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RESEARCH REPORT 67

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

By

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PLECOPTERA

Introduction

In Wisconsin, stoneflies are abundant in many streams in the northern half of the state, but are rare in most streams in the southeastern counties. About 21 genera and 72 species probably occur in Wisconsin, and new species are still being discovered. The nymphs are most abundant in well-oxygenated, rapidly flowing streams (Figs. A, B), with a few species also inhabiting sluggish streams. They are found on rocks, in gravel, and on vegetation, but are especially abundant in debris that is wedged between stones or caught on submerged roots or fallen trees. Most species have a one-year life cycle, although some have life cycles of two or three years. The adults emerge from February to August, depending on the species, and may be found crawling on stones, bridges, trees and other vegetation.

The nymphs are important as food for trout and other fish, and because they require highly oxygenated water, their disappearance from a stream has been widely used to indicate a deterioration of water quality. Their importance as indicators of water quality and as food for fish has necessitated their identification by pollution biologists, fisheries biologists, and others. The most recent generic keys to stonefly nymphs are by Ricker (1959), Jewett (1956), and Harden and Mickel (1952). The latter publication is concerned mainly with the identification of species, and the generic keys are not illustrated, while the keys by Ricker and Jewett include many genera that do not occur in Wisconsin, making them needlessly cumbersome and confusing for use in Wisconsin.

The key below was adapted from the key by Ricker (1959) to provide biologists in Wisconsin with a readily available, concise, illustrated key to the genera of Plecoptera nymphs. It is hoped that this key will promote the study of stoneflies

in Wisconsin. Following the key are notes on the probable species composition, distribution, abundance, habitat and life cycles of the various genera. This information was obtained mostly from collections made throughout Wisconsin in recent years, and from publications by Frison (1935, 1942), Harden and Mickel (1952), and Ricker (1952).

Key to Genera of Wisconsin Plecoptera Nymphs

1a. Tips of glossae produced nearly as far forward as tips of paraglossae, or farther (Fig. 1); tips of laciniae without sharp spines (Fig. 2).....(Filipalpia) 2

1b. Tips of glossae situated much behind tips of paraglossae (Fig. 3); laciniae almost always tipped with 1 or more sharp spines (Fig. 4).....(Setipalpia) 9

2a. Finely branched gills present on ventral side of abdominal segments 1 and 2 and on ventral side of thorax.....
.....PTERONARCIDAE, Pteronarcys

2b. Gills absent from abdominal segments 1 and 2.....3

3a. Second tarsal segment (side view) about as long as first (Fig. 5).....TAENIOPTERYGIDAE 4

3b. Second tarsal segment much shorter than first (Fig. 6).....5

4a. Single gills present on inner side of each coxa; ninth sternite only slightly produced (Fig. 7).....Taeniopteryx

4b. Gills absent; ninth sternite much produced (Fig. 8).....Brachyptera

5a. Hind wing pads strongly diverging from axis of body (Fig. 9); hairy, small, and robust; extended hind legs much surpass tip of abdomen.....NEMOURIDAE, Nemoura

5b. Hind wing pads nearly parallel to long axis of body (Figs. 10, 11, 12); hind legs, when extended, barely reach tip of abdomen.....6

6a. Only first 6 abdominal segments, usually fewer, divided into tergites and sternites by a membranous lateral fold (Fig. 17)...
.....LEUCTRIDAE, Leuctra

6b. Tergites and sternites of abdominal segments 1 to 9 divided by a membranous fold ventrolaterally (Fig. 16).....CAPNIIDAE 7

7a. Conspicuous bristles along posterior margin of posterior abdominal tergites and on other parts of body (Fig. 19); both pairs of wing pads similarly shaped (Fig. 10).....Paracapnia

7b. Bristles slender, and uniformly distributed on each tergite (Fig. 18).....8

8a. Inner margin of hind wing pad notched very close to tip, if at all; hind wing pad truncated and much different than fore wing pad (Fig. 11); wing pads may be absent.....Allocapnia

8b. Inner margin of hind wing pad with notch about halfway from base to tip (Fig. 12); rare (extreme north).....Capnia

9a. Profusely branched gills present at corners of thoracic sterna, above front coxae, and usually also above other coxae; paraglossae broadly rounded (Fig. 3).....PERLIDAE 10

9b. Thoracic gills lacking; paraglossae pointed (Figs. 27, 28).....16

10a. Eyes situated much anterior to hind margin of head (Figs. 20, 21).....11

10b. Eyes situated normally, close to hind margin of head (Figs. 22, 23, 24).....12

11a. Anterior ocellus absent (Fig. 20); body uniformly colored; full grown nymphs not exceeding 12 mm in length (excluding cerci)....Atoperla

11b. Anterior ocellus present, though small, indistinct in small nymphs (Fig. 21); body boldly patterned; full grown nymphs up to 20 mm long.....Perlinella

12a. Anterior ocellus absent; distinct transverse occipital ridge across back of head (Fig. 22); subanal gills present (Fig. 26)..*Neoperla*

12b. Three ocelli present (Figs. 23, 24).....13

13a. A closely set regular row of spinules inserted on a low occipital ridge completely across back of head (Fig. 22).....14

13b. Occipital ridge absent; spinules on back of head present mainly at sides, or arranged in a transverse row of varying completeness, but always at least a little wavy or irregular (Figs. 23, 24).....15

14a. Subanal gills present (Fig. 26).....*Phasganophora*

14b. Subanal gills absent (Fig. 25).....*Paragnetina*

15a. Dorsum of abdomen with conspicuous freckle-like spots on a uniform dark background; occipital spinules in an irregular line that is nearly complete across head (Fig. 23); subanal gills present.....*Perlesta*

15b. Dorsum of abdomen without freckle-like spots; with or without subanal gills.....*Acroneuria*

16a. Hind wing pads set at angle to axis of body (Fig. 13); hind legs reach or surpass tip of abdomen; body almost always pigmented in distinct pattern on some part or other.....PERLODIDAE 17

16b. Hind wing pads nearly parallel to axis of body (Figs. 14, 15); hind legs do not reach tip of abdomen; body almost uniformly brown, without distinct pattern.....CHLOROPERLIDAE 19

17a. Submental gills present, usually twice as long as their greatest width (Fig. 27).....18

17b. Submental gills absent (Fig. 28).....Isoperla

18a. Arms of Y-ridge meet posterior corners of furcal pits (Figs. 29, 30).....Isogenus

18b. Arms of Y-ridge of mesosternum approach anterior corners of furcal pits (Fig. 31); rare (near L. Superior).....Arcynopteryx

19a. Length of mature nymphs 4-7 mm; inner margins of hind wing pads almost straight (Fig. 14).....Hastaperla

19b. Length of mature nymph in excess of 7 mm; inner margins of hind wing pads sinuate or notched (Fig. 15).....Alloperla

Plate I

Figure 1. Labium of *Pteronarcys* showing location of glossae (G) and paraglossae (P).

Figure 2. Maxilla of *Pteronarcys* showing shape of lacinia (L).

Figure 3. Labium of *Acroneuria* showing location of glossae (G) and paraglossae (P).

Figure 4. Maxilla of *Acroneuria* showing shape of lacinia (L).

Figure 5. Tarsal segments (1, 2, 3) of *Taeniopteryx*.

Figure 6. Tarsal segments (1, 2, 3) of *Allocapnia*.

Figure 7. Ninth sternite (9) of *Taeniopteryx*.

Figure 8. Ninth sternite (9) of *Brachyptera*.

Figure 9. Wing pads of *Nemoura*.

Figure 10. Wing pads of *Paracapnia*.

Figure 11. Wing pads of *Allocapnia*.

Figure 12. Wing pads of *Capnia*.

Figure 13. Wing pads of *Isoperla*.

Figure 14. Wing pads of *Hastaperla*.

Figure 15. Wing pads of *Alloperla*.

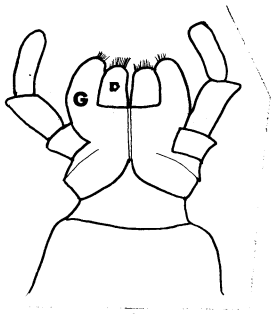
Figure 16. Lateral view of abdomen of *Allocapnia* showing lateral fold (LF).

Figure 17. Lateral view of abdomen of *Leuctra* showing lateral fold (LF).

Figure 18. Seventh and eighth abdominal tergites of *Allocapnia*.

Figure 19. Seventh and eighth abdominal tergites of *Paracapnia*.

PLATE I



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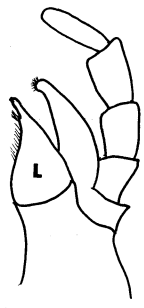

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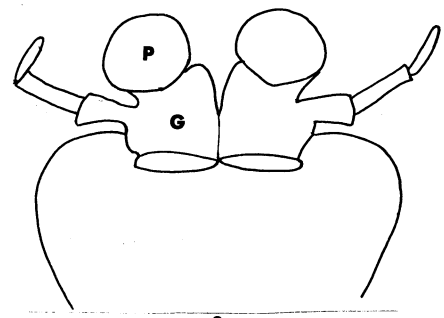

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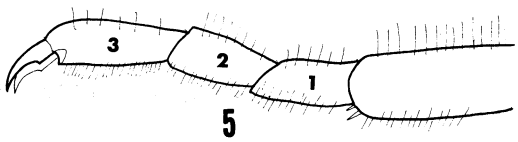

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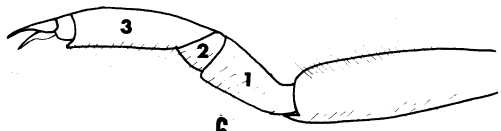

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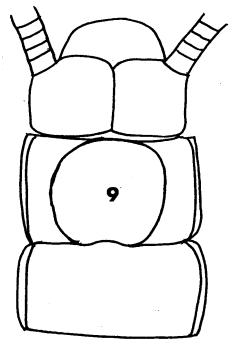

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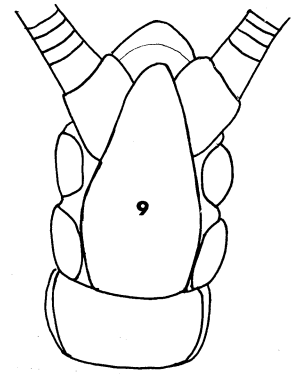

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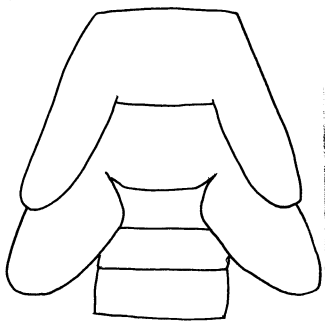

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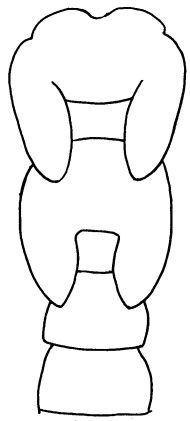

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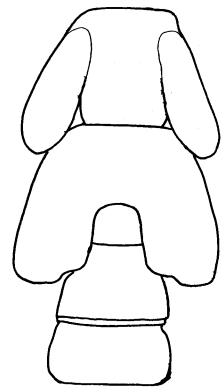

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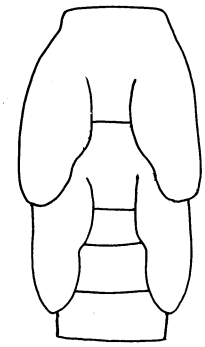

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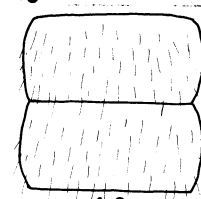

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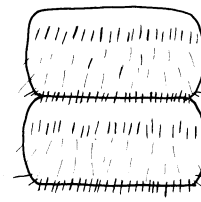

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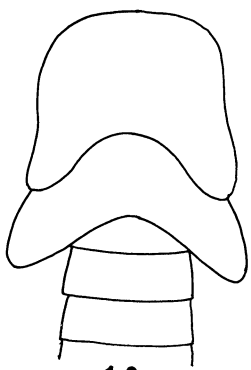

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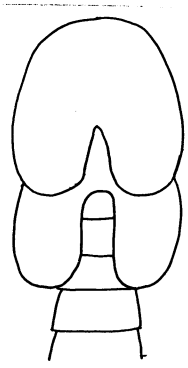

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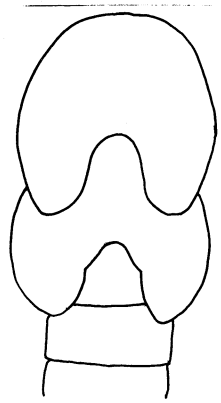

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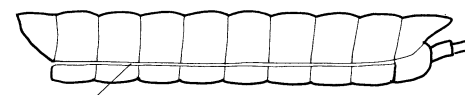

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Plate II

Figure 20. Head of *Atoperla*.

Figure 21. Head of *Perlinella* showing location of anterior ocellus (AO) and posterior ocelli (PO).

Figure 22. Head of *Neoperla* showing occipital ridge (OR).

Figure 23. Head of *Perlesta*.

Figure 24. Head of *Acroneuria*.

Figure 25. Dorsal view of posterior of *Paragnetina*.

Figure 26. Dorsal view of posterior of *Phasganophora* showing subanal gills (G).

Figure 27. Labium of *Isogenus* showing submental gills (G).

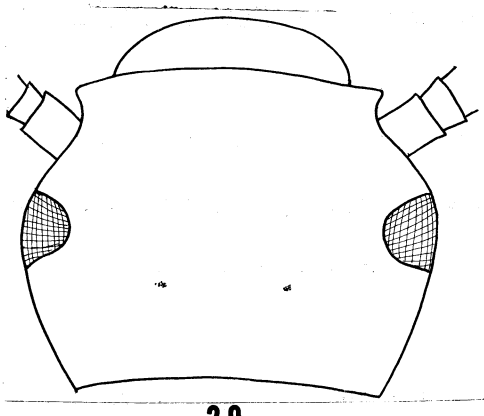
Figure 28. Labium of *Isoperla*.

Figure 29. Mesosternum of *Isogenus* (in part) showing location of furcal pits (FP) and Y-ridge (Y).

Figure 30. Mesosternum of other *Isogenus*.

Figure 31. Mesosternum of *Arcynopteryx*.

PLATE II



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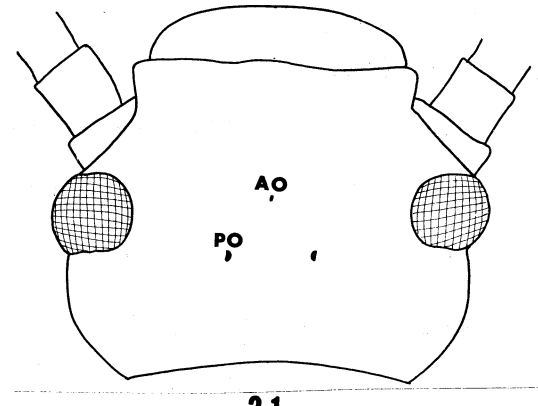

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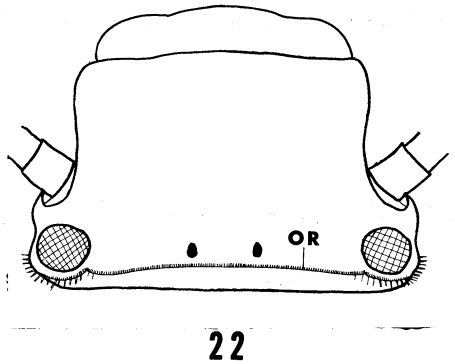

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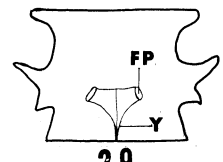

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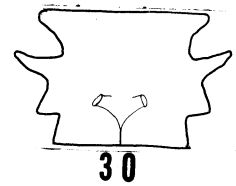

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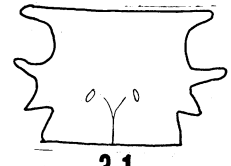

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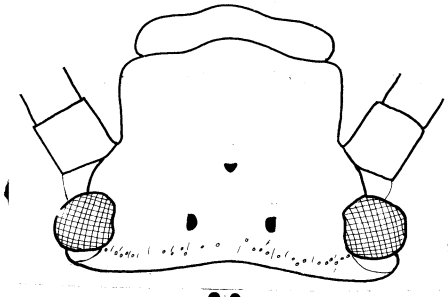

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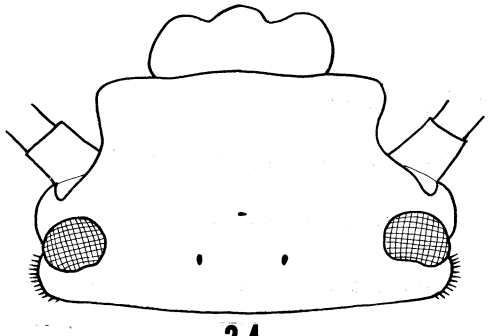

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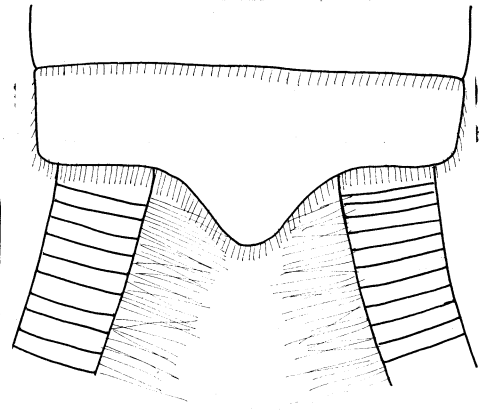

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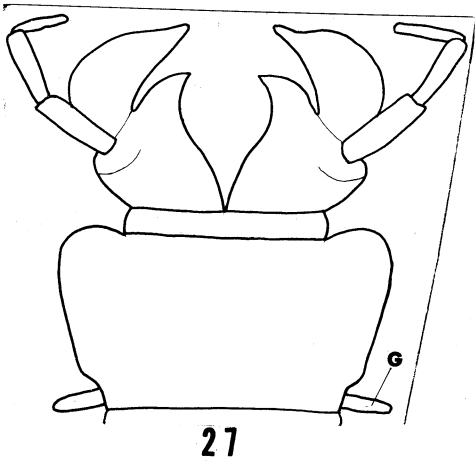

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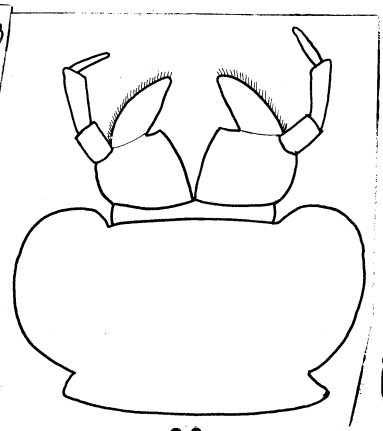

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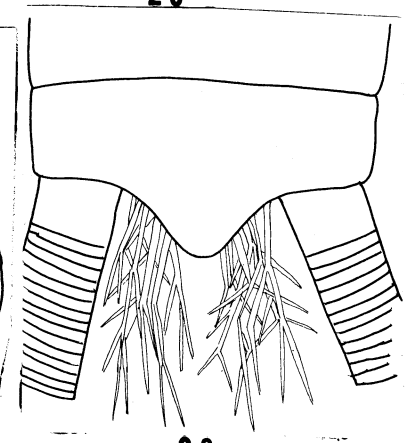

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Notes

CAPNIIDAE

Allocapnia - 7 species (granulata, illinoensis, minima, nivicola, pygmaea, rickeri, vivipara)

These are the "winter stoneflies" that emerge from February to early April. They are abundant in a variety of permanent and temporary streams, and the nymphs can be collected from stones and debris only from November to April.

Capnia - 1 species (vernalis)

This genus has not yet been collected in Wisconsin, but should occur in the north. The nymphs normally inhabit medium-sized streams, and emergence occurs in April and May.

Paracapnia - 2 species (angulata, opis)

The nymphs are common in permanent streams of all sizes where they may be collected from September to April from rocks and debris. Emergence occurs mostly during April.

CHLOROPERLIDAE

Alloperla - 3 species (caudata, imbecilla, quadrata)

The nymphs of this genus normally inhabit rapid streams, and would probably be present from September to July, but none have been collected in Wisconsin. Emergence occurs from May to August, depending on the species.

Hastaperla - 2 species (brevis, orpha)

The nymphs are fairly common in permanent streams of all sizes and may be collected from November to June. The adults emerge from late in May to July.

LEUCTRIDAE

Leuctra - 5 species (includes Zealeuctra) (decepta, hamula, narfi, sibleyi, tenuis)

Because the different species have emergence times ranging from May to

August, the nymphs of one or more species may be found throughout the year. They are relatively uncommon in permanent streams of all sizes, and are usually associated with debris.

NEMOURIDAE

Nemoura - 9 species (completa, delosa, linda, nigritta, rotunda, similis, trispinosa, vallicularia, varshava)

Emergence occurs from April to August, depending on the species. They have a one-year life cycle, but the nymphs of various species can be found throughout the year. They are fairly common in debris in permanent streams of all sizes.

PERLIDAE

Acroneuria - 4 species (abnormis, internata, lycorias, ruralis)

Collections indicate the life cycle of all the species is two years, so nymphs of various sizes can be found throughout the year. They commonly inhabit permanent streams of all sizes, and are most abundant on rocks and other substrates in very fast, well-oxygenated water. The adults emerge from May to July.

Atoperla - 1 species (ephyre)

The life cycle is probably one year, with emergence in June and July. The nymphs can be found from September to July on stones and gravel in medium to large streams with a rapid current, but they are rare.

Neoperla - 1 species (clymene)

The nymphs can be collected throughout most of the year from rocks in medium and large streams, but they are uncommon. The life cycle is probably one year, with emergence in June and early July.

Paragnetina - 1 species (media)

The only species has a two-year life cycle, with emergence in June and July.

The nymphs are common year-around on rocks in very rapid streams.

Perlesta - 1 species (placida)

Emergence occurs from June to August, and the nymphs have been collected only from April to July. They are common in many permanent streams with a moderate current and a bottom containing sand.

Perlinella - 1 species (drymo)

The nymphs have been found from August to May in the gravel riffles of medium to large streams, but they are rare. Emergence occurs mostly in May.

Phasganophora - 1 species (capitata)

The life cycle is probably two years, with adults emerging in June and July. The nymphs are commonly found year-around on rocks in the fast water of medium and large streams.

PERLODIDAE

Arcynopteryx - 1 species (compacta)

One species may occur in the vicinity of Lake Superior, but it has not yet been collected in Wisconsin.

Isogenus - 8 species (decisus, doratus, frontalis, krumholzi, nalatus, olivaceus, subvarians, varians)

The nymphs have been found from September to May, with the adults emerging in May and June. The nymphs may be fairly common in some very fast and cold streams.

Isoperla (Perlodidae) - 17 species (bilineata, confusa, cotta, dicala, emarginata, lata, longiseta, marlynia, maxana, minuta, montana, orata, richardsoni, signata, slossonae, transmarina, truncata)

The nymphs commonly inhabit a wide variety of streams where they are found in debris or on rocks and vegetation from October to July. The life cycle is one year, with the various species emerging from May to July.

PTERONARCIDAE

Pteronarcys - 2 species (dorsata, pictetii)

The life cycle in this genus is two or three years, with emergence occurring mostly in April and May. Because of the long life cycle, nymphs can be found throughout the year in permanent streams of all sizes. They are most frequently collected from debris, and although most common where there is a rapid current, they may also occur in areas of reduced current.

TAENIOPTERYGIDAE

Brachyptera - 2 species (fasciata, glacialis)

Nymphs can be collected from October to April, with emergence occurring mostly in late March and early April. The nymphs are fairly common in the rock riffles of streams of all sizes.

Taeniopteryx - 3 species (burksi, nivalis, parvula)

The nymphs may be abundant from October to April in debris and on the bank vegetation of many permanent streams, especially those in the northern half of the state. They have a one-year life cycle, with emergence occurring in late March and early April when ice may still cover much of the stream.

Otter Creek, Sauk Co., Wisconsin. This portion of the stream is inhabited by Allocapnia pygmaea, A. rickeri, Paracapnia angulata, Leuctra sibleyi, Zealeuctra narfi, Nemoura delosa, N. similis, Acroneuria lycorias, Paragnetina media, Isoperla confusa, I. dicala, I. orata, and Taeniopteryx nivalis.

Popple River, Florence Co., Wisconsin. This portion of the stream is inhabited by Brachyptera fasciata, B. glacialis, Taeniopteryx burksi, T. parvula, Allocapnia minima, A. pygmaea, Paracapnia angulata, Acroneuria abnormis, A. internata, A. lycorias, Paragnetina media, Phasganophora capitata, Isoperla dicala, I. signata, I. transmarina, I. truncata and Hastaperla brevis.

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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 prominant 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..... SIPHLONURIDAE 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) ..... Siphlonurus

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

Figure 4. Potamanthus, prothoracic leg

Figure 5. Hexagenia, frontal process (FP)

Figure 6. Ephemera simulans, frontal process (FP)

Figure 7. Tortopus incertus, dorsal view of right mandibular tusk

Figure 8. Ephoron leukon, dorsal view of right mandibular tusk

Figure 9. Ephemera simulans, lateral view of right mandibular tusk

Figure 10. Baetisca obesa, dorsal view

Figure 11. Stenonema vicarium, dorsal view of head

Figure 12. Siphlonurus alternatus, dorsal view of head

Figure 13. Pseudiron centralis, ventral view of gill on abdominal segment 3 (after Burks 1953)

Figure 14. Arthroplea bipunctata, dorsal view of head showing maxillary palpi (MP)

Figure 15. Rhithrogena pellucida, ventral view of abdomen showing gills (G)

Figure 16. Anepeorus, gill on abdominal segment 5 (after Burks 1953)

Figure 17. Stenonema vicarium, dorsal view of left half of abdominal segments 6 - 10

Figure 18. Heptagenia diabasia, dorsal view of right half of abdominal segments 6 - 10

Figure 19. Isonychia, prothoracic leg with basal gill tuft (G)

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

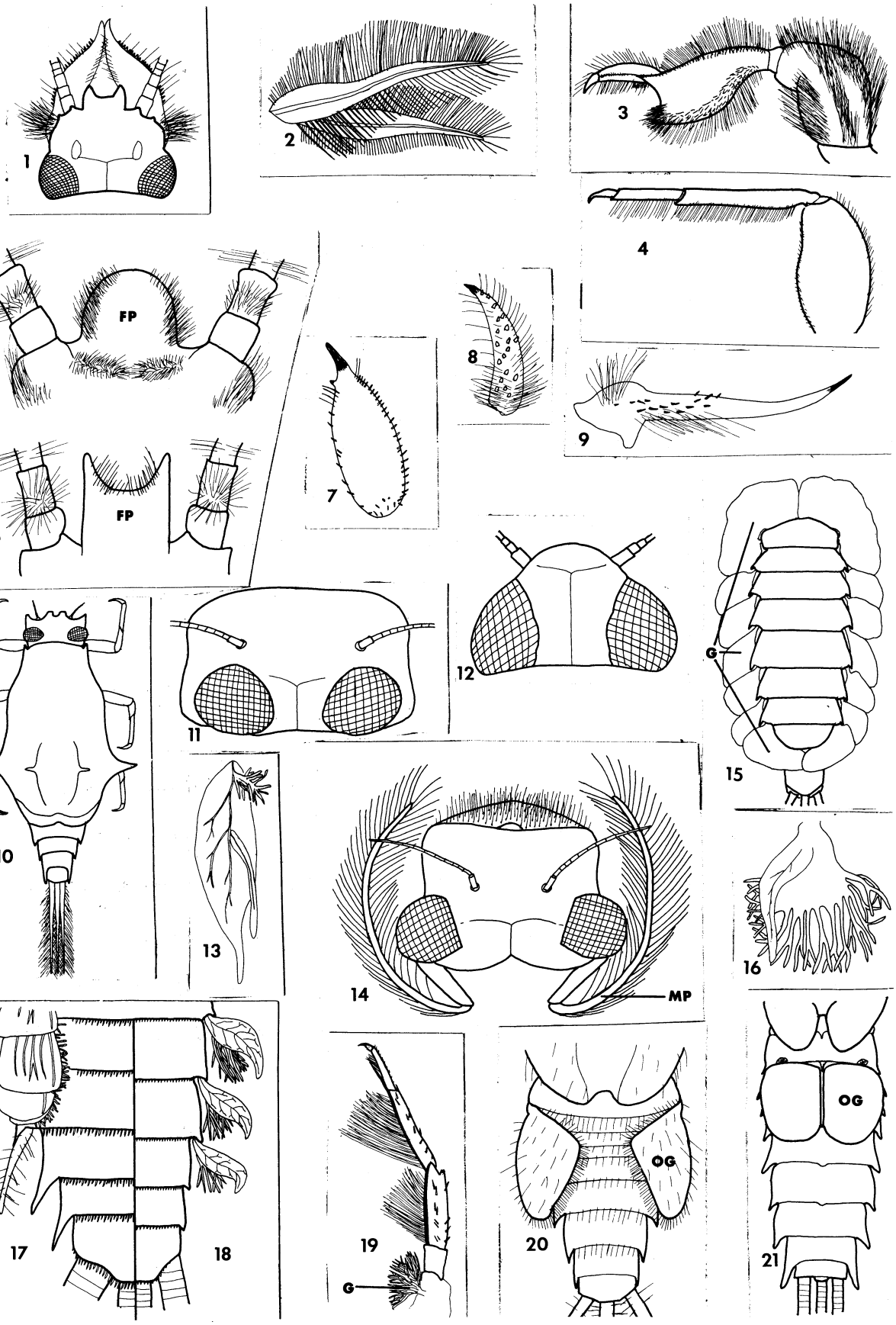

PLATE II

Figure 22. *Caenis*, dorsal view of abdomen showing operculate gills (OG)

Figure 23. *Brachycentrus nitidus*, dorsal view of head

Figure 24. *Ephemerella bicolor*, dorsal view of abdomen

Figure 25. *Siphloplecton interlineatum*, prothoracic leg

Figure 26. *Siphloplecton interlineatum*, metathoracic leg

Figure 27. *Habrophlebia vibrans*, gill of abdominal segment 5 (after Burks 1953)

Figure 28. *Paraleptophlebia mollis*, gill of abdominal segment 1

Figure 29. *Paraleptophlebia mollis*, gill of abdominal segment 3

Figure 30. *Leptophlebia cupida*, gill of abdominal segment 1

Figure 31. *Leptophlebia cupida*, gill of abdominal segment 3

Figure 32. *Choroterpes basalis*, gill of abdominal segment 1

Figure 33. *Choroterpes basalis*, gill of abdominal segment 3

Figure 34. *Habrophlebiodes*, labrum

Figure 35. *Habrophlebiodes*, dorsal view of abdominal segments 8 - 10

Figure 36. *Paraleptophlebia debilis*, labrum

Figure 37. *Paraleptophlebia debilis*, dorsal view of abdominal segments 8 - 10

Figure 38. *Ameletus lineatus*, dorsal view of abdominal segments 8 - 10

Figure 39. *Siphlonurus alternatus*, dorsal view of abdominal segments 8 - 10

Figure 40. *Baetis brunneicolor*, dorsal view of abdominal segments 8 - 10

Figure 41. *Callibaetis fluctuans*, dorsal view of abdominal segments 8 - 10

Figure 42. *Siphlonurus alternatus*, dorsal view of gill on left side of abdominal segment 3

Figure 43. *Ameletus lineatus*, dorsal view of gill on right side of abdominal segment 5

(Legend continued on page 30)

PLATE II

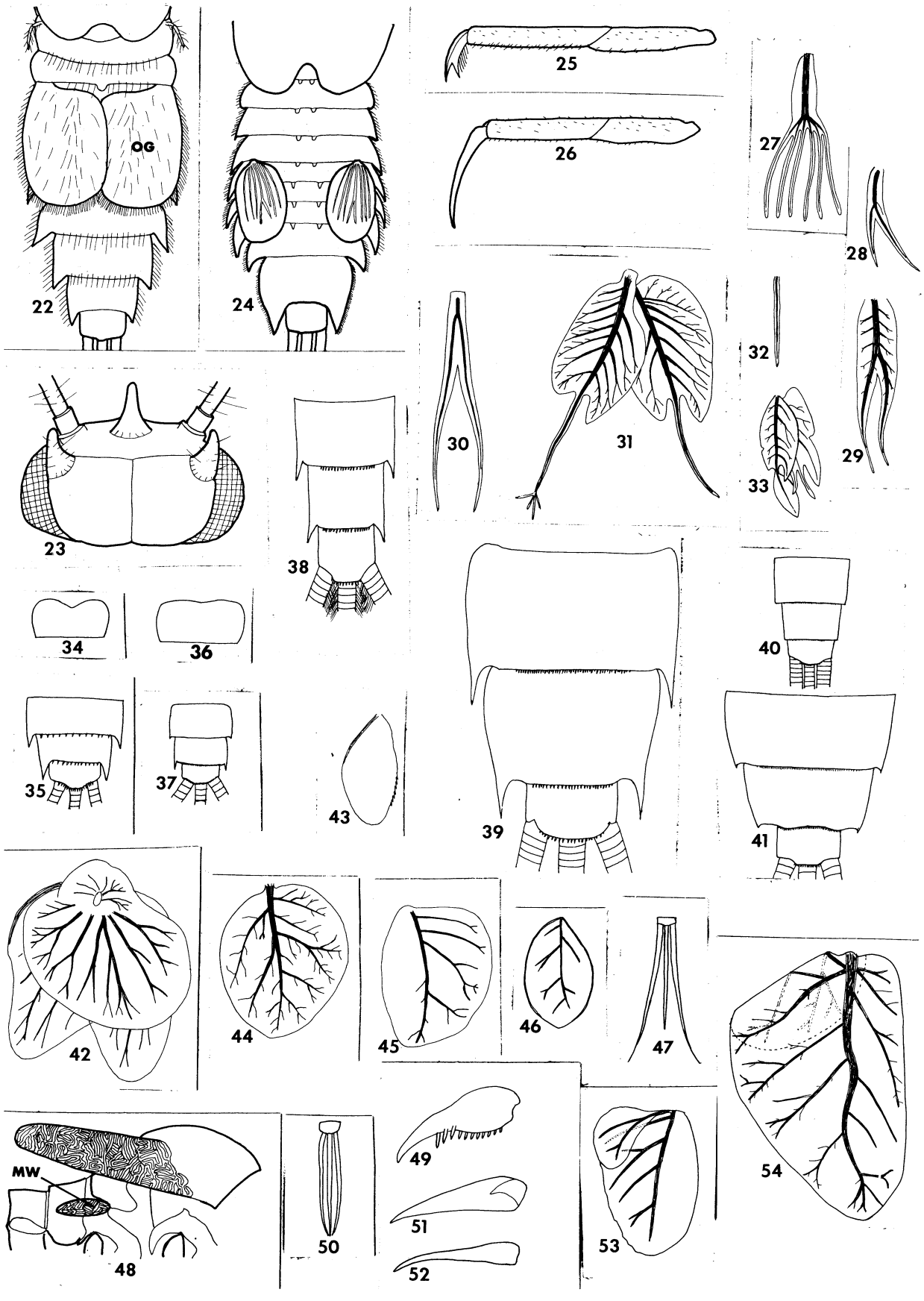
OG
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Figure 44. Parameletus, dorsal view of gill on abdominal segment 3

Figure 45. Neocloeon alamance, dorsal view of gill on left side of abdominal segment 3

Figure 46. Baetis frondalis, dorsal view of gill on left side of abdominal segment 3

Figure 47. Baetis brunneicolor, tail filaments

Figure 48. Baetis brunneicolor, lateral view of meso- and meta-thorax and abdominal segments 1 and 2 showing metathoracic wing pads (MW)

Figure 49. Baetis brunneicolor, tarsal claw of mesothoracic leg

Figure 50. Centroptilum bellum, tail filaments

Figure 51. Centroptilum bellum, tarsal claw of mesothoracic leg

Figure 52. Neocloeon alamance, tarsal claw of mesothoracic leg

Figure 53. Centroptilum bellum, dorsal view of gill on right side of abdominal segment 3

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, frivolus, 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.

Cloeon - 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, ellioti, ida, minutum, parvulum, punctiventris)

The prefered 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, prudentalis, 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, sanquinea)

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

Neoephemera - 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.

SIPHLONURIDAE

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.

Siphlonurus - 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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TRICHOPTERA

Introduction

The taxonomy of the larvae of Trichoptera is in a deplorable state. Wiggins (1964) determined that of about 1000 species of caddisflies known from the United States and Canada, the larval stage of fewer than 20% had been described. Even at the generic level, the larval stages of about 30% of the genera were totally unknown (Wiggins 1966). In recent years there has been some improvement in this situation, but a great deal of work still needs to be done.

The generic keys by Ross (1944), Pennak (1952), and Denning (1956) have proved inadequate for identifying Trichoptera larvae collected in Wisconsin. The best larval key is that by Ross (1959), but even parts of this key lead to serious difficulties.

Below, is an illustrated key to the genera of Trichoptera larvae in Wisconsin. It is based on the key by Ross (1959), but includes many changes. These changes were the result of more recent keys by Flint (1960, 1961, 1964) and Wiggins (1960, 1965), and studies of larvae collected in Wisconsin. This key is intended for use in Wisconsin and adjacent states and does not include many genera that occur in the western, southern, and mountain regions of North America. Some of the characters that are used are specific and not generic in nature, and would not apply in areas where other species occur. The larvae of Cernotina, Leptophylax, Fabria, and Hagenella are still unknown in North America and are not included in the key.

Following the key, additional information on the 69 genera suspected to occur in Wisconsin is summarized. On the basis of collections made in Illinois (Ross 1944), Michigan (Leonard and Leonard 1949), and Minnesota (Etnier 1965), 272 species that may occur in Wisconsin are listed. Of these,

173 species have been positively identified from Wisconsin as adults (Ross 1944, Longridge and Hilsenhoff 1970) and are marked with asterisks. When only a positive generic identification has been made, the genus is marked with an asterisk. The abundance of each genus in Wisconsin has been subjectively evaluated on the basis of collections since 1961, but these evaluations refer to the state-wide picture, and most genera can occasionally be collected abundantly in localized areas.

Key to the Trichoptera Larvae of Wisconsin

1a. Each thoracic segment covered with a single dorsal plate, which may have a mesal or transverse fracture line..... 2

1b. Metanotum mostly membranous, having only scattered hairs or small plates, or divided into 2 or more sclerites..... 19

2a. Abdomen with rows of branched gills; no portable case.. HYDROPSYCHIDAE 3

2b. Abdomen without gills, and usually much enlarged; larvae less than 5mm long and usually in barrel- or purse-like cases which may be attached to the substrate..... HYDROPTILIDAE 9

3a. Head with a broad, depressed, flat, dorsal area surrounded by an extensive arcuate carina (Fig. 1); anterior margin of fore tibiae and tarsi with a dense brush of pale setae..... Macronomum

3b. Head not as above; fore tibiae and tarsi without setal brush..... 4

4a. Fore trochantin forked (Fig. 2)..... 5

4b. Fore trochantin simple (Fig. 3)..... 6

5a. Prosternal plate with a pair of detached, moderate-sized, posterior sclerites (Fig. 4)..... Hydropsyche

5b. Prosternal plate with at most a pair of detached, very minute, sclerotized dots (Fig. 5)..... Cheumatopsyche

6a. Genae completely separated by an elongate gula (Figs. 6,7)..... 7

6b. Gula triangular and short, or virtually absent; genae fused for most of their length (Figs. 8,9)..... 8

7a. Gula with sides nearly parallel (Fig. 6); abdomen with short, black scalelike setae on dorsum and arranged in tufts along posterior margin..... Parapsyche

7b. Gula narrowed posteriorly (Fig. 7); abdomen with only coarse hairs of varying lengths, never in tufts..... Arctopsyche

8a. Meso- and metanotum entire; mentum cleft (Fig. 8)..... Potamyia

8b. Meso- and metanotum divided by transverse fracture line in posterior third; mentum subconical, not cleft (Fig. 9)..... Diplectrona

9a. Abdomen enlarged, at least some part of it much thicker than thorax (Fig. 10)..... 10

9b. Abdomen slender, not appreciably thicker than thorax; no case (early instars)..... Not Keyed

10a. Each abdominal segment with a small, dark, dorsal sclerite (Fig. 10); case translucent, ovoid, and flattened (Fig. 11a).. ..... Leucotrichia

10b. Abdominal segments 2 to 7 without dark, dorsal sclerites, at most with a small delicate ring or very pale sclerites..... 11

11a. Abdominal segments with conspicuous dorsal and ventral projections (Fig. 12)..... Ithytrichia

11b. Abdominal segments without dorsal and ventral projections..... 12

12a. Middle and hind legs almost 3 times as long as front legs (Fig. 13)..... Oxyethira

12b. Middle and hind legs not more than 1 1/2 times as long as front legs (Figs. 14,15)..... 13

13a. Tarsal claws about same length as tarsi (Figs. 14,15,16); case purselike (Figs. 11c,d,e)..... 14

13b. Tarsal claws much shorter than tarsi (Fig. 17); case not purselike, more barrel-shaped (Figs. 11f,g,h)..... 17

14a. Tarsal claws with long, stout, inner tooth (Fig. 16); larvae robust; case purse-like (Fig. 11c)..... Stactobiella

14b. Tarsal claws without stout inner tooth; case either purse-like or cylindrical..... 15

15a. Hind tibia twice as long as deep (Fig. 14)..... Agraylea

15b. Hind tibia about as long as deep (Fig. 15)..... 16

16a. Metanotum with setae at antero-ventral angle (Fig. 18); abdominal tergites often with inconspicuous, pale, rectangular sclerites..... Hydroptila

16b. Metanotum with setae dorsad of antero-ventral angle (Fig. 19); abdominal tergites with inconspicuous sclerotized mesal rings (Fig. 20)..... Ochrotrichia

17a. Anal legs apparently combined with body mass (Fig. 21); eighth abdominal tergite with only one or two pairs of weak setae (Fig. 22)..... Orthotrichia

17b. Anal legs distinctly projecting from body mass (Fig. 23); eighth abdominal tergite with many setae (Fig. 24)..... 18

18a. Thoracic tergites clothed with long, slender, erect, inconspicuous setae (Fig. 25); case of sand grains and evenly tapered (Fig. 11g)..... Neotrichia

18b. Thoracic tergites clothed with shorter, stout, black setae, which are conspicuous (Fig. 26); case evenly tapered, semi-translucent, and with dorsal side fluted with raised ridges (Fig. 11h)..... Mayatrichia

19a. Meso- and metanotum entirely membranous, or (in Oligostomis) with only weak sclerites on mesonotum at SA1 (for location of SA1 and other setal areas see Fig. 51)..... 20

19b. Meso- and often metanotum with some conspicuous sclerotized plates..... 38

20a. Abdominal segment 9 with dorsum entirely membranous; no portable cases..... 21

20b. Abdominal segment 9 bearing a sclerotized dorsal plate; with or without cases..... 30

21a. Labrum membranous and T-shaped (Fig. 27)..... PHILOPOTAMIDAE 22

21b. Labrum sclerotized and widest near base (Fig. 36)..... PSYCHOMYIIDAE 24

22a. Apex of fronto-clypeus deeply emarginate, often with a large or pointed left lobe and a smaller right one (Fig. 27)..... Chimarra

22b. Apex of fronto-clypeus at most slightly asymmetrical (Figs. 28,29)..... 23

23a. Fronto-clypeus almost perfectly symmetrical, widened abruptly near anterior margin (Fig. 28)..... Wormaldia

23b. Fronto-clypeus slightly asymmetrical, anterior portion uniformly widened (Fig. 29)..... Dolophilodes

24a. Fore trochantin broad, hatchet-shaped (Fig. 30)..... 29

24b. Fore trochantin pointed (Fig. 31)..... 25

25a. Tarsi broad and densely pilose (Fig. 32); mandibles short and triangular, each with a large, thick mesal brush (Fig. 33)..... Phylocentropus

25b. Tarsi with little or no pile (Fig. 34); mandibles elongate and with only a thin brush on left mandible, none on right (Fig. 35)..... 26

26a. Muscle scars of head darker than surroundings (Fig. 36)..... 28

26b. Muscle scars of head as pale or paler than surroundings..... 27

27a. Anal claw with well-developed ventral teeth (Figs. 38).... Nyctiophylax

27b. Anal claw without ventral teeth (Fig. 37)..... Cyrnellus

28a. Basal segment of anal proleg without setae (Fig. 39)..... Neureclipsis

28b. Basal segment of anal proleg with several setae (Fig. 40)..... Polycentropus

29a. Anal claw with several long teeth ventrally (Fig. 41); mentum with a pair of high, quadrangular sclerites (Fig. 42) Psychomyia

29b. Anal claw lacking ventral teeth (Fig. 43); mentum with a pair of wide, short sclerites (Fig. 44)..... Lype

30a. SA3 on meso- and metanotum consisting of a cluster of setae (Figs. 53,55,56,57); head with conspicuous, longitudinal, dark stripes dorsally (Figs. 53,55,56,57); case of vegetable matter is readily vacated..... PHRYGANEIDAE 34

30b. SA3 on meso- and metanotum consisting of a single seta (Figs. 49,51,52); no dark stripes on head..... 31

31a. Anal claw long, about as long as elongate sclerite on anal leg (Fig. 45); fore trochantin conspicuous; no portable case..... RHYACOPHILIDAE, Rhyacophila

31b. Anal claw small, much shorter than elongate sclerite on anal leg (Fig. 46); fore trochantin difficult to distinguish; saddle-shaped or turtle-like case (Fig. 47)..... GLOSSOSOMATIDAE 32

32a. Anal claw divided into many teeth (Fig. 48); meso- and metanotum with only one dorsal pair of hairs in addition to those at SA3 (Fig. 49); less than 4mm long..... Protoptila

32b. Anal claw with 1 large tooth, and 1 or 2 small ones (Fig. 50); mesonotum and usually metanotum with setae at both SA1 and SA2 (Figs. 51,52)..... 33

33a. Pronotum notched only at extreme anterolateral angle, at which point the legs are attached (Fig. 51); setae only at SA2 and SA3 on abdominal tergites..... Glossosoma

33b. Pronotum narrow from anterior margin to middle, legs attached at middle (Fig. 52); several abdominal tergites with setae at SA1, SA2, and SA3..... Agapetus

34a. SA1 of mesonotum with brownish-yellow sclerites (Fig. 53); case a series of rings (Fig. 54a)..... Oligostomis

34b. SA1 of mesonotum membranous..... 35

35a. Pronotum with a semi-circular dark stripe behind anterior pale margin (Fig. 55); case a series of rings (Fig. 54a)..... Ptilostomis

35b. Pronotum either with diagonal dark stripes or a dark anterior margin (Figs. 56-58); case built as a single spiral (Fig. 54b).....36

36a. Meso- and metanotum with two irregular, longitudinal dark bands, separated by a pale area (Fig. 56); pronotum with dark stripes converging posteriorly (Fig. 56)..... Banksiola

36b. Meso- and metanotum with fairly uniform pigmentation..... 37

37a. Anterior margin of pronotum bordered with black, followed by a dark brown band of variable width (Fig. 57); a dark stripe on fronto-clypeus (Fig. 57); posteroventral surface of fore and middle coxae with numerous, distinct, projecting scales..... Phryganea

37b. Pronotum either with diagonal dark stripes or a brown anterior margin (Fig. 58); fronto-clypeus with or without a dark stripe; scales on fore coxae small but distinct, those on middle coxae indistinct..... Agrypnia

38a. Mesonotum membranous, except for a pair of sclerotized, narrow, curved or angled bars (Fig. 59); cases ovate or convex..... LEPTOCERIDAE, Athripsodes

38b. Mesonotum without such a pair of sclerotized bars..... 39

39a. Antennae long, at least 8 times as long as wide, and arising near base of mandibles (Fig. 64)..... LEPTOCERIDAE 40

39b. Antennae very short, not more than 4 times as long as wide, often very inconspicuous and arising at various points (Figs. 80,93)..... 46

40a. Middle legs with claw stout and hook-shaped, tarsus bent (Fig. 61); case slender and transparent (Fig. 60b)..... Leptocerus

40b. Middle legs with claw slender, slightly curved, tarsus straight (Fig. 62); case seldom transparent..... 41

41a. Mandibles long, sharp at apex, teeth considerably below apex (Fig. 63); maxillary palpi nearly as long as stipes (Fig. 64).. Oecetis

41b. Mandibles shorter, blunt at apex, teeth near or at apex (Fig. 59); maxillary palpi usually short..... 42

42a. Head with suturelike pale areas paralleling arms of epicranial suture (Fig. 59)..... Athripsodes

42b. Head without a suturelike pale area in addition to epicranial arms..... 43

43a. Anal segment developed into a pair of sclerotized, concave plates, with spinose dorsolateral and mesal carinae, and an overhanging ventral flap (Fig. 65); case slender..... Setodes

43b. Anal segments convex and without carinae between anal hooks..... 44

44a. Hind tibiae with a fracture near middle which appears to divide tibiae into 2 segments (Figs. 66,67)..... 45

44b. Hind tibiae entirely sclerotized, without a fracture in middle (Fig. 62); case elongate, of various materials (Fig. 60c),.. Leptocella

45a. Hind tibiae with a regular fringe of long hair (Fig. 66); case elongate, made of spirally arranged bits of vegetation (Fig. 60d)..... Triaenodes

45b. Hind tibiae with only irregularly placed hairs (Fig. 67); case elongate, of sand, stones, or vegetation, often with pieces projecting beyond opening (Fib. 60e)..... Mystacides

46a. Claws of hind legs very small, those of middle and front legs long (Fig. 68); case of sand with lateral flanges (Fig. 69)..... MOLANNIDAE, Molanna

46b. Claws of hind legs as long as those of middle legs..... 47

47a. Pronotum divided by a sharp furrow across middle, the portion in front of furrow depressed (Fig. 70)..... BRACHYCENTRIDAE 48

47b. Pronotum with at most a shallow furrow..... 49

48a. Mesonotum with 4 elongate sclerites, plates of metanotum heavily sclerotized (Fig. 71); hind coxae with a ventral, semi-circular lobe bearing a row of long setae (Fig. 72)..... Brachycentrus

48b. Mesonotum with 2 very wide sclerites that may be longitudinally divided near lateral margin, plates of metanotum only lightly sclerotized (Fig. 73); hind coxae without a ventral lobe bearing a row of setae (Fig. 74)..... Micrasema

49a. Anterolateral margins of pronotum produced into long, sharp, forward-projecting points (Figs. 75,77,78)..... 50

49b. Anterolateral margins of pronotum not produced into long points..... 52

50a. Mesonotum divided into 2 pairs of plates (Fig. 75); lateral plates of mesothorax with anterior margins formed into long projecting sclerites (Fig. 75); case tubular, of sand with pebbles along side (Fig. 76)..... GOERIDAE, Goera

50b. Mesonotal plate divided only by a mesal fracture line (Figs. 77,78); case tubular, slightly curved, and of sand grains (Fig. 79)..... 51

51a. Fore trochantin produced as a short, curved point; four weakly sclerotized plates on metanotum at SA1 and SA2 (Fig. 77); basal gill tufts with 5 or fewer gills; tibiae and tarsi tan; case readily crushed..... SERICOSTOMATIDAE, Sericostoma

51b. Fore trochantin not produced beyond edge of coxa; 3 sclerotized plates on metanotum, SA1 combined to form a thin plate, with separate plates at SA3 (Fig. 78); basal gill tufts of 10 or more fine gills; tibiae and tarsi black; case extremely hard... ..... ODONTOCERIDAE, Psilotreta

52a. Antennae very close to eyes (Fig. 80); no dorsal spacing tubercle on abdominal segment 1; case usually of bits of vegetable matter (Fig. 81)..... LEPIDOSTOMATIDAE, Lepidostoma

52b. Antennae about mid-way between eye and base of mandible (Fig. 88); dorsal spacing tubercle usually prominent..... 53

53a. Spiral case of sand grains or tiny stones and resembling a snail shell (Fig. 82); larvae almost always remaining in case; metanotum with large sclerites that tend to coalesce (Fig. 83); lateral spacing tubercles with about 200 tiny, sclerotized, flat scales; anal claw with many teeth (Fig. 84)..... ..... HELICOPSYCHIDAE, Helicopsyche

53b. Case not spiral-shaped; SA1, SA2, and SA3 of metanotum with small plates or setae (Figs. 86,87)..... LIMNEPHILIDAE 54

54a. All gills single..... 55

54b. Most gills in clusters of 2 or more..... 60

55a. Femora, tibiae, and tarsi annulate with black (Fig. 85)... Psychoglypha

55b. Legs lacking contrasting annuli..... 56

56a. Anterior margin of mesonotum with a mesal rectangular emargination (Fig. 86); head elongated; case of sand grains and tiny stones (Fig. 94a)..... Neophylax

56b. Mesonotum without a mesal emargination; head nearly ovoid..... 57

57a. Anterior metathoracic plates replaced by a transverse row of setae (Fig. 87); case cornucopia-shaped of sand grains, with larger grains laterally..... Apatania

57b. Anterior metathoracic plates present..... 58

58a. Head brown with inconspicuous muscle scars posteriorly (Fig. 88); case of small sand grains, slightly tapered and curved (Fig. 94b)..... Pseudostenophylax

58b. Head pale with dark scars and blotches; cases usually of vegetable matter..... 59

59a. Abdominal segments 2-7 with ventral rings (Fig. 89)..... Hydatophylax

59b. Abdominal segments 3-7 with ventral rings (Fig. 90)..... Pycnopsyche

60a. Some gills in clusters of 4 or more..... 61

60b. No gills in clusters of more than 3..... 63

61a. Gills on basal segments arising in clusters of 10-15; case slightly curved and usually of wood fragments (Fig. 94d).....Ironoquia

61b. Fewer gills in clusters on basal segments..... 62

62a. Gills on basal segments in clusters of 6-8; case of sand grains (Fig. 94c)..... Hesperophylax

62b. Some gills on basal segments in clusters of 4, never 6; case of vegetable matter (Fig. 94f)..... Onocosmoecus

63a. Legs with contrasting black annuli, case of sticks..... Glyphopsyche

63b. Legs not annulate.....64

64a. Pronotum with numerous pale setae along anterior margin; setae on bulbous ventral portion of prolegs (Fig. 91); head almost uniformly brown with light muscle scars posteriorly; case of stones or sand (Fig. 94e)..... Frenesia

64b. Pronotum lacking pale setae along anterior margin; no setae on prolegs..... 65

65a. Head yellow with a dark stripe centrally on the fronto-clypeus and a dark U-shaped band on genae (Fig. 92); case of leaves or other vegetation..... Nemotaulius

65b. Head marked either with spots and infuscations, or mostly darkened, or with a V-shaped dark band on genae, cases extremely variable.....66

66a. Prosternal horn extending beyond apices of fore coxae (Fig. 93); head pale with dark spots; case usually of vegetation placed transversely (Fig. 94g)..... Platycentropus

66b. Prosternal horn at most reaching apices of fore coxae; head marked variously, pale with dark spots in some species; cases variable in material and construction, some similar to Platycentropus..... Limnephilus

Plate I

Figure 1. Macronemum, dorsal view of head showing arcuate carina (C).

Figure 2. Cheumatopsyche, lateral view of prothorax showing fore trochantin (T).

Figure 3. Parapsyche, lateral view of prothorax showing fore trochantin (T).

Figure 4. Hydropsyche, prosternum.

Figure 5. Cheumatopsyche, prosternum.

Figure 6. Parapsyche, ventral view of head.

Figure 7. Arctopsyche, ventral view of head.

Figure 8. Potamyia, ventral view of head.

Figure 9. Diplectrona, ventral view of head.

Figure 10. Leucotrichia, dorsal view.

Figure 11. Hydroptilidae, cases of a. Leucotrichia, b. Oxyethira, c. Stactobiella, d. Hydroptila, e. Ochrotrichia, f. Orthotrichia, g. Neotrichia, h. Mayatrichia.

Figure 12. Ithytrichia, lateral view.

Figure 13. Oxyethira, a. middle leg, b. front leg.

Figure 14. Agraylea, a. hind leg, b. front leg.

Figure 15. Hydroptila, a. hind leg, b. front leg.

Figure 16. Stactobiella, hind tibia and tarsus.

Figure 17. Orthotrichia, hind leg.

Figure 18. Hydroptila, lateral view of metanotum.

Figure 19. Ochrotrichia, lateral view of metanotum.

Figure 20. Ochrotrichia, dorsal view of abdominal segment 3.

Figure 21. Orthotrichia, lateral view of abdominal segments 8-10.

Figure 22. Orthotrichia, dorsal view of abdominal segments 8-9.

Figure 23. Neotrichia, lateral view of abdominal segments 7-10.

Figure 24. Neotrichia, dorsal view of abdominal segments 7-9.

Figure 25. Neotrichia, dorsal view of thorax.

Figure 26. Mayatrichia, dorsal view of thorax.

PLATE I

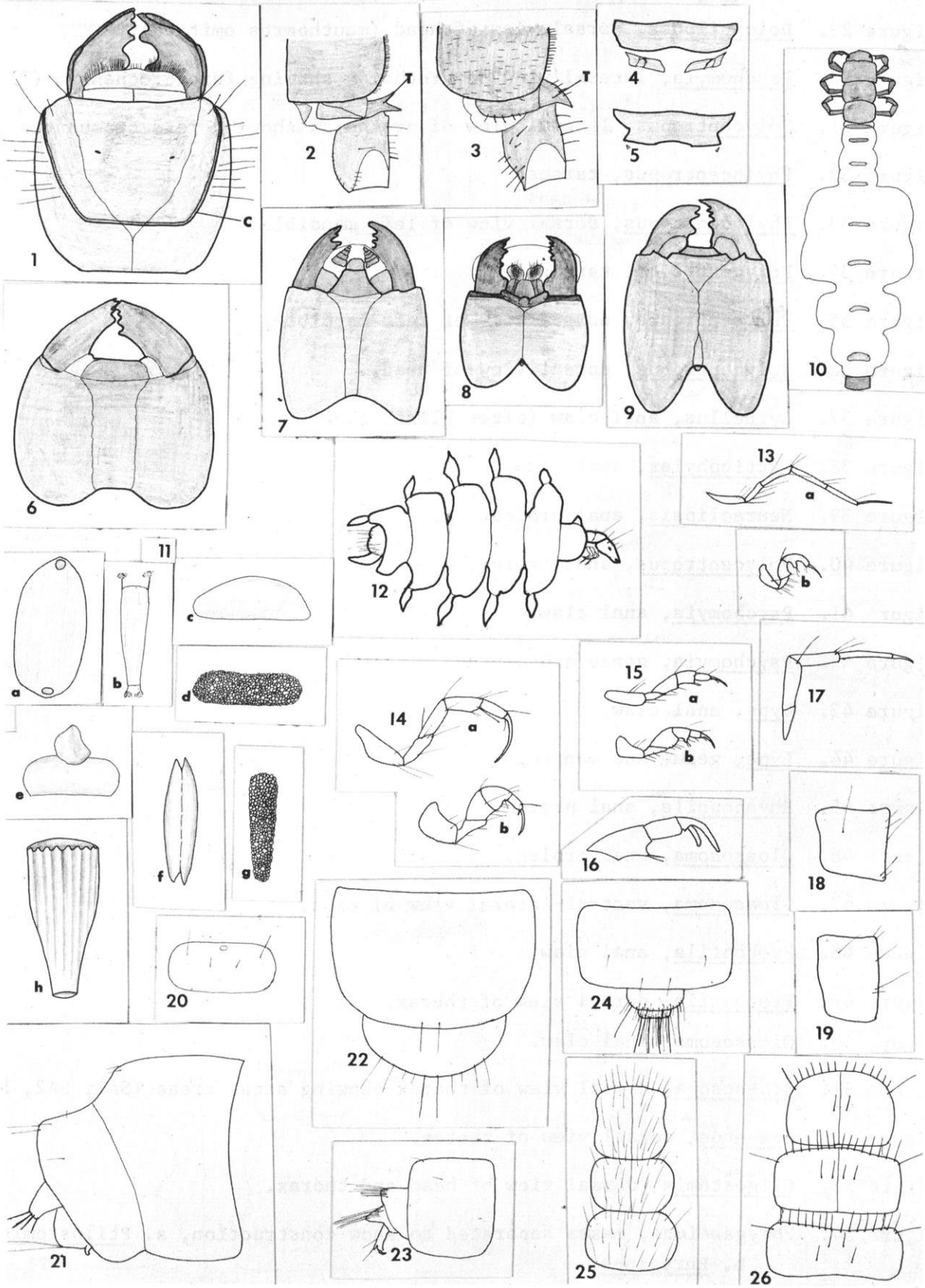
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Plate II

Figure 27. Chimarra, dorsal view of head showing labrum (L).

Figure 28. Wormaldia, dorsal view of head (mouthparts omitted).

Figure 29. Dolophilodes, dorsal view of head (mouthparts omitted).

Figure 30. Psychomyia, lateral view of prothorax showing fore trochantin (T).

Figure 31. Polycentropus, lateral view of prothorax showing fore trochantin (T).

Figure 32. Phylocentropus, tarsus.

Figure 33. Phylocentropus, dorsal view of left mandible.

Figure 34. Polycentropus, tarsus.

Figure 35. Polycentropus, dorsal view of left mandible.

Figure 36. Polycentropus, dorsal view of head.

Figure 37. Cyrnellus, anal claw (after Flint, 1964).

Figure 38. Nyctiophylax, anal claw.

Figure 39. Neureclipsis, anal proleg.

Figure 40. Polycentropus, anal proleg.

Figure 41. Psychomyia, anal claw.

Figure 42. Psychomyia, genae and mentum.

Figure 43. Lype, anal claw.

Figure 44. Lype, genae and mentum.

Figure 45. Rhyacophila, anal proleg.

Figure 46. Glossosoma, anal proleg.

Figure 47. Glossosoma, ventral-lateral view of case.

Figure 48. Protoptila, anal claw.

Figure 49. Protoptila, dorsal view of thorax.

Figure 50. Glossosoma, anal claw.

Figure 51. Glossosoma, dorsal view of thorax showing setal areas (SA1, SA2, SA3).

Figure 52. Agapetus, dorsal view of thorax.

Figure 53. Oligostomis, dorsal view of head and thorax.

Figure 54. Phryganeidae, cases separated to show construction, a. Ptilostomis, b. Phryganea.

Figure 55. Ptilostomis, dorsal view of head and thorax.

Figure 56. Banksiola, dorsal view of head and thorax.

PLATE II

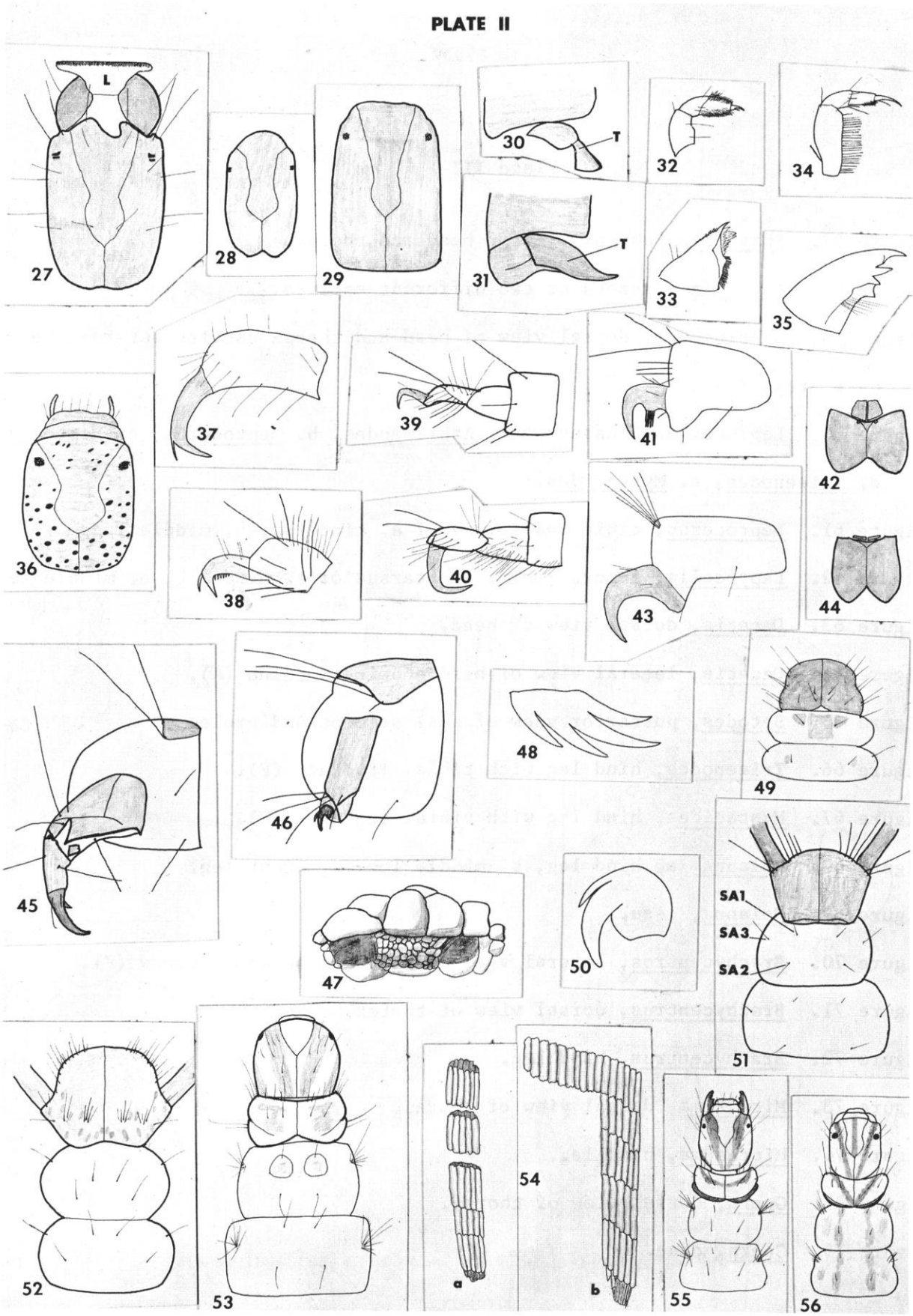
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Plate III

Figure 57. Phryganea, dorsal view of head and thorax.

Figure 58. Agrypnia, pronota of two different species.

Figure 59. Athripsodes, dorsal view of head and thorax showing suture-like pale areas (S).

Figure 60. Leptoceridae, cases of a. Athripsodes, b. Leptocerus, c. Leptocella, d. Triaenodes, e. Mystacides.

Figure 61. Leptocerus, tibia and tarsus of a. hind leg, b. middle leg.

Figure 62. Leptocella, femur, tibia, and tarsus of a. hind leg, b. middle leg.

Figure 63. Oecetis, dorsal view of head.

Figure 64. Oecetis, lateral view of head showing antenna (A).

Figure 65. Setodes, posterior view of anal segment and prolegs.

Figure 66. Triaenodes, hind leg with tibial fracture (F).

Figure 67. Mystacides, hind leg with tibial fracture (F).

Figure 68. Molanna, a. hind leg, b. middle leg, c. front leg.

Figure 69. Molanna, case.

Figure 70. Brachycentrus, lateral view of pronotum showing furrow (F).

Figure 71. Brachycentrus, dorsal view of thorax.

Figure 72. Brachycentrus, hind leg.

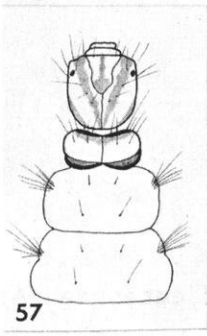
Figure 73. Micrasema, dorsal view of thorax.

Figure 74. Micrasema, hind leg.

Figure 75. Goera, dorsal view of thorax.

Figure 76. Goera, case.

PLATE III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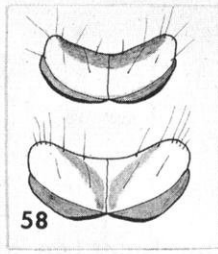
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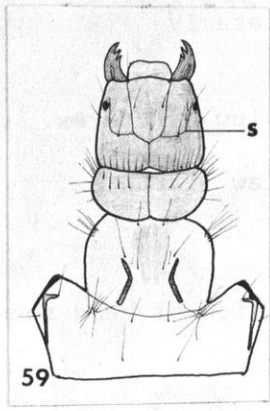
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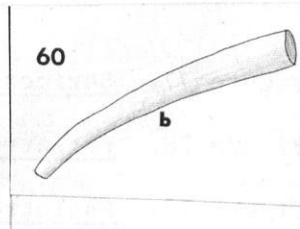
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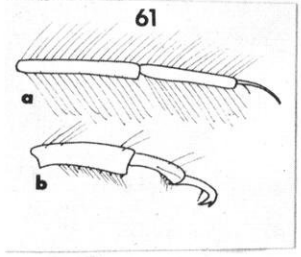
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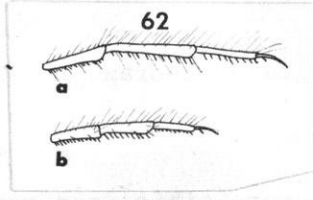
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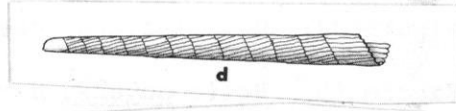
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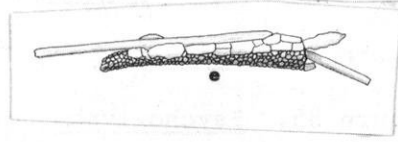
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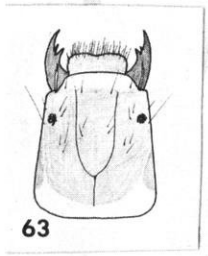
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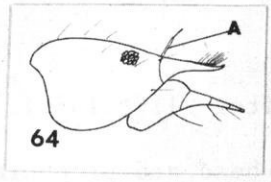
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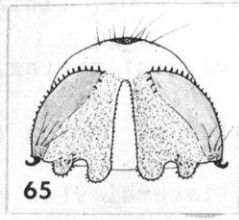
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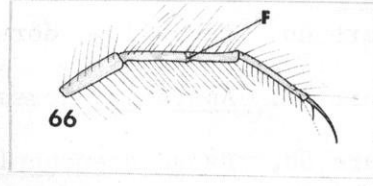
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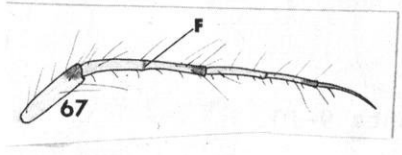
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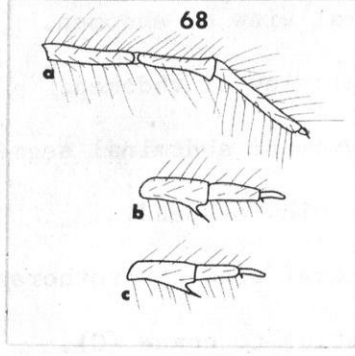
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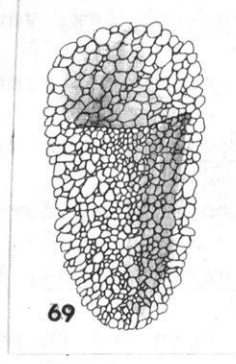
a
b
c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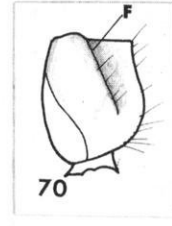
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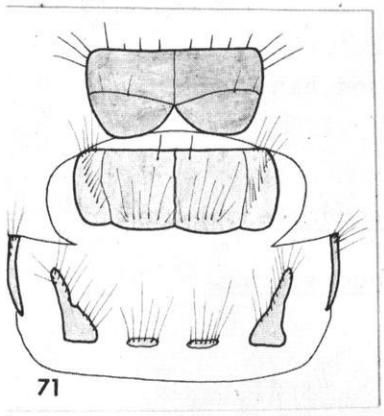
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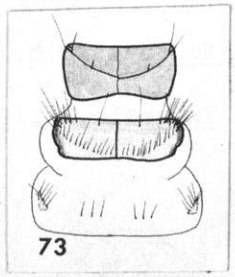
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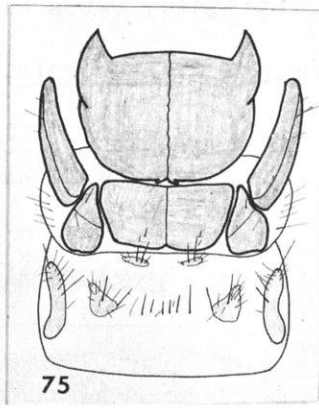
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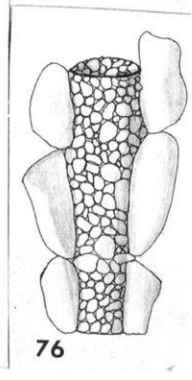
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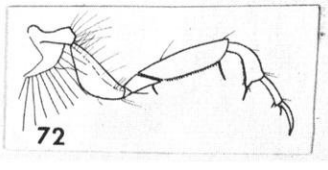
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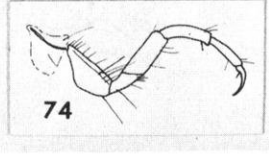
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Plate IV

Figure 77. Sericostoma, dorsal view of thorax.

Figure 78. Psilotreta, dorsal view of thorax.

Figure 79. Psilotreta, case.

Figure 80. Lepidostoma, dorasal view of head showing location of antennae (A).

Figure 81. Lepidostoma, case.

Figure 82. Helicopsyche, case.

Figure 83. Helicopsyche, dorsal view of thorax.

Figure 84. Helicopsyche, anal claw.

Figure 85. Psychoglypha, middle femur, tibia, and tarsus.

Figure 86. Neophylax, dorsal view of thorax.

Figure 87. Apatania, dorsal view of thorax (after Flint 1960).

Figure 88. Pseudostenophylax, lateral view of head and prothorax.

Figure 89. Hydatophylax, ventral view of abdomen.

Figure 90. Pycnopsyche, ventral view of abdomen.

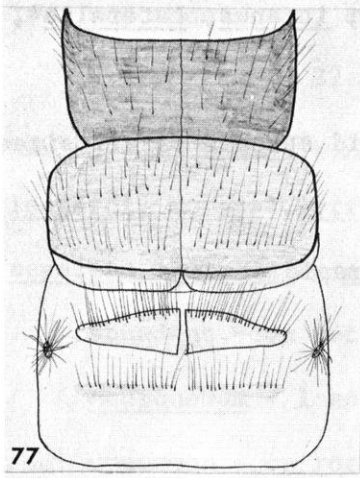
Figure 91. Frenesia, ventral view of abdominal segments 9-10.

Figure 92. Nemotaulius, dorsal view of head.

Figure 93. Platycentropus, lateral view of prothorax and head, showing prosternal horn (H) in relation to coxae (C).

Figure 94. Limnephilidae, cases of a. Neophylax, b. Pseudostenophylax, c. Hesperophylax, d. Ironoquia, e. Frenesia, f. Onocosmoecus, g. Platycentropus.

PLATE IV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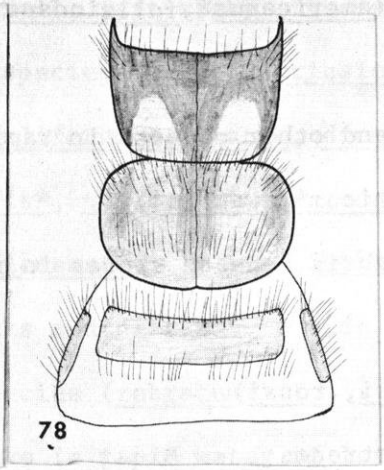
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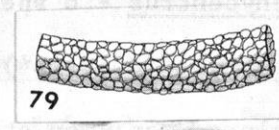
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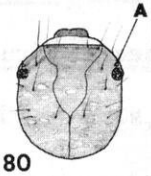

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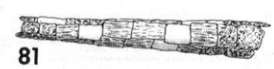
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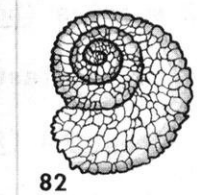
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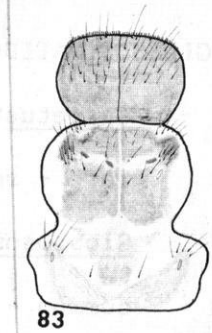
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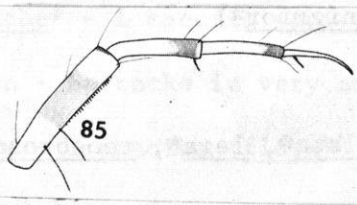
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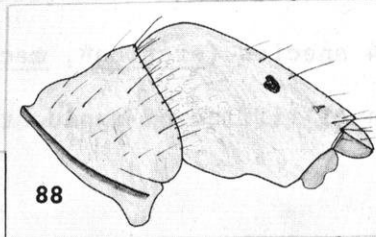
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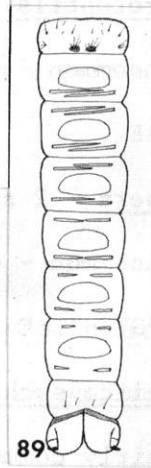
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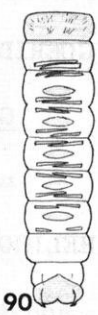
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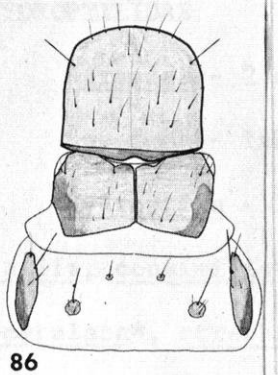
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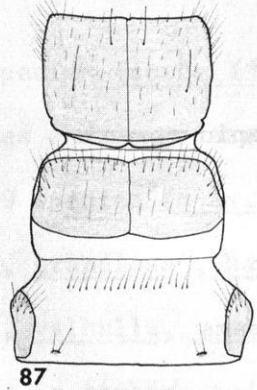
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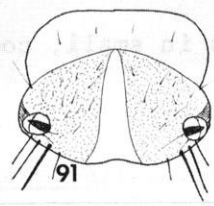
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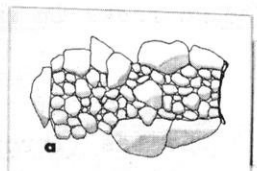

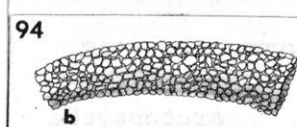

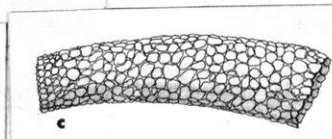

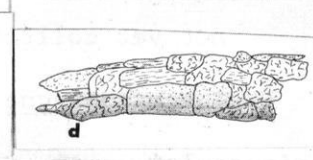

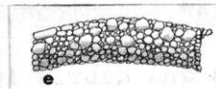

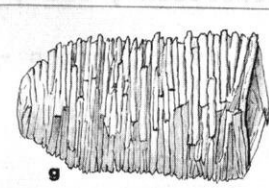

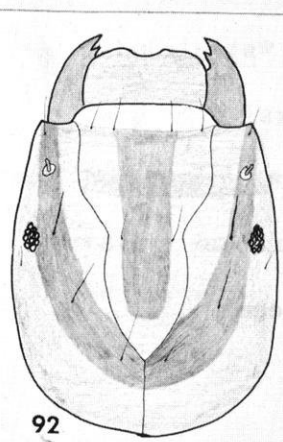
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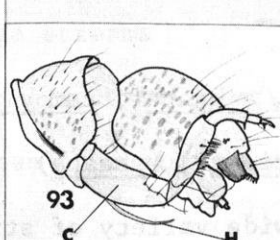

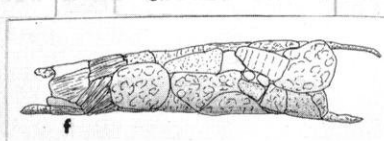

Notes

BRACHYCENTRIDAE

Brachycentrus - 6 species (americanus*, fuliginosus, incanus, lateralis*, numerosus*, occidentalis*)

fairly common - on stones and other objects in rapid streams of all sizes

Micrasema - 2 species (rusticum*, wataga*)

fairly common - sand and debris beneath stones in rapid streams

GLOSSOSOMATIDAE

Agapetus* - 2 species (hessi, rossi)

rare - small, clear, fast streams

Glossosoma - 2 species (intermedium*, nigrior*)

common - on rocks in rapid streams

Protoptila - 4 species (erotica*, maculata*, lega*, tenebrosa*)

uncommon - gravel riffles of rapid streams

GOERIDAE

Goera - 2 species (calcarata, stylata*)

uncommon - on rocks in small, cool, rapid streams

HELICOPSYCHIDAE

Helicopsyche - 1 species (borealis*)

fairly common - on rocks in rapid streams

HYDROPSYCHIDAE

Arctopsyche - 2 species (irrorata, ladogensis)

not yet collected

Cheumatopsyche - 10 species (analis*, aphanta*, campyla*, gracilis*, minuscula*, oxa*, pasella*, sordida*, speciosa*, wabasha)

very common - rocks and debris in a wide variety of streams

Diplectrona* - 1 species (modesta)

uncommon - very small, fast, rocky streams

Hydropsyche - 22 species (aerata, arinale*, betteni*, bidens*, bifida*, bronta*, cheilonis*, californica, cuanis, dicantha*, frisoni, hageni*, leonardi, morosa*, orris*, phalerata*, placoda*, recurvata*, riola, scalaris*, separata, simulans*, slossonae*, sparna*, valenis, vexa*, walkeri*)

abundant - on rocks and debris in a wide variety of streams

Macronemum - 1 species (zebratum*)

uncommon - on rocks in rapid water of large streams

Parapsyche* - 1 species (apicalis)

uncommon - on rocks in very small, fast streams

Potamyia - 1 species (flava*)

rare - on tops of rocks in reduced current of large, slow streams

HYDROPTILIDAE

Agraylea - 2 species (costello, multipunctata*)

uncommon - lakes and large streams

Hydroptila - 19 species (ajax, albicornis*, amoena*, armata*, berneri, callia, consimilis*, grandiosa*, hamata*, jackmanni, perdita, salmo, scolops, spatulata*, strepha, valhalla, virgata, waubesiana*, wyomia)

fairly common - in streams and sometimes lakes

Ithytrichia* - 1 species (clavata)

rare - in large streams

Leucotrichia - 1 species (pictipes*)

rare - on stones in rapid water of streams

Mayatrichia - 1 species (ayama)

not yet collected - riffles of clear, rapid streams

Neotrichia - 4 species (falca, halia, okopa, vibrans)

not yet collected - rapid streams

Ochrotrichia - 2 species (spinosa*, tarsalis*)

rare - clear, small to medium-sized streams

Orthotrichia - 3 species (americana, baldufi, cristata*)

rare - mostly ponds and lakes

Oxyethira - 11 species (araya, berneri, coercens, forcipata*, michiganensis, obtatus, pallida*, rivicola, serrata*, sida, zeronia)

fairly common - streams, lakes, and ponds

Stactobiella (Tascobia) - 2 species (delira*, palmata*)

uncommon - riffles of small, fast streams

LEPIDOSTOMATIDAE

Lepidostoma - 7 species (bryanti*, costalis, griseum*, sackeni*, strophis, togatum*, unicolor)

common - in streams of various sizes and currents

LEPTOCERIDAE

Athripsodes - 18 species (alagmus*, ancylus*, angustus*, annulicornis*, arielles, cancellatus*, dilutus*, erraticus*, flavus*, mentieus*, miscus, nephus, pfadti, punctatus, resurgens*, saccus, tarsi-punctatus*, transversus*)

common - streams of all sizes and lakes

Leptocella - 5 species (albida*, candida, diarina, exquisita*, pavida*)

fairly common - streams of all sizes and glacial lakes

Leptocerus - 1 species (americanus*)

uncommon - glacial lakes and slow streams

Mystacides - 2 species (longicornis*, sepulchralis*)

fairly common - lakes and slow streams.

Oecetis - 7 species (avara*, cinerascens*, immobilis*, inconspicua*, ochracea*, osteni*, persimilis*)

common - lakes and streams of all types.

Setodes - 3 species (guttatus, incerta*, oligia*)

uncommon - streams

Triaenodes - 10 species (aba*, baris*, borealis, dipsia, flavescens, ignita, injusta*, marginata*, nox, tarda*)

fairly common - lakes, streams, ponds, and marshes

LIMNEPHILIDAE

Apatania - 1 species (incerta*)

rare - very small, woodland streams

Frenesia - 1 species (missa*)

rare - spring-fed seepage areas and small, cold streams

Glyphopsyche - 1 species (irrorata*)

rare- in vegetation near banks of slow streams and ponds

Hesperophylax - 1 species (designatus*)

fairly common - springs and spring runs

Hydatophylax (= Astenophylax) - 1 species (argus*)

common - small, cold streams with vegetation

Ironoquia (= Caborius) - 2 species (lyrata*, punctatissima)

uncommon - ponds, marshes, and slow streams

Leptophylax - 1 species (gracilis*)

larvae unknown (rare)

Limnephilus (includes Anabolia, Asynarchus, Philarctus and Lenarchulus) - 26 species (acrocurvus, argenteus*, bimaculatus*, canadensis, consocius*, curtus, externus*, hyalinus*, indivisus*, infernalis*, janus*, moestus*, montanus*, ornatus*, ozburni*, partitus, parvulus*, perpusillus, pulchellus, quaeris, rhombicus*, rossi, secludens, sericeus*, sordidus, submonilifer*)

abundant - in vegetation of lakes, ponds, marshes, and streams

Nemotaulius* (= Glyphotaelius) - 1 species (hostilis)

fairly common - marshy areas

Neophylax - 5 species (autumnus*, concinnus*, consimilis, fuscus*, oligius*)

common - small to medium streams with a rapid current

Onocosmoecus - 1 species (quadrinotatus*)

uncommon - small, cold, stone-bottomed streams

Platycentropus - 4 species (amicus*, indistinctus, plectrus, radiatus*)

common - margins of streams, lakes, and ponds

Pseudostenophylax (= Drusinus) - 1 species (uniformis)

not yet collected - springs and spring runs

Psychoglypha* - 1 species (alaskensis)

rare - slow areas and margins of cold streams

Pycnopsyche - 7 species (aglona*, antica, guttifer*, lepida*, limbata*, scabripennis*, subfasciata*)

very common - on stones and in debris of streams of all sizes

MOLANNIDAE

Molanna - 5 species (blenda*, flavicornis*, musetta, tryphena*, uniophila*)

fairly common - streams and glacial lakes with sand and gravel substrate

ODONTOCERIDAE

Psilotreta - 1 species (indecisa*)

uncommon - fast streams with sand and gravel bottom

PHILOPOTAMIDAE

Chimarra - 4 species (aterrima*, feria*, obscura*, socia*)

common - on rocks in rapid streams

Dolophilodes (= Sortosa and Trentonius) - 1 species (distinctus*)

uncommon - small, cold, rapid streams

Wormaldia (= Dolophilus) - 1 species (moestus*)

rare - small, spring-fed streams

PHRYGANEIDAE

Agrypnia - 6 species (colorata, glacialis, improba, macdunnoughi, straminea*, vestita)

fairly common - ponds, lakes, and slow streams

Banksiola - 2 species (crotchi*, smithi*)

uncommon - lakes, ponds, and slow streams

Fabria - 2 species (complicata*, inornata)

larvae unknown

Hagenella - 1 species (canadensis*)

larvae unknown

Oligostomis* - 2 species (ocelligera, pardalis)

uncommon - small, cold, fast streams

Phryganea - 2 species (cinerea*, sayi*)

fairly common - lakes, ponds, slow streams

Ptilostomis - 4 species (augustipennnnis, ocellifera*, postica, semifasciata*)

very common - vegetation along streams of all types

PSYCHOMYIIDAE

Cernotina - 1 species (spicata)

not yet collected - clear, cool streams

Cyrnellus - 1 species (marginalis*)

rare - on rocks and wood in lakes and large streams

Lype - 1 species (diversa*)

uncommon - in debris and wood in streams

Neureclipsis - 3 species (bimaculatus*, crepuscularis*, validus)

common - large streams

Nyctiophylax (= Genus A and Genus B) - 2 species (uncus, vestitus*)

uncommon - fairly rapid streams of various sizes

Phylocentropus - 1 species (placidus*)

uncommon - sand-bottomed streams

Polycentropus - 15 species (aureolus*, centralis, cinereus*, clinei, confusus*, crassicornis, flavus*, glacialis*, interruptus*, melanae, nascotius*, pentus*, remotus*, sabulosus, weedi*)

common - marshes, lakes, ponds, streams of all types

Psychomyia - 1 species (flavida*)

fairly common - gravel and debris in rapid streams

RHYACOPHILIDAE

Rhyacophila - 5 species (acropedes, fuscula*, manistee, melita, vibox)

uncommon - small, clear, fast, cool streams

SERICOSTOMATIDAE

Sericostoma - 1 species (distinctum*)

uncommon - moderate-sized, rapid streams with sand and gravel substrate

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