2 nipple-like median teeth that are smaller than the first lateral teeth 4

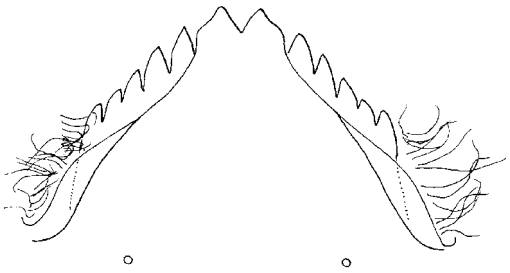




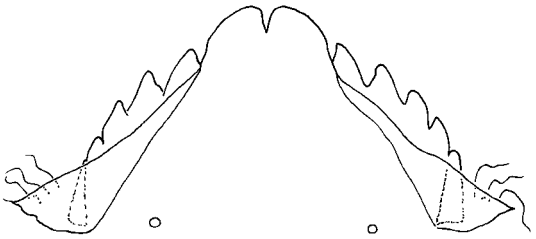




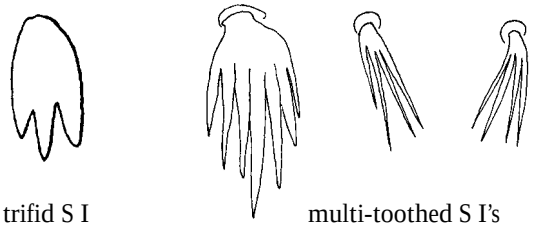
3(2) Median teeth apically pointed; mandible almost completely dark brown-black .. ***Ps. (Ps.) sordidellus* grp sp.**



3' Median teeth rounded; mandible with only apical and 3 inner teeth darkened ..... ***Ps. (Ps.) vernalis***

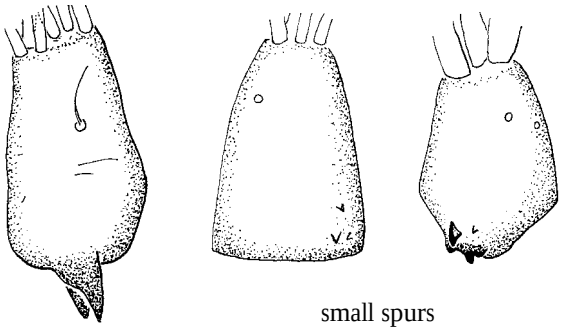


4(2') Procercus with large bifid or double spurs; S I broadly trifid 5



trifid S I

multi-toothed S I's

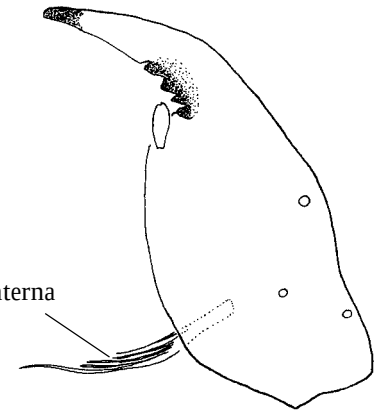


large bifid spur

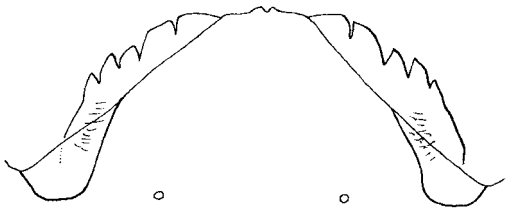
small spurs

4' Procercus with 1 to several small spurs; S I with 4 or more teeth or rays 6

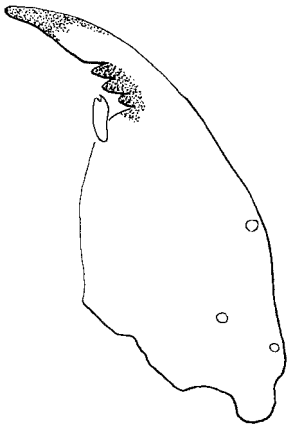
5(4) Mandible with seta interna ..... ***Ps. (Allopsectrocladius) pilosus***

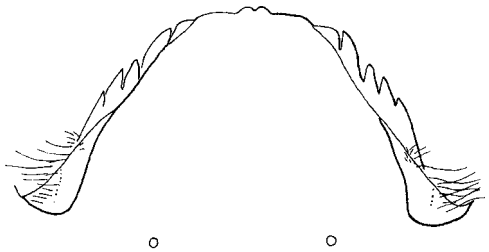


seta interna

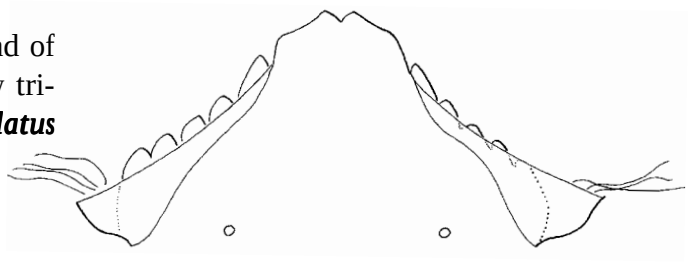


5' Mandible without seta interna .. ***Ps. (Allops.) flavus***

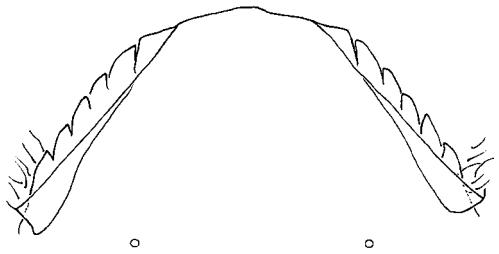


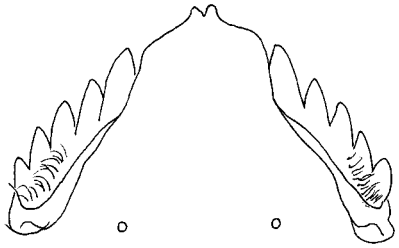


6(4') Median tooth/teeth project strongly ahead of lateral teeth; ventromental plates broadly triangular ..... ***Ps. (Ps.)* cf. *octomaculatus***



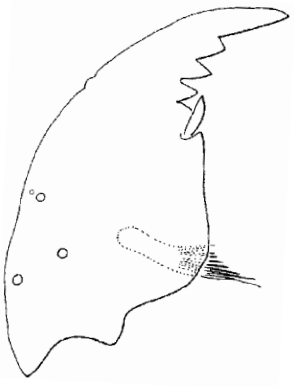
6' Median tooth/teeth do not project as strongly forward; ventromental plates smaller, generally more rounded ..... ***Ps. (Ps.) psilopterus* group** 7



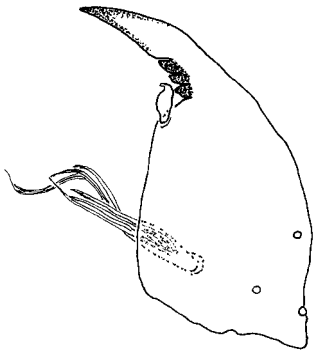


Ps. psilopterus grp. sp. 3

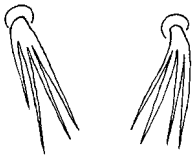
7(6') Apical tooth of mandible approximately as long as width of 3 median teeth; mentum as figured above .... ***Ps. (Ps.) psilopterus* group sp. 3**

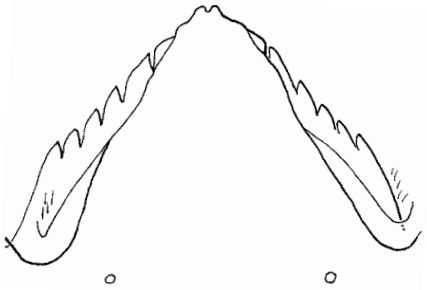


7' Apical tooth of mandible longer than width of 3 inner teeth 8



8(7') S I with 4 narrow teeth or rays ..... ***Ps. (Ps.) psilopterus* grp. sp. 2**

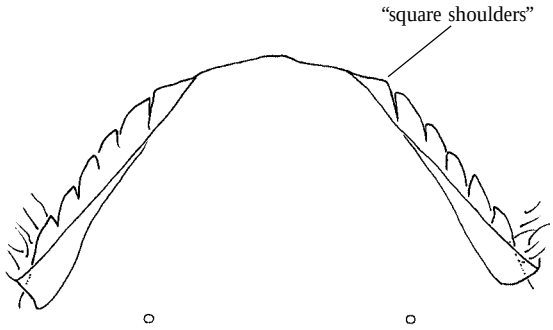




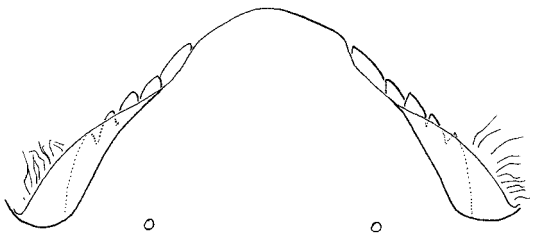
Ps. (Ps.) psilopterus grp. sp. 2 mentum

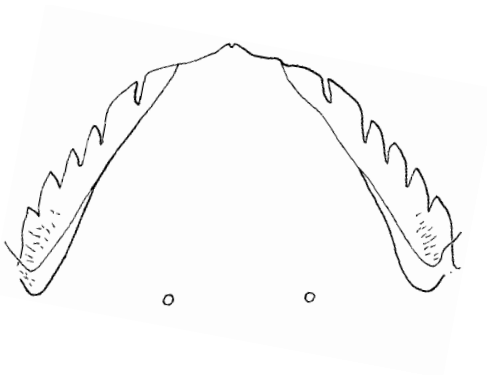
8' S I with 5 or more stouter teeth/rays 9

9(8') Median tooth of mentum broad, with relatively straight anterior margin and usually "square-shouldered" outer margin; premandible apically wider and darker ..... ***Ps. (Ps.) elatus***

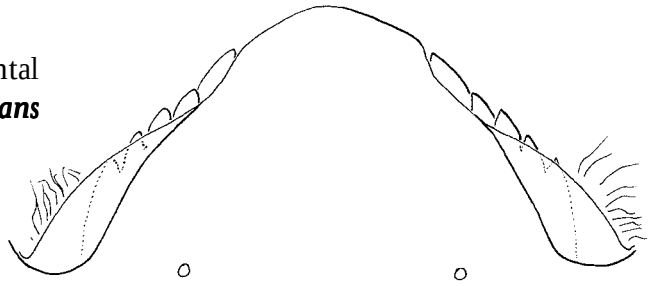


9' Median tooth of mentum rounded or if laterally angulate then with nipple-like central teeth; premandible apically narrow and not as darkened 10

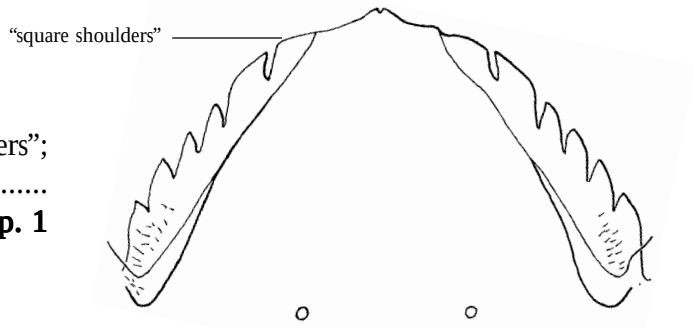




10(9') Median tooth of mentum rounded; ventromental plates wider ..... ***Ps. (Ps.) simulans***



10' Median tooth of mentum with "square shoulders"; ventromental plates narrower .... ***Ps. (Ps.) psilopterus* grp. sp. 1**



Notes on species

Note that the mentum can often be worn in many specimens; median teeth may be worn almost smooth and the normally angulate lateral margin of the median tooth of some species may be rounded.

Ps. (Ps.) elatus - Found throughout the Southeast; very similar to *Ps. simulans*. Roback (1957) described *Ps. elatus* as a new species and stated that it was very similar to *Ps. simulans*. In some larval specimens of *Ps. elatus*, including material in the Academy of Natural Sciences of Philadelphia collection identified by Roback, the outer margins of the median tooth are rounded, not squared off as originally described and figured by Roback. In such instances the broader and darker premandible will usually identify such larvae. Roback (1957) also examined type material of *Ps. simulans* and apparently used that material to find characters to separate his *Ps. elatus* from *Ps. simulans*. Pupae are separated by having more spines on the medial patch on T IV: 25 in *Ps. simulans*, 6-12 in *Ps. elatus*, although Sæther (1969: 85) noted that because of considerable variation in the genus this character might not work to separate the two taxa. Adult males are separated by the more quadrate inferior volsella and the more angulate terminus of the gonostylus of *Ps. simulans* (also see fig. 42 in Sæther (1969) for an illustration of the male genitalia of what Sæther called *Ps. simulans*). Note that although the mentum of *Ps. elatus* resembles that illustrated for *Ps. (Mesopsectrocladius)* in Cranston et al. (1983: fig. 61B), pupae indicate that *Ps. elatus* is a member of the nominate subgenus and should be placed in the *psilopterus* group.

Ps. (Allopsectrocladius) flavus - Not recorded from the Southeast, but I have examined pupal exuviae of putative *Ps. flavus* from northern Georgia. Some aspects of this species' identity are unclear. The larva is similar to *Ps. simulans* (and the Palaearctic *Ps. platypus*) except that it lacks a seta interna on the mandible. It is very similar to, and may be inseparable from, the larvae of *Ps. nigrus* and *Ps. obvius* (Walker). However, *Ps. obvius* and *Ps. nigrus* are darker as adults and are probably distinct species; these two species are probably synonymous; *obvius* is the older name and would have

priority. Johannsen's (1937: 66) description of *Ps. flavus* with four inner mandibular teeth is probably in error (the darkened molar area was probably mistaken for a tooth), but Johannsen's associated larval material of *Ps. flavus* could not be located in the Cornell University collection. Roback (1957) used Johannsen's 4 inner toothed mandible character in his key and also stated that the S I setae ("labral bristle") of *Ps. flavus* were not "compound", which I interpret as not palmate (similar to what Roback stated about the S I of another Johannsen species, *Ps. simulans*). However, a larval-prepupal association of an apparent *Ps. flavus* from New York, identified by pupal and adult (color) characters, has three inner mandibular teeth and a trifid S I, similar to that of *Ps. pilosus*. I have also examined pupal exuviae of apparent *Ps. flavus* from northern Georgia; these exuviae have thoracic horns longer than 0.5 mm and over 120 taeniae on the anal lobes. It is obvious that all of Johannsen's type material of *Psectrocladius* species must be re-examined, if it can be located in the Cornell University collection.

Ps. (Allopsectrocladius) nigrus - Originally described from Pennsylvania, this species has not been recorded from the Carolinas. It is not included in the key but would key to *Ps. flavus*. Although I've examined some of the type material of *Ps. nigrus* (the holotype male is in alcohol and lacks its hypopygium, not yet found on a separate slide), type material of *Ps. flavus* was not available, making an accurate distinction between the two species in the larval stage impossible (Johannsen's description of the larva of *Ps. flavus* with 4 inner teeth on the mandible is probably in error). Roback (1957) separated the adults of *Ps. flavus* and *Ps. nigrus* by the dark color of *Ps. nigrus*; the pupa were separated by the higher count of anal fin taeniae in *Ps. flavus* (125+ in *flavus*; 90+ in *nigrus*) and the larger thoracic horn of *flavus* (0.6 mm in *flavus*; 0.35 in *nigrus*). Is coloration a valid means of separating the two taxa and are the pupal measurements significant to separate the two species? An in depth study of all type material, if it can be located, is necessary. These two species may both be junior synonyms of *Ps. obvius* (Walker), a species originally described from the Palaearctic. See *Ps. flavus* above.

Ps. (Ps.) cf. *octomaculatus* - I've examined a larva from Georgia and a pupal exuviae from North Carolina that probably represent *Ps. octomaculatus*, but without reared material from both sides of the Atlantic the determination remains uncertain. This species is a member of the *Ps. (Ps.) limbatellus* group; this group and *Ps.* cf. *octomaculatus* were recorded for North Carolina by Caldwell et al. (1997).

Ps. (Allopsectrocladius) pilosus - Reared material from Florida, Georgia and Maine fits the description of this species except there are two spurs (one considerably smaller than the other) on the mid tibiae of the adults; *Ps. pilosus* was described with only one spur on the mid tibiae (although Roback (1957: 89) apparently misstated it as "tarsi with one spur"). Sublette (1967: 531) used the character of one tibial spur for *Ps. pilosus* in his key to *Psectrocladius* adults. However, I have examined the holotype female of *Ps. pilosus*; there are two spurs on the mid and hind tibiae, although one is considerably smaller than the other (the smaller is about 1/4 the length of the larger). The holotype is in alcohol; also in the microvial with the type is a partially decomposed female pupa. This pupa does not belong with the holotype because it is a separate, different animal. It appears the holtype's pupal and larval exuviae are each mounted on separate slides; I matched them following Roback's collection numbers and have labeled them accordingly. The associated exuviae from Georgia compare well with these exuviae and other material determined by Roback; I've also seen unassociated larvae from North Carolina. This species may the same as the Palaearctic *Ps. platypus* (Edwards), except that *Ps. platypus* was described as being almost wholly black (Edwards 1929: 333); *Ps. pilosus* was described as being brown and yellow (Roback 1957). The immature stages of the two taxa are morphologically similar and appear to be inseparable.

Ps. (Ps.) psilopterus group - At least five species in this group are present in the eastern United States; this includes *Ps. elatus*, *Ps. simulans* and the three taxa discussed here. Similar material from the South-

east, including larvae from South Carolina and reared material from northwestern Florida and southern Georgia, I've placed as *Ps. psilopterus* group sp. 1. It is unclear whether *Ps. psilopterus* group sp. 1 represents the same taxon as the Palaearctic *Ps. psilopterus*, but it strongly resembles it. *Psectrocladius psilopterus* grp. sp. 2 is represented by an unusual species based on one reared male and a larva from Georgia and adults from the Savannah River Site in South Carolina. The larva of this species has very finely dissected semi-palmate S I setae (with only 4 rays) and very fine, short beard setae. The mentum resembles that of *Ps. psilopterus* grp. sp. 1; the larva also has a narrow premandible apex and the apical tooth of the mandible is longer than the width of the three inner teeth, similar to that of *Ps. psilopterus* grp. sp. 1 and *Ps. simulans*. The pupa does not fit well into any defined species group; it may be an aberrant member of the *psilopterus* group. The adult resembles other members of the *Ps. psilopterus* group; it has microtrichia on the anal point, apparently lacking in other members of this group. I've reared an additional species from peat bogs in Maine that I'm calling *Ps. psilopterus* group sp. 3; this taxon may be *Ps. semicirculatus* Sæther. Some of these specimens were reared from larvae collected in the jelly of an amphibian egg mass. It is included in the key because it may eventually be found in boggy areas of the Carolinas.

Ps. (Ps.) simulans - Very similar to *Ps. elatus* (see above). Roback (1957: 87) stated in his key that the larva of *Ps. simulans*, based on examination of type material, lacked "compound labral bristles", referring to the S I setae. I was unsuccessful in obtaining any material of *Ps. simulans* from the Cornell University collection to confirm this. Sæther (1969) described a reared *Ps. simulans* with the "seta anteriores [S I] 5-rayed". I have seen one larva from North Carolina (with the normal *Psectrocladius* palmate S I) and larvae and a single male from the Savannah River Site in South Carolina that appear to be *Ps. simulans*.

Ps. (Ps.) sordidellus group - I've examined a larva that is probably true *Ps. sordidellus* that was collected in North Carolina; this larva resembles a *Rheocricotopus* and might be mistaken for that genus (but note the palmate S I).

Ps. (Ps.) vernalis - A distinctive species in the larval and adult stage, found throughout the eastern US and west to the Rocky Mountain states.

Ps. (Monopsectrocladius) sp. - There may be two species of the subgenus *Monopsectrocladius* present in the Southeast. I've examined a male from Alabama that is almost certainly the Palaearctic *Ps. (M.) calcaratus* (Edwards). Two reared males from Georgia appear to represent a different species, with a more rounded inferior volsella and more inflated gonostylus. More reared material from the Nearctic and Palaearctic is necessary to resolve the identity of these taxa; larvae should be identified as "*Ps. (Monopsectrocladius)* sp.". Note that in larvae from the southeastern U.S. the S I setae are usually bifid or trifid, in contrast to the palmate S I setae usually found in most *Psectrocladius* larvae. Also note that this larva resembles *Rheocricotopus tuberculatus* but lacks the ventral tubercles on the head capsule of that species in addition to other characters.

Ps. (Ps.) sp. 1 Epler - An undescribed species, known only from an adult male from Pen Branch at the Savannah River Site in South Carolina.

Genus ***Pseudorthocladius***

DIAGNOSIS: Distinguished by the mentum with well to weakly divided paired median teeth and 4 pairs of lateral teeth; mandible with 3 inner teeth; simple premandible; and 2-3 very long anal setae.

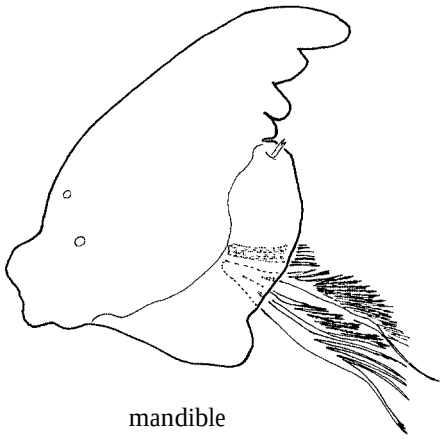
NOTES: *Pseudorthocladius* is a species-rich genus, with at least 11 species recorded from the Carolinas. However, larvae can not be identified to species.

Larvae are similar to *Parachaetocladius*; that genus has only 2 inner teeth on the mandible and one anal seta per procercus. Although Cranston et al. (1983) stated that *Pseudorthocladius* has 2-3 anal setae, I have seen apparent *Pseudorthocladius* larvae with only one seta and 3 inner teeth on the mandible. Given the number of species in the genus and the paucity of known larvae, there may be more variation in *Pseudorthocladius* larvae than is recorded in the literature.

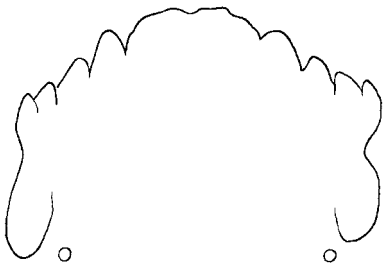
Larvae are found in mosses, bogs, springs and streams

ADDITIONAL REFERENCES: Cranston & Oliver 1988a; Sæther & Sublette 1983; Schnell 1991; Soponis 1980b.

antenna



mandible



menta

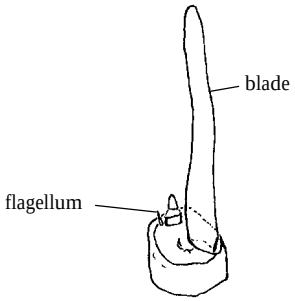
Genus *Pseudosmittia*

DIAGNOSIS: Identified by the bifid S I and S II; premandible with brush; antennae 3 or 4 segmented, with antennal blade greatly exceeding the flagellum and with ultimate segment longer than penultimate; lack of procerci, but 1-3 weak anal setae prersent; and posterior parapods weakly developed and with claws, or posterior parapods vestigial and anal claws absent.

NOTES: *Pseudosmittia* is currently being revised on a world wide basis by Drs. L.C. Ferrington, Jr. and O.A. Sæther. Several species occur in the Southeast; it is not possible to identify the larvae to species.

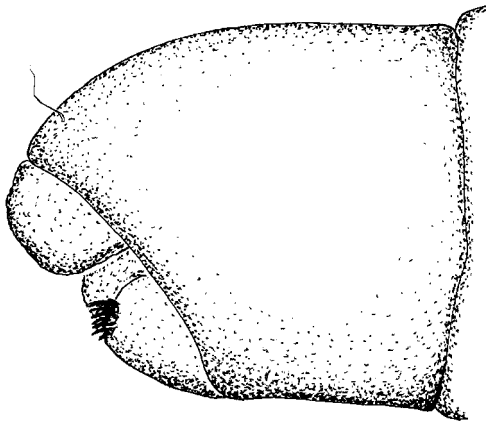
Larvae are found in terrestrial or semi-terrestrial habitats, but are also sometimes encountered in vegetated marshy areas, pond and stream borders, and in streams and rivers.

ADDITIONAL REFERENCES: Cranston & Oliver 1988a.



antenna

mentum



posterior end

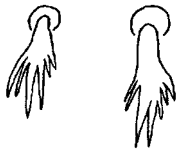
Genus ***Psilometriocnemus***

DIAGNOSIS: Distinguished by the apically dissected S I; 6 segmented antennae with 6th segment hairlike, vestigial; antennal blade subequal to flagellum; pecten epipharyngis of 3 slender scales; apically bifid premandible; maxilla with pecten galearis; mentum with 2 median teeth and 5 pairs of lateral teeth, 4th and 5th teeth subequal; and setae submenti well posterior to a line drawn between the bases of the ventromental plates.

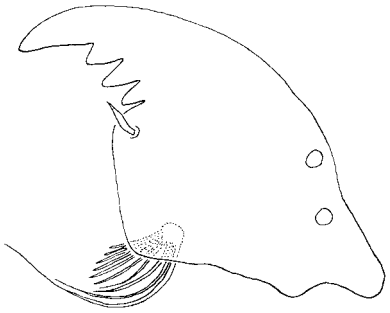
NOTES: One species, *Ps. triannulatus*, is known from the Carolinas, Georgia, Kansas, New Hampshire, Tennessee, New Brunswick, Nova Scotia, Ontario and Quebec. Larvae may be confused with *Platysmittia*, but that genus has the setae submenti placed more anteriorly and the antennal blade is markedly longer than the flagellum.

Larvae are found in damp soil, seeps, springs and small streams.

ADDITIONAL REFERENCES: Cranston & Oliver 1988a; Sæther 1969, 1982.

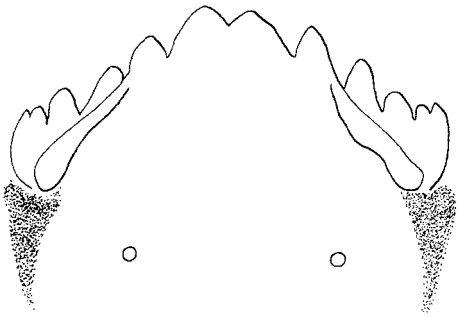


S I from 2 different specimens



mandible

antenna



mentum

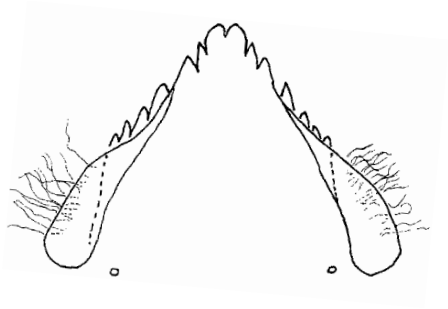
Genus *Rheocricotopus*

DIAGNOSIS: Larvae are distinguished by the bifid or apically multi-toothed S I; premandible apically simple, without brush; mandible with relatively short apical tooth; mentum with median tooth simple, medially notched or bifid (or with two teeth), with well developed ventromental plates and cardinal beard; and procerci usually with a distinct spur.

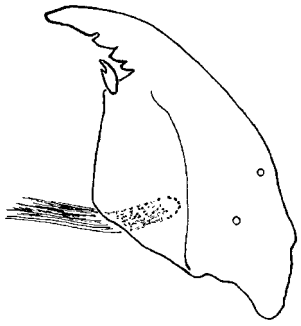
NOTES: Nine species are known from the Carolinas; the immature stages are undescribed for two of the species, and an additional larval type is known from Virginia.

Rheocricotopus robacki is the most common and widespread member of the genus in the eastern United States, often abundant in many lotic systems.

ADDITIONAL REFERENCES: Caldwell 1984; Sæther 1985b; Sæther & Schnell 1988.



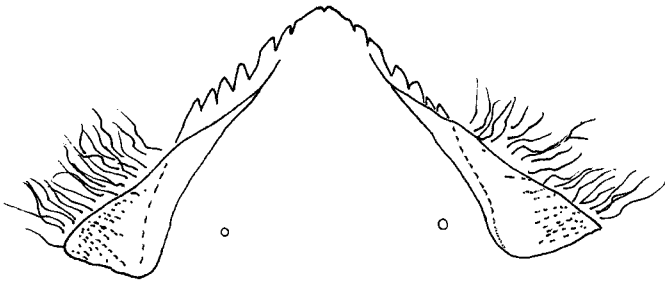
mentum



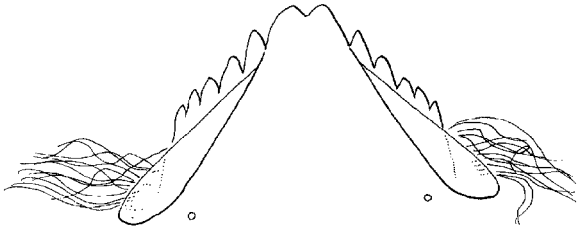
mandible

antenna

Rh. robacki



Rh. tuberculatus mentum

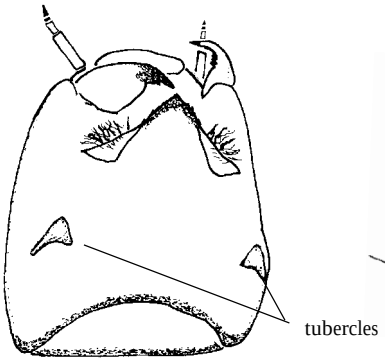


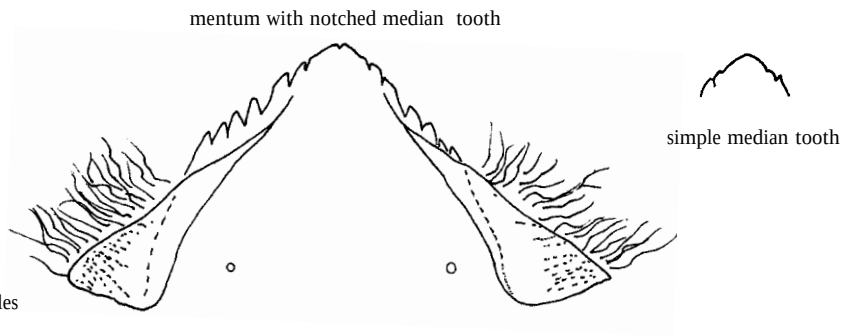
Rh. eminellobus mentum

Key to *Rheocricotopus* larvae of the southeastern United States

(larvae of *Rh. amplicristatus* and *Rh. conflusirus* are unknown)

1 Head capsule with a pair of ventrolateral tubercles; ventromental plates large and triangular ..... ***Rh. tuberculatus***

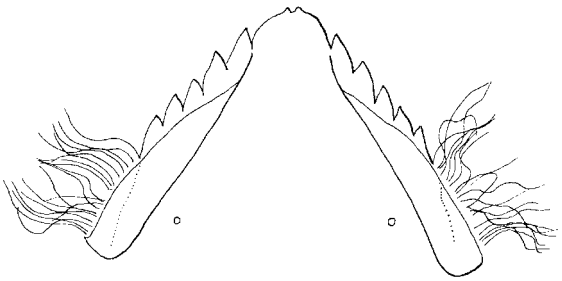




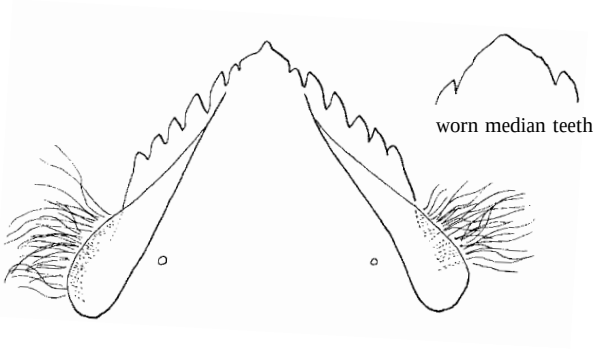
1' Head capsule without tubercles; ventromental plates not as broad, usually posteriorly rounded (see figures below) 2

2(1') Median tooth dome-like, with 2 small central teeth ..... ***Rh.* sp. VA**

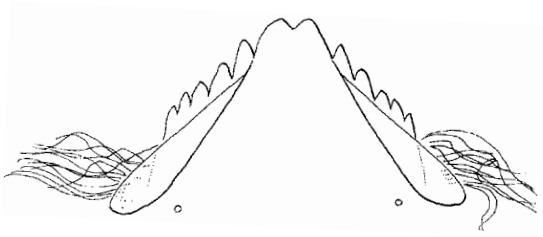
2' Median tooth simple or bifid (see below) .. 3

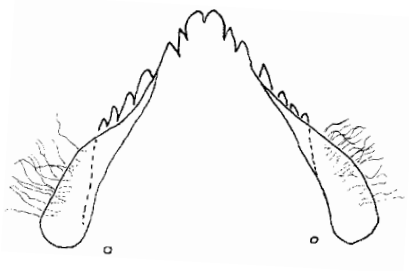


3(2') Mentum with single median tooth .... ***Rh. unidentatus***

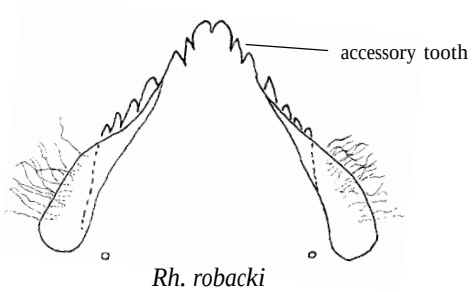


3' Mentum with bifid median tooth (or 2 median teeth) 4



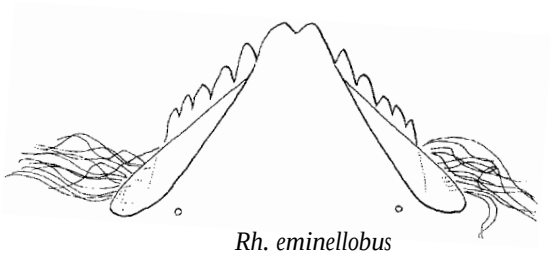


4(3') Each median tooth with a small lateral accessory tooth 5



Rh. robacki

4' Median teeth simple 6


Rh. eminellobus

5(4) Longest body setae > 100 µm long and relatively stout; last antennal segment 6-8 µm long; very common ..... ***Rh. robacki***

5' Longest body setae <100 µm long and thin, hairlike; last antennal segment 10 µm long; uncommon ..... ***Rh. pauciseta***

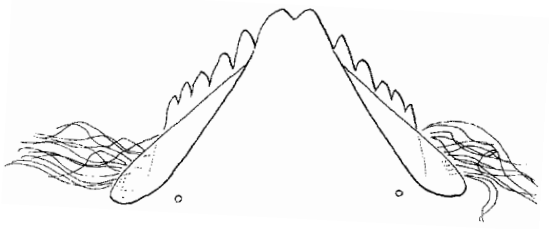
6(4') S I apically split into 4 or more teeth ..... ***Rh. glabricollis***

6' S I bifid 7

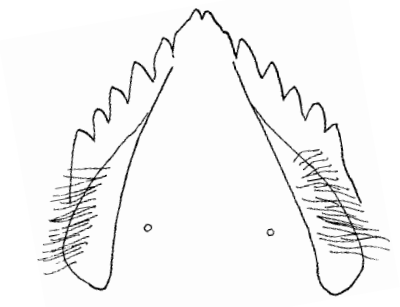

Rh. glabricollis


bifid S I of *Rh. effusus*

7(6') Beard beneath ventromental plate with 10-15 setae ..... ***Rh. eminellobus***



7' Beard beneath ventromental plate with 25-31 setae ..... ***Rh. effusus***


(mentum excessively flattened)

Notes on species

Rh. amplicristatus - The immature stages are undescribed; this species is known from adult males collected at the Savannah River Site in South Carolina and a record from Georgia in Caldwell et al. (1997).

Rh. conflusiris - The immature stages are undescribed; known only from the holotype, an adult male collected at the Jocassee Reservoir in South Carolina.

Rh. effusus - This Holarctic species is distinguishable from the similar *Rh. eminellobus* (q.v.) by the greater number of cardinal beard setae (25-31) and the higher AR (1.5-1.8). Another similar species is *Rh. effusoides*, described from South Dakota (Sæther 1985b: 98) and not recorded from the Southeast. It has 32-33 beard setae and an AR of 1.8-2.1. Note that Sæther (1985b: 71, couplet 7) keys the pupa of *Rh. effusus* with 4 taeniae (as "lamelliform setae") on T V-VI, but in his description for the pupa, he stated 3-4 taeniae for those tergites; pupal exuviae associated with reared North Carolina larvae bear only 3 taeniae on T V-VI. See also *Rh. pauciseta* below.

Rh. eminellobus - Similar to *Rh. effusus* but separable by the lower number of beard setae (fewer than 15) and lower AR (1.1-1.3). Both species are recorded from North and South Carolina.

Rh. glabricollis - In the highly stylized original figure of the larval mentum in Gouin (1936: fig. 18; as *Trichocladius Gouini* Goetghebuer, a junior synonym), the median teeth of the mentum were illustrated as being lighter in color than the lateral teeth; Cranston (1982) used this character in his key to *Rheocricotopus*. However, Sæther (1985b: 92) noted that the majority of the larvae he examined had dark median teeth. Sæther (1985b) described the S I as being split into 6-7 apical teeth but illustrated them (fig. 14B) with only four apical divisions. I have not seen associated larval material of this species but have seen a single larva from Virginia; its placement in the key is based on Saether's (1985b) description.

Rh. pauciseta - An apparently rare species; the larval description of this species is apparently from two larval exuviae described in Sæther (1969). I have not seen larval material of this species. Some reared larvae of *Rh. effusus* from North Carolina that I've examined might be mistakenly identified as *Rh. pauciseta* because there is a slight "shelf" on the outer margin of the median teeth that could be taken for a worn accessory tooth; this *Rh. effusus* material is apparently some of the same material Sæther (1985b) used in his description of the larva of *Rh. effusus*.

Rh. robacki - The most common and widespread member of the genus in the Southeast, usually easily identified by the accessory lateral tooth on the median teeth and the longer (at least 100 µm in fourth instar larvae), thicker body setae. These larger setae are usually more easily found on the more posterior body segments.

Rh. tuberculatus - An unmistakable species, easily identified by the ventral tubercles on the head capsule and the large, triangular ventromental plates. Caldwell (1984) described the larva with a single median tooth, but the majority of larvae I've assigned to this taxon have the median tooth slightly notched in the center of the anterior margin. Epler (1995) also noted that pupae associated with larvae with a notched median tooth had 4 taeniae on T VII, while type material he examined had only 3 taeniae on T VI. While this could certainly fall within a range of variation (e.g., see *Rh. effusus* above), a small possibility exists that a cryptic species may be involved.

Rh. unidentatus - Originally described from Ohio (Sæther and Schnell 1988), I've seen larvae from two sites in North Carolina. The small lateral notches on the median tooth may be worn down; I've seen material from one site in which larvae were present with such worn and unworn menta.

Rh. sp. VA Epler - This larva is known only from a single specimen from Virginia. It is not known whether it represents one of the two Southeastern *Rheocricotopus* species with undescribed immature stages, a new taxon or an aberrant specimen.

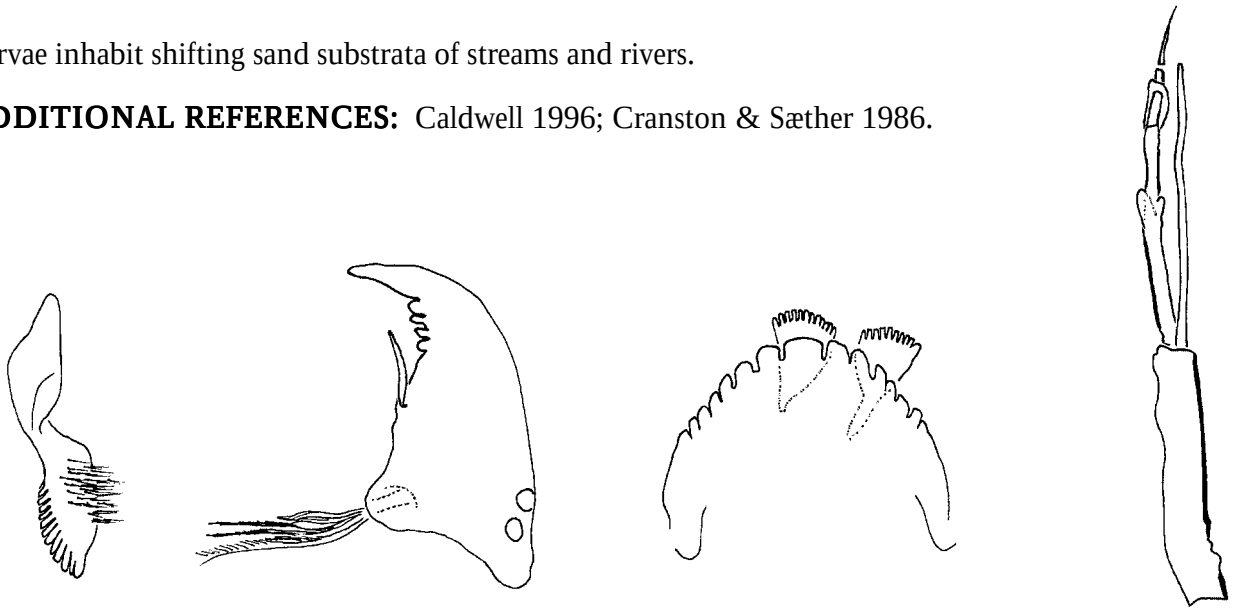
Genus ***Rheosmittia***

DIAGNOSIS: Distinguished by the distinctive antennae, which are at least ½ the length of head capsule, and have the second segment (and sometimes the first segment) unevenly sclerotized; and the strongly arched mentum, with 2 large hypopharyngeal scales dorsal to it.

NOTES: It appears that at least two species of *Rheosmittia* occur in the Southeast; only *Rh. arcuata* is described. The majority of unassociated larvae I've examined from the Southeast appear to be *Rh. arcuata* or a species very similar to it; I have only seen *Rheosmittia* sp. A from northern Florida. The two taxa can be separated by the longer apical mandible tooth of *Rh*. sp. A and the higher number of apical teeth on its hypopharyngeal scales: more than 10 in *Rh*. sp A; 5-8 in *Rh. arcuata* (Caldwell (1996) described the larva of *Rh. arcuata* with 5-6 teeth on the hypopharyngeal scales). Caldwell (1996) and Cranston & Sæther (1986) noted that the Lauterborn organs of antennal segment 2 are absent and suggested that structures reported as Lauterborn organs were probably extruded intersegmental membranes or the style.

Larvae inhabit shifting sand substrata of streams and rivers.

ADDITIONAL REFERENCES: Caldwell 1996; Cranston & Sæther 1986.



premandible mandible mentum and hypopharyngeal scales antenna

Rh. sp. A

mandible mentum and hypopharyngeal scales

Rh. arcuata paratype

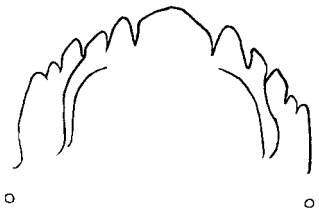
Genus ***Smittia***

DIAGNOSIS: Distinguished by the plumose S I; apically bifid premandible; antenna with 4 (possibly 5?) segments, with antennal blade less than or equal to flagellum; mandible with 3 inner teeth; and lack of procerci and anal setae.

NOTES: At least four species of *Smittia* are known from the Southeast; one described species and two undescribed species (based on adult males) are known from the Carolinas. The genus requires revision in the Nearctic. It is not possible to identify larvae to the species level.

Smittia larvae are generally considered terrestrial, but larvae are often found in water. Webb (1982) found *S. lasiops* larvae in soil in corn fields. I have illustrated two types of *Smittia* larvae below; both have been found in terrestrial leaf litter in hardwood forests and in streams. *Smittia* sp. B is unusual for the genus because of its trifid median tooth (or 3 median teeth). Note that *S.* sp. A is not a "worn mentum version" of *S.* sp. B.

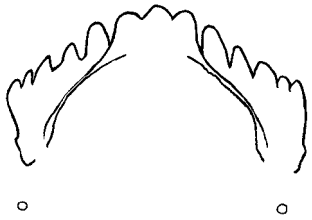
ADDITIONAL REFERENCES: Webb 1982.



Smittia sp. A mentum

Smittia sp. A antenna

Smittia sp. A premandible



Smittia sp. B mentum

Genus *Stilocladius*

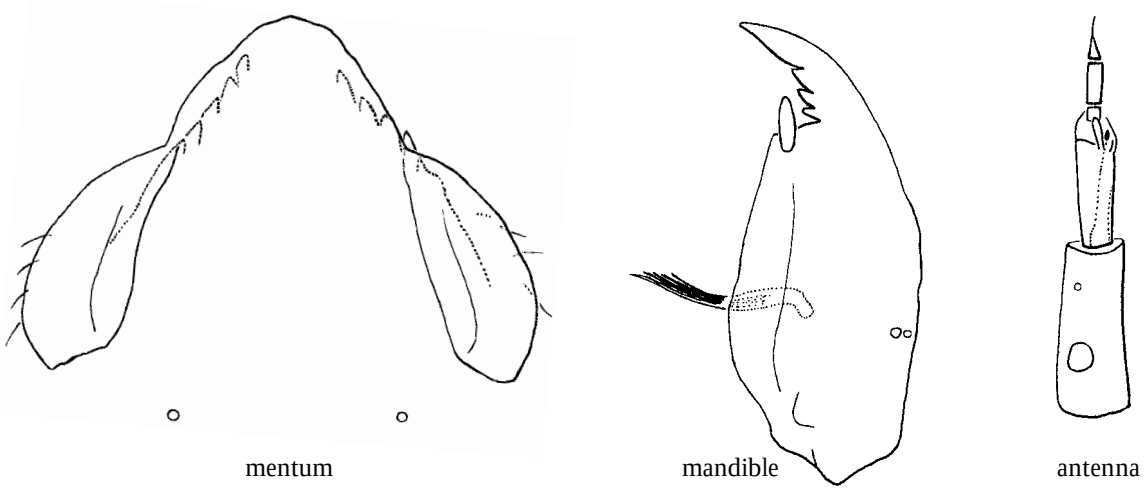
DIAGNOSIS: Distinguished by the simple or apically toothed S I; elongate ventromental plates with sparse beard beneath them; and 6 segmented antennae, with the last segment hairlike.

NOTES: One species, *S. clinopecten*, is known from the Southeast; an additional undescribed species is known from streams in Maryland and Pennsylvania. Material of the undescribed species, *S.* sp. A, was collected by Dr. Rick Jacobsen and will be described in a future publication; it can be distinguished from *S. clinopecten* by the right-angled outer margin of the first lateral tooth of the mentum and higher antennal ratio (1.3-1.6 for *S.* sp. A; 0.8-0.9 for *S. clinopecten*). *Stilocladius* sp. A appears similar to but is apparently not *S. montanus* of Rossaro (1984). The larva included as "*Stilocladius* ? sp." by Epler (1995) is placed in *Parakiefferiella* in this manual.

Note that the ventromentum of *Stilocladius* often covers the mental teeth, especially in specimens that have not been firmly pressed with the cover slip.

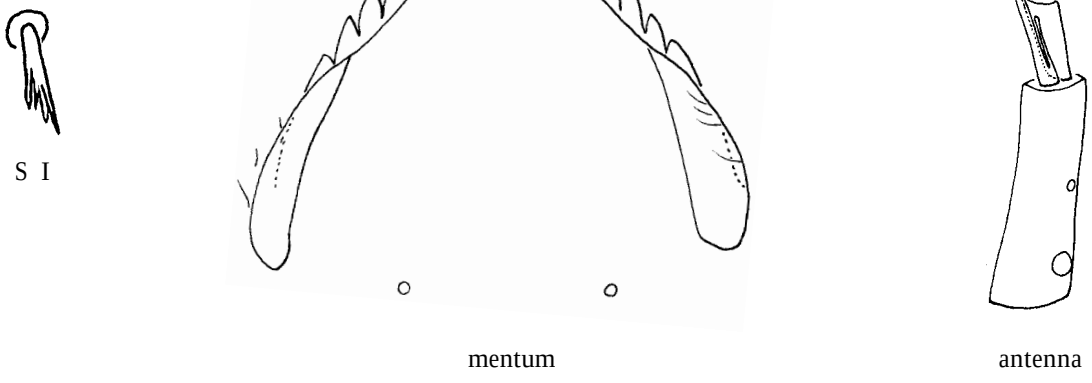
Stilocladius larvae are found most often in small streams.

ADDITIONAL REFERENCES: Rossaro 1984; Sæther 1982.



mentum mandible antenna

S. clinopecten



S I

mentum antenna

S. sp. A

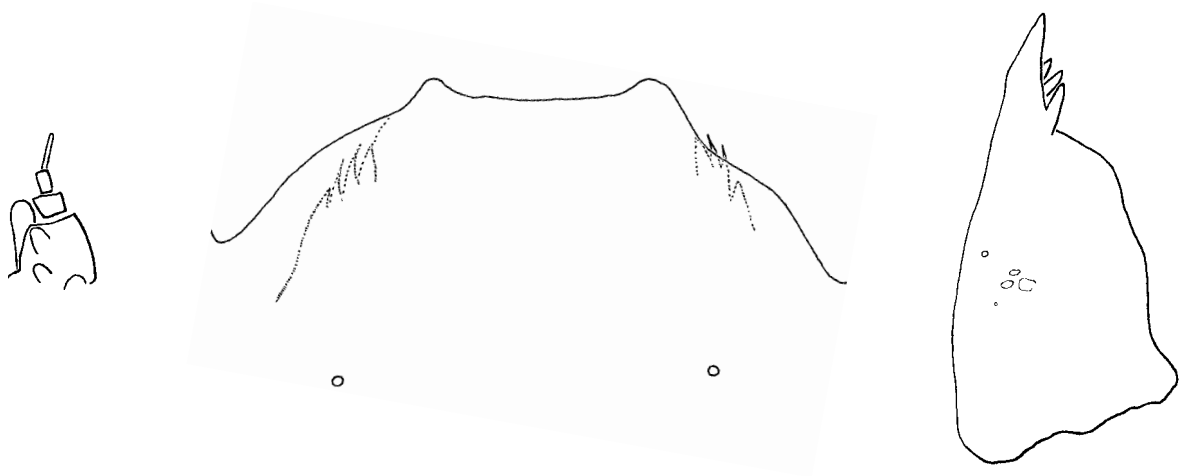
Genus *Symbiocladius*

DIAGNOSIS: The distinctive mentum, without median teeth and sharply pointed, almost spinelike lateral teeth; reduced antennae; vestigial procerci; and ectoparasitic habit will distinguish this genus.

NOTES: Two species are recorded from the Southeast; *S. chattahoocheensis* is known only from Georgia, *S. equitans* is recorded from North Carolina. Species level records of *Symbiocladius* based only on immature stages must be viewed with skepticism; immature stages of the two species known from eastern North America can not be distinguished at the species level.

Symbiocladius larvae are obligate parasites on mayfly nymphs; *S. chattahoocheensis* was described from specimens collected from the heptageniid *Epeorus* nr. *vitreus* (Walker); Roback (1966b) reported *Epeorus* sp. as a host from North Carolina.

ADDITIONAL REFERENCES: Caldwell 1984.



antenna mentum mandible

S. chattahoocheensis

Genus *Synorthocladius*

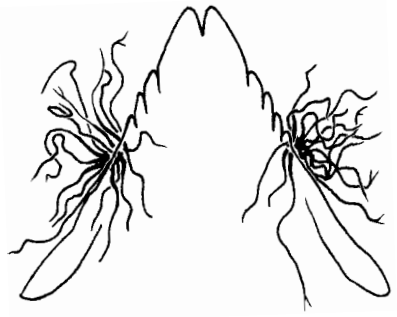
DIAGNOSIS: Distinguished by the simple S I; distinctive mentum with well developed ventromental beard with apically branched filaments; mandible without seta interna but bearing a large spine on the inner margin; large seta subdentalis; and abdominal segments with alternating simple and plumose setae.

NOTES: One described species, *S. semivirens*, is recorded from the Southeast. However, based on adult males, at least one additional species is known from North Carolina (Great Smoky Mountains National Park) and South Carolina (Savannah River Plant area). The larvae of the undescribed species is unknown; unassociated larvae from the Southeast should be identified as "*Synorthocladius* sp. ". *Synorthocladius* larvae were misidentified as *Parorthocladius* by Beck (1976, 1979).

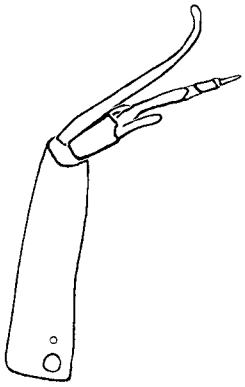
The extent of sclerotization of the third antennal segment is variable; antennae may appear to be four or five segmented. Larvae are usually blue-green in life and before slide mounting; this coloration is often carried through to the adult stage.

Larvae are most often found in running water, but may also occur in springs and other lentic situations.

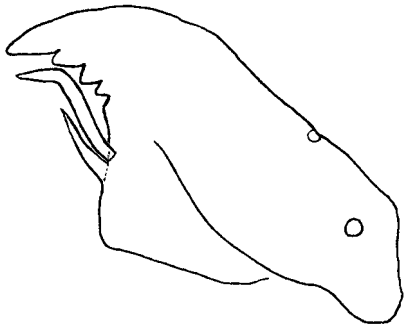
ADDITIONAL REFERENCES: None.



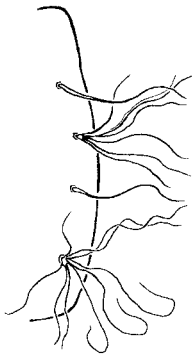
mentum



antenna



mandible



abdominal segment

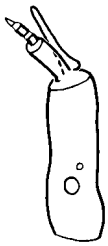
Genus ***Thienemannia***

DIAGNOSIS: The plumose S I; pair of serrated labral lamellae (in one Palaearctic species); 5 segmented antenna; premandible apically bifid, with brush; mentum with 2 median teeth; narrow ventromental plates; maxilla without pecten galearis; short, weakly sclerotized procerci; and the long supraanal setae distinguish this genus.

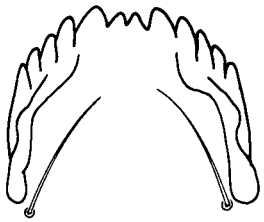
NOTES: One species, *Th. pilinucha*, is known from the eastern US. It was described from eastern Tennessee; it has not been reported from the Carolinas but can be expected in the mountainous western portions. The immature stages of *Th. pilinucha* are unknown; figures below are of a Palaearctic species, *Th. gracilis*. Larvae are similar to *Metriocnemus* and *Limnophyes*; note that figures 9.76B, D, G, H and J in Cranston et al. (1983) and figures 9, 11, 14, 16 and 17 in Sæther (1985h) are not *Thienemannia*, but *Limnophyes* (Sæther 1990). Note that although the key in Cranston et al. (1983) and Sæther et al. (2000) stated "labral lamellae apparently absent", a pair of apically serrated labral lamellae are illustrated for *Th. gracilis* in Cranston et al. (1983:fig. 9.76F) and Sæther (1985h:fig. 13).

Larvae have been found in springs and are considered hygropetric in streams.

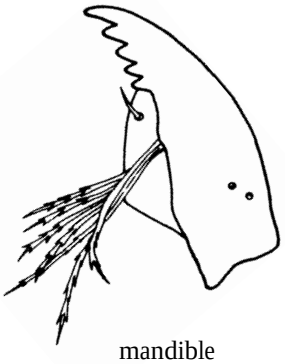
ADDITIONAL REFERENCES: Sæther 1985h.



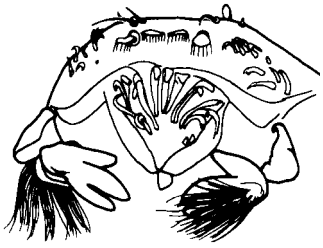
antenna



mentum



mandible



labrum

maxilla

(figs. adapted from Sæther 1985h)

Genus *Thienemanniella*

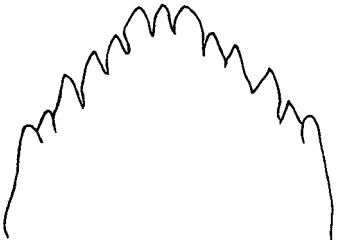
DIAGNOSIS: Larvae are distinguished by their small size (< 4 mm); long (> half the length of the head capsule), well sclerotized 5 segmented antennae; and simple subbasal setae of the posterior parapods.

NOTES: Seven species of *Thienemanniella* are known from the Southeast, five of which have been recorded from the Carolinas. The genus was recently reviewed by Hestenes & Sæther (2000); three new species were described, all of which have since been found in the Carolinas. *Thienemanniella xena* is by far the most commonly encountered species, but many older records of *Th. xena* must be viewed with skepticism because of previous inadequacies in identification materials.

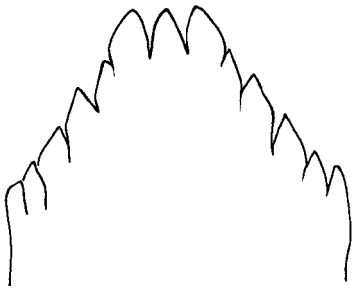
Larvae which have lost their antennae may be confused with *Corynoneura*; most *Corynoneura* have subbasal setae on the posterior parapods with spinose bases or sides; some *Corynoneura* species have sculptured head capsules. All *Thienemanniella* larvae known to me from the Southeast have thick, simple subbasal setae and none have head sculpturing.

Larvae occur in running and standing water, but are usually found in streams and rivers, and can be encountered in clean or enriched habitats. It is not unusual for several species to be found within one sample. Larvae are eaten by a variety of aquatic macroinvertebrates, and are often found in the guts of many tanypod species; I've also seen them in the gut of the naidid worm *Chaetogaster diaphanus* (Gruithusen).

ADDITIONAL REFERENCES: Boesel & Winner 1980; Hestenes & Sæther 2000; Schlee 1968.

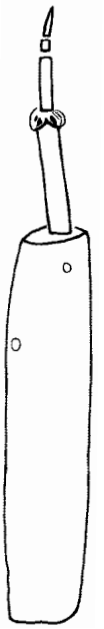


Th. xena mentum



Th. similis mentum

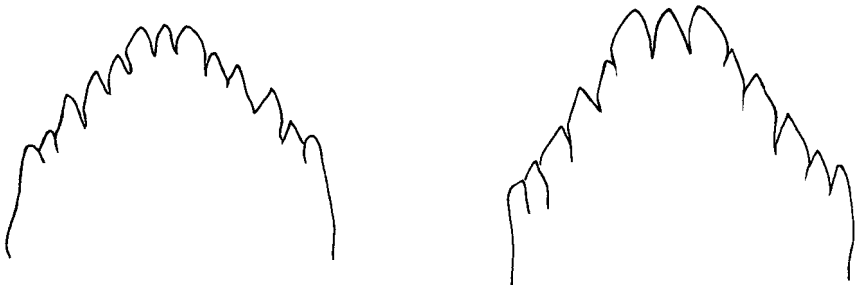
Th. xena antenna



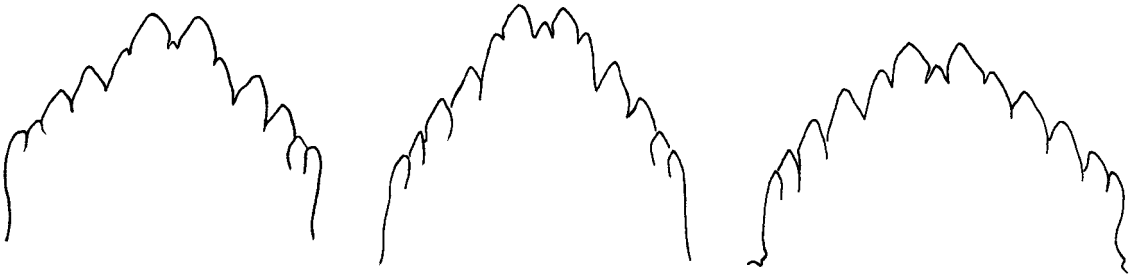
Th. similis antenna

Key to *Thienemanniella* larvae of the southeastern United States

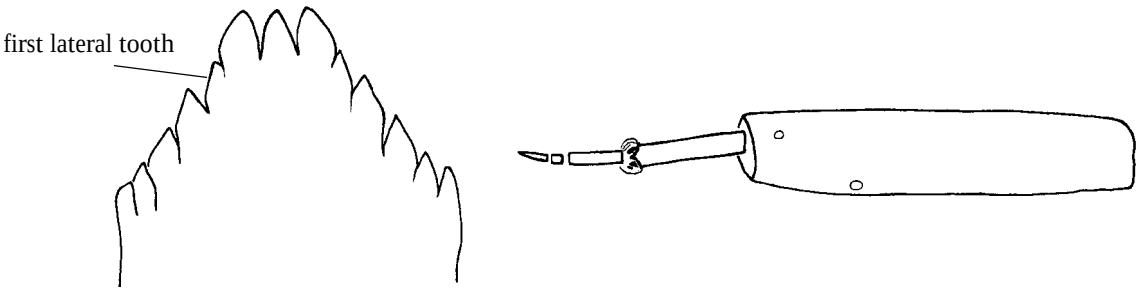
1 Mentum with 3 large median teeth, the central tooth at least 2/3 length of the outer median teeth 2



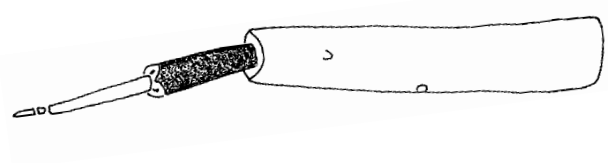
1' Mentum with 2 large median teeth, if central tooth is present it is vestigial or at most 1/2 length of outer median teeth 4



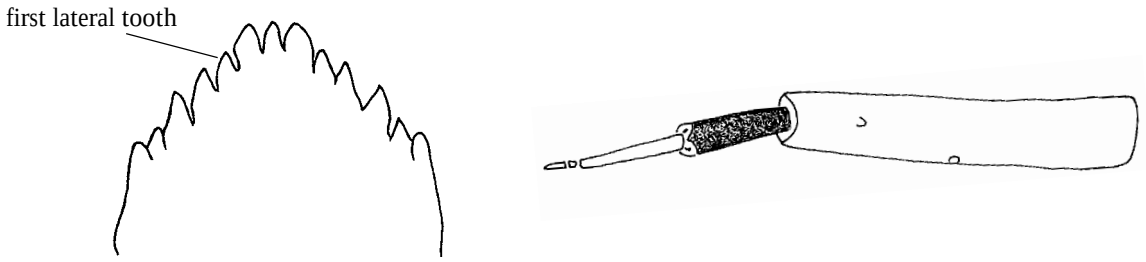
2(1) Antennal segment 3 0.5-0.7 as long as segment 2, segment 2 pale; mentum with first lateral tooth partially fused to outer median tooth ..... ***Th. similis***



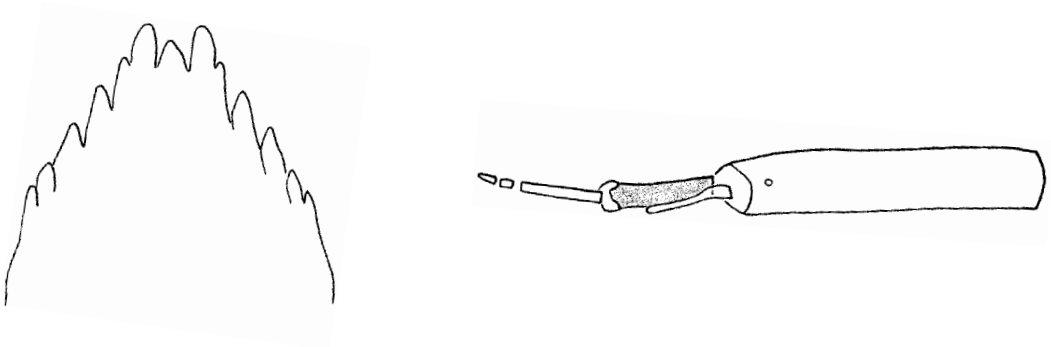
2' Antennal segment 3 equal to or slightly shorter than segment 2, segment 2 light to dark brown; mentum with first lateral tooth free or partially fused to outer median tooth 3



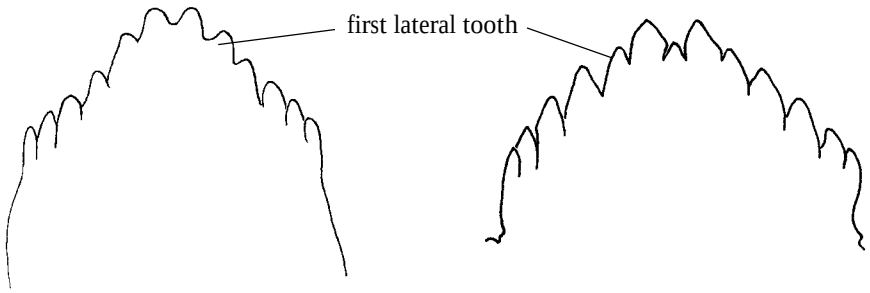
3(2') Mentum with central tooth equal to or slightly shorter than outer median teeth; first lateral tooth not partially fused to outer median tooth; antennal segment 2 dark brown ..... ***Th. xena***



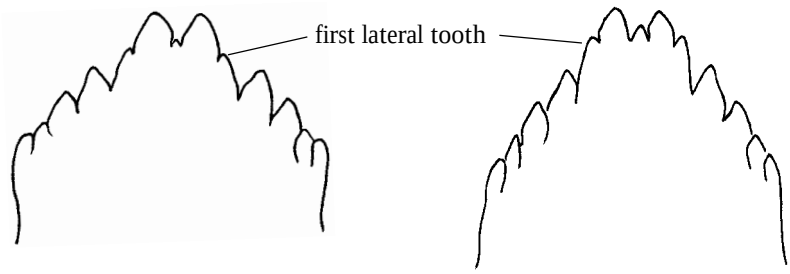
3' Mentum with central tooth clearly shorter than outer median teeth; first lateral tooth partially fused to outer median tooth; antennal segment 2 pale brown ..... ***Th. taurocapita***



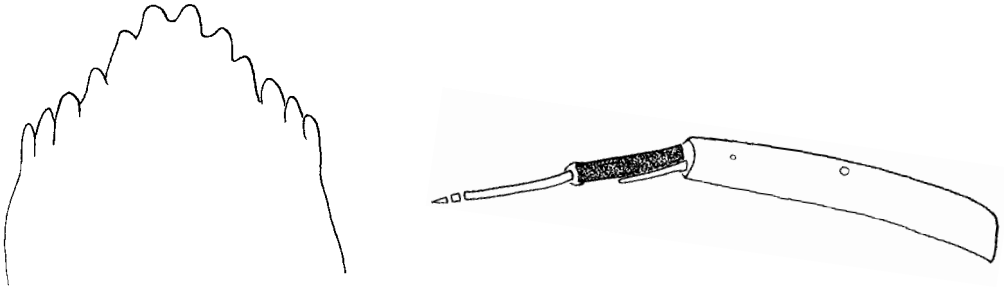
4(1') Mentum with first lateral tooth free, not partially fused to median tooth 5



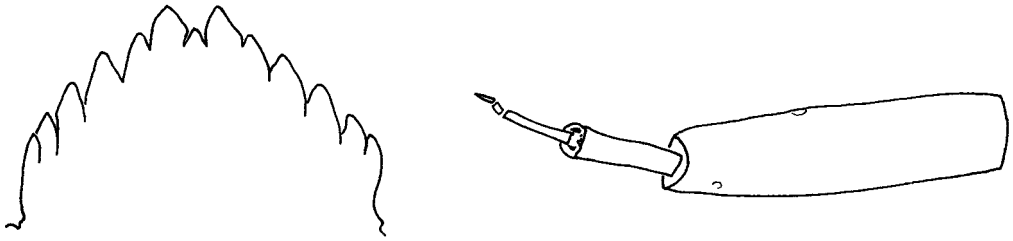
4' Mentum with first lateral tooth partially fused to median tooth 6



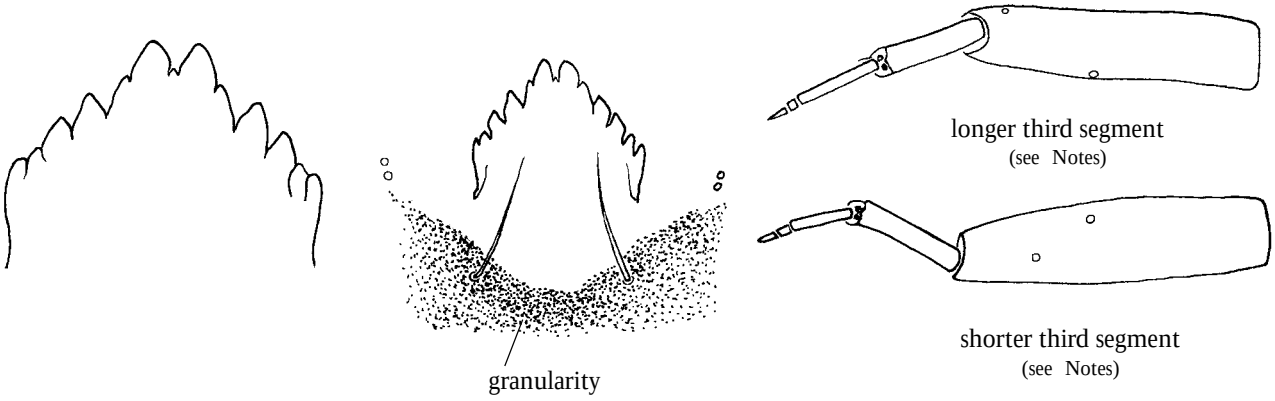
5(4) Mentum without a central tooth; second antennal segment brown; third antennal segment about as long as segment 2 ..... ***Th. boltoni***



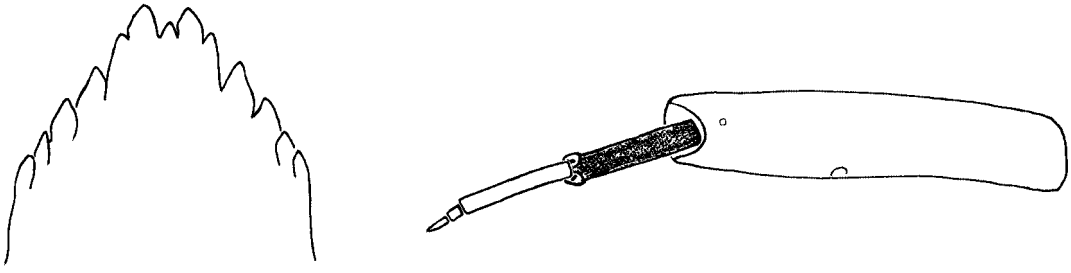
5' Mentum with a small central tooth; second antennal segment pale; third antennal segment about 0.8 as long as segment 2 ..... ***Th.* sp. C**



6(4') Central median tooth of mentum absent (worn away) or minute; third antennal segment 0.5-0.9 length of second; second antennal segment pale; venter of head capsule usually with granular appearance ending anteriorly in a semicircle ..... ***Th. lobapodema***



6' Central median tooth small but distinctive; third antennal segment equal to second; second antennal segment light brown; venter of head capsule without granular appearance ..... ***Th.* sp. B**



Notes on species

Th. boltoni - Described from and previously known only from Ohio. In addition to the holotype and two paratypes, I've examined a male and larvae from North Carolina. The species is apparently restricted to springs and small spring fed streams.

Th. lobapodema - This taxon is apparently the same as those called "*Thienemanniella* sp. A" and "*Th.* sp. D" in Epler (1995); it is also the same taxon as "*Thienemanniella* nr. *fusca* (Kieffer)" of Simpson & Bode (1980); note that *Th. fusca* is a junior synonym of *Th. acuticornis* (Kieffer) and is an entirely different species from *Th. lobapodema* – the mentum is different (with three equal median teeth) and the third antennal segment is very short, similar to that of *Th.* sp. A of Hestenes & Sæther (2000). Epler (1995) noted that two species might have been present in his *Th.* sp. A due to the range in third antennal segment lengths. Hestenes & Sæther (2000) gave lengths of antennal segment 3 being 0.5 - 0.7 the length of segment 2. I examined four paratypes of *Th. lobapodema*, all collected in Ohio at the same place and date (note that Hestenes & Sæther (2000: 117) list only the reared female from this series as a paratype, although all four specimens are marked as paratypes). Only one of the paratype larvae had an easily discernable semi-circular postmental mark; this specimen had an antennal segment 3/2 ratio of 0.7 and longest body setae of 130 µm. The other three specimens had ratios of 0.5-0.6 and longest body setae of 86-106 µm. In other, unreared, material I've examined, third antennal segment lengths run a continuum from 0.5 to 0.9 of the length of the second segment; usually those specimens with longer antennae have longer body setae. The semi-circular clear area (not granulose like the remainder of the head capsule) posterior of the mentum is usually distinctive in most fourth instar specimens mounted in CMC; it can be difficult to discern in very old material (hence the *Th.* sp. D of Epler (1995)) and in some larvae and larval exuviae mounted in other media. It appears that most larvae with a clearly defined semi-circle on the mentum also sport longer antennae and body setae (up to 180+ µm), but there are exceptions. Do these specimens represent another species? However, none of the longer antennal variety have been reared and it may be wise to set aside those specimens with long (more than 0.75 the length of segment 2) third antennal segments and longer (over 125 µm) body setae; such specimens may prove to be a different species. If so, this would mean that the type series is mixed; I have not seen the holotype (a mature male pupa). In the Southeast, *Th. lobapodema* is known from Alabama, Florida, Georgia, North and South Carolina, where it can be common in streams and rivers, and often occurs with other members of the genus.

Th. similis - A relatively common species throughout the Southeast, usually not as common as *Th. xena*, often occurring with it and *Th. lobapodema*. Epler (1995) called this taxon "*Th.* cf. *similis*". I've also seen some earlier instar (probably third) larvae from South Carolina that appear to be *Th. similis* but have shorter third antennal segments. Since these are not fourth instar larvae, it might be possible that the antennal segments do not attain their full respective lengths until the fourth instar. It is also possible they may represent an undescribed species, but until fourth instar larvae are found and associated with pupae and adults, their status remains unclear.

Th. taurocapita - Previously known only from type material from Ohio. It has been collected from headwater streams to rivers, but is most common in streams. I've examined a male captured at a light trap near a creek in Great Smoky Mountains National Park in North Carolina.

Th. xena - The most common and abundant species of the genus in the Southeast, usually easily recognized by the three median teeth that are subequal in length, first lateral teeth not partially fused to the outer median tooth, dark brown second antennal segment and long third antennal segment (subequal to second). I've seen what may be a variant from the Savannah River Plant area in South Carolina in which the median tooth is narrower than the outers and the second antennal segment

is not as dark brown. I've examined the type series, originally described from Pennsylvania.

Th. sp. B - This species has a very long third antennal segment, as long as the brown second antennal segment, and an almost always distinguishable central median tooth, at most about 1/3 the height of the outer median teeth. Known from northern Florida and northern Georgia. This taxon may be a variant of *Th. taurocapita* but I have not seen any *Th*. sp. B larvae with a central median tooth as long as those of *Th. taurocapita* specimens I've examined; its true identity will remain unknown until it is reared. In north Florida it often occurs with *Th. lobapodema, Th. similis* and *Th. xena*.

Th. sp. C - This taxon is known only from southern Florida.

Thienemanniella obscura Brundin and *Th. partita* Schlee are recorded from South Carolina by Hudson et al. (1990) and Caldwell et al. (1997). I have no idea where their records are from and have not seen any material that could be remotely associated with those taxa; these records should be considered dubious.

Genus ***Tokunagaia***

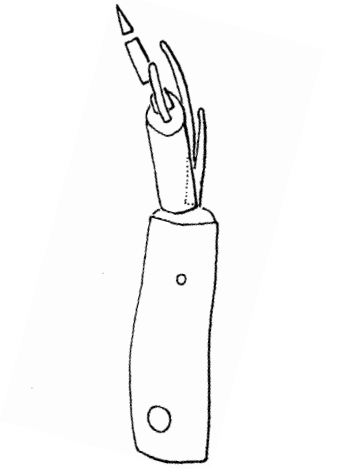
DIAGNOSIS: Distinguished by the dark brown to blackish head capsule; simple, thick S I; simple or weakly serrate labral chaetae and chaetulae laterales; simple, blunt premandible; elongate, well sclerotized basal sclerite; 5 segmented antenna with 4th segment about twice as long as third, with antennal blade extending at least to or past 4th segment; mentum with 5 pairs of lateral teeth and a pair of median teeth; inner margin of mandible with long spines (or spines reduced to points); seta interna of mandible with branches split to near base; procerci not reduced; and supraanal setae shorter than anal tubules.

NOTES: Halvorsen & Sæther (1987) expanded *Tokunagaia* by the inclusion of the *Eukiefferiella rectangularis* group, thus the larval diagnosis in Cranston et al. (1983) is incomplete. The taxonomy of *Tokunagaia*, *Cardiocladius* and *Eukiefferiella* remains unclear.

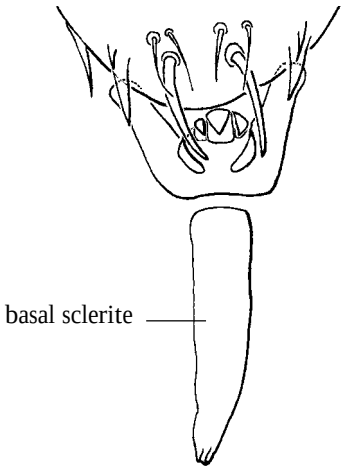
At least one unnamed species is known from mountainous western North Carolina. A pupal exuviae collected from a pool at Coweeta Hydrologic Lab is similar to that figured as *"Adactylocladius* sp." by Sæther (1969:fig. 28A). Other North Carolina material includes a larva with developing pupal characters that match it with the Coweeta pupal exuviae, and several unassociated larvae. I've also seen a larva from Oconee Co., SC, that appears to be a *Tokunagaia*, but the mentum is badly worn. I've also examined additional specimens of what might be two additional undescribed species from Ohio.

Tokunagaia larvae are found in moss or algal mats on stones in streams and can also be hygropetric. The central portion of the mentum is often badly worn or broken.

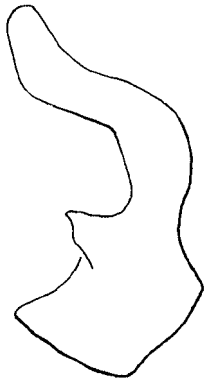
ADDITIONAL REFERENCES: Bode 1983; Halvorsen & Sæther 1973; Sæther 1969.



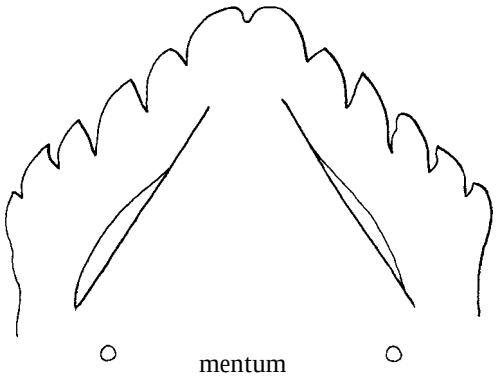
antenna



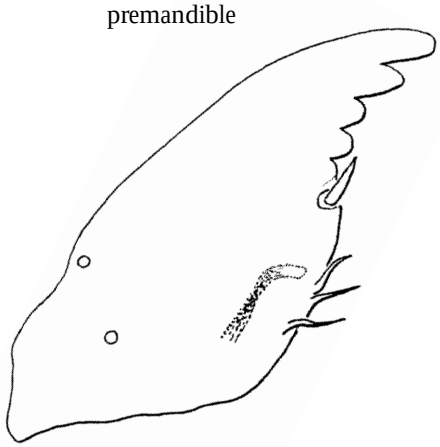
labrum and basal sclerite



premandible



mentum



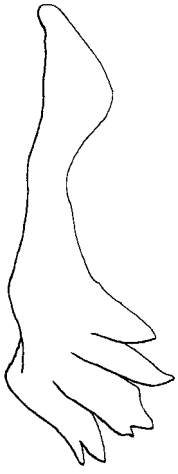
mandible

Genus *Trichochilus*

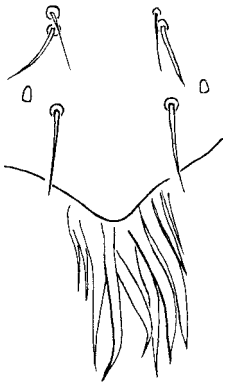
DIAGNOSIS: Distinguished by the simple S I; reduced antennae, apparently 3 segmented; premandible with multiple large apically serrated branches; ventromentum without teeth and extending below lateral plates of dorsomental teeth; mandible with long apical tooth and only a slight indication of inner teeth (a series of low serrations is apparent on most specimens), without seta subdentalis and seta interna; procerci developed, with anal setae; large, ovoid anal tubules that are larger than the posterior parapods; and by the apparently parasitic habit of the larvae within unionid mussels.

NOTES: The genus *Trichochilus* was established by Sæther (1985i) for a peculiar female originally described as *Trichocladius lacteipennis* Johannsen. Recent associated material from Pennsylvania (R. Jacobsen, pers. comm.) shows that the immature stages of *Trichochilus* live within unionid molluscs. In the collection at Florida A & M university, I found pupal specimens with associated larval exuviae misidentified as *Baeoctenus* (another taxon whose larvae live within unionid clams) that are identical to the Pennsylvania material. Unfortunately, these specimens bear only the data "27 March 1965, found ass'td with *E. buckleyi*" on their labels; it is unknown where the specimens were collected. *Trichochilus* larvae are similar to the specimens from Louisiana unionids briefly described by Roback (1979b) as "genus nr. *Phycoidella*", but lack the "comblike row of preapical setae" on the mandible. Roback noted that the Louisiana specimens were the same as larvae from New Brunswick mentioned in a paper by Gordon et al. (1978) and earlier by Sæther (1977b). Roback's specimens were presumed to be instar 1 larvae; it is possible that the row of setae on the mandible might not be present in later instars. Specimens from the locality Roback (1979b) cited could not be located in the collection at the Philadelphia Academy of Natural Sciences; however a single early instar larva from another site in Louisiana, collected from "between the demibranchs of *Lampsilis hydriana*", was found in the collection and examined. It has a mandible similar to that illustrated by Roback, but the specimen is not in good enough condition to determine if it is *Trichochilus*. The existence of *Trichochilus* in the Carolinas is a definite possibility.

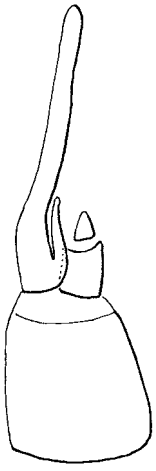
ADDITIONAL REFERENCES: Roback 1979b; Sæther 1985i.



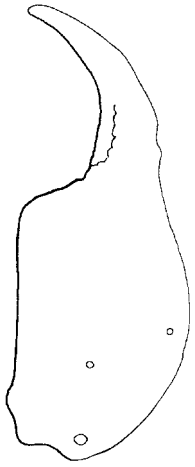
premandible



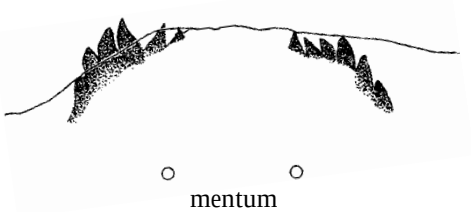
labrum



antenna



mandible



mentum

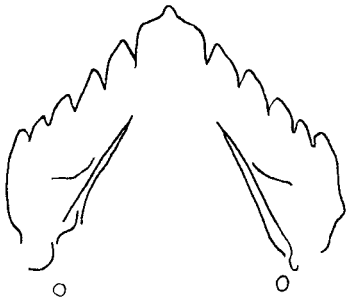
Genus ***Tvetenia***

DIAGNOSIS: The coarsely toothed to plumose SI; mandible with 1-3 inner spines or serrations; seta interna divided to near base; narrow ventromental plates; lack of beard; and the long, strong body setae that are at least 1/2 the length of body segment that bears them will distinguish this genus.

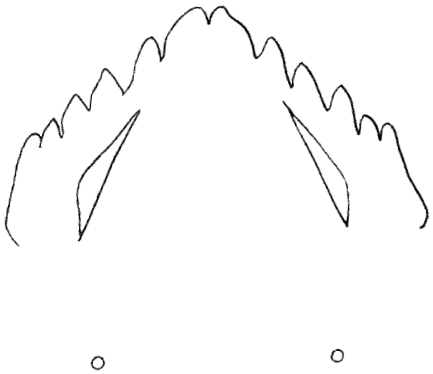
NOTES: At least four species are known from the Southeast; there may be as many as six. Species in the genus were formerly placed in *Eukiefferiella*; Sæther & Halvorsen (1981) transferred these species to *Tvetenia*. Note that some *Eukiefferiella* species may have long body setae and can be confused with *Tvetenia*; their simple S I setae and, in some cases dark brown head capsules, will separate them Many previous records of various *Tvetenia* species in the eastern US should be treated with skepticism.

Tvetenia larvae are found in running water; *T. vitracies* can be tolerant of high organic nutrient levels.

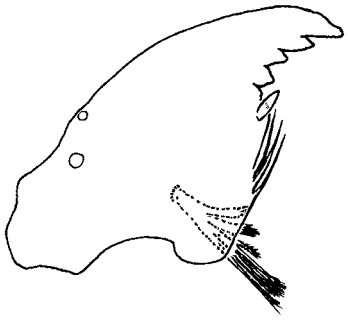
ADDITIONAL REFERENCES: Bode 1983; Mason 1985c; Sæther 1969; Sæther & Halvorsen 1981.



T. vitracies mentum



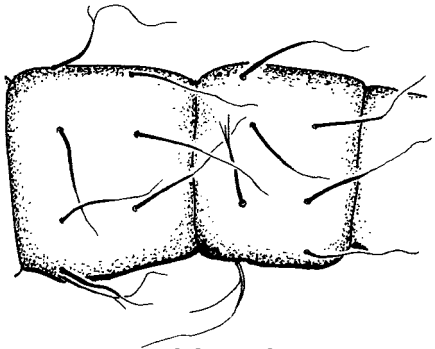
T. paucunca mentum



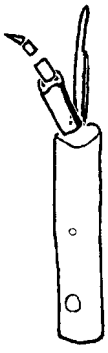
T. vitracies mandible

T. vitracies S I

T. sp. GA S I



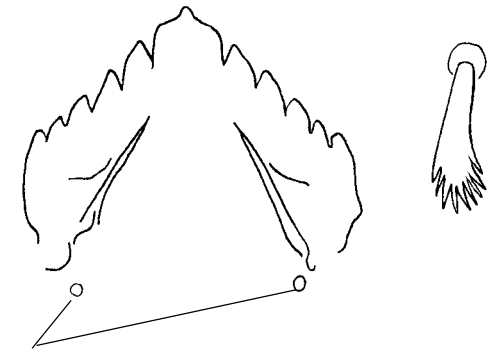
T. vitracies abdominal segments



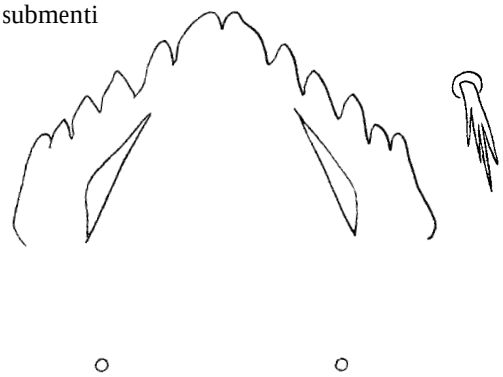
T. vitracies antenna

T. paucunca antenna

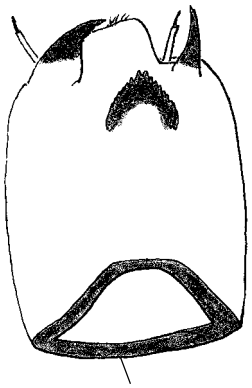
Key to *Tvetenia* larvae of the southeastern United States



1 Mentum with single median tooth; setae submenti placed close to mentum; S I plumose ..... ***T. vitracies***



1' Mentum with bifid median tooth; setae submenti placed more posteriorly; S I coarsely branched 2



2(1') Postoccipital margin pale, about same color as rest of head capsule; basal segment of antenna 45-60 µm long 3

2' Postoccipital margin much darker than rest of head capsule; basal segment of antenna > 65 µm 4

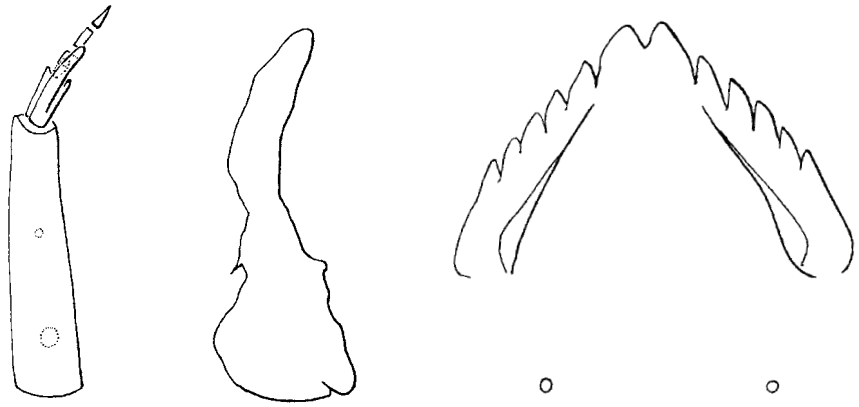
NOTE: 4th instar larvae are necessary for accurate measurements!!

3(2) 4th antennal segment about 2X as long as 3rd ..... ***T. paucunca***

3' 4th antennal segment about 4-6X as long as 3rd ..... ***T. bavarica*** (see Notes on species)

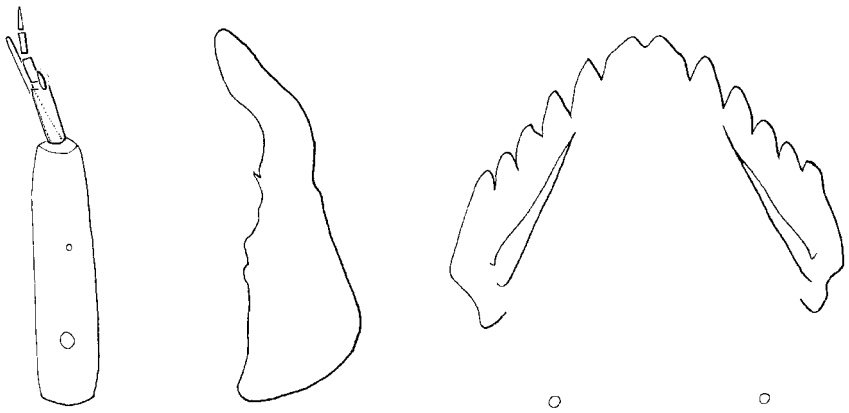
4(2') Basal antennal segment about 66-78 µm long; premandible apically notched; longest abdominal seta 200-225 µm long ..... ***T.* sp. GA**

NOTE: 4th instar larvae are necessary for accurate measurements!!



4' Basal antennal segment about 83-96 µm long; premandible without apical notch; longest abdominal seta 260-340 µm long ..... ***T.* sp. NC**

NOTE: 4th instar larvae are necessary for accurate measurements!!



Notes on species

T. bavarica - Recorded from the Carolinas by Hudson et al. (1990) and Caldwell et al. (1997), but I have not seen material of *T. bavarica* from the Southeast. All larvae I've examined that were previously identified as *T. bavarica* were assignable to *T. paucunca*. Following Schmid (1993), the 4th antennal segment of *T. bavarica* is 4-6X longer than the 3rd; in all material I examined the 4th antennal segment was about 2X as long as the 3rd. The pupa of *T. bavarica* is distinctive, bearing a band of tiny spines around the apex of the wing sheath rather than the more usual single row found in other members of the genus.

T. calvescens - Recorded for Georgia by Hudson et al. (1990) and Caldwell et al. (1997); all material I've seen identified as this taxon I've referred to *T. paucunca*; see below.

T. paucunca - Relatively common in the Carolinas; more common in the mountains and coastal plain regions. This species may be the same as the Palaearctic species *T. calvescens*; however, until more work is done I feel it is best to retain the name *paucunca* for this taxon. It is also possible that both are valid species and both may occur in the Nearctic; if so, all associated material (especially the pupal stage) I've examined would still be referable to *T. paucunca*. The reared material I examined was from Georgia and North Carolina and produced measurements lower than those given by Sæther (1969) for *T. paucunca* (as a *Eukiefferiella*); the first antennal segment of southeastern speci-

mens ranged from 45-50 µm, mean 47, while Sæther's material was 54-60, mean 57; AR's of southeastern material ranged from 1.36-1.48, mean 1.43, while those of Sæther's material were 1.54-1.75, mean 1.64. Note that the median teeth can be worn to appear as a single broad tooth; the 3-4 branched S I setae, more posteriorly placed setae submenti and pale postocciput will help separate this species from *T. vitracies*, which has a more plumose S I and darkened postocciput. *Tvetenia paucunca* would belong with the "*T. bavarica* group" of Bode (1983) and is probably the species illustrated in his work.

T. verralli - I have not seen material of this species, recorded for North Carolina by Hudson et al. (1990) and Caldwell et al. (1997). It is not included in the key, but if it did occur here it would key to *T.* sp. GA (which it definitely is not) or *T.* sp. NC.

T. vitracies - This is the species referred to as "*T. discoloripes* group" by Bode (1983). It is common and widespread throughout the Southeast, occurring as far south as Florida. In the Carolinas, this species appears to be more common on the Coastal Plain than in the mountains, where *T. paucunca* is more common.

T. sp. GA - An undescribed species similar to the Palaearctic *T. duodenaria* Kieffer. Pupae are similar in that they lack the recurved hooklets on the posterior margins of the abdominal tergites; adult males are similar except they lack the seta-bearing "plate" on tergum IX. I've examined associated material from the northern portion of the Coastal Plain in southern Georgia (Crisp County).

T. sp. NC - A large species I've seen only as unassociated larvae from North Carolina. It may be undescribed or perhaps *T. discoloripes* or *T. verralli*, but associated material would be necessary for accurate identification.

Genus *Unniella*

DIAGNOSIS: Distinguished by the plumose S I; apically bifid premandible; 5 segmented antennae; mentum with median tooth lower than second lateral teeth, with first lateral tooth reduced and fused to the second; well developed ventromental plates which extend beyond the lateral margin of the mentum; and mandible with 4 inner teeth.

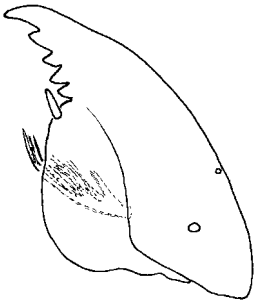
NOTES: One species, *U. multivirga*, is found in the southeastern United States. Larvae were called "*Trissocladius*" in Beck (1976, 1979). The antennae are apparently 5 segmented, but in many specimens it is difficult to distinguish the 4th and 5th segments; thus the antennae may appear 4 segmented.

Larvae occur in streams and rivers; *U. multivirga* can be abundant in streams from northern Florida to South Carolina in late Winter to early Spring.

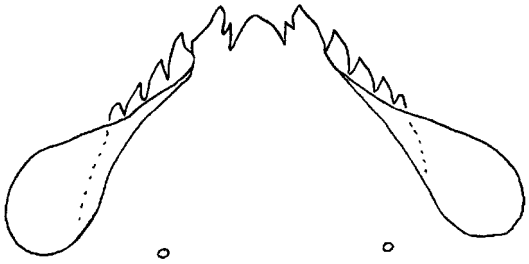
ADDITIONAL REFERENCES: Caldwell 1986.

antenna

premandible



mandible



mentum

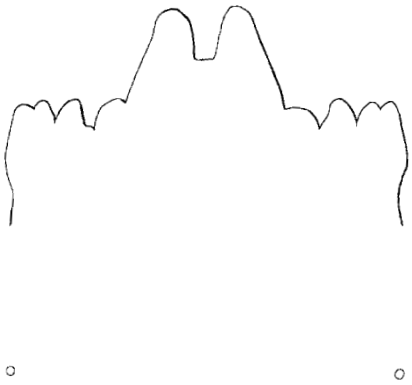
Genus ***Xylotopus***

DIAGNOSIS: Distinguished by the heavily sclerotized, dark head capsule; distinctive mentum with 2 large, elongate median teeth; and the lateral fringe of setal tufts on the abdominal segments.

NOTES: One species, *X. par*, is known from North America. The species was formerly placed in *Brillia*.

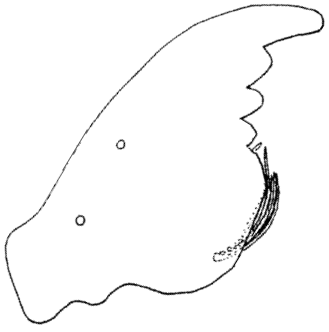
Larvae mine in submerged, partially decomposed wood.

ADDITIONAL REFERENCES: Oliver 1982; 1985.

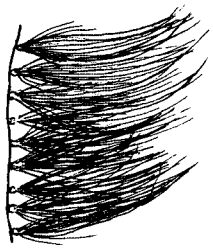


mentum

antenna



mandible



abdominal setal tufts

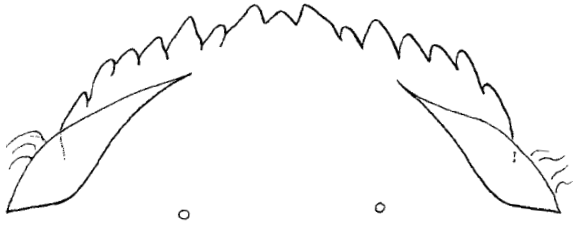
Genus *Zalutschia*

DIAGNOSIS: The plumose to coarsely pectinate S I; mentum with first lateral tooth reduced; well developed ventromental plates with weak beard; and mandible with 3 inner teeth distinguish this genus.

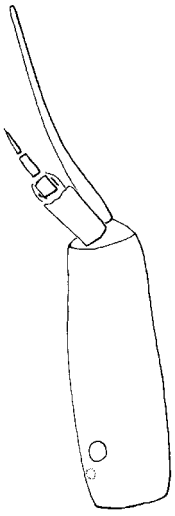
NOTES: At least three species, one undescribed, occur in the Southeast. All three taxa usually have a mentum with the median and first lateral teeth lighter in color than the remaining lateral teeth, and the three inner teeth of the mandible are usually darker than the apical tooth.

Larvae are found in lakes, streams and rivers.

ADDITIONAL REFERENCES: Dowling & Murray 1980; Sæther 1976; Soponis 1979.

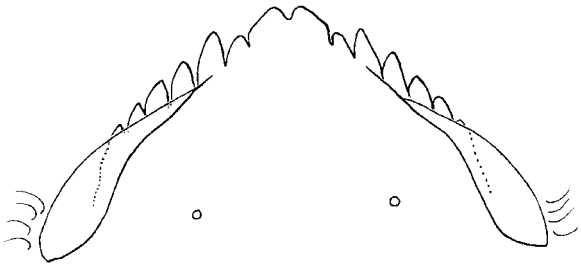


Z. cf. *zalutschicola* mentum

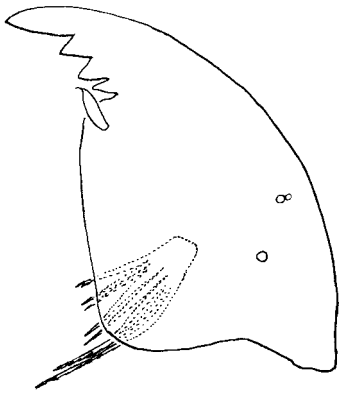


Z. cf. *zalutschicola* antenna

Z. sp. A antenna

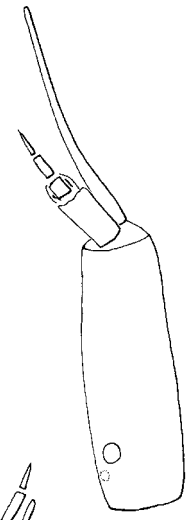


Z. sp. A mentum



Z. sp. A mandible

Key to *Zalutschia* larvae of the southeastern United States

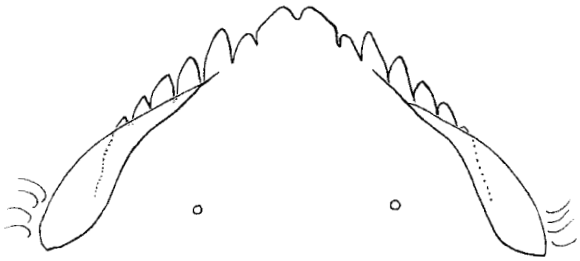


1 Mentum with 2-4 median teeth and reduced 6th lateral tooth; antennal blade much longer than flagellum ..... ***Z.* cf. *zalutschicola***

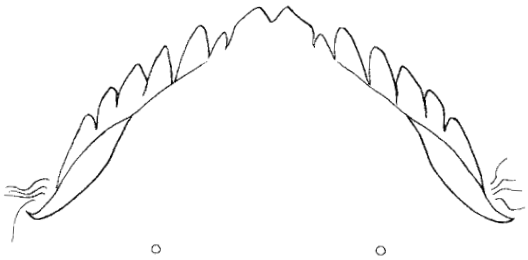
center of mentum with 4 median teeth

1' Mentum with 2 median teeth (figures below); antennal blade subequal to or shorter than flagellum 2

2(1') Premandible simple ..... ***Z.* sp. A**



2' Premandible apically bifid ..... ***Z. briani***



Notes on species

Z. briani - Originally described from northern Florida. Although Hudson et al. (1990) and Caldwell et al. (1997) record this species from North and South Carolina, I've seen only one larva from South Carolina that appears to be this species. Soponis (1979) found *Z. briani* larvae on aquatic vegetation in lakes. *Zalutschia obsepta* (Webb), described from Ontario and also known from Quebec, will key to *Z. briani* in the key above. Following the description of Sæther (1976), *Z. obsepta* lacks pectinate lamellae on the maxilla which are present in *Z. briani*.

Z. cf. *zalutschicola* - Larvae of this taxon appear very similar to those of *Z. zalutschicola* Lipina, and adult males (from Georgia) are similar in having ocelli and similar genitalia. However, based on associated material from Georgia, the pupa differs from those described for *Z. zalutschicola*: the frontal setae are shorter (<200 µm), the thoracic horn has only a small apical extension, not the long tooth of typical *zalutschicola*, and tergite VI has four taeniate setae, not the single one as described for *zalutschicola* by Sæther (1976: 190, 215). More Nearctic and Palaearctic material must be examined to determine the variability of *Z. zalutschicola*, and to ascertain if this taxon represents an undescribed species.

Z. sp. A - An undescribed species that appears to be widespread throughout the Southeast; I have reared it from northern Florida and B.A. Caldwell has reared it from Georgia. I've also examined unassociated larvae from North and South Carolina. Note that this species is not the same as the *Z.* sp. A of Sæther (1976). Larvae do not fit the diagnosis in Sæther (1976) and Cranston et al. (1983) in that they have a simple premandible. The adult has a gonostylus similar to that of *Z. humphriesiae* Dowling & Murray from Ireland (Dowling & Murray 1980), but the immature stages differ.

Orthocladiinae species C

DIAGNOSIS: Distinguished by the "mop-like" S I; premandible with simple apex; mandible with small inner teeth, inflated base and no seta interna; partially weakly sclerotized antennal flagellar segments; and distinctive mentum with large ventromental plates covering most of the mental teeth.

NOTES: Briefly described by Sæther (1982), the adult of this taxon remains unknown. I have examined associated pupae, but they are in poor condition, resembling *Acamptocladius* and *Parakiefferiella* pupae.

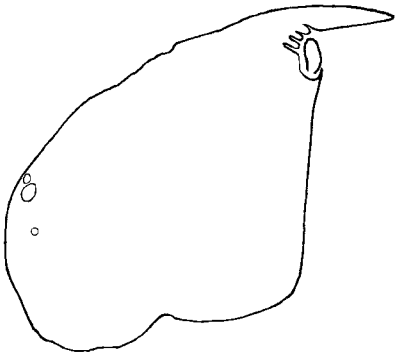
Larvae are found in sand-bottomed streams and rivers.

ADDITIONAL REFERENCES: Sæther 1982.

mentum

premandible

S I



mandible

antenna

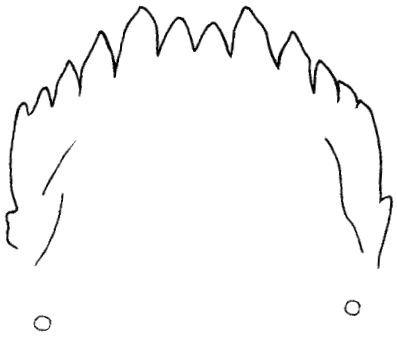
Orthocladiinae genus E

DIAGNOSIS: The coarsely plumose S I; mentum with 4 median teeth; reduced ventromental plates and lack of beard; pecten epipharyngis with more than 12 teeth; well developed posterior parapods with well developed claws; and the presence of procerci and anal tubules distinguish this taxon.

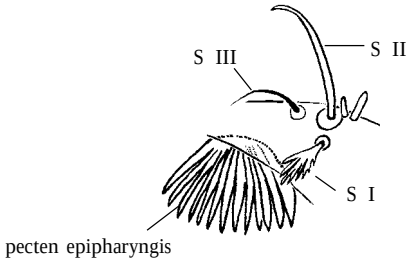
NOTES: I have only seen this taxon from northern Florida; most specimens have come from hardwood forest litter run through a Berlese funnel, indicating that the larva is terrestrial. I have also seen one specimen from the Santa Fe River in northern Florida, where it was probably washed in. Although not known from the Carolinas, in general most chironomid taxa found in northern Florida should also occur at least on the Coastal Plain in the Carolinas.

The multi-toothed pecten epipharyngis is distinctive. Another at least partially terrestrial orthoclad, *Antillocladius*, also has a multi-toothed pecten epipharyngis but lacks procerci and anal tubules, which are present in Orthocladiinae genus E.

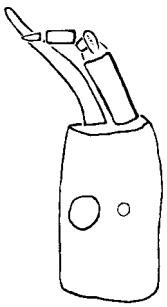
ADDITIONAL REFERENCES: None.



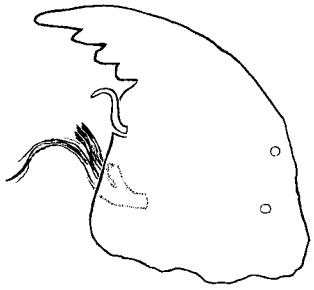
mentum



labrum



antenna



mandible

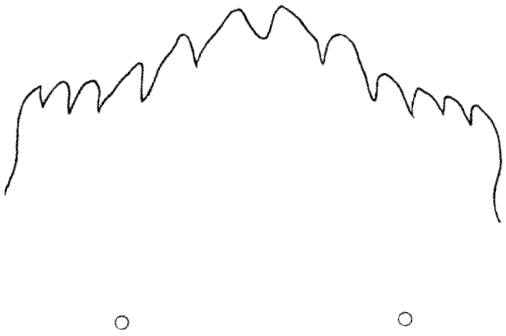
Orthocladiinae genus H

DIAGNOSIS: Distinguished by the plumose S I, with other S setae simple; lack of labral lamellae; antenna 5 segmented, with blade longer than flagellum; apically bifid premandible, without brush; mandible with 4 inner teeth; maxilla without pecten galearis; abdominal setae relatively short, less than half as long as segment bearing them; weakly developed procerci; and well developed supraanal setae.

NOTES: Not known from the Carolinas; known only from bromeliad phytotelmata (plant-held water) in southern Florida.

Larvae of this taxon, collected from the arboreal bromeliad *Tillandsia*, were treated as *Metriocnemus* sp. B by Epler (1995: 6.52-6.54). I have recently reared larvae of this species from phytotelmata in terrestrial bromeliads near Lorida, FL; pupae indicate that establishment of a new genus is necessary. The taxon shows similarities to *Compterosmittia, Limnophyes, Paralimnophyes* and *Thienemannia*. Only female pupae and adults were obtained by rearing, indicating that perhaps this species is parthenogenetic.

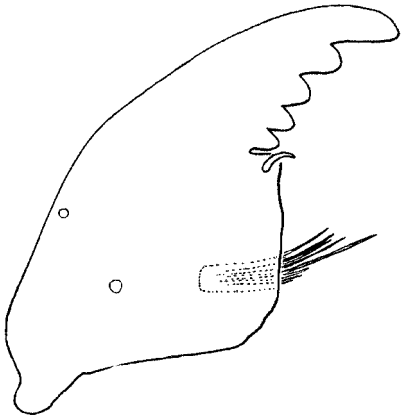
ADDITIONAL REFERENCES: None.



mentum

S setae and pecten epipharyngis

antenna



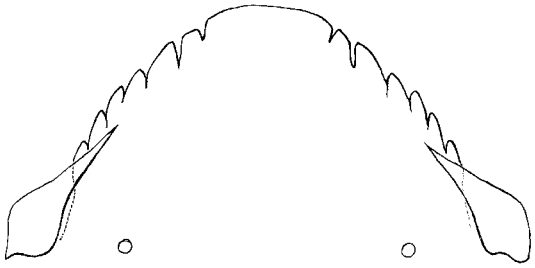
mandible

Orthocladiinae genus I

DIAGNOSIS: Distinguished by the apparently plumose SI; antenna with 6 segments, 6th segment hairlike; premandible with 3 large apical teeth, brush absent; maxilla apparently without a pecten galearis; well developed ventromental plates, without a beard; mandible with inflated apical tooth and long seta subdentalis; and normal procerci.

NOTES: This taxon is known from a single larval specimen from North Carolina. Unfortunately, some structures, such as the S I and pecten epipharyngis, are obscured, but the structures that are visible indicate that this specimen can not be placed in any known genus. The mandible, with its inflated apical tooth and long seta subdentalis, is similar to that of *Heterotrissocladius* sp. C of Sæther (1975a). However, the premandible lacks a brush (present in *H*. sp. C) and the antennae are entirely different. The larva is also somewhat similar to *Oliveridia,* but apparently lacks a pecten galearis and the mandible and premandible are different. Reared material will be necessary to elucidate this taxon's true identity.

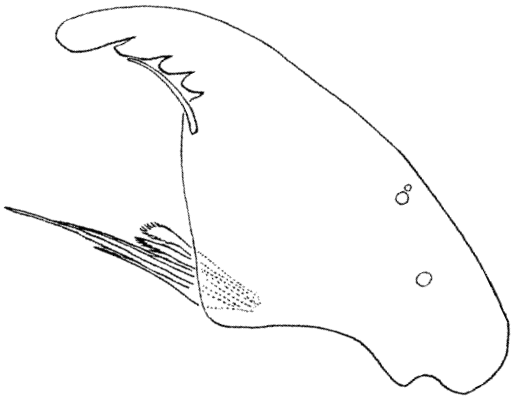
ADDITIONAL REFERENCES: None.



mentum

premandible

antenna



mandible