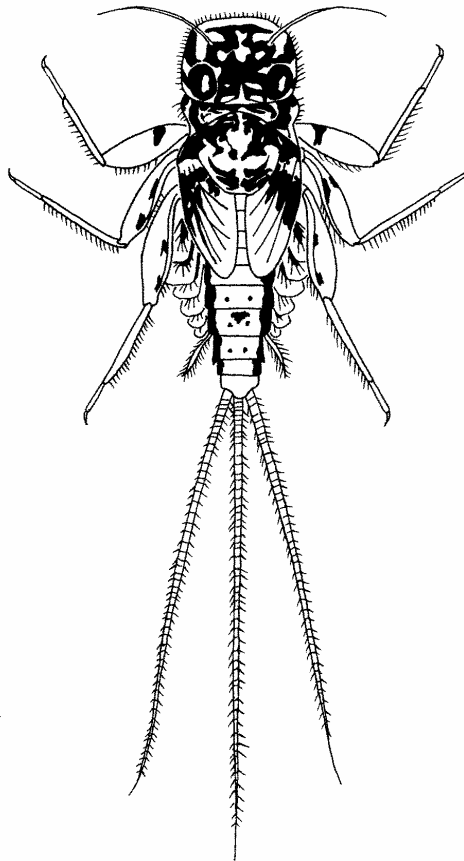


CHAPTER 4

EPHEMEROPTERA

(Mayflies)



Citation:

Bouchard, R.W., Jr. 2004. Guide to aquatic macroinvertebrates of the Upper Midwest. Water Resources Center, University of Minnesota, St. Paul, MN. 208 pp.

4

ORDER EPHEMEROPTERA

Mayflies

Mayfly larvae are found in a variety of locations including lakes, wetlands, streams, and rivers; however, they are most common and diverse in lotic habitats. They are common and abundant in stream riffles and pools, at lake margins and in some cases lake bottoms. All mayfly larvae are aquatic with terrestrial adults. In most mayfly species the adult only lives for 1-2 days. Consequently, the majority of a mayfly's life is spent in the water as a larva. The adult lifespan is so short there is no need for the insect to feed and therefore the adult does not possess functional mouthparts. Mayflies are often an indicator of good water quality because most mayflies are relatively intolerant of pollution. Mayflies are also an important food source for fish.

Ephemeroptera Morphology

Most mayflies have three caudal filaments (tails) (Figure 4.1) although in some taxa the terminal filament (middle tail) is greatly reduced and there appear to be only two caudal filaments (only one genus actually lacks the terminal filament). Mayflies have gills on the dorsal surface of the abdomen (Figure 4.1), but the number and shape of these gills vary widely between taxa. All mayflies possess only one tarsal claw at the end of each leg (Figure 4.1). Characters such as gill shape, gill position, and tarsal claw shape are used to separate different mayfly families.

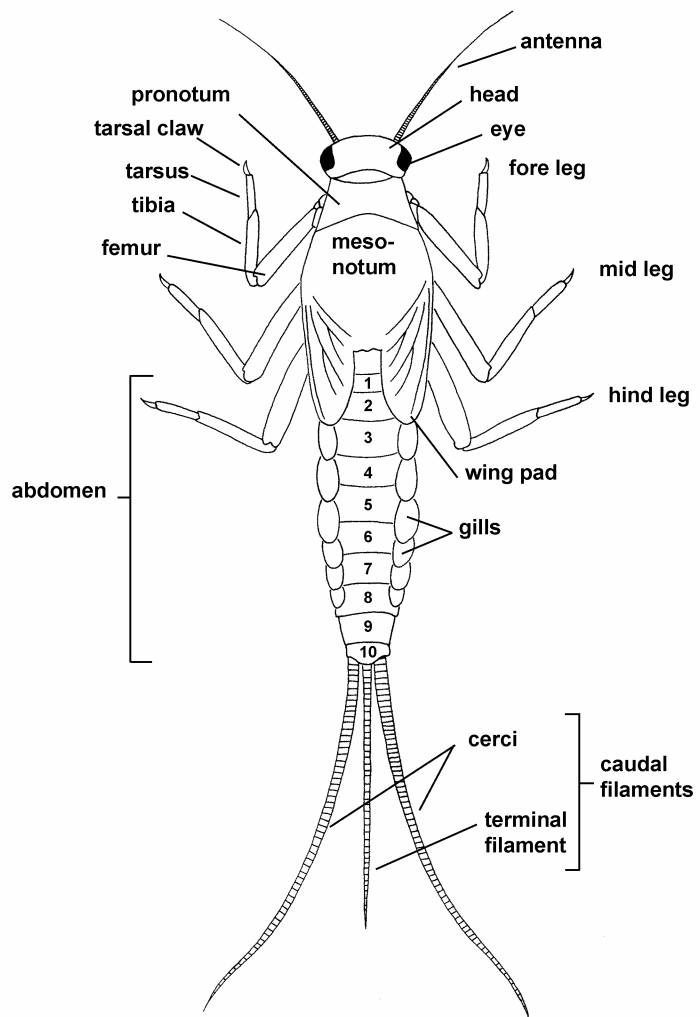


Figure 4.1: Dorsal view of ephemeropteran larva.

Key to Ephemeroptera Families (Larvae)

1. Thoracic notum (top of thorax) large and extending back over much of the abdomen (Figs. 4.2, 4.3)..... **Baetiscidae p. 56**

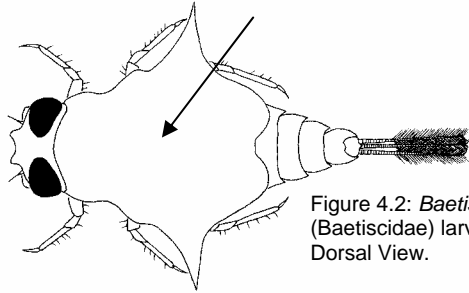


Figure 4.2: *Baetisca* sp. (Baetiscidae) larva, Dorsal View.

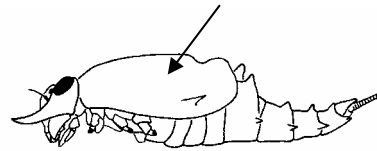


Figure 4.3: *Baetisca* sp. (Baetiscidae) larva, Lateral View.

- 1'. Thoracic notum not as above (Figs. 4.4, 4.5) 2

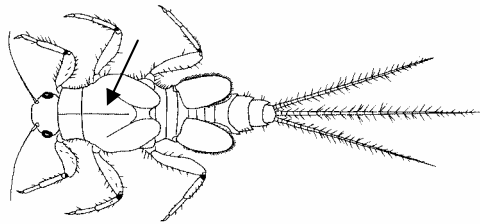


Figure 4.4: *Tricorythodes albilineatus* (Tricorythidae) larva, Dorsal View.

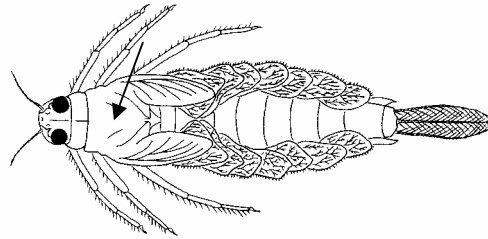


Figure 4.5: *Siphonurus occidentalis* (Siphonuridae) larva, Dorsal View.

- 2(1'). Head with mandibular tusks that project forward (Figs. 4.6, 4.7); gills on segments 2-7 forked with fringed margins (Fig. 4.8) 3

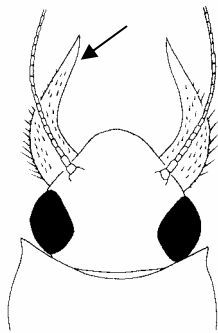


Figure 4.6: Head of *Anthopotamus* sp. (Potamanthidae) larva, Dorsal View.

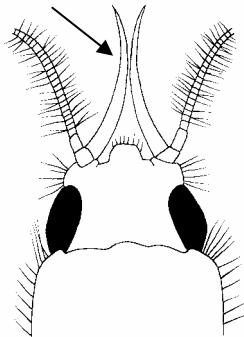


Figure 4.7: Head of *Hexagenia limbata* (Ephemeridae) larva, Dorsal View.

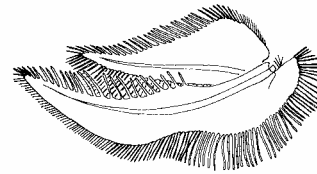


Figure 4.8: Gill of *Ephoron* sp. (Polymitarcyidae) larva.

- 2'. Head without mandibular tusks (Figs. 4.9, 4.10); gills variable..... 5

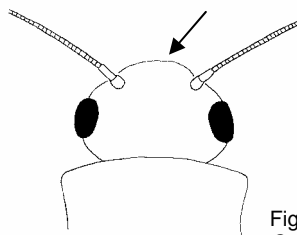


Figure 4.9: Head of *Caenis* sp. (Caenidae) larva, Dorsal View.

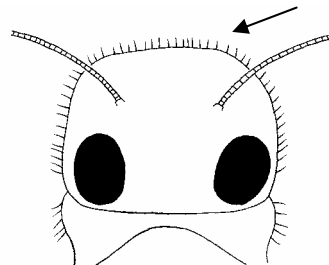


Figure 4.10: Head of *Stenonema exiguum* (Heptageniidae) larva, Dorsal View.

3(2) Abdominal gills held laterally (Fig. 4.11); legs slender **Potamanthidae p. 61**

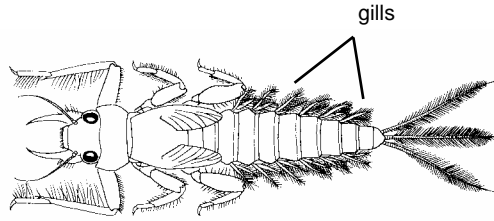


Figure 4.11: *Potamanthus* sp. (Potamanthidae) larva, Dorsal View.

3'. Abdominal gills held dorsally over abdomen (Fig. 4.12)4

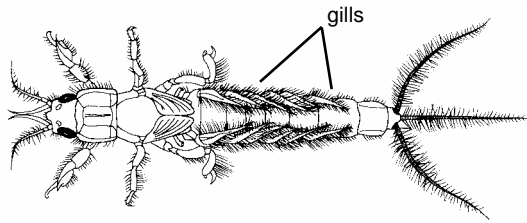


Figure 4.12: *Hexagenia limbata* (Ephemeridae) larva, Dorsal View.

4(3'). Mandibular tusks project outward or upward apically (at end) (Fig. 4.13); apex of hind tibiae projected into a point..... **Ephemeridae p. 58**

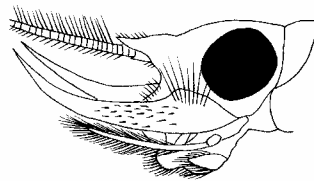


Figure 4.13: Head of *Ephemer* sp. (Ephemeridae) larva, Lateral View.

4'. Mandibular tusks projecting inward and downward (Fig. 4.14); apex of hind tibiae rounded **Polymitarcyidae p. 60**

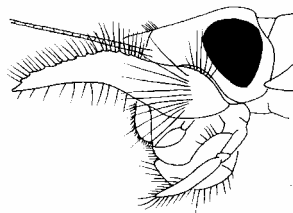


Figure 4.14: Head of *Ephoron* sp. (Polymitarcyidae) larva, Lateral View.

- 5(2). Gills on abdominal segment 2 operculate (plate-like) and covering succeeding pairs of gills (Figs. 4.15, 4.16) 6

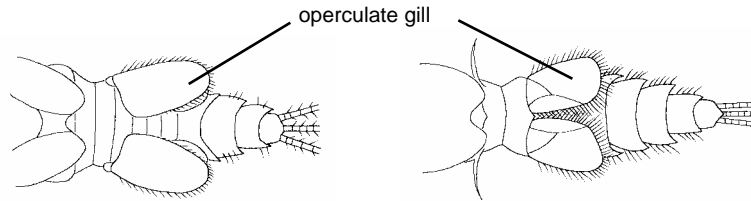


Figure 4.15: Abdomen of *Tricorythodes albilineatus* (Tricorythidae) larva, Dorsal View.

Figure 4.16: Abdomen of *Caenis* sp. (Caenidae) larva, Dorsal View.

- 5'. Gills on abdominal segment 2 similar to succeeding pairs of gills if present (Figs. 4.17, 4.18, 4.19); if operculate gills present then not on abdominal segment 2 (Fig. 4.19) 7

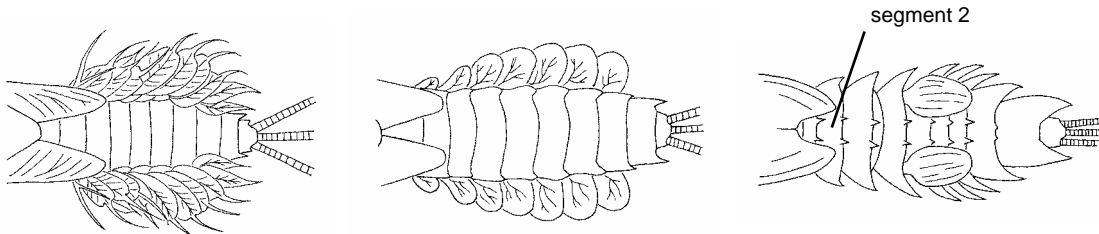


Figure 4.17: Abdomen of *Leptophlebia* sp. (Leptophlebiidae) larva, Dorsal View.

Figure 4.18: Abdomen of *Isonychia arida* (Isonychiidae) larva, Dorsal View.

Figure 4.19: Abdomen of *Ephemerella doris* (Ephemerellidae) larva, Dorsal View.

- 6(5). Operculate gills on abdominal segment 2 triangular (Fig. 4.20) or oval (Fig. 4.21); gills do not touch or overlap at the midline (Figs. 4.20, 4.21) **Tricorythidae p. 62**

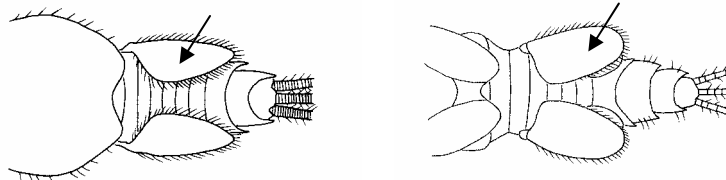


Figure 4.20: Abdomen of *Tricorythodes* sp. (Tricorythidae), larva, Dorsal View

Figure 4.21: Abdomen of *Tricorythodes albilineatus* (Tricorythidae) larva, Dorsal View.

- 6'. Gills on abdominal segment 2 square (Fig. 4.22); gills overlapping, touching or nearly touching at the mid line (Fig. 4.22) **Caenidae p. 57**

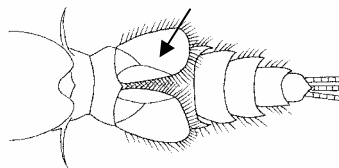


Figure 4.22: Abdomen of *Caenis* sp. (Caenidae) larva, Dorsal View.

- 7(5'). Gills absent on abdominal segment 2 (may also be absent from segments 1 and 3) (Fig. 4.23); gills on abdominal segments may be operculate (Fig. 4.23) **Ephemerellidae p. 57**

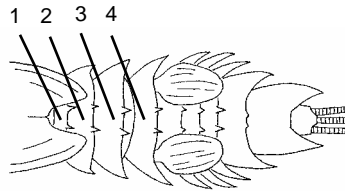


Figure 4.23: Abdomen of *Ephemerella doris* (Ephemerellidae) larva, Dorsal View.

- 7'. Gills present on abdominal segments 1-7 or 2-7 (Figs. 4.24, 4.25).....8

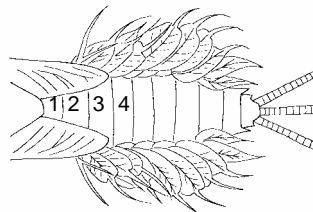


Figure 4.24: Abdomen of *Leptophlebia* sp. (Leptophlebiidae) larva, Dorsal View.

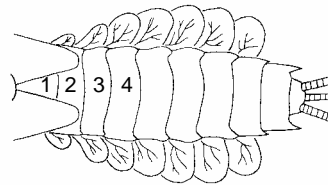


Figure 4.25: Abdomen of *Isonychia arida* (Isonychiidae) larva, Dorsal View.

- 8(7'). Head and body flattened (Figs. 4.26, 4.27) **Heptageniidae p. 58**

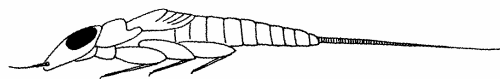


Figure 4.26: Heptageniidae larva, Lateral View.

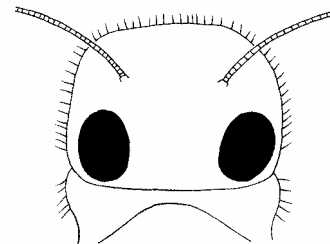


Figure 4.27: Head of *Stenonema exiguum* (Heptageniidae) larva, Dorsal View.

- 8'. Head and body not flattened (Fig. 4.28).....9

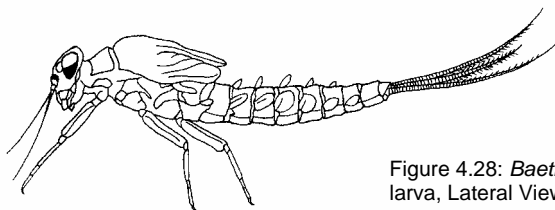


Figure 4.28: *Baetis* sp. (Baetidae) larva, Lateral View.

- 9(8'). Abdominal gills on segments 2-7 forked (Fig. 4.29b), consisting of slender filaments (Fig. 4.29a), or broad and ending in slender filaments (Figs. 4.29c, 4.29d) **Leptophlebiidae p. 59**

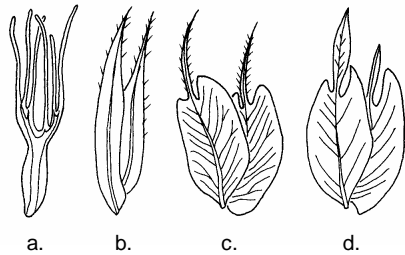


Figure 4.29: Gills of a) *Habrophlebia* sp., b) *Paraleptophlebia* sp., c) *Leptophlebia* sp., and d) *Choroterpes* sp. (Leptophlebiidae) larvae.

- 9'. Gills not as above, usually oval or heart-shaped (Figs. 4.30a, 4.30b, 4.30c) 10

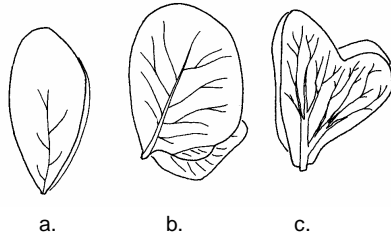


Figure 4.30: Gills of a) *Ameletus* sp. (Ameletidae), b) *Acanthametropodidae* sp. (Acanthametropodidae), and c) *Siphonurus* sp. (Siphonuridae) larva.

- 10(9'). Claws on fore legs bifid (forked) (Fig. 4.31)..... **Metretopodidae p. 60**

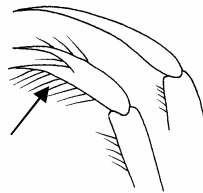


Figure 4.31: Tarsal claws of fore leg and hind leg of *Siphloplecton* sp. (Metretopodidae) larva.

- 10'. Claws on fore legs simple (Fig. 4.32) 11

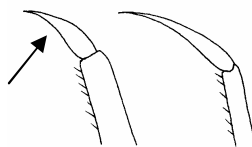


Figure 4.32: Tarsal claws of Baetidae larvae.

- 11(10'). A double row of long setae (hairs) on inner margin of fore legs (Fig. 4.33)
 **Isonychiidae p. 59**

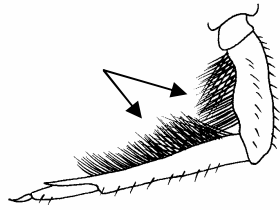


Figure 4.33: Leg of *Isonychia* sp. (*Isonychiidae*) larva.

- 11'. Scattered hairs present on fore legs but not as long or arrayed as above (Fig. 4.34) 12

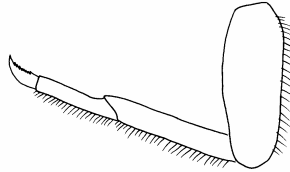


Figure 4.34: Leg of *Acentrella* sp. (*Baetidae*) larva.

- 12(11'). 2-3 tails present; antennae at least 2x width of head (Fig. 4.35); if antennae shorter than 2x width of head then only 2 tails are present; labrum with a deep notch (Fig. 4.36); posterolateral angles of abdominal segment 9 without spines (Fig. 4.37)
 **Baetidae p. 56**

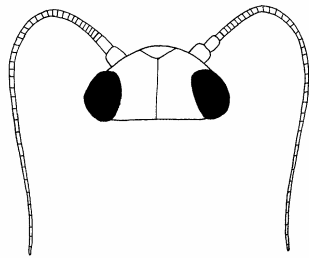


Figure 4.35: Head of *Baetis* sp. (*Baetidae*) larva, Dorsal View.

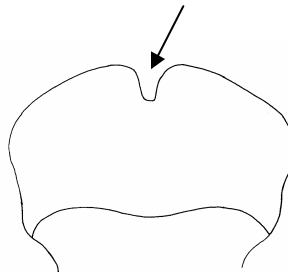


Figure 4.36: Labrum of *Baetis vagans* (*Baetidae*) larva, Dorsal View.

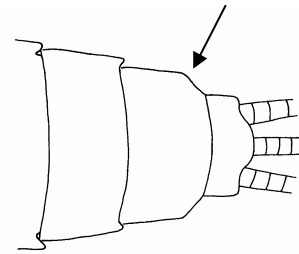


Figure 4.37: Abdomen apex of *Cloeon* sp. (*Baetidae*) larva, Dorsal View.

- 12'. 3 tails present; antennae less than 2x width of head (Fig. 4.38); labrum entire or with a shallow notch (Fig. 4.39); posterolateral angles of abdominal segment 9 with spines (Fig. 4.40).....
 **Siphonuridae p. 61**



Figure 4.38: Leg of *Siphonurus* sp. (*Siphonuridae*) larva, Dorsal View.

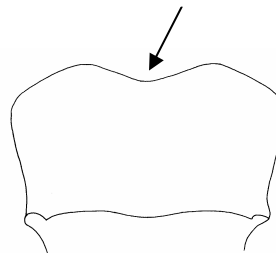


Figure 4.39: Labrum of *Siphonurus marshalli* (*Siphonuridae*) larva, Dorsal View.

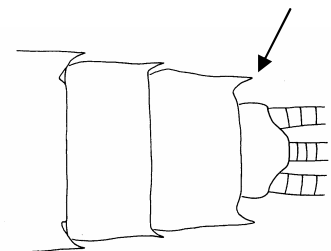


Figure 4.40: Abdomen apex of *Siphonurus* sp. (*Siphonuridae*) larva, Dorsal View.

Ephemeroptera Family Descriptions

Baetidae

- Common Name:** Small Minnow Mayflies
Feeding Group: Collector/Gatherers, Scrapers
Tolerance Value: 4 (Moderate)
Habitat: These mayfly larvae are found in a variety of habitats and are widespread in the Upper Midwest. Some are found in streams of moderate current or in areas of slack water. Other species are primarily restricted to lakes and ponds.
Size: Small to Medium (3-12 mm)
Characteristics: Antennae in most genera 2-3x longer than the width of the head; gills present on abdominal segments 1 or 2 through 7; gill shape variable; 2-3 caudal filaments present.
Notes: These mayflies are often very small and sometimes very abundant when conditions permit. Most baetid mayflies are good swimmers, hence the name minnow mayfly. Some species can be very common in polluted streams.

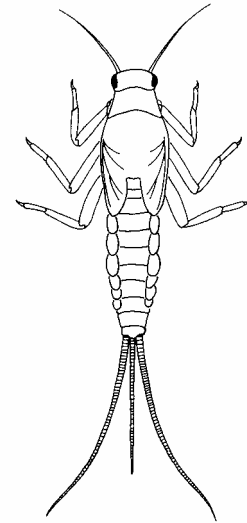


Figure 4.41:
Generalized Baetidae
larva, Dorsal View.

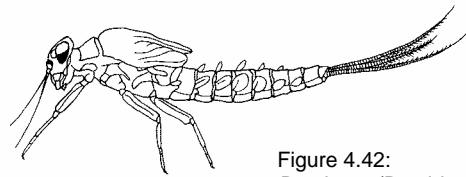


Figure 4.42:
Baetis sp. (Baetidae)
larva, Lateral View.

Baetiscidae

- Common Name:** Armored Mayflies
Feeding Group: Collector/Gatherers
Tolerance Value: 3 (Low)
Habitat: Baetiscids are commonly found in pools or runs in sandy streams.
Size: Small to Medium (4-14 mm)
Characteristics: Cuticle harder than most mayfly larvae; thoracic notum (top portion of thorax) is fused and covers first 5 abdominal segments; gills are usually concealed by thoracic notum; caudal filaments relatively short and fringed with hairs.
Notes: The larvae of baetiscids have a unique and bizarre appearance due to the enlarged thoracic notum and often the presence of large spines. Baetiscids swim by tucking their legs under their body and undulating their abdomen and caudal filaments.

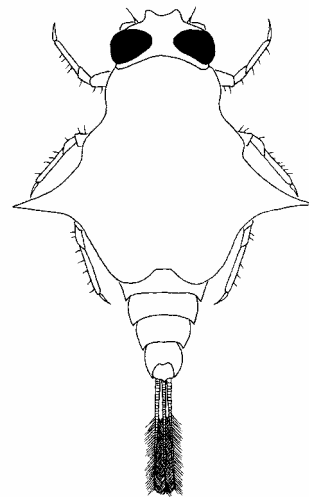


Figure 4.43:
Baetisca sp.
(Baetiscidae) larva,
Dorsal View.

Caenidae

- Common Name:** Small Square-Gill Mayflies
- Feeding Group:** Collector/Gatherers, Scrapers
- Tolerance Value:** 7 (High)
- Habitat:** Caenid mayfly larvae occur in streams in areas of slow current, at the edges of lakes, and in wetlands.
- Size:** Small (2-8 mm)
- Characteristics:** Gills on abdominal segment 1 vestigial (small and finger-like); gills on abdominal segment 2 square operculate (plate-like) and covering succeeding gills; operculate gills touch or overlap at midline; fringed gills present on abdominal segments 3-6; setae on caudal filaments restricted to apex of each annulation.
- Notes:** The operculate gills do not take up dissolved oxygen, but instead are used to cover and protect the other gills, which absorb dissolved oxygen from the water. Since these mayflies occur in areas where the current is slow, sediment can rapidly settle on the gills and prevent dissolved oxygen uptake. In order to keep their gills free of sediment, caenid mayflies wave their operculate gills.

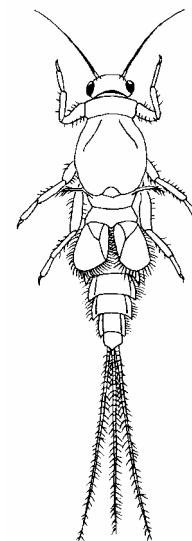


Figure 4.44:
Caenis sp. (Caenidae)
larva, Dorsal View.

Ephemerellidae

- Common Name:** Spiny Crawler Mayflies
- Feeding Group:** Collector/Gatherers
- Tolerance Value:** 1 (Low)
- Habitat:** Spiny crawler mayflies occur in a variety of habitats, but are most common in flowing waters of streams and rivers. They can also occur in lake edge habitats.
- Size:** Small to Medium (4-15 mm)
- Characteristics:** Gills absent from abdominal segment 2; gills present on abdominal segments 3-7 or 4-7.
- Notes:** When threatened, spiny crawler mayflies have an interesting habit of raising their three tails up, presumably to appear larger. If this posture does not frighten the intruder, the mayfly will curl its abdomen over its body so that their tails project in front of the head. The tails will then be used to jab the attacker.

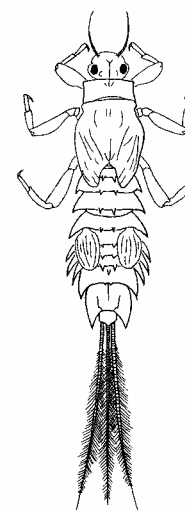


Figure 4.45:
Ephemerella doris
(Ephemerellidae)
larva, Dorsal View.

Ephemeridae

- Common Name:** Common Burrowing Mayflies
- Feeding Group:** Collector/Gatherers
- Tolerance Value:** 4 (Moderate)
- Habitat:** Ephemerid mayflies are found in the soft silt or sand of streams and lakes.
- Size:** Medium to Large (10-32 mm)
- Characteristics:** Uprturned mandibular tusks present; frontal process between antennae; fore legs modified (widened) for burrowing; gills present on segments 1-7; gills on segment 1 are small (vestigial) and simple; gills on segments 2-7 forked with fringed margins (feathered) and held over the abdomen.
- Notes:** Ephemerid mayflies make U-shaped burrows in soft sediments. Within this burrow these mayflies generate flow through the burrow by moving their gills. This current brings dissolved oxygen and food particles into the burrow. When the adults emerge on warm summer evenings they can cause problems as they can cover bridges, buildings, and vehicles near lakes and streams where they occur. In some cases, there are so many mayflies that driving can be slick and snowplows may be used to move piles of dead mayflies from bridges.

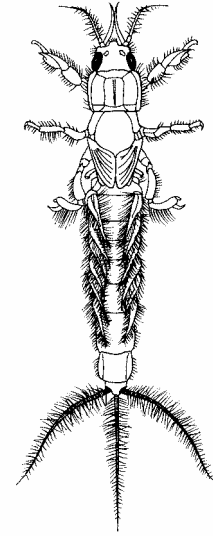


Figure 4.46:
Hexagenia limbata
(Ephemeridae)
larva, Dorsal View.

Heptageniidae

- Common Name:** Flathead Mayflies
- Feeding Group:** Scrapers
- Tolerance Value:** 4 (Moderate)
- Habitat:** Flathead mayflies are most common in slow to fast flowing streams where they occur on the surface of rocks, logs, vegetation, and leaves.
- Size:** Small to large (5-20 mm)
- Characteristics:** Body, head, and legs (femora) flattened; mouthparts not visible from dorsal view; gills present on abdominal segments 1-7; only short setae present on caudal filaments.
- Notes:** Flathead mayflies are very common in streams in the Upper Midwest. They are well adapted for swift flowing waters. Their bodies, head, and legs are flattened which reduces drag by forcing water over the organism. Most of these mayflies feed on algae and microorganisms growing on rocks. One genus of heptageniid mayfly has only two tails, but can be separated from stoneflies by the presence of a single tarsal claw at the end of each leg.

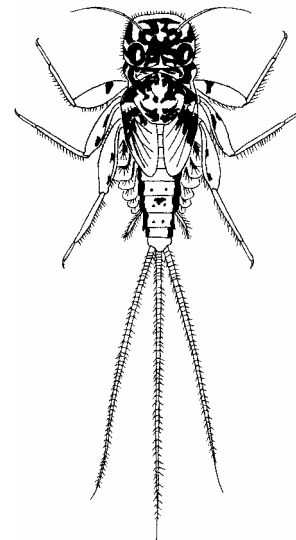


Figure 4.47:
Stenonema exiguum
(Heptageniidae)
larva, Dorsal View.

Isonychiidae

- Common Name:** Brush-Legged Mayflies
- Feeding Group:** Collector/Filterers
- Tolerance Value:** 2 (Low)
- Habitat:** Species of this family found in the Upper Midwest are usually in streams with swift to moderate current. They are commonly associated with tangles of vegetation consisting of sticks, leaves and roots.
- Size:** Medium (8-17 mm)
- Characteristics:** **Forelegs** with a double row of long setae; gills oval and present on abdominal segments 1-7; long hairs along the margins of caudal filaments.
- Notes:** Isonychiids feed on algae, diatoms, and detritus which they filter from the water using the brush-like hairs on their fore legs. They do this by clinging to the substrate with their middle legs and hind legs and holding their fore legs in the current to collect small particles in the water. Isonychiids then consume the material collected in their hairs. These mayflies are good swimmers, but they spend most of the time clinging to the substrate. The rows of hairs on the tails help these mayfly larvae swim by functioning as a paddle.

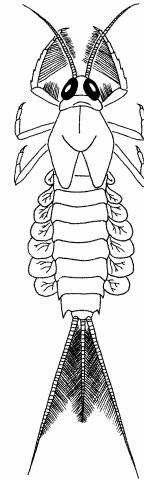


Figure 4.48:
Isonychia arida
(Isonychiidae) larva,
Dorsal View.

Leptophlebiidae

- Common Name:** Prong-Gilled Mayflies
- Feeding Group:** Collector/Gatherers
- Tolerance Value:** 2 (Low)
- Habitat:** The larvae of prong-gilled mayflies occur in a variety of habitats including lakes, ponds, and swift and slow flowing streams. They are found on rocks and gravel, leaf packs, and submerged roots.
- Size:** Small to medium (4-15 mm)
- Characteristics:** Gills on first abdominal segment usually slender and finger-like; gills on abdominal segments 2-7 forked with variable shape (consisting of slender filaments, or broad and ending in slender filaments); setae on caudal filaments present at apex of each segment.
- Notes:** A common distinguishing characteristic of leptophlebiid mayflies is the presence of forked gills. Unfortunately, these gills are commonly broken off making identification difficult.

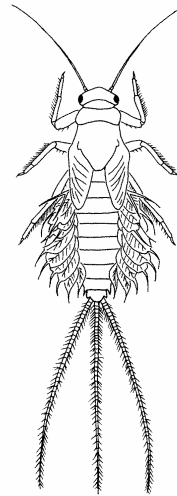


Figure 4.49:
Leptophlebia sp.
(Leptophlebiidae)
larva, Dorsal View.

Metretopodidae

- Common Name:** Cleft-Footed Minnow Mayflies
Feeding Group: Predators, Collector/Gatherers
Tolerance Value: 2 (Low)
Habitat: Metretopodid mayflies are generally collected from vegetated margins of slow flowing streams and rivers.
Size: Medium (9-16 mm)
Characteristics: Tarsal claws on fore legs bifid (forked); oval gills on abdominal segments 1-7; terminal filament (middle tail) with long hairs on both sides; cerci (outer tails) with long hairs only on inner margin.
Notes: One genus of this family has been collected in deep dredges of Lake Superior. Cleft-footed mayflies are apparently very good swimmers and tend to be difficult to collect.

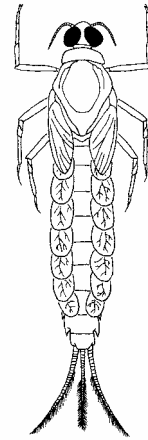


Figure 4.50:
Siphloplecton sp.
(Metretopodidae)
larva, Dorsal View.

Polymitarciidae

- Common Name:** Pale Burrowing Mayflies
Feeding Group: Collector/Gatherers, Filterers
Tolerance Value: 2 (Low)
Habitat: These mayflies burrow in rivers under rocks or in clay banks.
Size: Medium to large (9-30 mm)
Characteristics: Down turned mandibular tusks present; fore legs modified (widened) for burrowing; gills present on segments 1-7; gills on segment 1 are single or double; gills on segments 2-7 forked with fringed margins (feathered) and held over the abdomen.
Notes: Pale burrowing mayflies are uncommon.

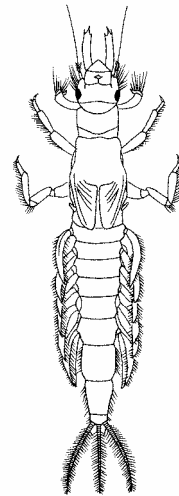


Figure 4.51:
Tortopus incertus
(Polymitarciidae)
larva, Dorsal View.

Potamanthidae

- Common Name:** Hacklegill Mayflies
- Feeding Group:** Collector/Filterers
- Tolerance Value:** 4 (Moderate)
- Habitat:** Potamanthids generally occur in moderate to fast flowing streams and rivers.
- Size:** Medium (8-15 mm)
- Characteristics:** Mandibular tusks present; fore legs slender (not modified for burrowing); gills held laterally; feathery gills present on segments 1-7; gills on segment 1 are small (vestigial) and simple; gills on segments 2-7 forked with fringed margins and held laterally; caudal filaments fringed with hairs.
- Notes:** The young larvae of potamanthids are burrowers in soft silt, but as the larvae mature they move to erosional habitats with cobble and gravel where they can be found on rocks. The potamanthid mayflies are closely related to other burrowing mayflies (Ephemeridae and Polymitarcyidae), but their fore legs are not adapted for burrowing.

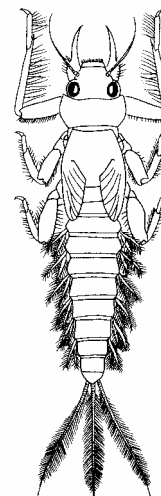


Figure 4.52: *Potamanthus* sp. (Potamanthidae) larva, Dorsal View.

Siphonuridae

- Common Name:** Primitive Minnow Mayflies
- Feeding Group:** Collector/Gatherers
- Tolerance Value:** 7 (High)
- Habitat:** Primitive minnow mayflies can be found in vegetation along large rivers, in the riffles of small streams, in seeps, in swamps, and in ponds.
- Size:** Small to large (6-20 mm)
- Characteristics:** Antennae less than 2x the width of head; gills usually present on abdominal segments 1-7; gills usually oval; long setae present on caudal filaments (present on both sides of terminal filament and only on the inner side of the cerci).
- Notes:** These mayflies superficially look like brush-legged (Isonychiidae) or small minnow (Baetidae) mayflies, but they can easily be separated by the lack of rows of long hairs on the fore legs and short antennae (<2x width of head). Like the small minnow mayflies, these larvae are also good swimmers. The rows of hairs on the tails help these mayfly larvae swim by functioning as a paddle.

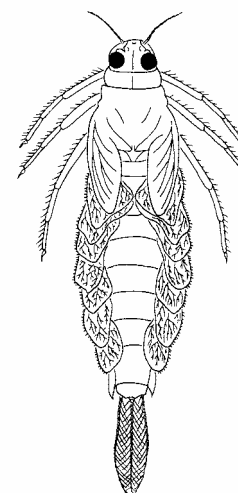


Figure 4.53: *Siphonurus occidentalis* (Siphonuridae) larva, Dorsal View.

Tricorythidae

Common Name: Little Stout Crawler Mayflies

Feeding Group: Collector/Gatherers

Tolerance Value: 4 (Moderate)

Habitat: Tricorythid mayflies most commonly occur in streams and rivers in areas of slow current and are associated with a variety of substrates. These mayflies can also occur at the margins of lakes.

Size: Small (3-10 mm)

Characteristics: Gills absent from abdominal segment 1; gills on abdominal segment 2 operculate (plate-like) and triangular or oval; these operculate gills do not touch or overlap; functional gills present on abdominal segments 3-6 and concealed by operculate gills on segment 2; setae on caudal filaments restricted to apex of each segment.

Notes: The operculate gills on segment 2 in tricorythid mayflies function similarly to those of caenid mayflies.

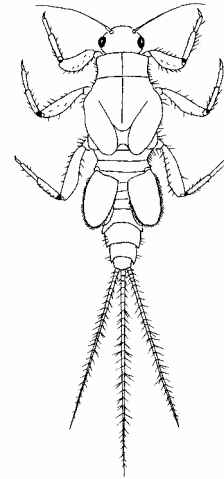


Figure 4.54: *Tricorythodes albilineatus* (Tricorythidae) larva, Dorsal View.