United States
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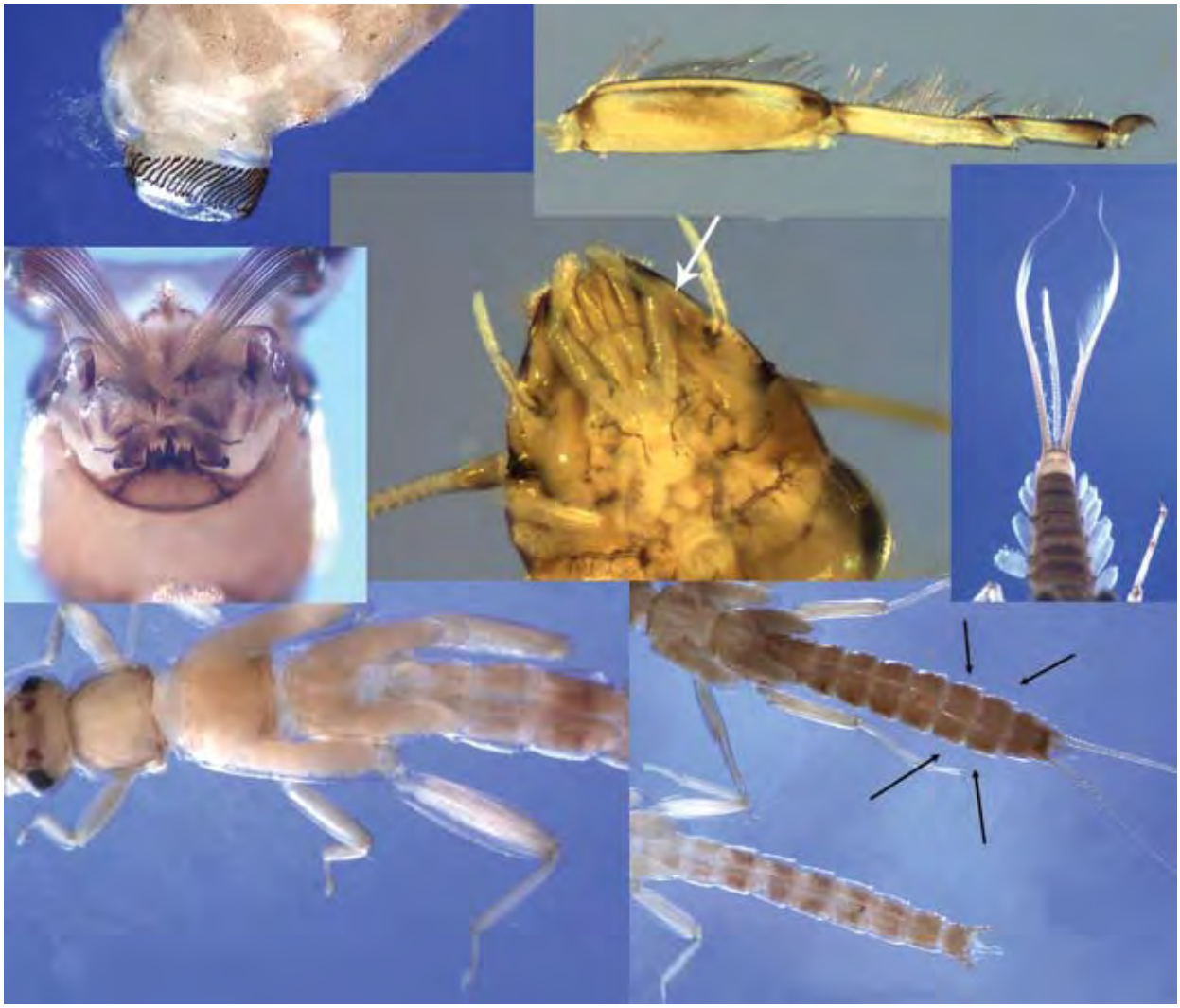
Taxonomic Aids for Mid-Atlantic Benthic Macroinvertebrates

Ephemeroptera: Baetidae
Plecoptera: Capniidae/Leuctridae
Diptera: Simuliidae



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Contents

Notice v
Acknowledgements v
Figures vii
Introduction x
Ephemeroptera: Baetidae A-1
Plecoptera: Separation of Leuctridae and Capniidae B-1
Diptera: Simuliidae C-1
Literature Cited D-1

Figures

Figure A-1. Median caudal filament reduced (*Heterocloeon* sp.) A-1
Figure A-2. Median caudal filament developed (*Baetis* sp.) A-1
Figure A-3. Caudal filaments are often damaged, particularly in bioassessment samples A-1

Figure A-4. Hair fringe on the dorsal surface of the femur, tibia and tarsi..... A-2
Figure A-5. Lateral view of the thorax of *Acentrella* sp. A-2

Figure A-6. Lateral view of *Plauditus* sp. thorax A-3
Figure A-7. Tarsal claw of *Heterocloeon* sp. A-3
Figure A-8. Procoxal gills of *Heterocloeon* sp. A-3
Figure A-9. Lateral view of thorax of *Heterocloeon* sp. A-3

Figure A-10. Labial palps truncate, ventral view. (*Centroptilum* sp.)..... A-4
Figure A-11. Labial palps more elongate, sometimes resembling mittens. (*Heterocloeon* sp.) A-4

Figure A-12. Labrum with deep notch. (*Pseudocentroptiloides* sp.) A-5
Figure A-13. Labial palps and labium of *Pseudocentroptiloides* sp. A-5
Figure A-14. Notched labrum. (*Centroptilum* sp.) A-5
Figure A-15. The glossae and paraglossae are often hidden behind the labial palps. (*Centroptilum* sp.)..... A-5

Figure A-16. Incisor region of right mandible (lower right) separated nearly to the base. (*Centroptilum* sp.)..... A-6
Figure A-17. Maxillary palp of *Centroptilum* sp. A-6
Figure A-18. Incisor regions of mandible separated less than halfway to base. (*Procloeon* sp.)..... A-6
Figure A-19. Maxillary palp of *Procloeon* sp. A-6

Figure A-20. Compound gills present. (*Callibaetis* sp.)..... A-7
Figure A-21. One simple gill arising from the posterior margin of most abdominal segments. (*Baetis* sp.) A-7

Figure A-22. Oblique angle of labial palps. (*Cloeon* sp.)..... A-8
Figure A-23. Labial palps not truncate and appearing 2-segmented. (*Callibaetis* sp.) A-8

Figure A-24. Long tarsal claws lack denticles even at high magnification. (400x, *Apobaetis* sp.) A-9
Figure A-25. Short tarsal claws. Denticles present. (*Baetis* sp.) A-9
Figure A-26. Labrum of *Apobaetis* sp. (400x). A-9
Figure A-27. Labial palp. (*Paracloeodes* sp.) A-9

Figure A-28. Maxillary palp with excavation prior to apex. (*Pseudocloeon* sp.)..... A-10
Figure A-29. The scape is the first apparent segment of an insect antenna. (*Pseudocloeon* sp.) A-10
Figure A-30. Labial palp with large, developed medial process. (*Pseudocloeon* sp.)..... A-10

Figure A-31. Antennae are inserted close together forming a raised keel between. (*Acerpenna* sp.) A-11
Figure A-32. Antennae inserted apart. (*Baetis* sp.) A-11

Figures (con't)

Figure A-33. Gills on abdominal segment 7 are longer and narrower (arrow) than those on preceding segments. (*Acerpenna* sp.) A-12
Figure A-34. Dorsal view. (*Acerpenna* sp.) A-12
Figure A-35. Lateral view of *Diphetor hageni* A-12
Figure A-36. Ventral view. (*Diphetor hageni*) A-12

Figure A-37. *Baetis* sp. larvae A-13

Figure A-38. *Acentrella turbida* in dorsal view A-14
Figure A-39. Lateral margin of the thorax of a late instar *Acentrella* larva showing the hind wing pad reduced to a small, downward pointing "scale" A-14
Figure A-40. Two late instar *Acentrella turbida* larvae A-14
Figure A-41. Dorsal view of *Acentrella parvulum* A-14

Figure A-42. *Plauditus* sp. in dorsal view A-15
Figure A-43. Another *Plauditus* sp. in dorsal view A-15

Figure A-44. Dorsal view of *Heterocloeon* sp. A-16
Figure A-45. *Heterocloeon amplum*, one of the species formerly in the genus *Acentrella* sp. A-16
Figure A-46. The simplest diagnostic character for *Heterocloeon* sp., when present, is the occurrence of simple gills arising from the base of the procoxae (arrows) A-16
Figure A-47. *Heterocloeon* sp. larvae sometimes have a heavily scleritized ridge in addition to a row of denticles on the tarsal claw A-16

Figure A-48. Dorsal view of the abdomen of *Pseudocentroptiloides* sp. A-17
Figure A-49. The deeply cleft labrum of *Pseudocentroptiloides* sp. A-17

Figure A-50. Dorsal view of *Centroptilum* sp. A-18
Figure A-51. Dorsal view of *Procloeon* sp. A-18
Figure A-52. The banding on the caudal filaments of *Centroptilum* sp. and *Procloeon* sp. A-18

Figure A-53. Dorsal view of *Cloeon* sp. A-19
Figure A-54. Close-up of the compound gills of *Cloeon* sp. A-19

Figure A-55. Dorsal view of *Callibaetis* sp. A-20
Figure A-56. Ventral view of the head of *Callibaetis* sp. A-20
Figure A-57. Ventral view of the palps of *Callibaetis* sp. A-20

Figure A-58. Dorsal view of *Apobaetis* sp. A-21
Figure A-59. Dorsal view of *Paracloeodes* sp. A-21

Figure A-60. Dorsal view of *Pseudocloeon* sp. A-22
Figure A-61. Ventral view of the head of *Pseudocloeon* sp. A-22

Figure A-62. Dorsal view of *Acerpenna pygmaea* A-23
Figure A-63. Gill 7 of *Acerpenna pygmaea* A-23

Figures (con't)

Figure A-64. Dorsal and lateral views of *Diphetor hageni*.....A-24
Figure A-65. The reduced, bifid prostheca on the right mandible of *Diphetor hageni* A-24

Figure A-66. *Baetis intercalaris*, a common species in the mid-Atlantic. A-25
Figure A-67. The labial palps of *Baetis tricaudatus.* A-25

Figure B-1. Ventral view of the abdominal segments of *Allocapnia* sp. (Capniidae)..... B-1
Figure B-2. Ventral view of the abdomen of *Leuctra* sp. (Leuctridae). B-1

Figure B-3. Dorsal view of Leuctridae (top) and Capniidae (bottom) abdomens. B-2
Figure B-4. Dorsal view of a late instar Capniidae larva thorax (*Allocapnia* sp.). B-2
Figure B-5. Dorsal view of a late instar Leuctridae larva thorax (*Leuctra* sp.). B-2

Figure C-1. Head lacking labral fans (*Twinnia* sp.)..... C-1
Figure C-2. Anal sclerite "Y" shaped. Dorsal view of end of abdomen of *Twinnia* sp. C-1
Figure C-3. Head with labral fans present (*Simulium* sp.)..... C-1
Figure C-4. Anal sclerite "X" shaped. Compound anal gills are visible just to the left of the sclerite (*Simulium* sp.)..... C-1

Figure C-5. Dorsum of *Prosimulium* sp. head. C-2
Figure C-6. Ventral view of *Prosimulium* sp. head..... C-2
Figure C-7. Antenna of *Prosimulium* sp. C-2
Figure C-8. Dorsum of *Greniera* sp. head. C-2

Figure C-9. Lateral view of *Stegopterna* sp. abdomen..... C-3
Figure C-10. Hypostomal teeth of *Stegopterna* sp. C-3
Figure C-11. Ventral view of the posterior of *Greniera* sp. C-3

Figure C-12. Ventral view of *Simulium* sp. head..... C-4
Figure C-13. Compound anal gills, present in some species of *Simulium* sp. C-4
Figure C-14. Anal gills consisting of three simple lobes (*Cnephia* sp.)..... C-4

Figure C-15. Posterior of *Cnephia* sp. abdomen..... C-5
Figure C-16. Venter of the head of *Cnephia* sp. C-5
Figure C-17. Posterior of *Greniera* sp. abdomen. C-5

Figure C-18. Lateral view of *Greniera* sp. C-6
Figure C-19. Ventral view of *Greniera* sp. head..... C-6

Introduction

As the use of biological monitoring becomes more prevalent, biological monitoring data are being collected by a variety of state, federal, tribal and local governments as well as watershed groups, conservation districts, and volunteer organizations. To ensure that the maximum benefits are realized from these data, it is important to maintain consistency in the collection, identification, analysis, and reporting of biological data. One difficulty in using benthic macroinvertebrates as indicators of stream water quality has been that some taxonomic groups have undergone frequent and extensive systematic revision, making data consistency problematic.

One of the groups commonly encountered that has recently undergone revision is the mayfly (Ephemeroptera) family Baetidae. The genera covered in this key include: *Acentrella, Acerpenna, Apobaetis, Baetis, Barbaetis, Callibaetis, Centroptilum, Cloeon, Diphetor, Heterocloeon, Paracloeodes, Plauditus, Procloeon, Pseudocentroptiloides*, and *Pseudocloeon*. The key to genera of the family Baetidae is based on keys in Merritt and Cummins (1996) and Lugo-Ortiz and McCafferty (1998). The distributional data is based on Randolph (2002).

Larvae of the black fly (Diptera) family Simuliidae have proven to be among the more difficult macroinvertebrate groups to identify to the generic level. The following genera are covered in the key: *Cnephia, Ectemnia, Greniera, Prosimulium/Helodon, Simulium, Stegopterna*, and *Twinnia*. The key to the genera of Simuliidae is based on the genus key by Adler, et al. (2004).

Finally, separation of larvae of the stonefly (Plecoptera) families Leuctridae and Capniidae can be difficult, especially in early instars. The most reliable character to separate the two taxa, the membranous pleural fold on the venter of the abdomen, is often difficult to see in preserved specimens. The key to distinguishing these two genera is based on Stewart and Stark, 2002.

The purpose of this document is to help improve accuracy and consistency of taxonomist identifications in the mid-Atlantic Region by providing the most recent information available and by clarifying difficult couplings with photographs. The following keys are designed to be used in the mid-Atlantic region, covering the states of Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia. Several taxa not documented from these states but occurring in adjacent regions have been included.

Ephemeroptera: Baetidae

1. Median caudal filament reduced, approximately 1/10 or less length of cerci (Fig. A-1) 2

1'. Median caudal filament longer, usually 1/2 to sub-equal in length to cerci (Figs. A-2 and A-3) 4

Figure A-1. Median caudal filament reduced (*Heterocloeon* sp.).

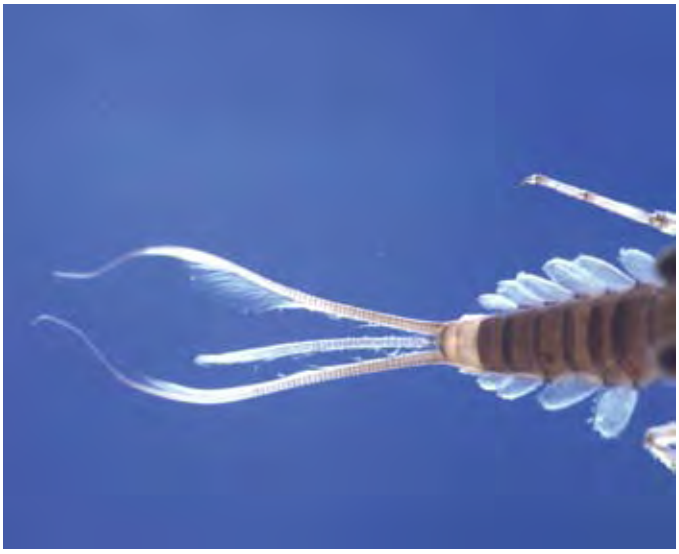


Figure A-2. Median caudal filament developed (*Baetis* sp.).

Figure A-3. Caudal filaments are often damaged, particularly in bioassessment samples. Look for broken filaments. If the broken median filament is approximately the same diameter as the cerci, its length was likely to have been sub-equal or greater in length than that of the cerci.

2. (1) Usually with a row of fine setae on dorsal margin of femur, tibia, and tarsus (Fig. A-4); hind wing pads reduced to a small "scale" (Fig. A-5) ..... *Acentrella*

2'. Tibia and tarsus without dorsal row of fine setae, although dorsal setal row often present on femur; hind wing pads absent or reduced, but not as above 3

Figure A-4. Hair fringe on the dorsal surface of the femur, tibia and tarsi. The hair fringe is apparent on all legs, but may be worn or broken on older specimens. (*Acentrella* sp.)

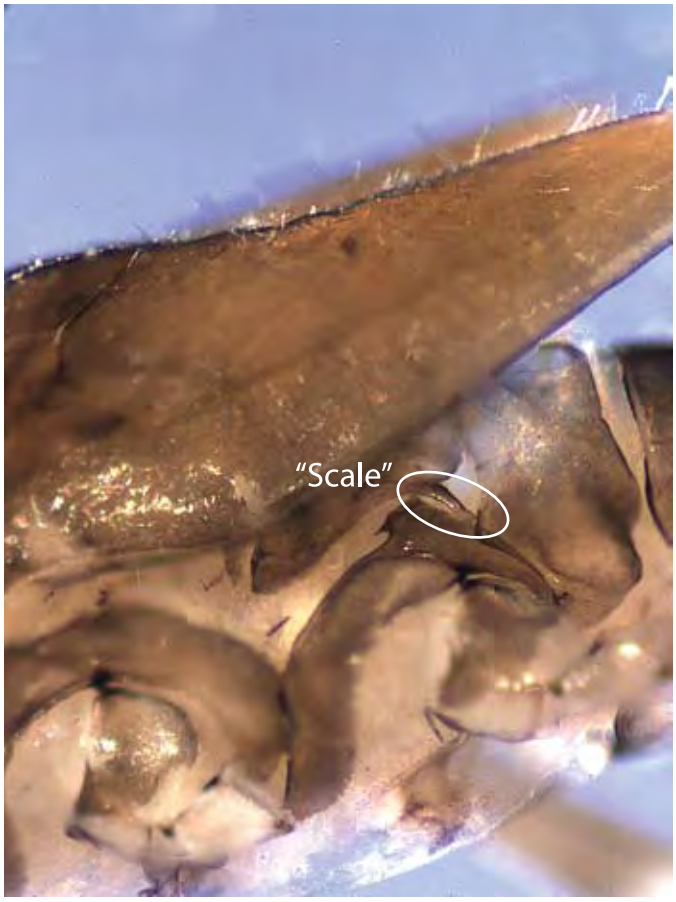


Figure A-5. Lateral view of the thorax of *Acentrella* sp. Hind wing pads reduced to a small, downward-pointing "scale". This can be difficult to discern, particularly in immature specimens.

3. (2') Claws with a single row of denticles; hind wing pads absent and posterior lateral margin of metanotum approximating a right angle in lateral view (Fig. A-6); procoxal gills never present ..... *Plauditus*

3'. Claws with two rows of denticles or one row of denticles and a parallel ridge in place of second row (Fig. A-7). (Note that magnification of 400X is usually required to see these characters); some species with simple gills on procoxa (Fig. A-8); hind wing pads reduced but present (Fig. A-9) ..... *Heterocloeon*

Figure A-6. Lateral view of *Plauditus* sp. thorax. Posterior lateral margin of metanotum (arrow) visible under front wing pad forming a right angle. Even in late instar larvae such as this, no trace of a hind wing pad is present. Compare to Figures A-5 and A-9.

Figure A-7. Tarsal claw of *Heterocloeon* sp. In this species, there is one row of denticles with a ridge in the place of the second row of denticles (400x).

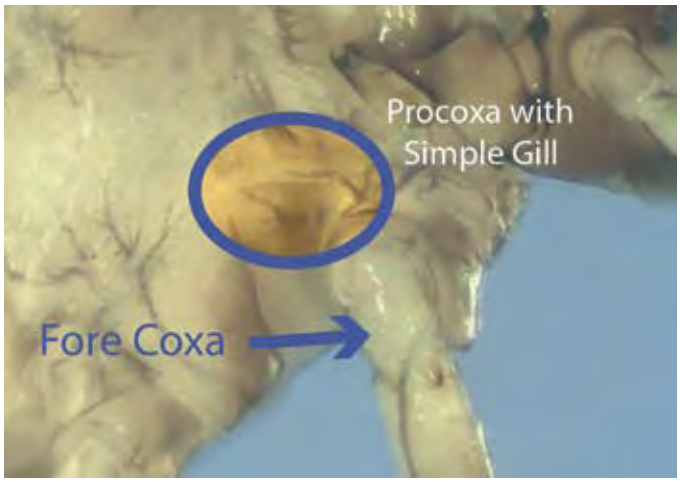


Figure A-8. Procoxal gills of *Heterocloeon* sp. The simple gill on the procoxa usually sticks out away from the body and can best be seen against a dark background.

Figure A-9. Lateral view of thorax of *Heterocloeon* sp. Hind wing pads are reduced but visible (arrow).

4. (1') Apex of labial palps simple and truncate (Fig. A-10); caudal filaments with distinct banding every 3rd or 5th segment 5

4'. Labial palps variable but never truncate as above (Fig. A-11); caudal filaments not banded every 3rd or 5th segment 7

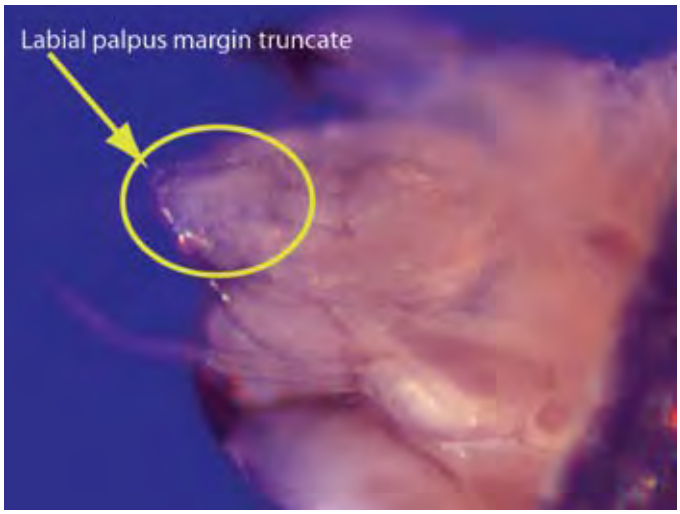


Figure A-10. Labial palps truncate, ventral view. (*Centroptilum* sp.)

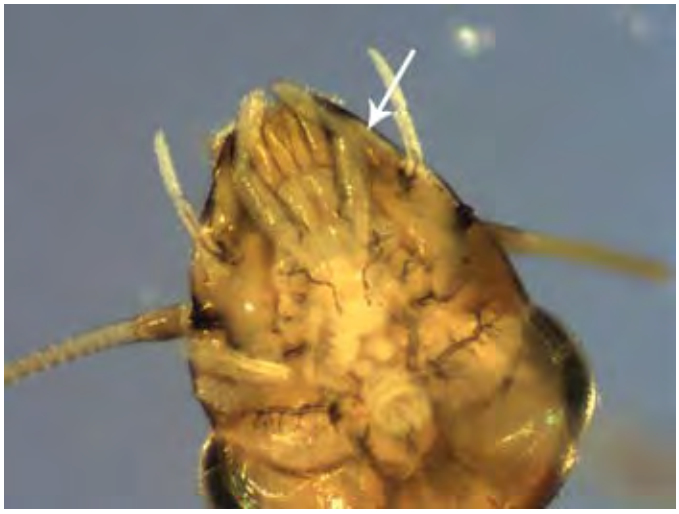


Figure A-11. Labial palps more elongate, sometimes resembling mittens. (*Heterocloeon* sp.)

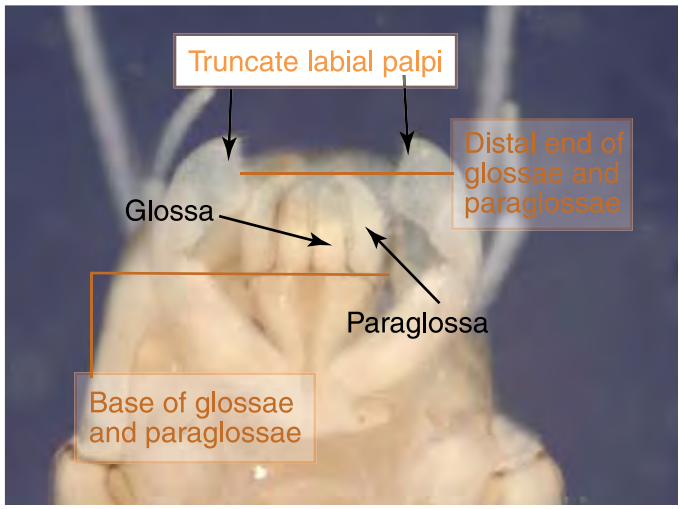
5. (4) Labrum w/deep triangular median notch on anterior margin (Fig. A-12); Labial palps broadly truncate and paraglossae broad and longer than glossae (Fig. A-13); claws longer than respective tarsi; gills simple (not known from states included in this key, but found in adjacent states (OH) ..... *Pseudocentroptiloides*

5'. Labrum with smaller, squared median notch along anterior margin (Fig. A-14); paraglossae sub-equal to glossae (Fig. A-15); claws usually shorter than respective tarsi; gills simple or compound 6

Figure A-12. Labrum with deep notch. (*Pseudocentroptiloides* sp.)

Figure A-13. Labial palps and labium of *Pseudocentroptiloides* sp.

Figure A-14. Notched labrum. The "smaller" notch is clearly visible using a dissecting scope. (*Centroptilum* sp.)



6. (5') Incisor of mandible usually separated to base (Fig. A-16); maxillary palps 3-segmented with segment 3 as long or longer than segment 2 (Fig. A-17); gills simple; cerci with lateral setae absent in distal fourth; abdomen with lateral spines absent or reduced ..... *Centroptilum*

6'. Incisor of mandible usually separated less than half the distance to base (Fig. A-18); maxillary palps 2 or 3-segmented with segment 3 shorter than segment 2 when present (Fig. A-19) ; gills usually compound; cerci with lateral setae usually present to tip; abdomen with lateral spines well developed on at least segments 8 and 9 .....*Procloeon*

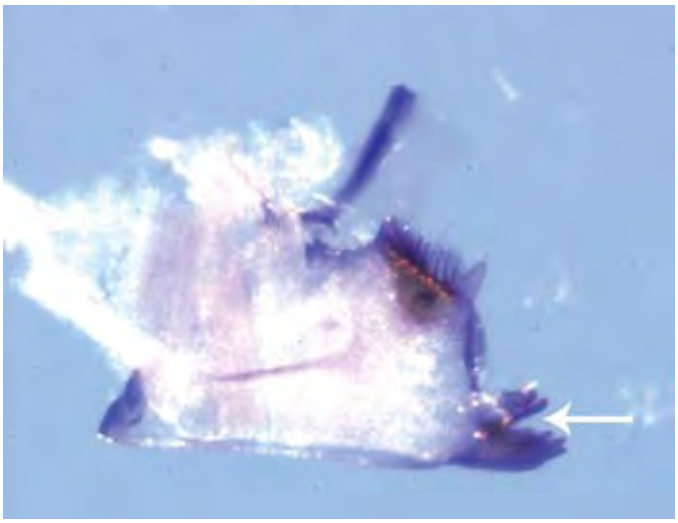


Figure A-16. Incisor region of right mandible (lower right) separated nearly to the base. This character can usually be seen by pushing down on the head to spread the mouthparts. (*Centroptilum* sp.)

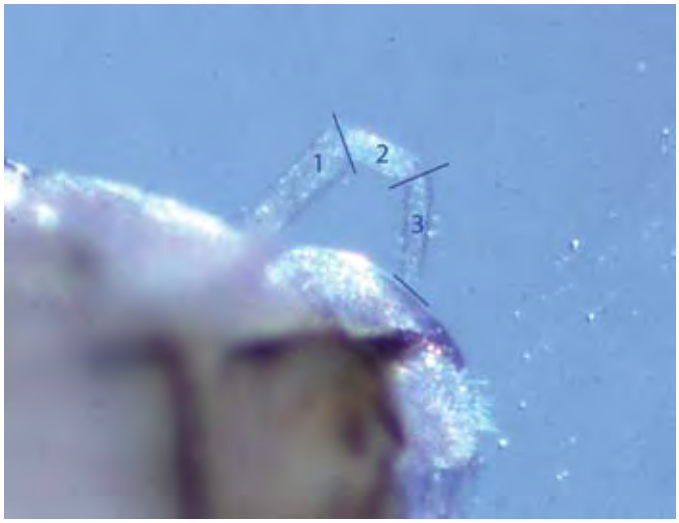


Figure A-17. Maxillary palp of *Centroptilum* sp. The second and third segments of the maxillary palp are about equal in length.

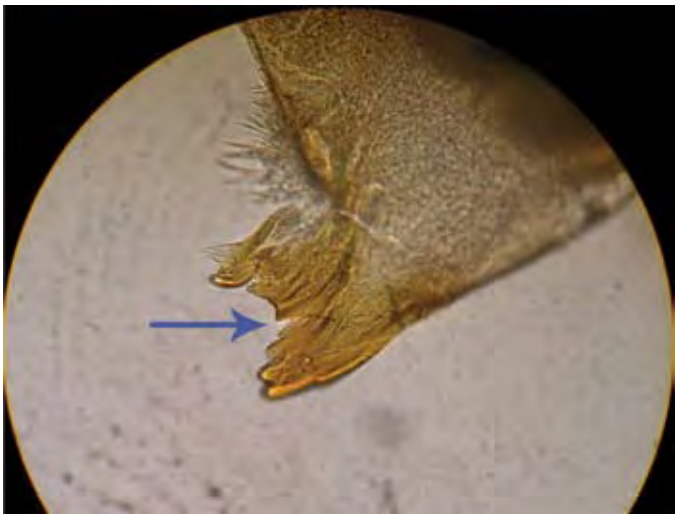


Figure A-18. Incisor regions of mandible separated less than halfway to base. (*Procloeon* sp.)

Figure A-19. Maxillary palp of *Procloeon* sp. The third (apical) segment is much shorter than the second.

7. (4') Compound gills present (Fig. A-20) ..... (*Cloeon, Callibaetis*)..... 8

7'. All gills simple (Fig. A-21)..... 9

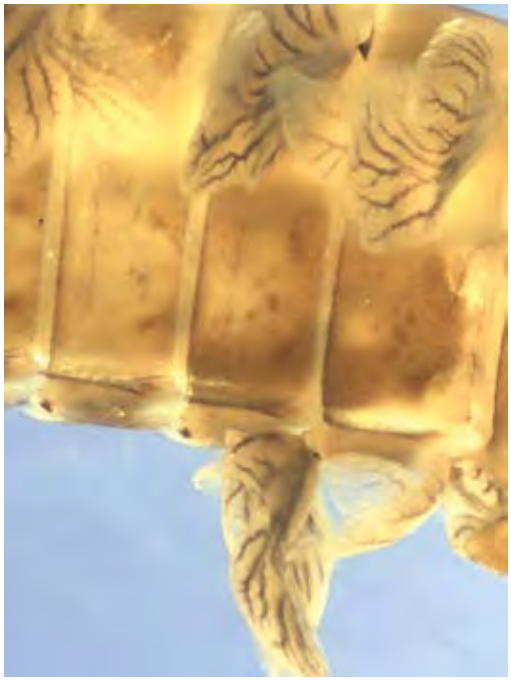


Figure A-20. Compound gills present. These often appear as two separate gills arising from the same base near the posterior margin of each abdominal segment. (*Callibaetis* sp.)

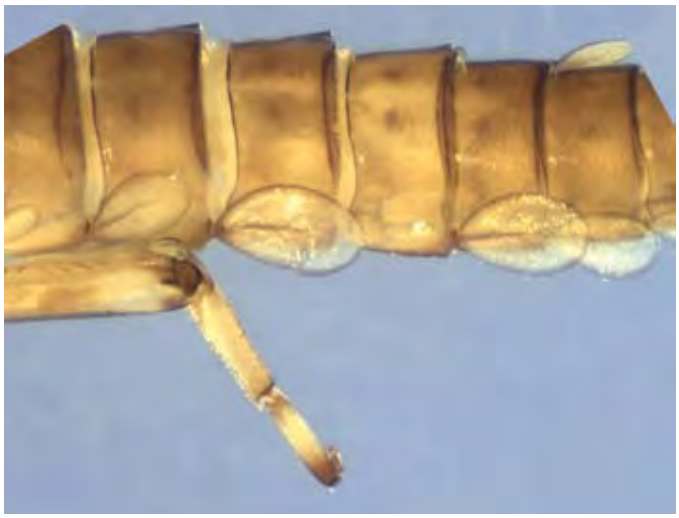


Figure A-21. Simple gills. One simple gill arising from the posterior margin of most abdominal segments. (*Baetis* sp.)

8. (7) Labial palps 3-segmented, obliquely truncate (Fig. A-22); hind wing pads absent; recurved flaps on gills folded dorsally ..... *Cloeon*

8'. Labial palps appearing 2-segmented, long and "spoon-shaped" (Fig. A-23); hind wing pads present; recurved flaps on gills folded ventrally ..... *Callibaetis*

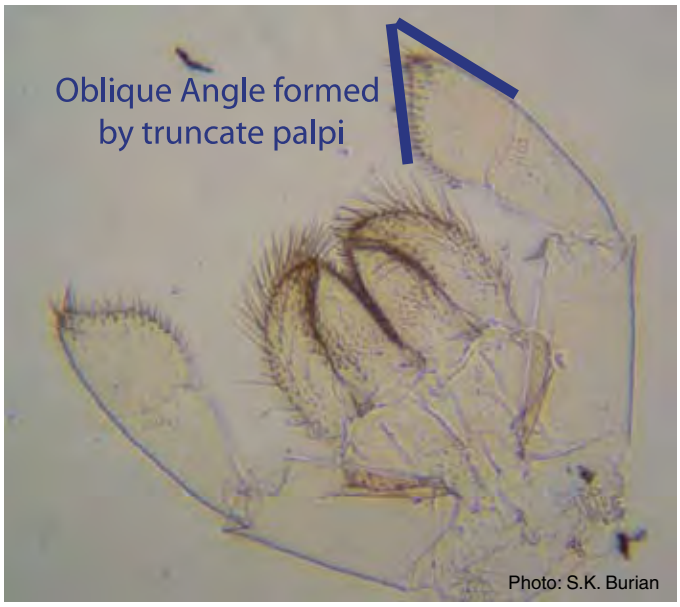


Figure A-22. Oblique angle of labial palps. *Cloeon* is usually found in seasonal wetlands; rare in stream bioassessment samples. (*Cloeon* sp.)

Figure A-23. Labial palps not truncate and appearing 2-segmented. This taxon is more common in stream bioassessment samples but is also collected from ephemeral habitats. (*Callibaetis* sp.)

9. (7') Claws without denticles and long, equal to or greater than half the length of their respective tarsi (Fig. A-24) ..... (*Apobaetis, Paracloeodes*) 10

9'. Claws with denticles and shorter, less than half the length of their respective tarsi (Fig. A-25) 11

Figure A-24. Long tarsal claws lack denticles even at high magnification. (400x, *Apobaetis* sp.)

Figure A-25. Short tarsal claws. Denticles present. Total length less than 50% of tarsus. (*Baetis* sp.)

10. (9) Claws sub-equal to length of tarsi (Fig. A-24); labrum without median notch on anterior margin (Fig. A-26) (not recorded from the mid-Atlantic, but found in adjacent states)..... *Apobaetis*

10'. Claws about half the length of tarsi; labrum with median notch; labial palps notched as in Fig. A-27. (not recorded from the mid-Atlantic, but found in adjacent states NY, OH) ..... *Paracloeodes*

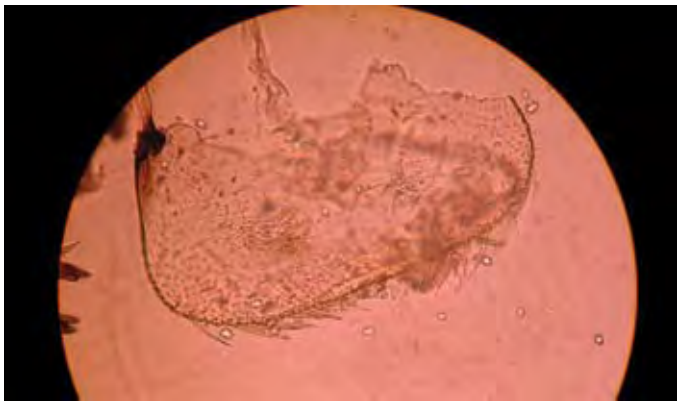


Figure A-26. Labrum of *Apobaetis* sp. (400x). Unlike other Baetidae, there is no median notch on the front margin of the labrum.

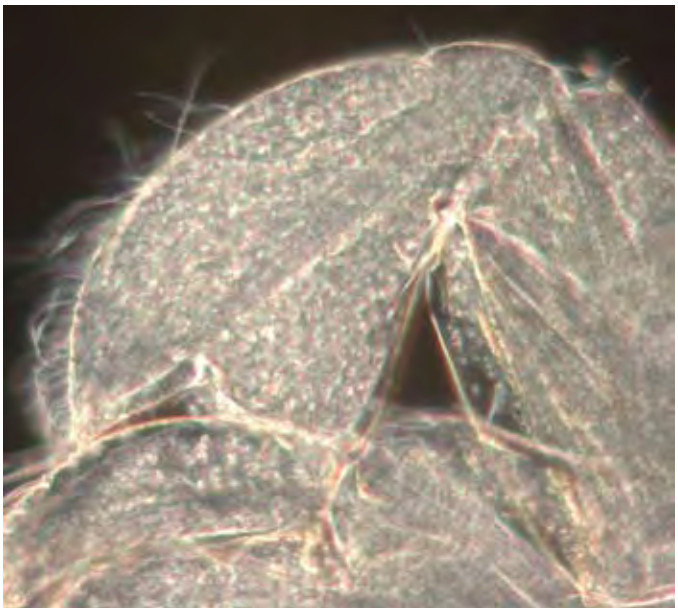


Figure A-27. Labial palp. (*Paracloeodes* sp.)

11. (9') Maxillary palps with sub-apical excavation (Fig. A-28); antennal scape with distal lobe (Fig. A-29); labial palp often with well developed medial process (Fig. A-30) ..... *Pseudocloeon*

11'. Maxillary palps and scape not as above, medial process may or may not be developed 12

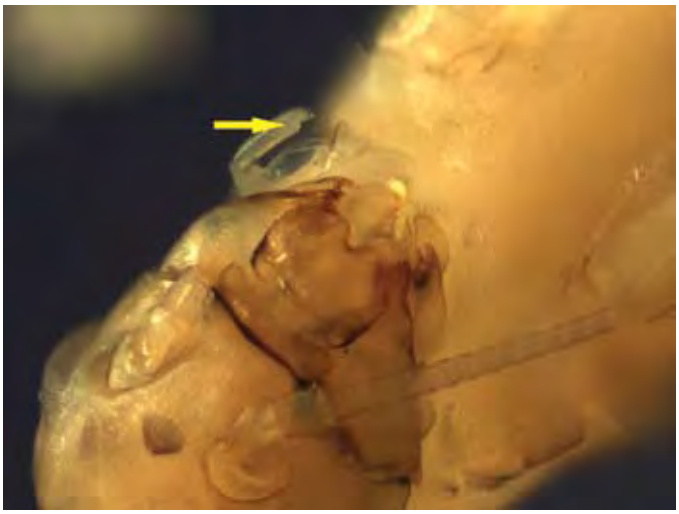


Figure A-28. Maxillary palp with excavation prior to apex. (*Pseudocloeon* sp.)

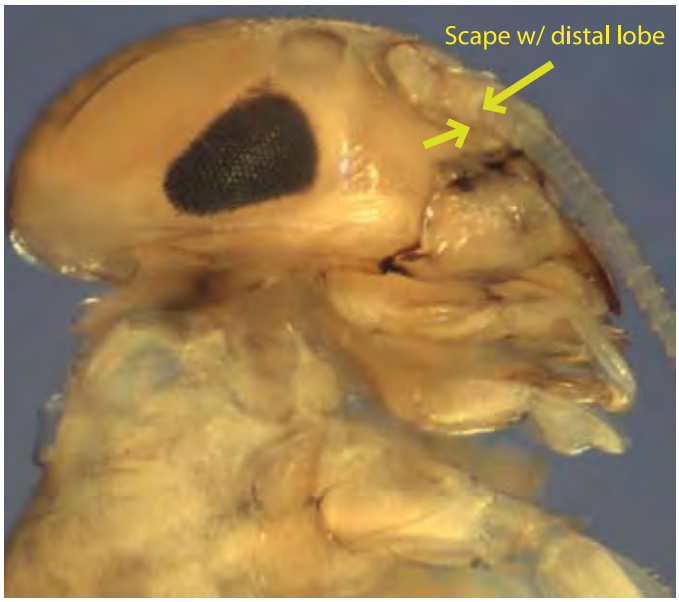


Figure A-29. The scape is the first apparent segment of an insect antenna. (*Pseudocloeon* sp.)

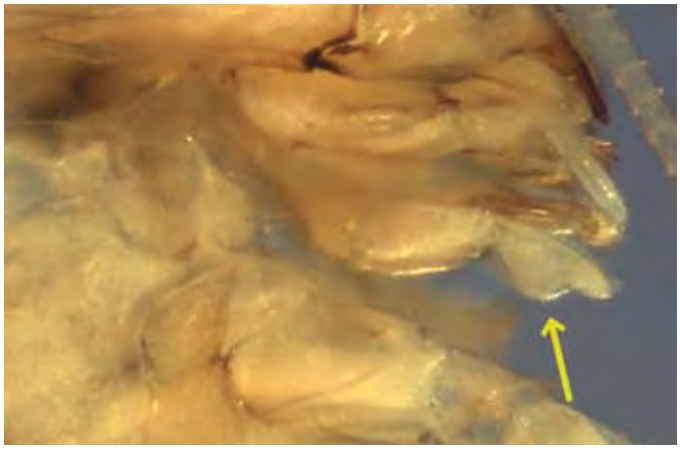


Figure A-30. Labial palp with large, developed medial process. (*Pseudocloeon* sp.)

12. (11') Antennae inserted close together forming a raised keel between insertion points (Fig. A-31) 13

12'. Antennae inserted apart, area between antenna insertions points not raised (Fig. A-32) 14

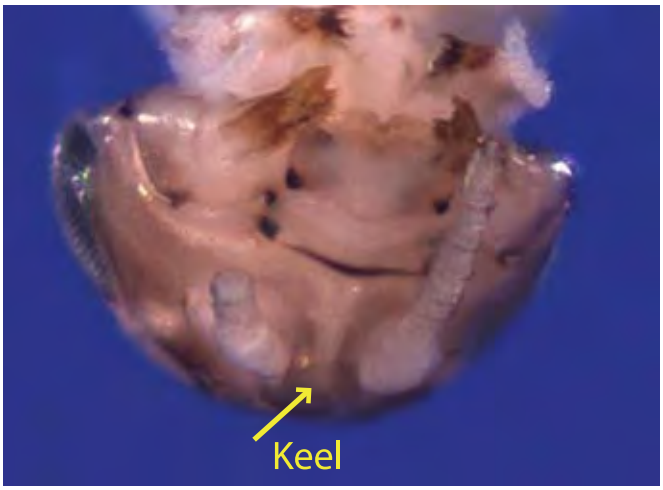


Figure A-31. Antennae are inserted close together forming a raised keel between. (*Acerpenna* sp.)

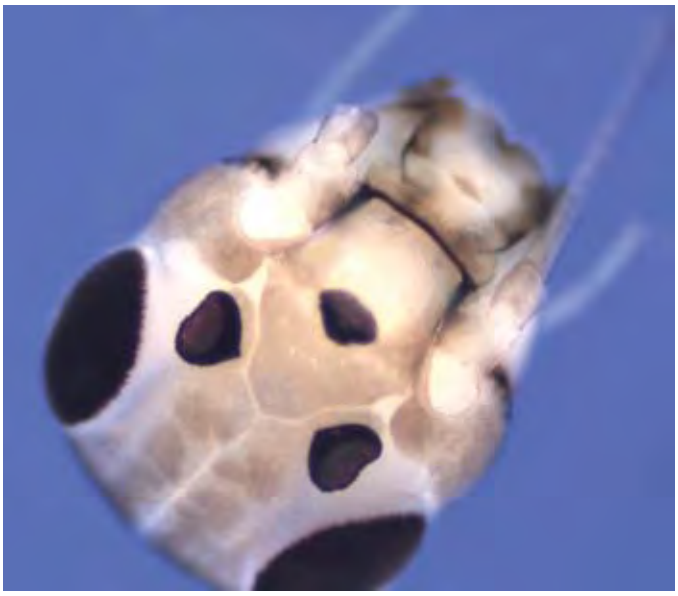


Figure A-32. Antennae inserted apart. In these taxa, the area between the antennae (frons) is relatively flat and does not form a keel. (*Baetis* sp.)

13. (12) Lateral gills present on abdominal segment 1; gill on abdominal segment 7 pointed and narrower than preceding gills (Fig. A-33); Labial palp with well developed medial process (similar to Fig. A-30); tuft of setae on right mandible between incisors and molar region (Fig. A-34)..... *Acerpenna*

13'. Gills absent on abdominal segment 1 (Fig. A-35); gill on abdominal segment 7 rounded and similar in shape to gills on preceding segments; prostheca on right mandible reduced; bifid and serrate on inner margin (Fig. A-36); generally brown without distinct marking; occasionally light lateral margins on abdominal segments ..... *Diphetor hageni*

Figure A-33. Gills on abdominal segment 7 are longer and narrower (arrow) than those on preceding segments. (*Acerpenna* sp.)

Figure A-34. The tuft of setae between the molar region (right bottom) and the incisors (left bottom) is located proximal to the incisors best viewed at 400x. Dorsal view. (*Acerpenna* sp.)

Figure A-35. Lateral view of *Diphetor hageni*. On the first abdominal segment, no gill or gill scar is present on the posterior lateral margin (black arrow). Even though the gills on following segments may be missing, a darkened gill scar is usually visible (yellow arrows).

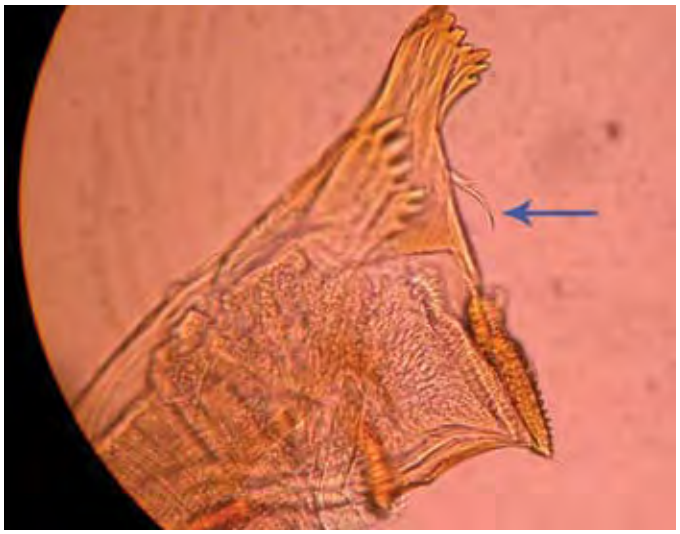


Figure A-36. In *Diphetor*, the prostheca is reduced to a bifid (forked) hair. This species is often misidentified as *Baetis*. Ventral view. (*Diphetor hageni*)

14. (12') Antennae long, length greater than twice the length of the head capsule; color variable (Fig. A-37) ..... *Baetis*

14'. Antennae short, sub-equal in length to head capsule; color pale with dark pigment bands encircling some abdominal segments (in the mid-Atlantic, known only from southern Virginia) ..... *Barbaetis*

Figure A-37. *Baetis* sp. larvae have long antennae. This is one of the most commonly collected baetid taxa in North America. (*Baetis tricaudatus*)

Acentrella sp.

The genus *Acentrella* sp. is a common component of the baetid community in mid-Atlantic streams. The fringe of fine hairs present on the femur, tibia, and tarsus is the easiest character to use in distinguishing this genus. In older specimens this fringe may be worn or broken but is usually still apparent. One species (*Acentrella turbida*) is recorded from the region. A second species (*Acentrella parvulum*), has been recorded from Ohio westward, and may eventually be found in the mid-Atlantic.

Additional References:

Jacobus, L.M. and W.P. McCafferty. (2006). A new species of *Acentrella* Bengtsson (Ephemeroptera: Baetidae) from Great Smoky Mountains National Park, USA: Aquatic Insects, v. 28, p. 101-111.

McCafferty, W.P., Wigle, M.J. and R.D. Waltz. (1994). Systematics and biology of *Acentrella turbida* (McDunnough) (Ephemeroptera:Baetidae). Pan-Pacific Entomologist 70[4], 301-308.

Morihara, D.K. and W.P. McCafferty. (1979). The Baetis Larvae of North America (Ephemeroptera:Baetidae). Transactions of the American Entomological Society 105, 139-221.

Wiersema, N.A. (2000). A new combination for two North American small Minnow Mayflies (Ephemeroptera: Baetidae). Entomological News 111[2], 140-142.

Figure A-38. *Acentrella turbida* in dorsal view. The body form superficially resembles that of Heptageniidae in many eastern specimens.

Figure A-39. Lateral margin of the thorax of a late instar *Acentrella* larva showing the hind wing pad reduced to a small, downward pointing “scale”.

Figure A-40. Two late instar *Acentrella turbida* larvae.

Figure A-41. Dorsal view of *Acentrella parvulum*. This species has not been recorded from the mid-Atlantic, but has been found in Ohio.

Plauditus sp.

The genus *Plauditus* sp. was erected in 1998 encompassing species which were previously placed in the genera *Baetis* sp. and *Barbaetis* sp. (Lugo-Ortiz and McCafferty, 1998). Species within the genus have a reduced median caudal filament and lack a hind wing pad. They are generally small, rather fragile baetids. *Plauditus* sp. is common in stream bioassessment samples from the mid-Atlantic.

Additional References:

Lugo-Ortiz, C.R. and W.P. McCafferty. (1998). A new North American genus of Baetidae (Ephemeroptera) and key to Baetis complex genera. Entomological News 109[5], 345-353.

Morihara, D.K. and W.P. McCafferty. (1979). The Baetis Larvae of North America (Ephemeroptera:Baetidae). Transactions of the American Entomological Society 105, 139-221.

Figure A-42. *Plauditus* sp. in dorsal view. The wing pads are dark because this specimen was about to emerge when collected. The body is shaped fundamentally different from most *Acentrella* sp.

Figure A-43. Another *Plauditus* sp. in dorsal view.

Heterocloeon sp.

The genus *Heterocloeon* sp. was recently revised by McCafferty et al. (2005). Several species formerly included in the genera *Acentrella* sp. and *Plauditus* sp. were moved into *Heterocloeon* sp. Therefore, many of the species recently moved into *Heterocloeon* will not key correctly in older keys.

Additional References:

McCafferty, W.P., Waltz, R.D. , Webb, J.M. and L.M. Jacobus. (2005). Revision of *Heterocloeon* McDunnough (Ephemeroptera:Baetidae). Journal of Insect Science, v. 5. Insectscience.org/5.35

Morihara, D.K. and W.P. McCafferty. (1979). The Baetis Larvae of North America (Ephemeroptera:Baetidae). Transactions of the American Entomological Society 105, 139-221.

Muller-Liebenau, I. (1974). *Rheobaetis*, a New Genus from Georgia (Ephemeroptera:Baetidae). Annals of the Entomological Society of America 67:555-567.

Figure A-44. Dorsal view of *Heterocloeon* sp.

Figure A-45. *Heterocloeon amplum*, one of the species formerly in the genus *Acentrella* sp.

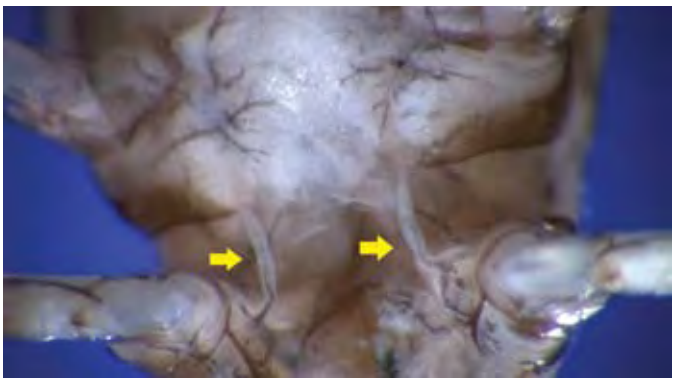


Figure A-46. The simplest diagnostic character for *Heterocloeon* sp., when present, is the occurrence of simple gills arising from the base of the procoxae (arrows). This can usually be observed without high magnification. They are more durable than abdominal gills and are usually attached to even severely damaged specimens. However, they can be very difficult to see in rotting or digested specimens.

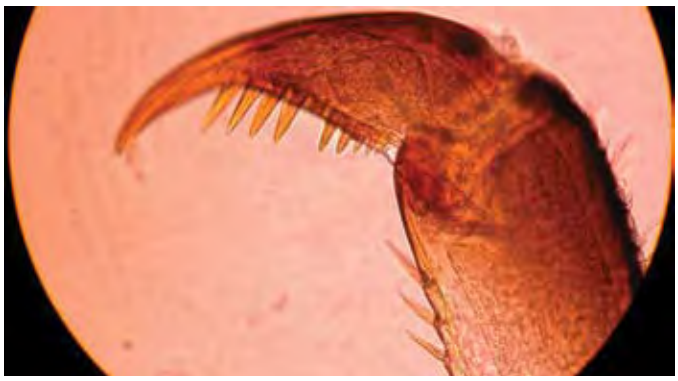


Figure A-47. *Heterocloeon* sp. larvae sometimes have a heavily scleritized ridge in addition to a row of denticles on the tarsal claw. In this image the ridge occurs in the foreground and the denticles arise behind the ridge in the background. This feature occurs in taxa that may not exhibit procoxal gills.

Pseudocentroptiloides sp.

The genus *Pseudocentroptilodes* sp. has not been recorded from the states comprising the mid-Atlantic, but occurs in Ohio.

Additional References:

Waltz, R.D. and W.P. McCafferty. (1989). New species, redescriptions, and cladistics of the genus *Pseudocentroptiloides* (Ephemeroptera:Baetidae). Journal of the New York Entomological Society 97[2], 151-158.

Figure A-48. Dorsal view of the abdomen of *Pseudocentroptiloides* sp.

Figure A-49. The deeply cleft labrum of *Pseudocentroptiloides* sp.

Centroptilum sp./*Procloeon* sp.

Both *Centroptilum* sp. and *Procloeon* sp. are found throughout the mid-Atlantic. Both genera have truncate labial palps and tails banded every 3rd to 5th segment.

Additional References:

Lowen, R.G. and J.F. Flannagan. (1991). Four Manitoba species of Centroptilum Eaton (Ephemeroptera): Baetidae) with remarks on the genus. Pages 189-205 in Overview and Strategies of Ephemeroptera and Plecoptera, J. Alba-Tercedor and A. Sanchez-Ortega, eds. The Sandhill Crane Press, Inc. Gainesville, Florida, USA.

Lowen, R.G. and J.F. Flannagan. (1992). Nymphs and imagoes of four North American species of *Procloeon* Bengtsson with description of a new species (Ephemeroptera:Baetidae). The Canadian Entomologist 124:97-108.

Wiersema, N.A. (1999). Two new species of *Procloeon* (Ephemeroptera:Baetidae) from Texas. Entomological News 110(1):27-35.

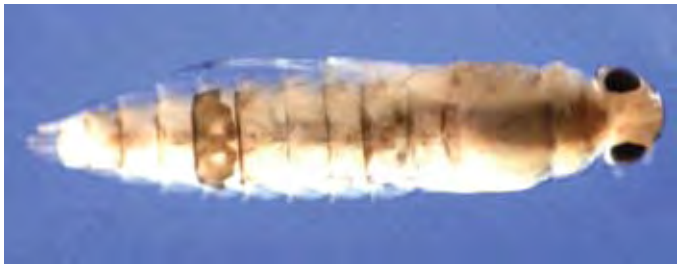


Figure A-50. Dorsal view of *Centroptilum* sp.

Figure A-51. Dorsal view of *Procloeon* sp.

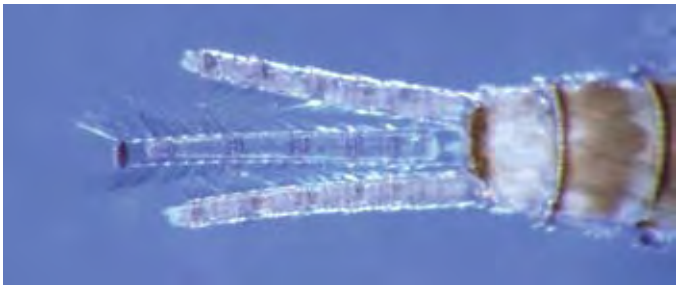


Figure A-52. The banding on the caudal filaments of *Centroptilum* sp. and *Procloeon* sp. are often visible even if the majority of the cerci are missing.

Cloeon dipterum

The genus *Cloeon* sp. consists of one species in North America, *Cloeon dipterum*. This taxon occurs in permanent and temporal pools and other small, quiet water bodies, and therefore is rarely collected in bioassessment samples.

Figure A-53. Dorsal view of *Cloeon* sp.

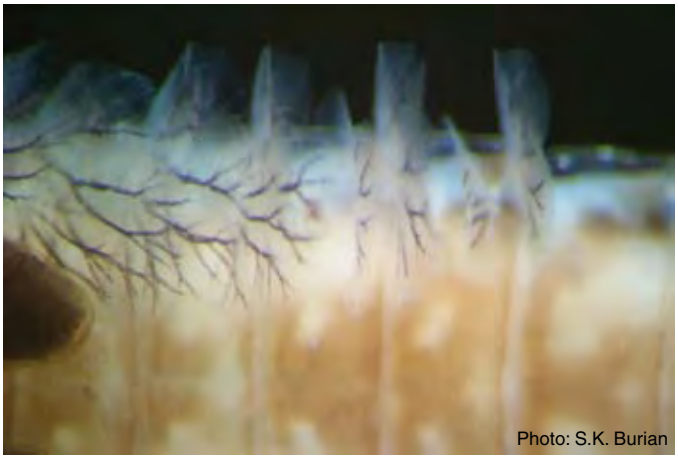


Figure A-54. Close-up of the compound gills of *Cloeon* sp.

Callibaetis sp.

Callibaetis sp. is primarily a mayfly of lentic habitats, but will often occur in bioassessment samples from pools or slow streams. The large, “spoon-shaped” palps are distinctive among North America Baetidae.

Additional References:

Check, G.R. (1982). A revision of the North American species of *Callibaetis* (Ephemeroptera:Baetidae) PhD Dissertation, University of Minnesota.

Figure A-55. Dorsal view of *Callibaetis* sp.

Figure A-56. Ventral view of the head of *Callibaetis* sp.

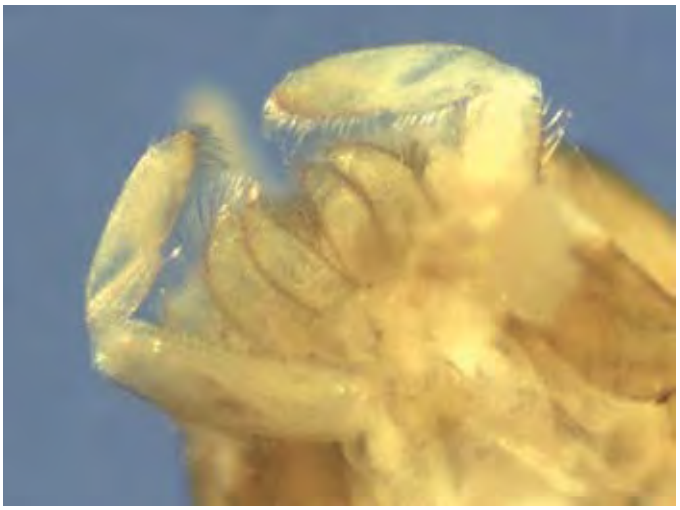


Figure A-57. Ventral view of the palps of *Callibaetis* sp.

Apobaetis sp./*Paracloeodes* sp.

Neither of these genera have been recorded from the states comprising region 3, but have been found in adjacent states and may eventually be encountered in the Region.

Additional References:

McCafferty, W.P. and D.R. Lenat. (2003). A new Nearctic *Paracloeodes* (Ephemeroptera:Baetidae). Entomological News 114:33-36.

McCafferty, W.P. (2000). A new Nearctic species of *Apobaetis* (Ephemeroptera:Baetidae). Entomological News, 111:265-269.

Figure A-58. Dorsal view of *Apobaetis* sp. This is a genus of large, sandy rivers. The labrum without a median notch and the long claws help to separate this genus from other baetids.

Figure A-59. Dorsal view of *Paracloeodes* sp.

Pseudocloeon sp.

The species in this genus were formerly in the genus *Labiobaetis* sp. and are often listed as such in older keys. *Pseudocloeon* sp. is found throughout the mid-Atlantic.

Additional References:

McCafferty, W.P. and R.D. Waltz. (1995). *Labiobaetis* (Ephemeroptera:Baetidae): new status, new North American species, and related new genus. Entomological News 106[1], 19-28.

Morihara, D.K. and W.P. McCafferty. (1979). The *Baetis* Larvae of North America (Ephemeroptera:Baetidae). Transactions of the American Entomological Society 105, 139-221.

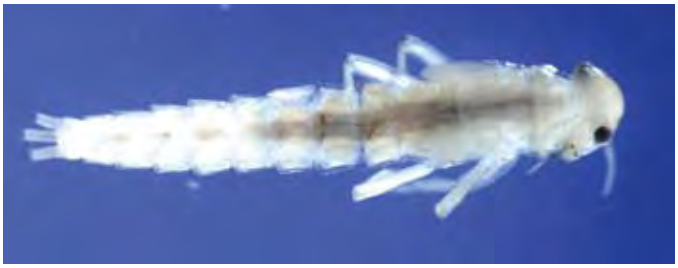


Figure A-60. Dorsal view of *Pseudocloeon* sp.

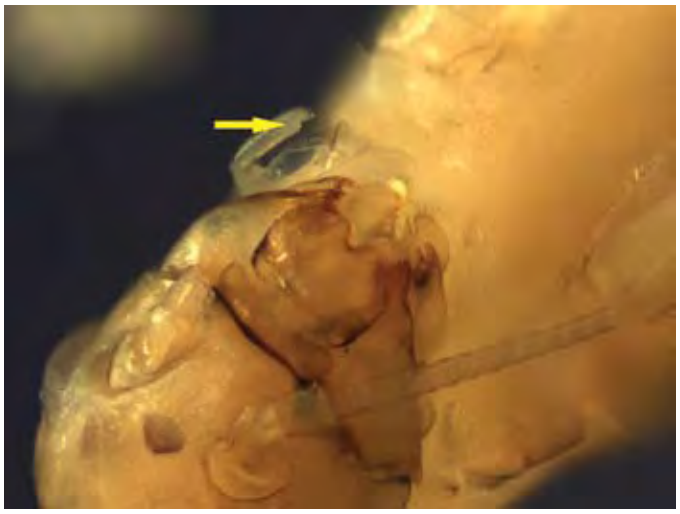


Figure A-61. Ventral view of the head of *Pseudocloeon* sp. The subapical excavation on the maxillary palp is an easily visible character to identify this genus.

Acerpenna sp.

Acerpenna sp. is common throughout the mid-Atlantic. The genus is separated from other Baetidae by the narrowed gill on abdominal segment 7 which is dissimilar from proceeding gills, antenna inserted close together forming a raised keel, and a well developed median projection on the labial palp.

Additional References:

Waltz, R.D. and W.P. McCafferty. (1987). New genera of Baetidae for some Nearctic species previously included in *Baetis* Leach (Ephemeroptera). Annals of the Entomological Society of America 80[5], 667-670.

Morihara, D.K. and W.P. McCafferty. (1979). The Baetis Larvae of North America (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105, 139-221.

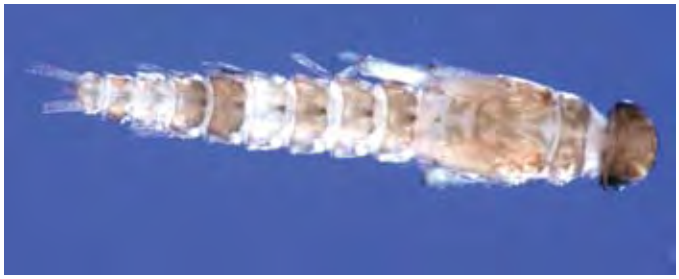


Figure A-62. Dorsal view of *Acerpenna pygmaea*.

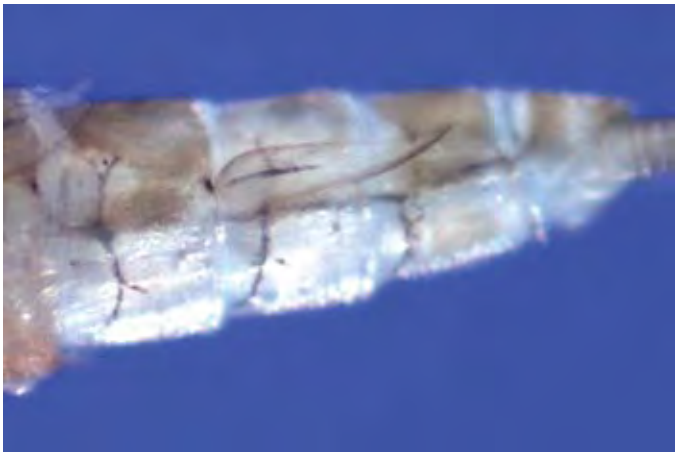


Figure A-63. Gill 7 of *Acerpenna pygmaea.*

Diphetor hageni

This genus is monotypic, with *Diphetor hageni* as the sole species assigned to the genus. *D. hageni* occurs throughout the mid-Atlantic and are fairly common in stream bioassessment samples. The absence of gills on abdominal segment 1 and the reduced prostheca are reliable characters for identifying this genus.

Additional References:

Waltz, R.D. and W.P. McCafferty. (1987). New genera of Baetidae for some Nearctic species previously included in *Baetis* Leach (Ephemeroptera). Annals of the Entomological Society of America 80[5], 667-670.

Morihara, D.K. and W.P. McCafferty. (1979). The Baetis Larvae of North America (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105, 139-221.

Figure A-64. Dorsal and lateral views of *Diphetor hageni*.

Figure A-65. The reduced, bifid prostheca on the right mandible of *Diphetor hageni* is distinctive for NA Baetidae, but requires slide mounting the mandible and a magnification of around 400x.

Baetis sp.

The genus *Baetis* sp. is often the most common mayfly component of bioassessment samples.

Additional References:

Morihara, D.K. and W.P. McCafferty. (1979). The Baetis Larvae of North America (Ephemeroptera:Baetidae). Transactions of the American Entomological Society 105, 139-221.

Weirsema, N.A., Nelson, C.R. and K.F. Kuehnl. (2004). A New Small Minnow Mayfly (Ephemeroptera: Baetidae) from Utah, USA. Entomological News 115:139-145.

Figure A-66. *Baetis intercalaris*, a common species in the mid-Atlantic.

Figure A-67. The labial palps of *Baetis tricaudatus.*

Barbaetis sp.

Barbaetis benfieldi, the only species now assigned to this genus, is recorded from the southeastern U.S. and is known in the mid-Atlantic only from southern Virginia.

Additional References:

Waltz, R.D., W.P. McCafferty and J.H. Kennedy. (1985). *Barbaetis*: A new genus of eastern Nearctic mayflies (Ephemeroptera:Baetidae). The Great Lakes Entomologist 18[4], 161-165.

Description of *Barbaetis benfieldi*, the sole species in the genus.

Plecoptera: Separation of Capniidae and Leuctridae

Separation of larvae of the families Leuctridae and Capniidae can be difficult, especially in early instars. The most reliable character to separate the two taxa, the membranous pleural fold on the venter of the abdomen, is often difficult to see in preserved specimens. The pleural fold reaches to abdominal segment 9 on Capniidae (Fig. B-1), while in Leuctridae the pleural fold ends at abdominal segment 7 or before (Fig. B-2).

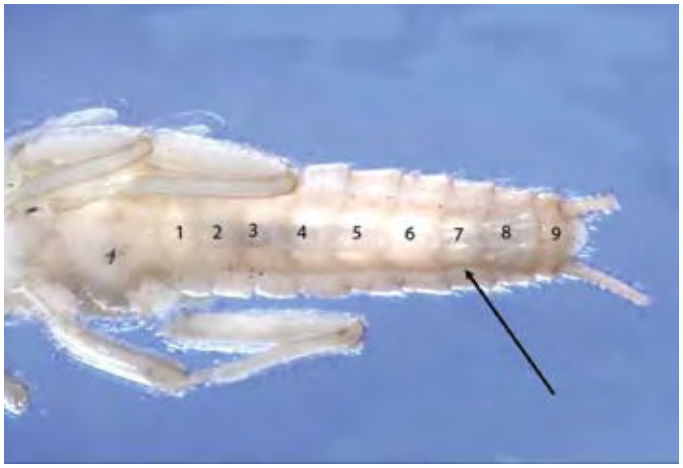


Figure B-1. Ventral view of the abdominal segments of *Allocapnia* sp. (Capniidae). The pleural fold is a crease that runs just inside the lateral margin of each abdominal segment from segments 1 through 9. It is visible just inside the top and bottom margins of the abdomen as a darker line, easiest to see on the bottom side in this photo (arrow).

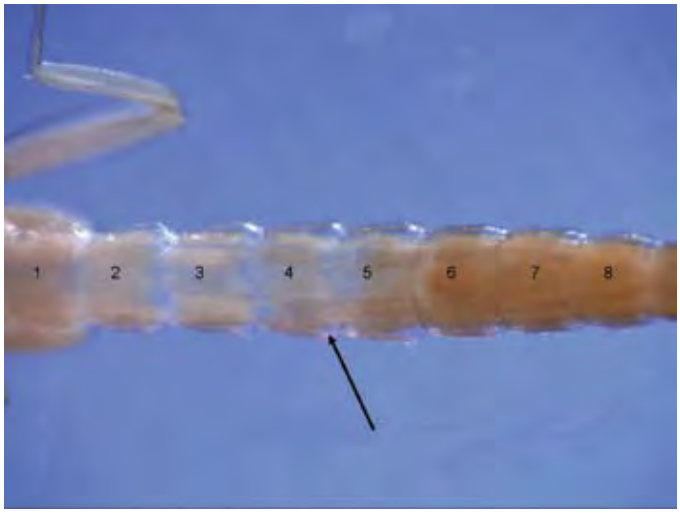


Figure B-2. Ventral view of the abdomen of *Leuctra* sp. (Leuctridae). The pleural folds on Leuctridae are often difficult to see, as in this specimen. In this genus, the most commonly found Leuctridae in Region 3, the pleural fold is from segments 1-4 (arrow).

The shape of the abdomen can also aid in the separation of the two families; this character is generally easier to see than the pleural folds. The abdomen of Leuctridae is generally parallel sided, while in Capniidae the abdomen appears wider at the distal end (Fig. B-3).

In Capniidae, the length of the hind wing pad is generally less than twice the greatest width (Fig. B-4). In Leuctridae, the length of the hind wing pad is 2-1/2 to 3 times the greatest width (Fig. B-5).

Figure B-3. Dorsal view of Leuctridae (top) and Capniidae (bottom) abdomens. Note abdominal segments 6 to 8 on Capniidae are wider than the proximal and distal segments, while in Leuctridae the width of the segments are relatively uniform throughout.

Figure B-4. Dorsal view of a late instar Capniidae larva thorax (*Allocapnia* sp.). The length of the hind wing pad is shorter than twice its greatest width. In this genus, commonly collected in bioassessment samples in Region 3, the hind wing pads are truncate; in most other Capniidae, the hind wing pads are more rounded.

Figure B-5. Dorsal view of a late instar Leuctridae larva thorax (*Leuctra* sp.). The length of the hind wing pads of this common eastern genus is approximately three times the greatest width.

Diptera: Simuliidae

1. Labral fans absent (Fig. C-1); anal sclerite 'Y' shaped (Fig. C-2); lateral margins of head strongly convex ..... *Twinnia*

1'. Labral fans present (Fig. C-3); anal sclerite 'X' shaped (Fig. C-4); lateral margins of head slightly convex 2

Figure C-1. Head lacking labral fans (*Twinnia* sp.).

Figure C-2. Anal sclerite "Y" shaped. Dorsal view of end of abdomen of *Twinnia* sp.

Figure C-3. Head with labral fans present (*Simulium* sp.).

Figure C-4. Anal sclerite "X" shaped. Compound anal gills are visible just to the left of the sclerite (*Simulium* sp.).

2. (1) Postocciput nearly complete dorsally, enclosing cervical sclerites (Fig. C-5); median tooth of hypostoma compound (Fig. C-6); usually with 3rd antennal segment dark with 1st and 2nd segments light (Fig. C-7) ..... *Prosimulium/Helodon*

2'. Cervical sclerites free (Fig. C-8); median tooth of hypostoma single (Fig. C-10 and C-12); antennal pigment not as above 3

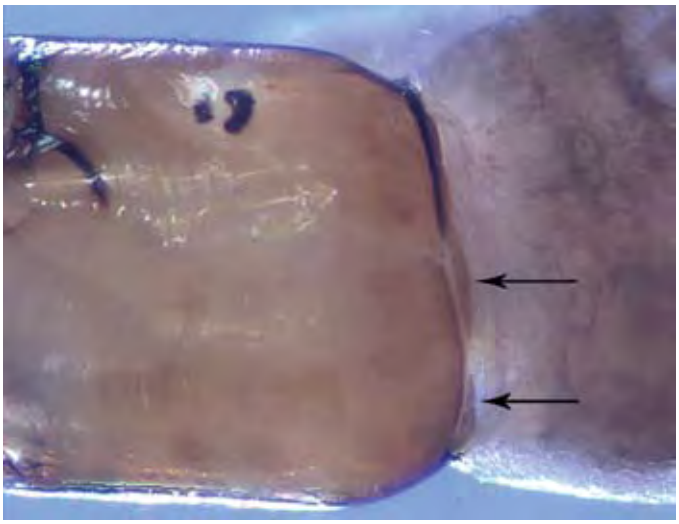


Figure C-5. Dorsum of *Prosimulium* sp. head. The postocciput encloses the two cervical sclerites (arrows-compare to Fig. C-8).

Figure C-6. Ventral view of *Prosimulium* sp. head. Note the large, compound median hypostomal tooth.

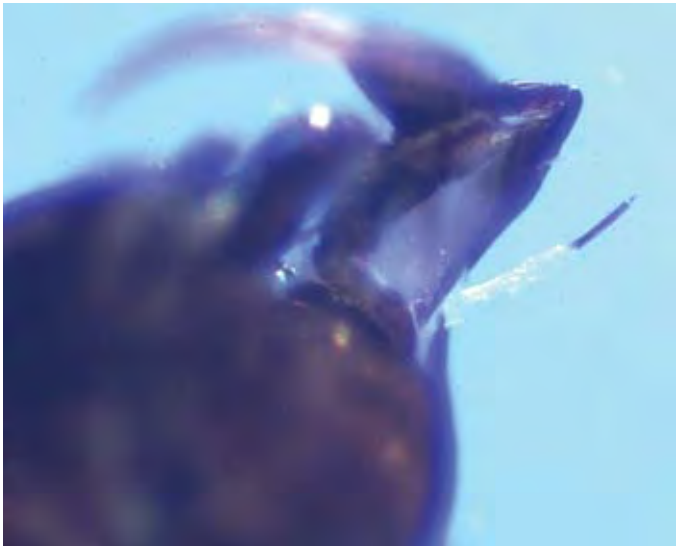


Figure C-7. Antenna of *Prosimulium* sp. Most *Prosimulium* have the basal segments of the antenna pale, while the last segment is pigmented.

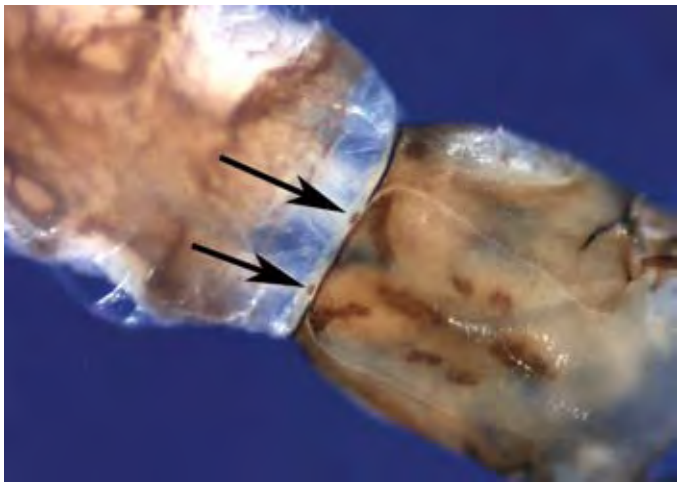


Figure C-8. Dorsum of *Greniera* sp. head. The cervical sclerites are not enclosed and are visible as two brown spots at the back of the head (arrows).

3. (2) Abdominal segment 9 with transverse midventral bulge (Fig. C-9); Hypostomal teeth in three distinct groups (Fig. C-10) ..... *Stegopterna*

3. Abdominal segment 9 without transverse midventral bulge although two ventral tubercles sometimes present (Fig. C-11); hypostomal teeth not as above 4

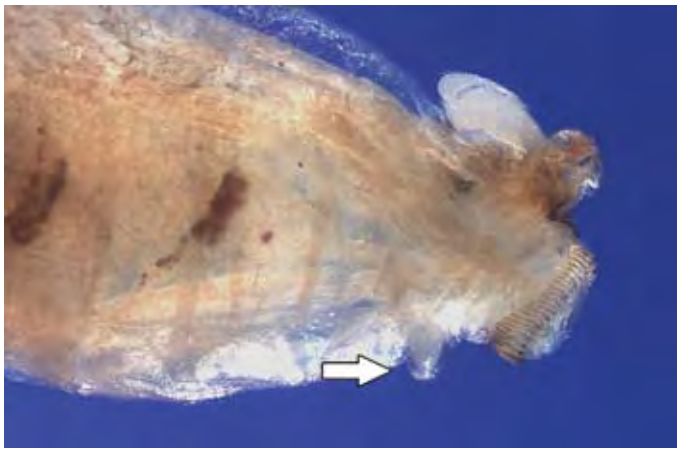


Figure C-9. Lateral view of *Stegopterna* sp. abdomen. A median, transverse, ventral bulge (arrow) is present on abdominal segment 9.

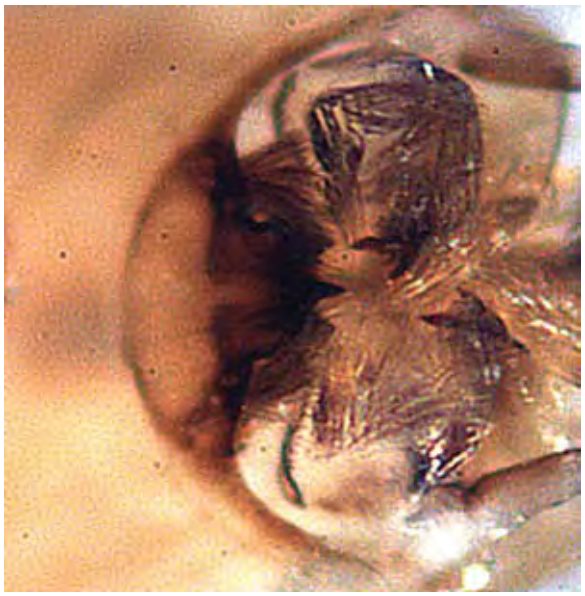


Figure C-10. Hypostomal teeth of *Stegopterna* sp. The smaller teeth are grouped around the median and lateral teeth.

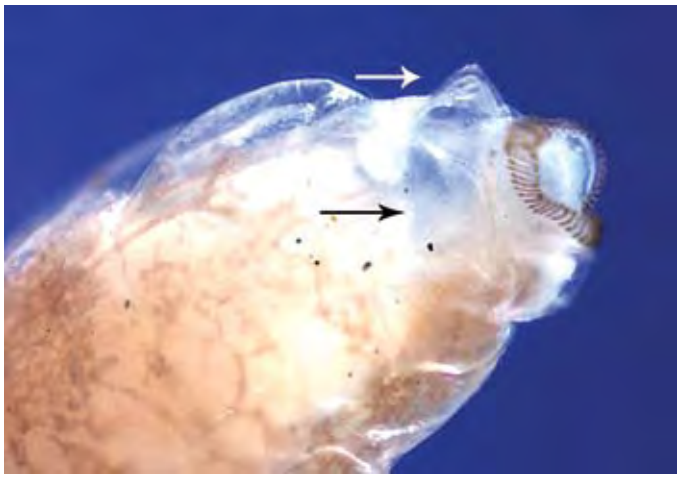


Figure C-11. Ventral view of the posterior of *Greniera* sp., showing the ventral tubercles (arrows).

4. (3) Hypostoma with median tooth and outer lateral teeth moderately large and subequal in height, with three smaller but nearly equal sublateral teeth between (Fig. C-12); anal gills simple or compound (Fig. C-13) ..... *Simulium*

4'. Hypostoma with teeth otherwise; gills always simple (Fig. C-14) 5

Figure C-12. Ventral view of *Simulium* sp. head. The lateral (yellow arrows) and median teeth (black arrow) are simple and approximately equal, with three smaller teeth between the median and each lateral tooth.

Figure C-13. Compound anal gills, present in some species of *Simulium* sp. In this lateral view, one major lobe is seen, with the accessory lobes to the right. Other genera have three simple lobes as in Fig. C-14.

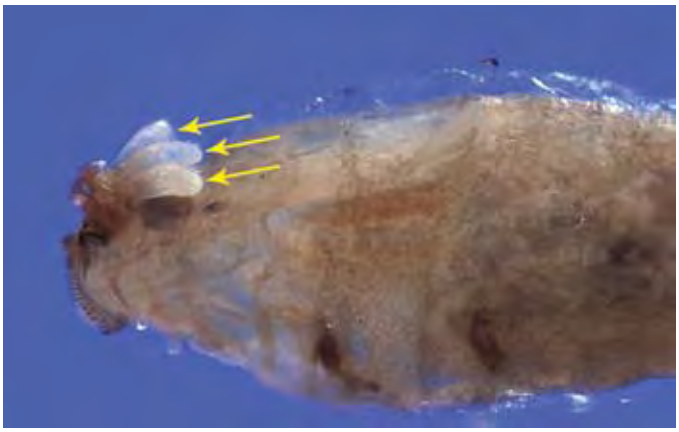


Figure C-14. Anal gills consisting of three simple lobes (*Cnephia* sp.).

5. (4) Segment 9 without cone-shaped tubercles (Fig. C-15); teeth of hypostoma uniformly small (Fig. C-16); length of antenna shorter than bases of labral fans ..... *Cnephia*

5'. Segment 9 with cone-shaped tubercles (Fig. C-17); teeth of hypostoma and length of antenna variable 6

Figure C-15. Posterior of *Cnephia* sp. abdomen. No lobes or cone-shaped tubercles are present.

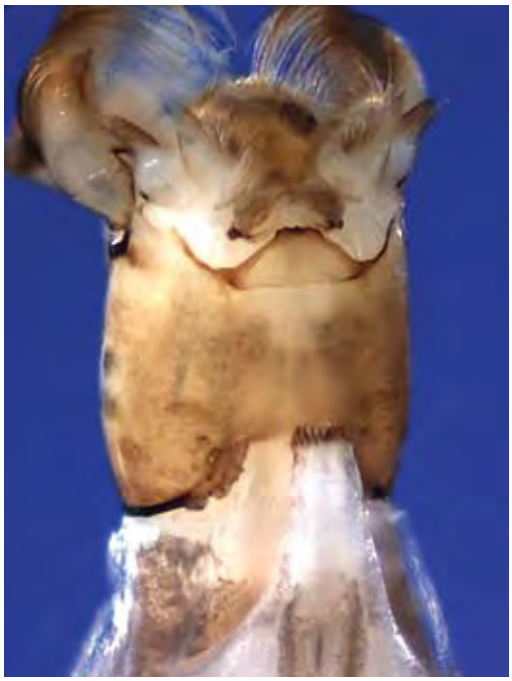


Figure C-16. Venter of the head of *Cnephia* sp. Note the small, irregular hypostomal teeth.

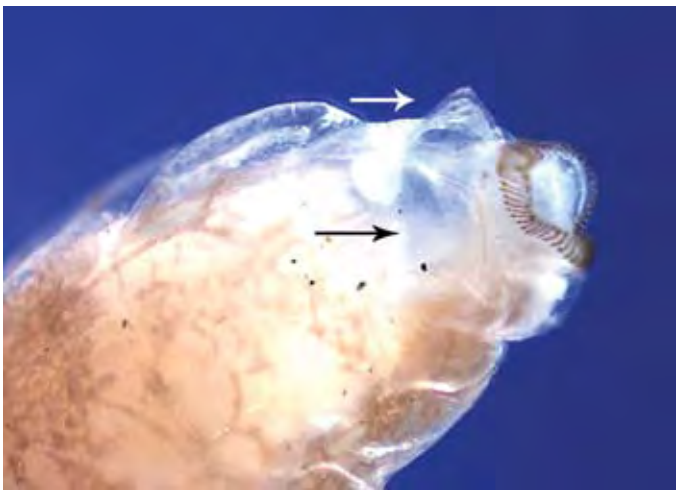


Figure C-17. Posterior of *Greniera* sp. abdomen. Two cone-shaped tubercles are present on ab segment 9.

6. Abdomen greatly expanded at segment 5; teeth of hypostoma small and indistinct; anal sclerite absent ..... *Ectemnia*

6'. Abdomen not greatly expanded as above (Fig. C-18); lateral teeth of hypostoma large and pronounced (Fig. C-19); anal sclerite present; rare, generally found in small headwater streams and seeps ..... *Greniera*

Figure C-18. Lateral view of *Greniera* sp. The abdomen tapers gradually towards the posterior, with no abrupt bulge at segment 5.

Figure C-19. Ventral view of *Greniera* sp. head. Note the large lateral hypostomal teeth and the smaller, recessed median tooth.

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