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RESEARCH REPORT 67

KEY TO GENERA OF WISCONSIN PLECOPTERA (STONEFLY) NYMPHS EPHEMEROPTERA (MAYFLY) NYMPHS TRICHOPTERA (CADDISFLY) LARVAE

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By

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EPHEMEROPTERA

Introduction

Mayflies are often abundant in a wide variety of streams throughout Wisconsin, and may occasionally be found in lakes, ponds, marshes, and swamps. Most species have a one-year life cycle, and because of an overlapping of the generations both within and among species in each genus, the nymphs of most genera can be found year-around. They are important as food for trout and other game fish, and more recently have been widely used to detect pollution. But in spite of their abundance and importance, the Ephemeroptera of Wisconsin are poorly known. I estimate that 37 genera and 159 species may occur in this state, but to date we have collected fewer than half of that number of species, and many of our records are based upon nymphal identifications that must be considered tenuous.

The taxonomy of mayflies is based primarily on the identification of male adults, and in most genera the nymphs of only a portion of the known species have been described. However, nymphs that have reached sufficient maturity can be readily identified to genus.

To promote the study of mayflies in Wisconsin, I have constructed and illustrated generic keys to the nymphs that occur in this state, and following these keys have summarized the present state of knowledge concerning the probable species composition, distribution, abundance, and habitat of each genus. The keys have been modified from those by Edmunds (1959), and the summaries are based upon recent collections and on the records of Daggy (1941), Burks (1953), Leonard and Leonard (1962), and Krueger (1969).

Key to Genera of Wisconsin Ephemeroptera Nymphs

- 1a. Mandibles with large forward-projecting tusks (Fig. 1); all gills with fringed margins (Fig. 2)..... 2
- 1b. Mandibles without such tusks..... 7
- 2a. Gills dorsal, curving up over abdomen; foretibiae fossorial (Fig. 3)..... 3
- 2b. Gills lateral, projecting from sides of abdomen; foretibiae slender, subcylindrical (Fig. 4)..... POTAMANTHIDAE, Potamanthus
- 3a. Conspicuous frontal process between bases of antennae (Figs. 1, 5, 6)..... 4
- 3b. No such process; mandibular tusks with a single, prominent subapical tooth on inner margin (Fig. 7) POLYMITARCIDAE, Tortopus
- 4a. Mandibular tusks curve inward apically, upper surface with numerous tubercles (Fig. 8)..... POLYMITARCIDAE, Ephoron
- 4b. Mandibular tusks curve upward apically, no tubercles on upper surface (Fig. 9)..... EPHEMERIDAE 5
- 5a. Frontal process bifid (Figs. 1, 6)..... 6
- 5b. Frontal process either truncate, rounded, or conical (Fig. 5)..... Hexagenia
- 6a. Mandibular tusks with teeth on outer or upper margin (Fig. 1); labial palpi 2-segmented..... Pentagenia
- 6b. Mandibular tusks smooth on margins (Fig. 9); labial palpi 3-segmented..... Ephemera
- 7a. Mesonotum modified into a carapace-like structure that covers the gills on abdominal segments 1-6 (Fig. 10)..... BAETISCIDAE, Baetisca
- 7b. Mesonotum not modified into a carapace; gills exposed..... 8
- 8a. Head flattened dorso-ventrally; eyes and antennae dorsal (Figs. 11, 14); gills a single lamella, often with a fibrilliform tuft (Figs. 13, 16-18) HEPTAGENIIDAE 9

- 8b. Not as above; antennae and eyes lateral (Fig. 12)..... 15
- 9a. Gills with a fingerlike projection on lamellae (Fig. 13); claws very long; maxillary palpi 3-segmented..... Pseudiron
- 9b. Gill lamellae without such a projection; claws not unusually long; maxillary palpi 2-segmented..... 10
- 10a. Nymph with only 2 tails..... Epeorus
- 10b. Nymph with 3 tails..... 11
- 11a. Distal segment of maxillary palpi at least 4 times as long as galea-lacinia (Fig. 14)..... Arthroplea
- 11b. Distal segment of maxillary palpi much shorter..... 12
- 12a. Gills enlarged on segments 1 and 7, meeting beneath body to form a ventral disc (Fig. 15)..... Rhithrogena
- 12b. Gills on segments 1 and 7 not as above, usually smaller than intermediate pairs (Figs. 17, 18)..... 13
- 13a. Gills ventral with fibrilliform portion large, lamellar portion small and fingerlike (Fig. 16)..... Anepeorus
- 13b. Gills dorsal or lateral; fibrilliform portion smaller than lamellar portion..... 14
- 14a. Last pair of gills reduced to a single slender filament with tracheation reduced or absent (Fig. 17)..... Stenonema
- 14b. Last pair of gills similar to preceding pairs, but smaller; tracheation in all gills similar (Fig. 18)..... Heptagenia
- 15a. Forelegs with a dense row of long setae on inner surface (Fig. 19) a tuft of gills at base of each maxilla..... 16

- 15b. Forelegs with setae other than above; no gill tufts on maxillae..... 17
- 16a. Gills dorsal on abdominal segment 1; gill tufts at bases of forecoxae (Fig. 19)..... SIPHLONURIDAE, Isonychia
- 16b. Gills ventral on abdominal segment 1; no gill tufts at bases of forecoxae..... OLIGONEURIIDAE, Homoeoneuria
- 17a. Gills on abdominal segment 2 operculate or semi-operculate, covering or partially covering the gills on the succeeding segments (Figs. 20-22). 18
- 17b. Gills on abdominal segment 2 similar to other gills or absent..... 21
- 18a. Operculate gills somewhat triangular and well separated from each other mesally (Fig. 20); succeeding gills without fringed margins TRICORYTHIDAE, Tricorythodes
- 18b. Operculate gills quadrate and proximate mesally; (Figs. 21, 22); succeeding gills with fringed margins.....19
- 19a. Operculate gills fused to each other mesally (Fig. 21); metathoracic wing pads present..... NEOEPHEMERIDAE, Neophemera
- 19b. Operculate gills not fused (Fig. 22); metathoracic wing pads absent..... CAENIDAE 20
- 20a. Three prominent tubercles on head (Fig. 23); maxillary and labial palpi 2-segmented..... Brachycercus
- 20b. No tubercles on head; maxillary and labial palpi 3-segmented..... Caenis
- 21a. Gills absent from abdominal segment 2, and sometimes from segments 1 and 3 also; gills on segment 3 or 4 may be operculate (Fig. 24)..... EPHEMERELLIDAE, Ephemerella
- 21b. Gills present on segments 1 to 7..... 22
- 22a. Claws of forelegs bifid (Fig. 25); claws of middle and hind legs long and slender, about as long as tibiae (Fig. 26).. AMETROPODIDAE, Siphloplecton
- 22b. Claws on all legs similar in structure..... 23

- 23a. Gills forked (Figs. 28-30) or bilamellate and terminating in a filament or point (Figs. 31, 33), or clusters of filaments (Fig. 27).....
 LEPTOPHLEBIIDAE 24
- 23b. Gills single or double lamellae (Figs. 42-46, 53-54)..... 28
- 24a. Each gill on segments 2 to 6 consists of 2 clusters of filaments (Fig. 27)
 Habrophlebia
- 24b. Gills forked or bilamellate..... 25
- 25a. Gills on segment 1 different in structure from succeeding pairs (Figs. 30-33)..... 26
- 25b. Gills on segments 1 to 7 narrowly lanceolate and bifid (Fig. 28,29)... 27
- 26a. Gills on segment 1 forked (Fig. 30), remaining gills bilamellate (Fig. 31)..... Leptophlebia
- 26b. Gills on segment 1 single linear lamellae (Fig. 32), remaining gills bilamellate (Fig. 33)..... Choroterpes
- 27a. Front of labrum rather deeply emarginate (Fig. 34); posterolateral spines on segment 9 one-half as long as that segment (Fig. 35).....
 Habrophlebiodes
- 27b. Front of labrum only shallowly emarginate (Fig. 36); posterolateral spines on segment 9 not more than one-fourth as long as that segment (Fig. 37)..... Paraleptophlebia
- 28a. Abdominal segments 8 and 9 produced posterolaterally into distinct, flattened spines (Figs. 38, 39); if spines are weak, antennae are less than twice width of head..... SIPHONURIDAE 29

- 28b. Abdominal segments 8 and 9 without such spines (Fig. 40); if weak spines are present (Fig. 41), antennae are more than twice as long as width of head..... **BAETIDAE** 32
- 29a. Head, pronotum, and mesonotum with conspicuous lateral spines; a row of median spines on abdominal tergites..... **Acanthametropus**
- 29b. Without such spines..... 30
- 30a. Gill lamellae double on segments 1 and 2, sometimes on 1 to 6 (Fig. 42) **Siphonurus**
- 30b. Gill lamellae single on all segments (Figs. 43, 44)..... 31
- 31a. Gills with sclerotized band on ventral margin and little or no tracheation (Fig. 43); maxillae with a crown of pectinate spines..... **Ameletus**
- 31b. Gills with well-developed tracheation (Fig. 44); maxillae without pectinate spines..... **Parameletus**
- 32a. All gills single, flat lamellae (Figs. 45, 46)..... 33
- 32b. Gills on at least first two segments double lamellae, or single lamellae with a recurved ventral or dorsal flap (Figs. 53,54)..... 37
- 33a. With only 2 well-developed tails, median tail absent or no longer than tenth tergite..... 34
- 33b. With 3 well-developed tails, although median tail may be shorter and thinner than laterals, it is much longer than tenth tergite (Fig. 47) 35
- 34a. Metathoracic wing pad present, though they may be minute (Fig. 48)....
..... **Baetis**
- 34b. Metathoracic wing pads absent..... **Pseudocloeon**

- 35a. Median tail shorter and often thinner than lateral ones (Fig. 47); tarsal claws short and denticulate (Fig. 49)..... Baetis
- 35b. Median tail subequal to lateral ones (Fig. 50); claws long and slender, usually not denticulate (Figs. 51, 52)..... 36
- 36a. Metathoracic wing pads present..... Centroptilum
- 36b. Metathoracic wing pads absent..... Neocloeon
- 37a. Gills with tracheal branches usually on inner side only; a small dorsal flap at base of at least first two gills (Fig. 53)..... Centroptilum
- 37b. Gills with tracheal branches pinnate, palmate, or primarily on outer side..... 38
- 38a. Metathoracic wing pads present; small lamella or flap on ventral surface of first two pairs of gills (Fig. 54)..... Callibaetis
- 38b. Metathoracic wing pads absent; small lamella on dorsal surface of gills..... Cloeon

PLATE I

- Figure 1. Pentagenia vittigera, dorsal view of head
- Figure 2. Hexagenia, gills on right side of abdominal segment 3.
- Figure 3. Hexagenia, prothoracic leg
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- Figure 7. Tortopus incertus, dorsal view of right mandibular tusk
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- Figure 20. Tricorythodes, dorsal view of abdomen showing operculate gills (OG)
- Figure 21. Neoephemera youngi, dorsal view of abdomen showing operculate gills (OG)

PLATE I

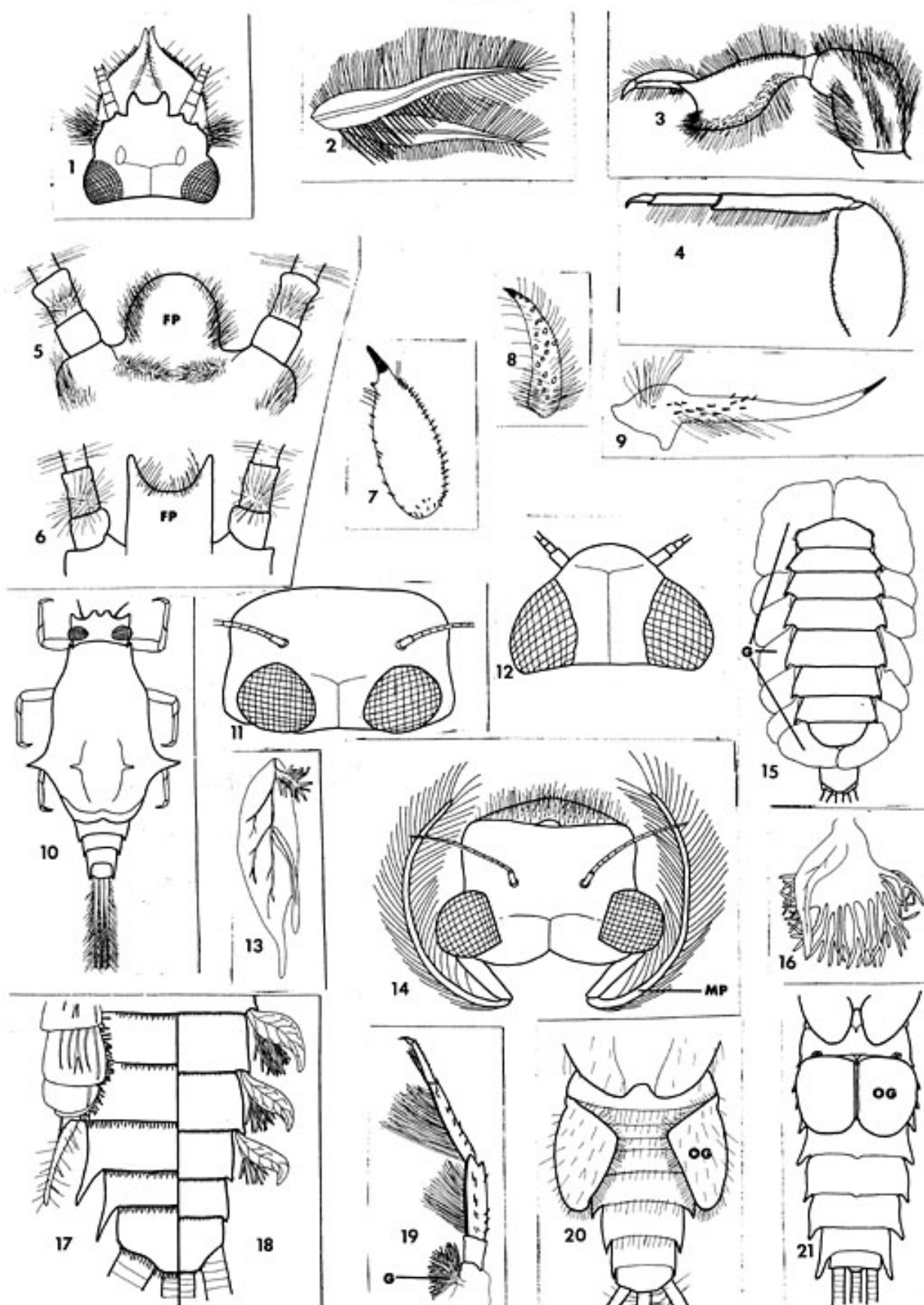
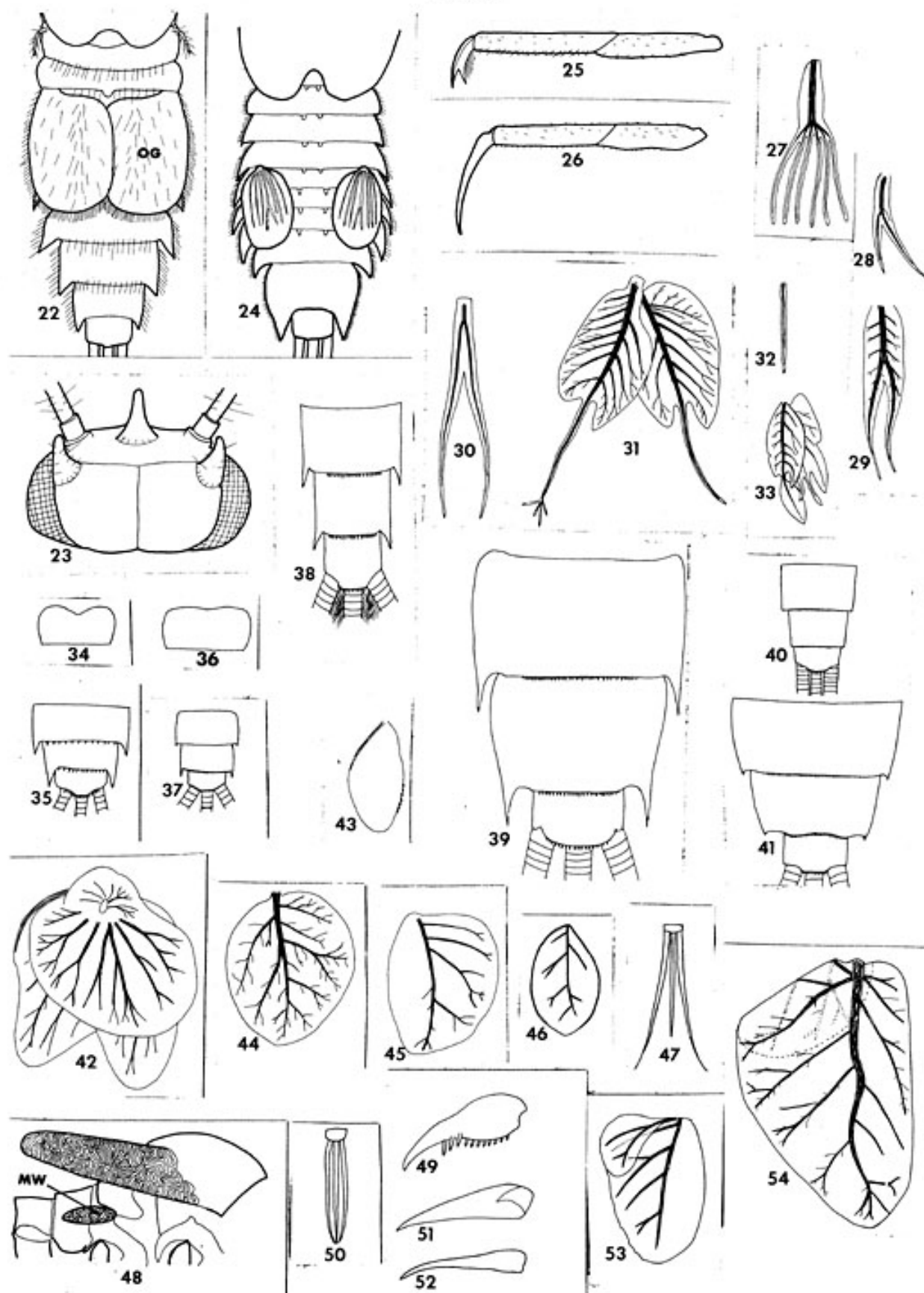


PLATE II

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PLATE II



- Figure 44. Parameletus, dorsal view of gill on abdominal segment 3
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- Figure 54. Callibaetis fluctuans, dorsal view of gill on right side of abdominal segment 3

Notes

AMETROPODIDAE

Siphloplecton - 2 species (basale, interlineatum)

The nymphs are fairly common and may be found from September to May amid the aquatic vegetation near the banks of large, slow streams.

BAETIDAE

Baetis - 15 species (brunneicolor, cingulatus, curiosus, frivulus, frondalis, hiemalis, intercalaris, levitans, nanus, pallidulus, pluto, propinquus, pygmaeus, spinosus, vagans)

The nymphs are found throughout the year in the riffles of streams of all sizes, and also may occur in debris and vegetation near the banks. They are common, except during the winter months.

Callibaetis - 5 species (brevicostatus, ferrugineus, fluctuans, hageni, skokianus)

Most species have more than one generation each year, and nymphs can be found year-around amid the vegetation in slow to calm water of streams, backwaters, lakes, ponds, and ditches.

Centroptilum - 4 species (album, bellum, convexum, rufostrigatum)

The nymphs are uncommon and have been collected only from June to September. They cling to stones or vegetation in slow to moderately fast streams.

Gloeon - 5 species (insignificans, mendax, minor, rubropictum, simplex)

Although rare in Wisconsin, the nymphs may be found on vegetation in slow streams or backwaters of faster streams.

Neocloeon - 1 species (alamance)

The nymphs have been found in the northern half of the state from May to November in cold, clear streams with a moderate to fast current. They have been collected mostly from vegetation near the banks, and are uncommon.

Pseudocloeon - 9 species (anoka, carolina, cingulatum, dubium, elliotti, ida, minutum, parvulum, punctiventris)

The preferred habitat of the nymphs is fast water, and they can be collected off of rocks and vegetation in the riffles of moderate to rapid streams. They are common from April to October, and can also be found during the winter months.

BAETISCIDAE

Baetisca - 3 species (bajkovi, laurentina, obesa)

Common year-around, the nymphs occur mostly in sandy areas where they inhabit the sand, silt, and debris near the banks of medium to large streams with a moderate to fast current.

CAENIDAE

Brachycercus - 3 species (lacustris, nitidus, prudens)

The nymphs are uncommon, occurring in the mud, silt, and sand of the quiet parts of medium-sized streams.

Caenis - 7 species (amica, forcipata, hilaris, jocosa, punctata, ridens, simulans)

The nymphs are common year-around in a wide variety of habitats ranging from the stagnant water of marshes, ponds, and ditches to the slow to moderately fast water of streams.

EPHEMERELLIDAE

Ephemerella - 23 species (attenuata, aurivillii, bicolor, bicoloroides, cornuta, coxalis, deficiens, dorothea, excrucians, funeralis, invaria, lata, lita, lutulenta, needhami, prudentialis, rotunda, simplex, sordida, subvaria, temporalis, verisimilis, walkeri)

The nymphs may be found in streams of all sizes and currents, and frequently are abundant. They can be found year-around, but are most common during the spring months.

EPHEMERIDAE

Ephemera - 1 species (simulans)

Although the nymphs may occasionally be found in lakes, they are most frequently found in the shallow, fast water of streams of all sizes. They are common all year, especially in the northern two-thirds of the state.

Hexagenia - 6 species (atrocaudata, bilineata, limbata, munda, recurvata, rigida)

The nymphs burrow in the silt bottoms of streams of all sizes, and are common year-around. They also inhabit lakes with dissolved oxygen near the bottom all year.

Pentagenia - 1 species (vittigera)

The nymphs are rare, and are found in the mud bottoms of large streams.

HEPTAGENIIDAE

Anepeorus - 1 species (simplex)

Not yet collected in Wisconsin, this genus would be most likely to occur in larger streams in the southern counties.

Arthroplea - 1 species (bipunctata)

The nymphs have been collected from medium-sized streams with a moderate to slow current in the northern fourth of the state. They have been found only in May and June, and are uncommon.

Epeorus - 2 species (rubidus, vitrea)

The nymphs inhabit rocks and debris in the riffles of cool, fast streams in the northern half of the state, and are fairly common from November to June.

Heptagenia - 8 species (aphrodite, diabasia, elegantula, flavescens, hebe, lucidipennis, maculipennis, pulla)

The nymphs are common year-around under stones and debris in the riffles and near the banks of moderate to fast streams.

Pseudiron - 1 species (centralis)

Although they have not yet been found in Wisconsin, the nymphs may occur in fairly rapid, medium-sized streams.

Rhithrogena - 4 species (impersonata, jejuna, pellucida, sanguinea)

The nymphs are uncommon and may be collected throughout the year from beneath rocks in fast, cold streams.

Stenonema - 19 species (ares, bipunctatum, candidum, exiguum, femoratum, fuscum, integrum, interpunctatum, ithaca, luteum, mediopunctatum, metriotes, minnetonka, nepotellum, pulchellum, rubromaculatum, rubrum, terminatum, vicarium)

The nymphs are very common year-around on rocks in streams of all sizes and velocities. They also may be found along the shores of some lakes.

LEPTOPHLEBIIDAE

Choroterpes - 1 species (basalis)

Large streams with a gravel bottom and a moderate current are the normal habitat for the nymphs, but they also may be found along the shores of lakes. They are uncommon, and have been collected year-around, primarily in the northern half of the state.

Habrophlebia - 1 species (vibrans)

Although not yet collected in Wisconsin, the nymphs should occur among vegetation and debris near the edges of small streams.

Habrophlebiodes - 1 species (americana)

Not yet collected in Wisconsin, the nymphs should occur in debris among the stream banks and in shallow, still eddies of streams with a moderate to fast current.

Leptophlebia - 3 species (cupida, johnsoni, nebulosa)

The nymphs are common from September to April in ponds and eddies near the banks of streams with a slow or relatively slow current.

Paraleptophlebia - 7 species (adoptiva, debilis, guttata, moerens, mollis, ontario, praepedita)

Although most abundant during the winter and spring months, the nymphs may be commonly found year-around in the fast, shallow water of streams of all sizes. They are most frequently found on rocks.

NEOEPHEMERIDAE

Neophemera - 1 species (bicolor)

Not yet collected in Wisconsin, the nymphs would be most likely to occur among debris anchored in the currents of streams.

OLIGONEURIIDAE

Homoeoneuria - 1 species (ammophila)

The nymphs could occur in the shifting sand bottoms of large, rapid streams in the southern part of the state, but they have not yet been found in Wisconsin.

POLYMITARCIDAE

Ephoron - 2 species (album, leukon)

All Wisconsin collections have been made during the summer months, but the nymphs probably occur year-around. They are uncommon, and are found in medium to large streams with a rapid current where they burrow into the substrate under rocks.

Tortopus - 1 species (primus)

Although not yet found in Wisconsin, the nymphs normally occur in burrows in clay banks at bends in large streams.

POTAMANTHIDAE

Potamanthus - 2 species (myops, verticis)

The nymphs are fairly common throughout the year in the sand and silt beneath stones in streams with a moderate to rapid current.

SIPHONURIDAE

Acanthametropus - 1 species (pecatonica)

The only North American specimen was collected in Illinois, very close to the Wisconsin border. The nymph was found in a rapid, shallow, moderate-sized stream with a sand and rock bottom.

Ameletus - 2 species (lineatus, ludens)

The nymphs occur on vegetation and debris in small, fast streams, and occasionally can be found in cool, clear lakes. They are rare in Wisconsin.

Isonychia - 6 species (bicolor, harperi, rufa, sadleri, sayi, sicca)

The nymphs are common year-around in streams of all sizes. They are most frequently found on rocks and in debris in the strong current of riffles, but also occur in vegetation along the banks of rapid streams.

Parameletus - 2 species (croesus, midas)

The nymphs inhabit swamps and forest pools, but have not yet been collected in Wisconsin.

Siphonurus - 5 species (alternatus, marshalli, quebecensis, rapidus, typicus)

The nymphs are fairly common in late winter and spring, but are only occasionally encountered at other times of the year. They are found among vegetation or on the bottom in shallow pools and eddies near the banks of large streams, and also in the backwaters of these streams.

TRICORYTHIDAE

Tricorythodes - 2 species (atratus, stygiatus)

The rapid water of small- and medium-sized permanent streams is the preferred habitat of the nymphs. They are fairly common and may be found throughout the year, but they have been collected most frequently during the summer months.

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