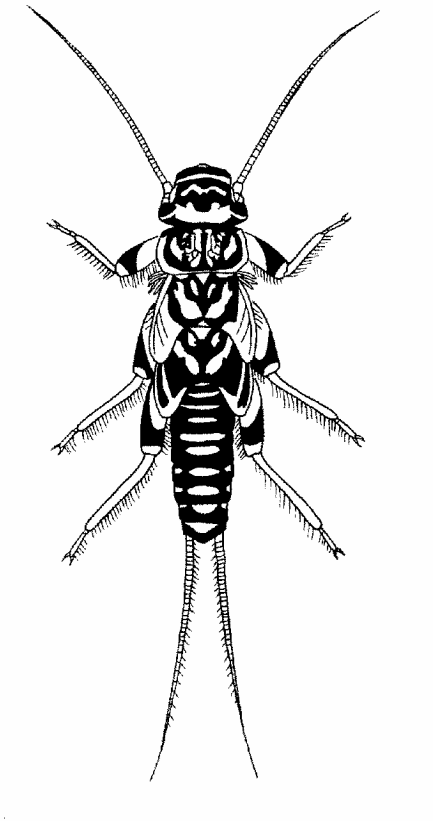
CHAPTER 6

PLECOPTERA
(Stoneflies)



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.

6 ORDER PLECOPTERA
Stoneflies

Plecoptera larvae are almost exclusively found in running waters and they reach their greatest diversity in small cold streams. They are generally associated with coarse substrates such as cobble, leaf packs, and large woody debris. Plecoptera are the most sensitive order of aquatic insects and many species are restricted to habitats with high levels of dissolved oxygen. Most stoneflies are either predators or shredders. When a stonefly larva is ready to emerge as an adult, it crawls out of the water and sheds the larval skin or exoskeleton. Compared to the length of the immature stage (6 months to 3 years), the adult life span is short and usually lasts only 1-4 weeks.

Many adult stoneflies exhibit an interesting behavior of drumming to locate mates. A male will usually initiate drumming by tapping its abdomen on the substrate. A female that perceives the vibrations will then drum a response. By moving toward each other while periodically stopping to drum, males and females are able to locate each other. In order to insure that males and females of the same species find each other, each species has a unique drumming pattern.

Plecoptera Morphology

Stonefly larvae can be recognized by the presence of two claws at the end of each leg, wing pads in mature larvae, and an abdomen terminating in two long, segmented filaments.

Characters such as wing pad shape, gill presence and location, and labium shape (Fig. 6.1 – *shaded*) are used to discriminate between Plecoptera families.

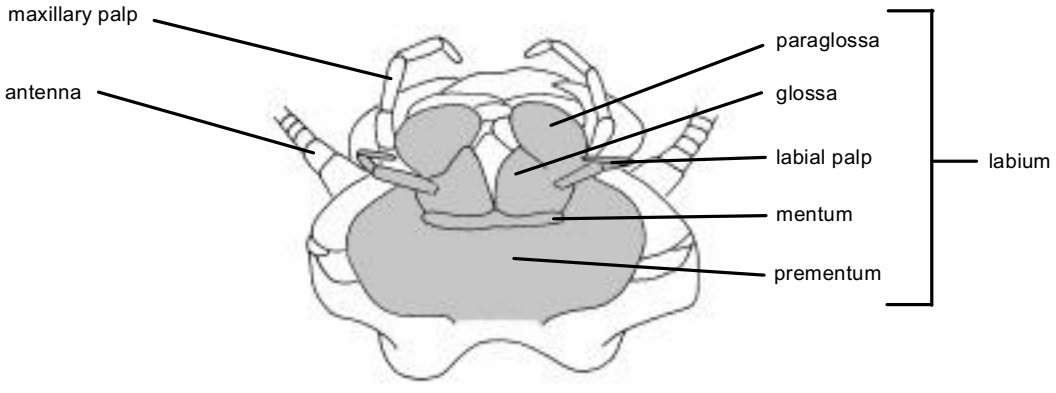


Figure 6.1: Head of *Eccoptura xanthenes* (Perlidae) larva, Ventral View.

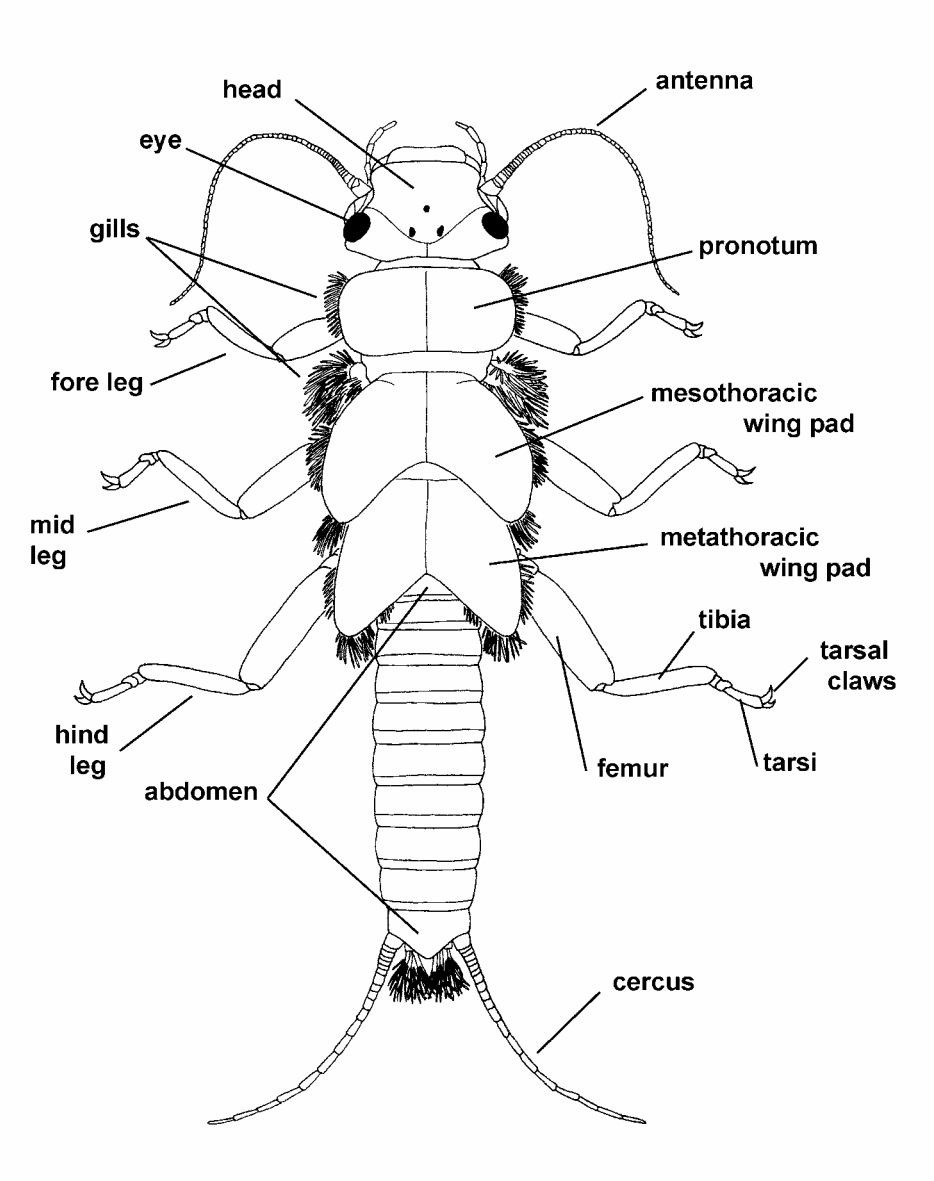


Figure 6.2: Dorsal view of stonefly larva.

Key to Plecoptera Families (Larvae)

1. Finely branched gills present on thoracic segments (Fig. 6.3); finely branched gills present or absent on abdomen (Fig. 6.4) 2

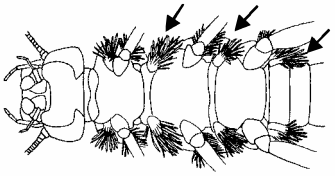


Figure 6.3: Head and thorax of *Eccoptura xanthenes* (Perlidae) larva, Ventral View.

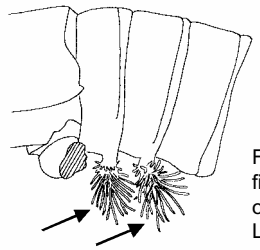


Figure 6.4: Metathorax and first 3 abdominal segments of Pteronarcyidae larva, Lateral View.

1'. Finely branched gills absent from thoracic segments, although single gills may be present on neck and thoracic segments(Fig. 6.5) or finely branched gills may be present on neck only; gills absent from abdomen 3

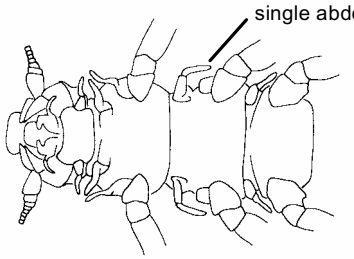


Figure 6.5: Head and thorax of *Perlinodes aurea* (Perlodidae) larva, Ventral View.

2(1). Finely branched gills present on abdominal segments 1-2 (Fig. 6.6); finely branched gills present on thorax (Fig. 6.7) ..... **Pteronarcyidae *p .86***

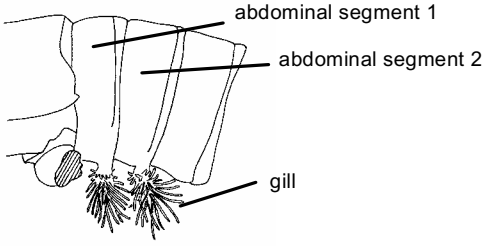


Figure 6.6: Metathorax and first 3 abdominal segments of Pteronarcyidae larva, Lateral View.

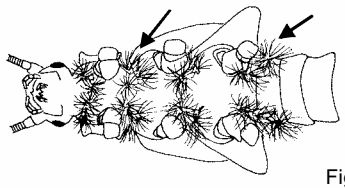


Figure 6.7: Head, thorax, and first four abdominal segments of *Pteronarcys dorsata* (Pteronarcyidae) larva, Ventral View.

2'. Finely branched gills absent from abdominal segments 1-2 (Fig. 6.8); finely branched gills present on thoracic segments (Fig. 6.8) ..... **Perlidae *p. 85***

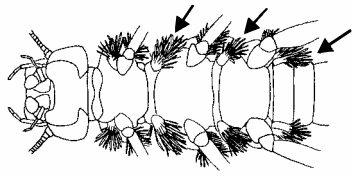


Figure 6.8: Head and thorax of *Eccoptura xanthenes* (Perlidae) larva, Ventral View.

3(1'). Body robust with pronotum much wider than abdomen (Fig. 6.9); wing pads divergent from the midline (Fig. 6.9) – if wing pads are not developed then outer margins of metanotum divergent (Fig. 6.10) 4

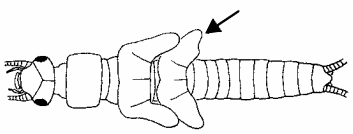


Figure 6.9: Body of *Zapada haysi* (Nemouridae) larva, Dorsal View.

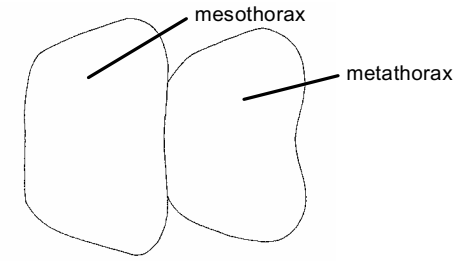


Figure 6.10: Mesothorax and metathorax of *Isoperla* sp. (Perlodidae) larva, Dorsal View.

3'. Body slender with pronotum only slightly wider than abdomen (Fig. 6.11); wing pads not divergent from midline (Figs. 6.11) – if wing pads not developed then metanotum not divergent (Fig. 6.12)..... 6

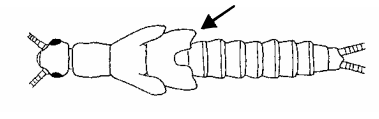


Figure 6.11: Body of *Allocapnia vivipara* (Capniidae) larva, Dorsal View.

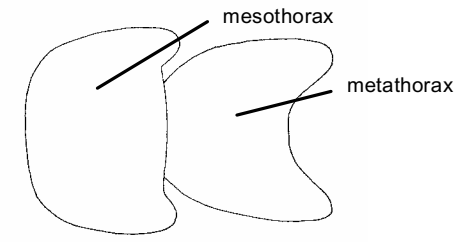


Figure 6.12: Mesothorax and metathorax of *Paracapnia* sp. (Capniidae) larva, Dorsal View.

4(3). Labium with deep notch and paraglossa extending beyond glossa (Fig. 6.13); labial palps slender (Fig. 6.13) ..... **Perlodidae *p .85***

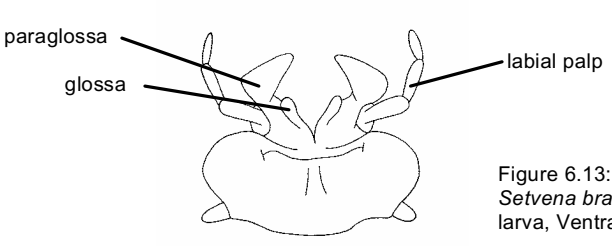


Figure 6.13: Labium of *Setvena bradleyi* (Perlodidae) larva, Ventral View.

4'. Labium compact with three small notches (Fig. 6.14); paraglossa not extending beyond glossa; labial palps robust (Fig. 6.14) 5

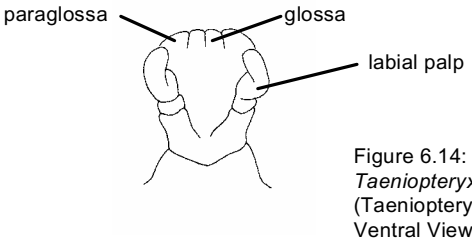


Figure 6.14: Labium of *Taeniopteryx maura* (Taeniopterygidae) larva, Ventral View.

5(4'). Tarsal segment 2 (T_2) shorter than segment 1 (T_1) (Fig. 6.15); coxal gills absent (Fig. 6.16) and triangular plate absent from ventral apex of abdomen (Fig. 6.17) ....**Nemouridae *p. 84***

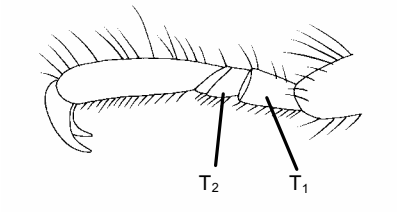


Figure 6.15: Tarsi and tarsal claw of *Shipsa rotunda* (Nemouridae) larva, Lateral View.

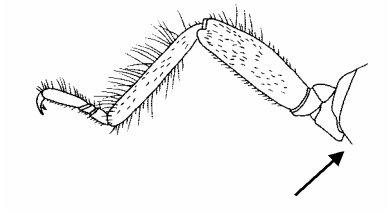


Figure 6.16: Leg of *Shipsa rotunda* (Nemouridae) larva, Lateral View.

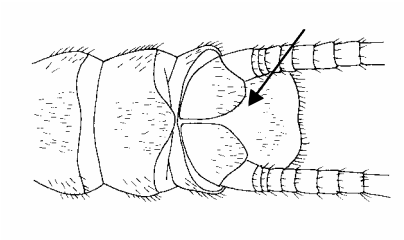


Figure 6.17: Terminal abdominal segments of *Shipsa rotunda* (Nemouridae) larva, Ventral View.

5'. Tarsal segment 2 (T_2) approximately equal to the length of segment 1 (T_1) (Fig. 6.18); coxal gills present (Fig. 6.19) or triangular plate present on ventral apex of abdomen (Figs. 6.20, 6.21).....**Taeniopterygidae *p. 86***

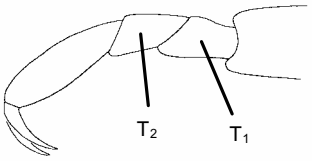


Figure 6.18: Tarsi and claws of *Taeniopteryx* sp. (Taeniopterygidae) larva, Dorsal View.

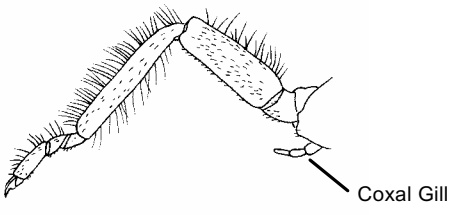


Figure 6.19: Leg of *Taeniopteryx maura* (Taeniopterygidae) larva, Lateral View.

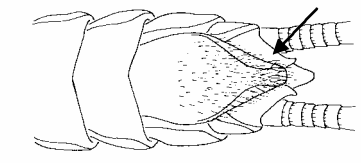


Figure 6.20: Terminal abdominal segments of *Strophopteryx fasciata* (Taeniopterygidae) larva, Ventral View.

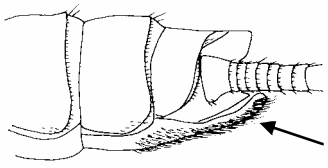


Figure 6.21: Terminal abdominal segments of *Strophopteryx fasciata* (Taeniopterygidae) larva, Lateral View.

6(3'). Cerci (tails) approximately ¾ the length of abdomen (Fig. 6.22); labium with deep notch and paraglossa extending beyond glossa (Fig. 6.23); labial palps slender (Fig. 6.23)..... .....**Chloroperlidae *p. 83***

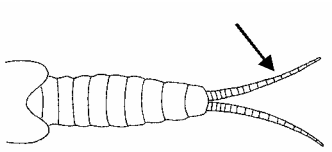


Figure 6.22: Abdomen of *Sweltsa* sp. (Chloroperlidae) larva, Dorsal View.

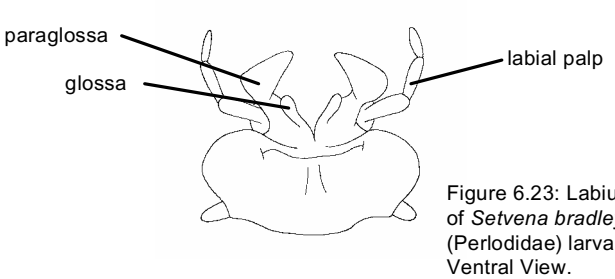


Figure 6.23: Labium of *Setvena bradleyi* (Perlodidae) larva, Ventral View.

6'. Cerci as long or longer than abdomen (6.24); labium compact with three small notches; paraglossa not extending beyond glossa; labial palps robust (Fig. 6.25)..... 7

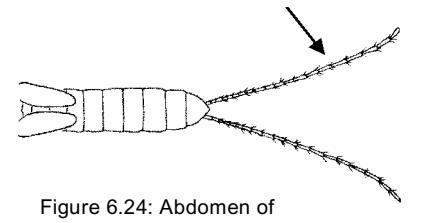


Figure 6.24: Abdomen of *Leuctra* sp. (Leuctridae) larva, Dorsal View.

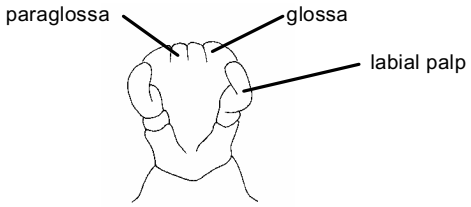


Figure 6.25: Labium of *Taeniopteryx maura* (Taeniopterygidae) larva, Ventral View.

7(6'). Abdominal segments 1-9 separated by membranous fold (Fig. 6.26); wing pads on mesothoracic and metathoracic segments separated by an equal distance (Fig. 6.27), or wing pads absent, or wing pads on metathorax truncated (Fig. 6.28)..**Capniidae *p. 83***

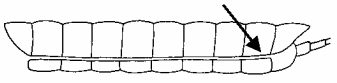


Figure 6.26: Abdomen of *Allocapnia* sp. (Capniidae) larva, Lateral View.

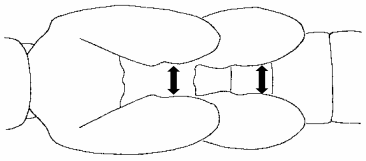


Figure 6.27: Mesothorax and metathorax of *Nemocapnia* sp. (Capniidae) larva, Dorsal View.

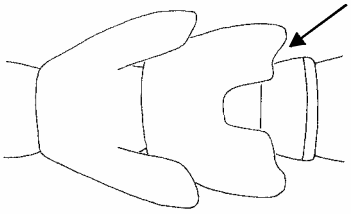


Figure 6.28: Mesothorax and metathorax of *Allocapnia vivipara* (Capniidae) larva, Dorsal View.

7'. Abdominal segments 7-9 without membranous fold (Fig. 6.29); wing pads similar in shape with mesothoracic wing pads 2-3x further apart than metathoracic wing pads (Fig. 6.30).....**Leuctridae *p. 84***

Figure 6.29: Abdomen of *Leuctra* sp. (Leuctridae) larva, Lateral View.

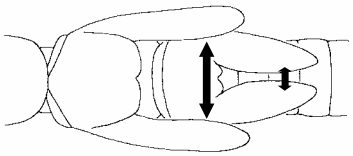


Figure 6.30: Mesothorax and metathorax of *Leuctra* sp. (Leuctridae) larva, Dorsal View.

Plecoptera Family Descriptions

Capniidae

Common Name: Small Winter Stoneflies
Feeding Group: Shredders
Tolerance Value: 1 (Low)
Habitat: Capniid stonefly larvae are found in small streams and medium rivers, but are most common in small streams, including temporary streams and springs. They are usually located in gravel or detritus in sections of fast or moderate flow.
Size: Small (5-10 mm)
Characteristics: Body slender and elongate with pronotum only slightly wider than abdomen; labium compact with three small notches; paraglossa not extending beyond glossa; labial palps robust; wing pads variously shaped and not divergent from midline; abdominal segments 1-9 separated by membranous fold.

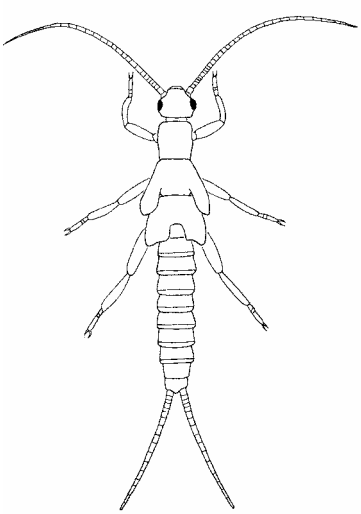


Figure 6.31: *Allocapnia vivipara* (Capniidae) larva, Dorsal View.

Notes: Most capniid stoneflies emerge during cold months. These stoneflies are the most common stonefly emerging in the winter, although taeniopterygids also emerge during this time. They are often active on snow and can easily be seen due to their dark coloration. Some species are found in temporary streams where they spend dry months burrowed down in the wetted substrate.

Chloroperlidae

Common Name: Green Stoneflies
Feeding Group: Predators
Tolerance Value: 1 (Low)
Habitat: Most species of green stoneflies are restricted to cool, clean, flowing waters often in mountainous areas. In these streams, they are most commonly found on stones and gravel, but can also be located in leaf packs and snags.
Size: Small to Medium (10-20 mm)
Characteristics: Body elongate with pronotum only slightly wider than abdomen; labium with deep notch and paraglossa extending beyond glossa; labial palps slender; wing pads not divergent from midline; cerci (tails) shorter than abdomen;
Notes: Adults of this family of stoneflies tend to be bright yellow-green, hence their common name. These larvae have short legs and cerci which allow them to move through the substrate.

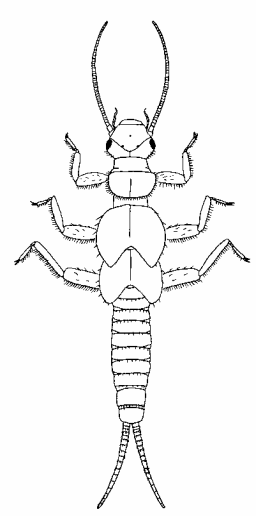


Figure 6.32: *Sweltsa* sp. (Chloroperlidae) larva, Dorsal View.

Leuctridae

Common Name: Roll-Winged Stoneflies
Feeding Group: Shredders
Tolerance Value: 0 (Low)
Habitat: Roll-winged stonefly larvae are most commonly collected in streams where they hide in gravel and detritus in areas of swift current.
Size: Small (6-10 mm) – sometimes larger (20 mm)
Characteristics: Body slender and elongate with pronotum only slightly wider than abdomen; labium compact with three small notches; paraglossa not extending beyond glossa; labial palps robust; wing pads not divergent from midline; wing pads similar in shape with mesothoracic wing pads 2-3x further apart than metathoracic wing pads; abdominal segments 7-9 without membranous fold.
Notes: The larvae of this family are not commonly collected except when they are close to emergence. This is because roll-winged stonefly larvae spend most of their time burrowed in the substrate. Their elongate body shapes allow them to move through gravel substrates.

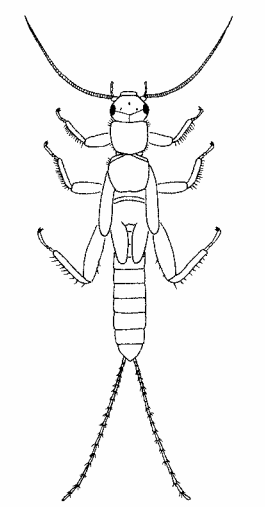


Figure 6.33: *Leuctra* sp. (Leuctridae) larva, Dorsal View.

Nemouridae

Common Name: Brown Stoneflies
Feeding Group: Shredders
Tolerance Value: 2 (Low)
Habitat: Brown stoneflies are most common in small coldwater streams, but they can also be found in larger rivers and lake edges. They usually inhabit leaf packs, roots, and snags.
Size: Small to medium (5-20 mm)
Characteristics: These are generally small brown stoneflies that are often hairy in appearance; wings pads diverge greatly from midline; tarsal segment 2 much shorter than segment 1; hind legs when pulled back nearly reach or exceed the tip of the abdomen; labium compact with three small notches; paraglossa not extending beyond glossa; labial palps robust; gills may be present on neck between thorax and head.
Notes: Nemourid mayflies can be very common in some conditions. Most nemourids emerge in late spring and summer although some emerge in the fall.

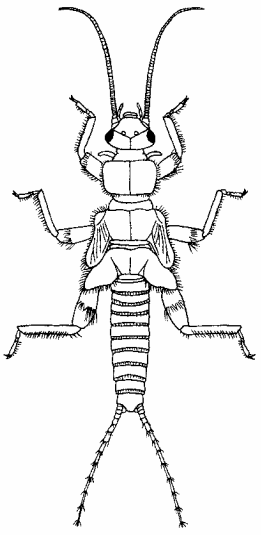


Figure 6.34: *Zapada haysi* (Nemouridae) larva, Dorsal View.

Perlidae

Common Name: Common Stoneflies
Feeding Group: Predators
Tolerance Value: 1 (Low)
Habitat: The larvae of this family are found in streams and rivers of all sizes. They are commonly found under logs and stones and in snags where an abundance of prey can be found.
Size: Large (20-50 mm)
Characteristics: These relatively large larvae are usually strikingly patterned; finely branched gills are present on all 3 thoracic segments (absent from abdominal segments 1-2); labium with deep notch and paraglossa extending beyond glossa; labial palps slender.
Notes: Common stonefly larvae require 1-3 years to mature depending on their geographic location.

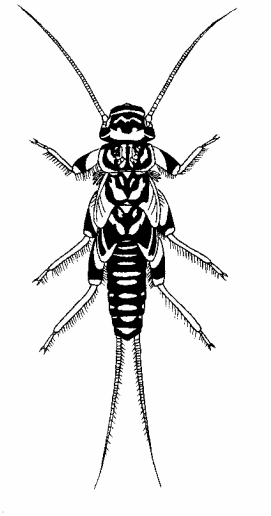


Figure 6.35: *Acroneuria carolinensis* (Perlidae) larva, Dorsal View.

Perlodidae

Common Name: Patterned Stoneflies
Feeding Group: Predators
Tolerance Value: 2 (Low)
Habitat: Perlodid stoneflies are most commonly found in flowing waters under stones and in snags and leaf packs. They are also sometimes found along the edges of cold lakes.
Size: Medium to large (10-50 mm)
Characteristics: These long slender larvae are usually strikingly patterned like common stoneflies (not shown in Fig. 6.36), but lack branched gills on the thoracic segments; labium with deep notch and paraglossa extending beyond glossa; labial palps slender; hind wing pads divergent from body axis.
Notes: Many species of perlodids are large with distinctive patterns. These stoneflies have one generation per year. Most species emerge in the early spring or fall and aestivate during the hot summer months as eggs.

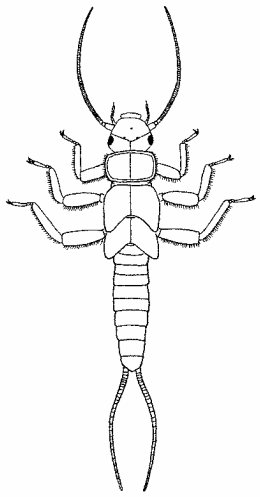


Figure 6.36: *Isoperla fulva* (Perlodidae) larva, Dorsal View.

Pteronarcyidae

Common Name: Giant Stoneflies
Feeding Group: Shredders
Tolerance Value: 0 (Low)
Habitat: These large stoneflies are most commonly found in small swiftly flowing streams. They are found in areas of swift current in leaf packs and snags.
Size: Large (15-70 mm)
Characteristics: Larvae are large and dark brown; finely branched gills are present on all 3 thoracic segments and abdominal segments 1-2.
Notes: Giant stonefly larvae require 1-3 years to mature depending on their geographic location. The larvae of this family have an interesting way of reacting when disturbed by a predator. Pteronarcyid larvae can autohemorrhage by forcing blood through pores in joints on the hind leg. This behavior is thought to cause a bad taste or serves to confuse predators.

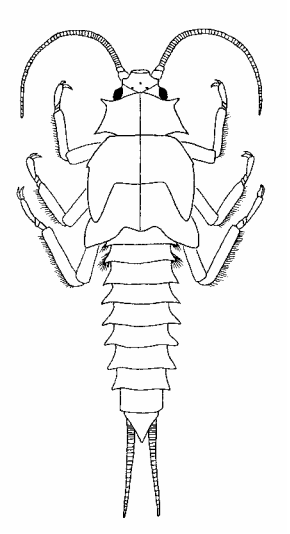


Figure 6.37: *Pteronarcys* sp. (Pteronarcyidae) larva, Dorsal View.

Taeniopterygidae

Common Name: Winter Stoneflies
Feeding Group: Shredders (Some Scrapers)
Tolerance Value: 2 (Low)
Habitat: These stoneflies are found in flowing waters in root mats, snags, leaf packs and sometimes on stones. They are usually found at the edges of streams and rivers where the current is reduced.
Size: Small to Medium (10-20 mm)
Characteristics: Stout body with pronotum considerably wider than abdomen; wing pads greatly divergent from midline; tarsal segment 2 approximately equal to the length of segment 1; labium compact with three small notches; paraglossa not extending beyond glossa; labial palps robust.
Notes: These stoneflies are commonly called winter stoneflies because the adults often emerge during cold months. Most species of this stonefly family are generally intolerant to pollution, but some species are well adapted to large polluted rivers.

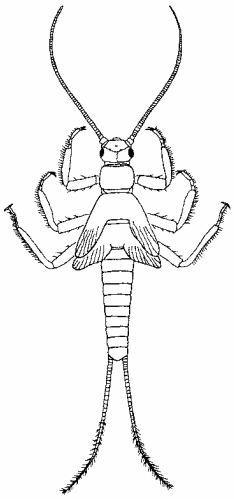


Figure 6.38: *Taeniopteryx* sp. (Taeniopterygidae) larva, Dorsal View.