

**Guide
to the
riffle invertebrates
of
Australian Wet Tropics streams
with a bibliography of their ecology**

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Oligochaeta (worm)



Ecnomidae (Trichoptera – caddis larva)



Introduction

This guide is derived from a research project on the ecology of stream invertebrates in the Australian Wet Tropics bioregion, north-eastern Queensland (the largely forested coastal region between Cooktown and Townsville). The invertebrate fauna of this region is very rich, with particular sites recording many more species than have been found elsewhere in Australia (see bibliography).

The guide focuses on the fauna of riffles because they provide a standard habitat for comparison between sites, and because they are easy to sample. Riffles are those shallow stony areas of streams where the flow is strongest and more or less turbulent (see plates overleaf). The keys presented here include fauna found during a three-year survey of about 80 sites (Pearson et al. 2017). It is possible that animals not represented here will turn up in riffles from time to time (for example, many different dragonfly groups occur in pool habitats).

The keys are to major groups of invertebrates, mostly to the family level, based on more extensive keys, cited in each section. This level of identification is adequate for most monitoring purposes. For some invertebrate groups, while keys to genera and even species are available, they are unlikely to be comprehensive because of the ever-increasing number of species being described. Additionally, specific identifications are mostly unnecessary for the likely users of the guide.

The drawings in this guide are all original (by Andi Cairns and Linda Davis) and based on alcohol-preserved material. They should help identify most specimens even when the keys are difficult to follow. Precise identification often depends on understanding the morphology of the animal in question, so we provide explanatory figures as necessary. A glossary of morphological terms is included towards the end of the guide. We also provide a list of references cited, followed by a bibliography of scientific papers and reports concerning the ecology of aquatic invertebrates of the Wet Tropics.

Users may be interested in following up other more comprehensive guides such as Williams (1980), CSIRO (1991), Hawking and Smith (1997), Gooderham and Tsyrlin (2002) and the many excellent publications by the Cooperative Research Centre for Freshwater Ecology and the Murray Darling Freshwater Research Centre. Information on all the invertebrate groups included here is readily available via the Internet and at Wikipedia. The keys and drawings were originally produced in the 1990s and have not been updated in making this guide generally available.

Using the keys

The keys are all dichotomous – that is, each stage of a key gives two choices. The choices either identify the animal in question or lead to other dichotomous stages. Key 1 identifies the major groups, and leads to the subsequent, more detailed keys to the families. Usually each choice will be clear-cut; where it isn't, follow the choice that most resembles the specimen. Reference to the figures will greatly assist. In some cases, examples of variation among genera within families are illustrated. However, as these examples are not a complete representation of the family, they do not necessarily provide accurate identification of genera. Specimens that do not seem to fit the keys may be identifiable using the references at the end of this guide.

Most major freshwater invertebrate groups occur as both adults and juveniles in fresh waters, but several insect families have only larval forms in fresh waters, hence the absence of keys to the adults. Some insect larvae (e.g., Hemiptera) resemble the adults (apart from wing development), whilst others go through a major change from larva to adult (e.g., Coleoptera), requiring separate keys.

Acknowledgments

We thank those experts on different animal groups who kindly commented on this guide: David Cartwright, Faye Christidis, Peter Cranston, John Dean, John Hawking, Jean Jackson, John Lawrence, Richard Rowe, Ros St.Clair, Phil Suter and Alice Wells.

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Some representative Wet Tropics riffles: (a) Yuccabine Ck., (b) Douglas Ck., (c) Behana Ck., (d) Crystal Ck., (e) Birthday Ck.

1. Major invertebrate groups (based on Williams 1980)

Note: Microscopic forms not included. Key includes free-living macroscopic forms visible with a hand lens.

- 1. Animal with shell and no jointed appendages.....2
- Animal without shell, or if with apparent shell, have jointed appendages inside3
- 2. Shell single, coiled or conical snails, **Gastropoda** (2a,b; Key 2A)
- Shell with two similar halves mussels, **Bivalvia** (2c; Key 2B)

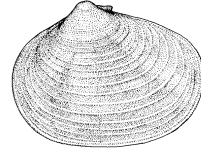
2a. **Gastropoda: Hydrobiidae**
(3–12 mm)



2b. **Gastropoda: Ancyliidae**
(< 6 mm)

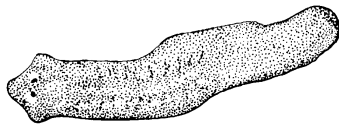


2c. **Bivalvia**
(< 25 mm)



- 3. Body not divided into a series of segments4
- Body divided into a series of segments7
- 4. Body flattened and soft5
- Body cylindrical6
- 5. Without tentacles; moving with gliding motion.....flat worms or planarians, **Turbellaria** (5a)
- With tentacles; living attached to freshwater crustaceans **Temnocephalida** (5b)

5a. **Turbellaria** (< 10 mm)

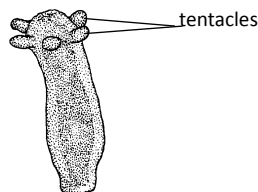


5b. **Temnocephalida** (< 10 mm)

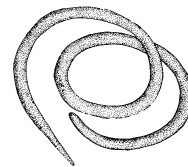


- 6. Body stem-like, with terminal tentacles encircling mouth hydras, **Cnidaria** (6a)
- Body elongate round worms, **Nematoda** (6b); whip worms, horse hair worms, **Nematomorpha** (6c) and **Nemertea** (6d)

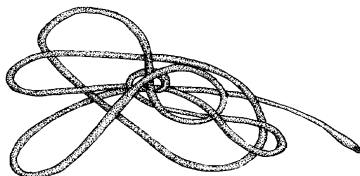
6a **Cnidaria: Hydra** (< 10 mm)



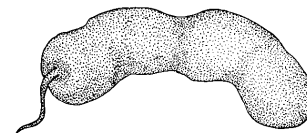
6b. **Nematoda** (< 10 mm)



6c. **Nematomorpha** (~ 100 mm)



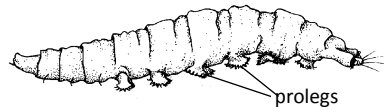
6d. **Nemertea** (< 1 mm)



- 7. Without jointed limbs, worm-like or maggot-like.....8
- With jointed limbs on some segments10

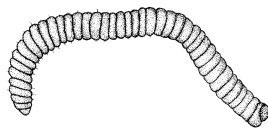
8. Body soft and worm-like with numerous segments; no obvious appendages (legs etc.).....**9**
 – Body worm- or maggot-like but with fewer than 15 segments; prolegs and/or other appendages may be present; head sclerotised (hardened) fly larvae, **Insecta: Diptera** (8a; Key 12)

8a. **Insecta: Diptera** (2–30 mm)

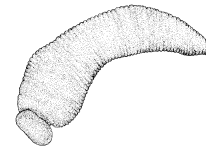


9. Body elongate with numerous segments; chaetae (microscopic fine bristles) present on segments worms, **Oligochaeta** (9a)
 – Body less elongate; chaetae absent; anterior and posterior suckers leeches, **Hirudinea** (9b)

9a. **Oligochaeta** (5–50 mm)

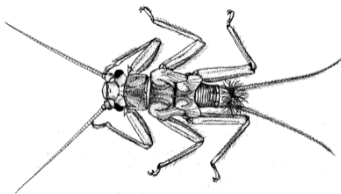


9b. **Hirudinea** (10–50 mm)

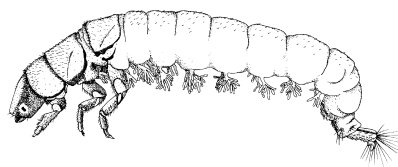


10. More than three pairs of legs **11**
 – Three pairs of legs **Insecta** (10a-f; Key 4)

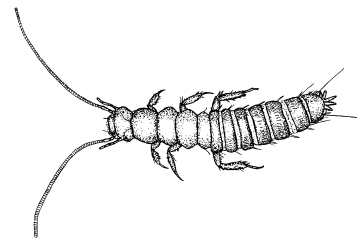
10a. **Insecta: Plecoptera**
(5–25 mm)



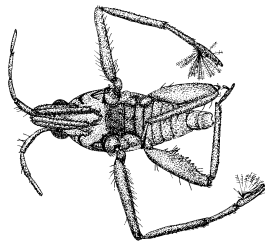
10b. **Insecta: Trichoptera**
(3–30 mm)



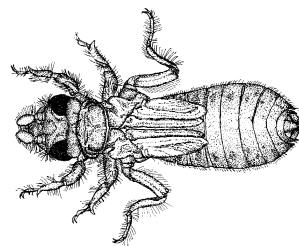
10c. **Insecta: Coleoptera**
(2–20 mm)



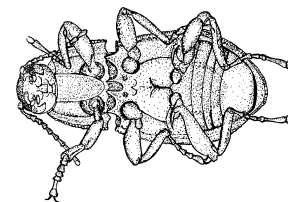
10d. **Insecta: Hemiptera**
(2–8 mm)



10e. **Insecta: Odonata**
(5–25 mm)

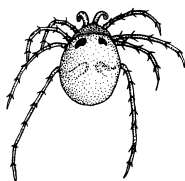


10f. **Insecta: Coleoptera**
(3–20 mm)



11. Four pairs of legs, no antennae spiders and mites, **Arachnida** (11a)
 – More than four pairs of legs (sometimes hidden within carapace), two pairs of antennae **Crustacea** (11b,c; Key 3)

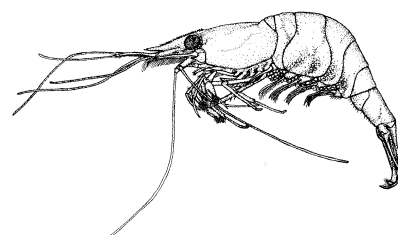
11a. **Arachnida: Hydracarina**
(< 5 mm)



11b. **Crustacea: Copepoda**
(< 4 mm)



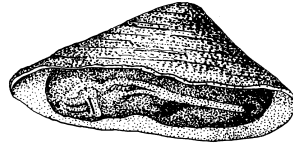
11c. **Crustacea: Decapoda**
(> 10 mm)



2A. Mollusca: Gastropoda (snails) (based on Smith 1996, Williams 1980)

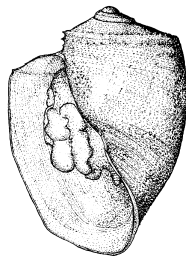
1. Shell coiled.....2
 – Shell not coiledfreshwater limpets, **Ancylidae** (1a)

1a. **Ancylidae** (< 5 mm)

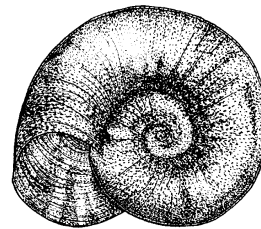


2. Shell with elevated spire.....3
 – Shell without elevated spire, coiled in one plane **Planorbidae** (2a,b)

2a. **Planorbidae: Amerianna** sp.
 (< 15 mm)

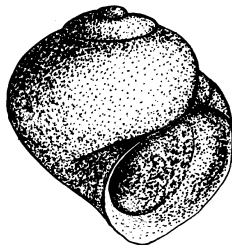


2b. **Planorbidae: Gyraulus** sp.
 (< 10 mm)



3. Shell smoothly rounded without sculptured surface.....**Hydrobiidae** (3a)
 – Shell with sculptured surface **Thiaridae** (3b)

3a. **Hydrobiidae** (< 5 mm)



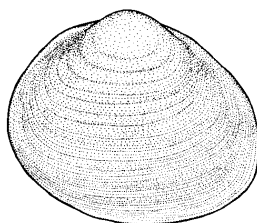
3b. **Thiaridae** (< 20 mm)



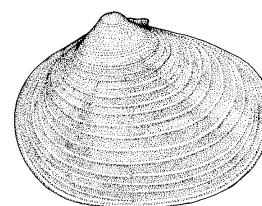
2B. Bivalvia (mussels) (based on Smith 1996, Williams 1980)

1. Shell thin, without concentric ridges, often transparent, colourless.....**Sphaeriidae** (1a)
 – Shell not thin, with concentric ridges, often coloured..... **Corbiculidae** (1b)

1a. **Sphaeriidae** (< 10 mm)



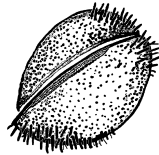
1b. **Corbiculidae** (>10 mm)



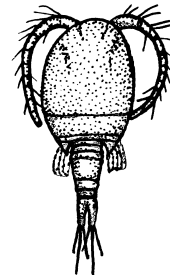
3. Crustacea (shrimps etc.) (based on Williams 1980; Horowitz *et al.* 1995)

- 1. Body of animal completely enclosed in bivalved carapaceseed shrimps, **Ostracoda** (1a)
- Body of animal not completely enclosed in bivalved carapace2
- 2. Very small animals with characteristic upside-down teardrop shape; distinctive antennae; single eyespotcopepods, **Copepoda** (2a)

1a **Ostracoda** (0.2–6 mm)

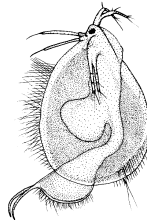


2a **Copepoda** (< 4 mm)

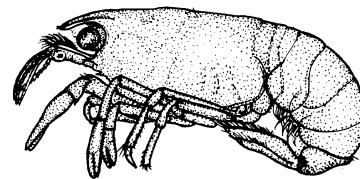


- Not as above.....3
- 3. Carapace enclosing trunk but not head, often transparent with internal structures visible; conspicuous eye and large antennules..... water fleas, **Cladocera** (3a)
- Carapace present, extending down sides of thorax but only partly covering legs; eyes on stalks Order Decapoda...4
- 4. Second segment of abdomen overlapped by first laterally; first 3 pairs of legs chelate.....**Parastacidae** (4a)

3a **Cladocera** (0.2–6 mm)

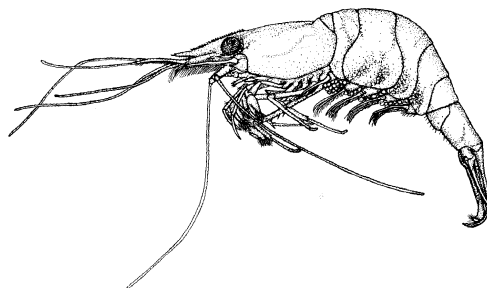


4a **Parastacidae** (> 10 mm)

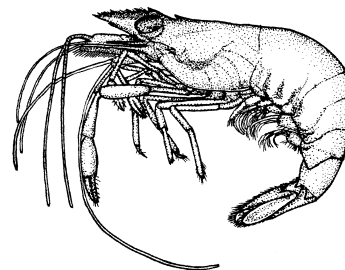


- Second segment of abdomen overlapping first laterally; first two pairs of legs chelate5
- 5. First 2 pairs of legs of similar size and tipped with thick tufts of long setae..... shrimps, **Atyidae** (5a)
- Second pair of legs longer than the first; neither pair with terminal tufts of long setaeprawns, **Palaemonidae** (5b)

5a **Atyidae** (10-60 mm)



5b **Palaemonidae** (25–150 mm)

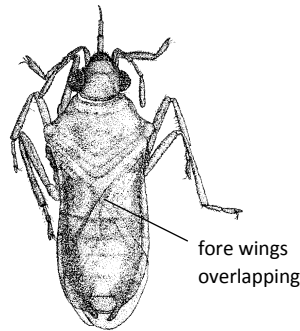


4. Orders of Insects (based on Williams 1980, CSIRO 1991)

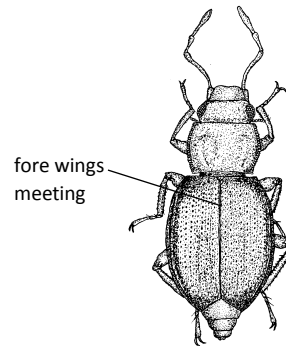
Note: all < 30 mm

1. Wings large, covering all abdominal segments2
 - Wings absent or small, not covering all abdominal segments3
2. Forewings overlap along mid-dorsal line, hardened at base and membranous towards tip; mouthparts beak-like for piercing and suckingadult water bugs, **Hemiptera** (2a;Key 8)
 - Forewings not overlapping, meeting in mid-line; forewings hardened and covering second (membranous) pair of wings; mouthparts mandibulate for chewing adult beetles, **Coleoptera** (2b;Key 12A)

2a. **Hemiptera:** Veliidae

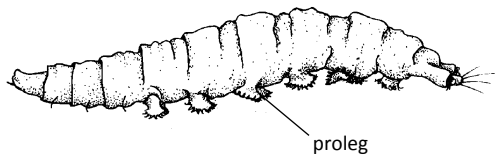


2b. **Coleoptera:** Hydraenidae

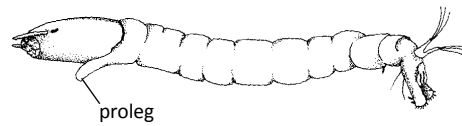


3. Jointed legs absent; stumpy prolegs may be present larval flies, **Diptera** (3a,b;Key 11)
 - Three pairs of jointed legs present on first three segments behind head4

3a. **Diptera:** Empididae

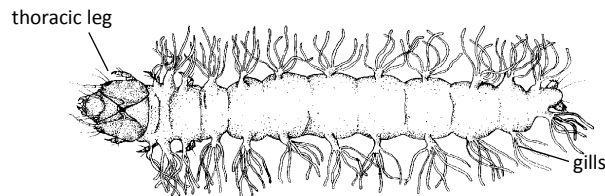


3b. **Diptera:** Chironomidae



4. Without wings; compound eyes with few facets5
 - With wings partly developed; compound eyes with many facets9
5. Three pairs of thoracic legs; abdominal segments 3–6 and last segment each with a pair of short prolegs; each segment with filamentous tracheal gills in mature larvae larval moths, **Lepidoptera** (5a)

5a. **Lepidoptera:** Pyralidae

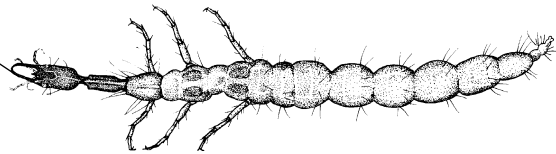


- Not as above6

6. Mouthparts long and slender larval lacewings, **Neuroptera** (6a)

6a. **Neuroptera: Neurorthidae**

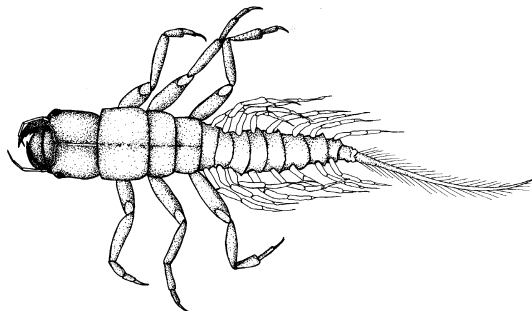
long, slender mouthparts



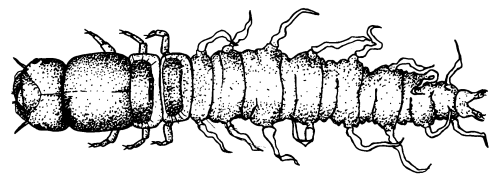
– Mouthparts with well-developed, short mandibles7

7. Body flattened and elongate; prothorax large; mandibles stout, robust and sharply toothed; unbranched, segmented abdominal gills present..... alderfly larvae, **Megaloptera** (7a,b;Key 9)

7a. **Megaloptera: Sialidae**



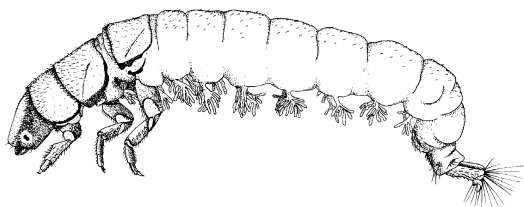
7b. **Megaloptera: Corydalidae**



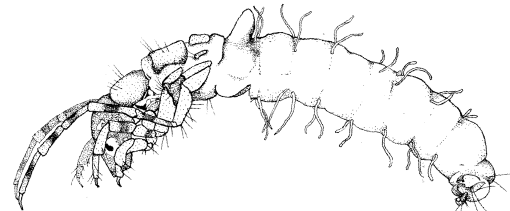
– Not as above.....8

8. Head and at least part of thorax sclerotised, abdomen not so; abdomen ends in a pair of prolegs; free-living, in fixed silken retreats or in portable cases of sand, plant or secreted material caddisfly larvae, **Trichoptera** (8a,b;Key 10)

8a. **Trichoptera: Hydropsychidae**

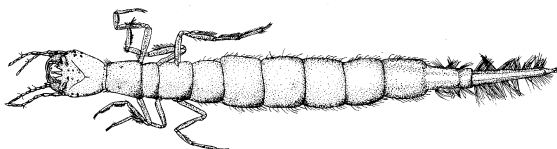


8b. **Trichoptera: Leptoceridae**

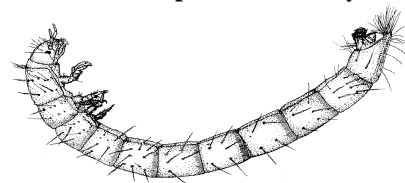


– Thorax no more sclerotised than abdomen; abdomen with terminal processes (not leg-like); never in a case.. larval water beetles, **Coleoptera** (8c,d;Key 12B)

8c. **Coleoptera: Dytiscidae**



8d. **Coleoptera: Ptilodactylidae**

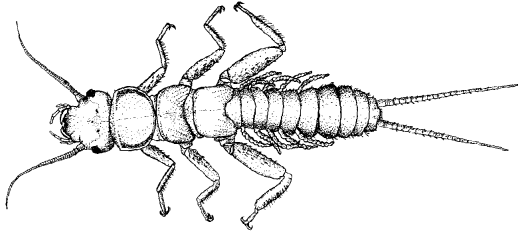


9. Abdomen without terminal processes; mouthparts usually beak-like (see 2a)..... water bug nymphs, **Hemiptera** (Key 8)

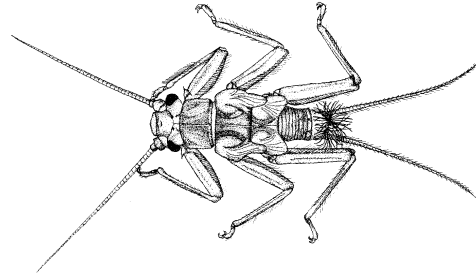
– Abdomen with terminal processes; mouthparts never beak-like10

10. Abdomen ending in two long tails; antennae long; gills occur as lateral abdominal processes (Eustheniidae) or as a tuft on posterior abdomen (Gripopterygidae) stone-fly nymphs, **Plecoptera** (10a,b;Key 6)

10a. **Plecoptera:** Eustheniidae



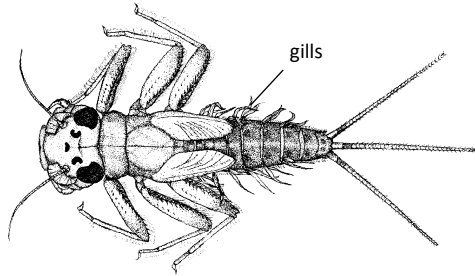
10b. **Plecoptera:** Gripopterygidae



– Abdomen ending in three processes (very short, or long).....11

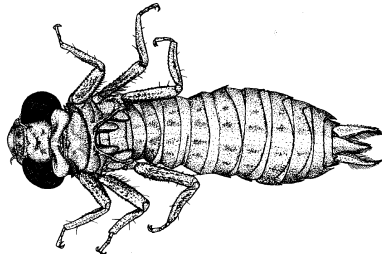
11. Tail processes filamentous; paired gills on sides of abdomen; tarsi with single claw mayfly nymphs, **Ephemeroptera** (11a;Key 7)

11a. **Ephemeroptera:** Leptophlebiidae

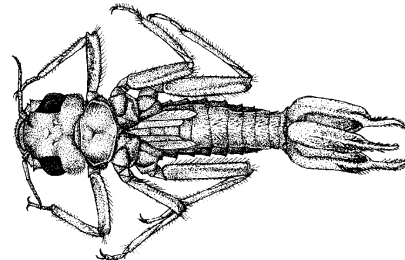


– Tail processes not filamentous; no gills on sides of abdomen; tarsi with two claws; mouthparts include extensible labium, often covering face Dragonfly and damselfly nymphs, **Odonata** (11b,c;Key 5)

11b. **Odonata:** Aeshnidae



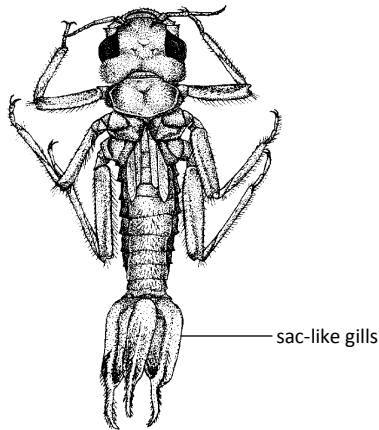
11c. **Odonata:** Amphypterygidae



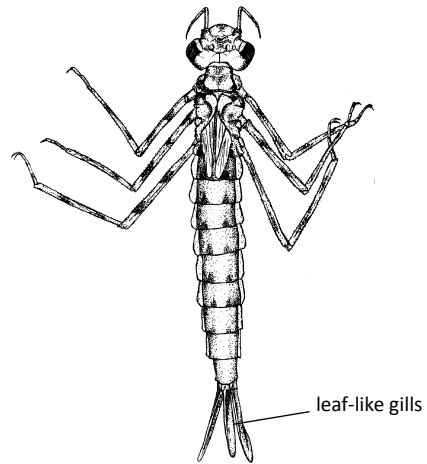
5. Larval Odonata (damselflies and dragonflies) (based on CSIRO 1991)

1. Body usually slender, bearing three leaf-like or sac-like tracheal gills attached to tip of abdomen (see 2a,b) ..
.....suborder **Zygoptera** ...**2**
- Body usually stout, without external tracheal gills, but with three conspicuous substantial spine-like or
triangular processes at tip of abdomen, forming anal 'pyramid' surrounding anus (see 4a,b)
.....suborder **Anisoptera** ...**3**
2. Caudal gills sac-like **Amphipterygidae** (2a)
- Caudal gills flattened, leaf-like **Synlestidae** (2b)

2a. Amphipterygidae

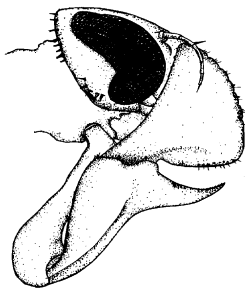


2b. Synlestidae

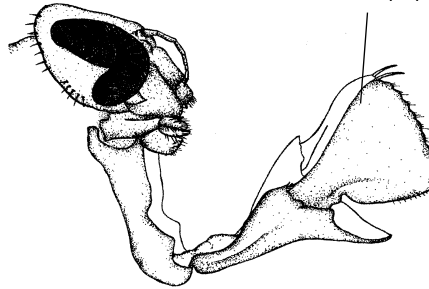


3. Labium deeply concave, ladle-shaped; labial palps broadened (3c), forming mask in front of head when
closed (3a, 3b); prementum bearing large setae**4**

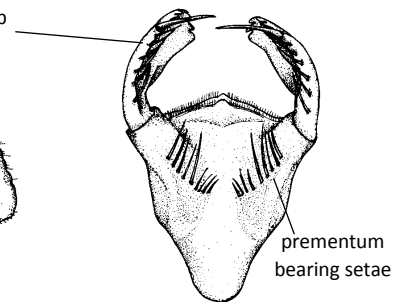
3a. Concave labium retracted



3b. Labium extended

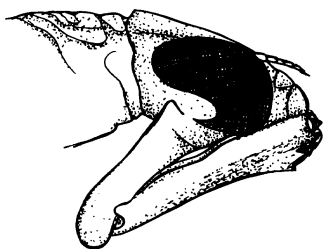


3c. Concave labium

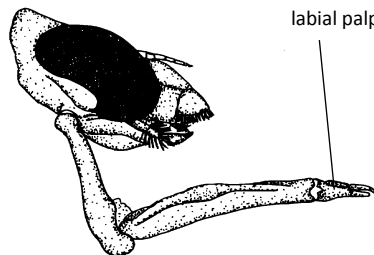


- Labium flat, lying beneath head when closed (3d, 3e); labial palps not broadened (3f); prementum without
setae**5**

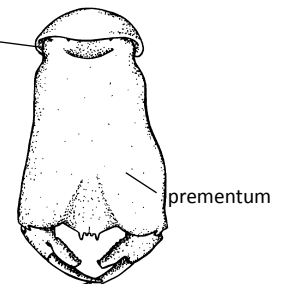
3d. Flat labium retracted



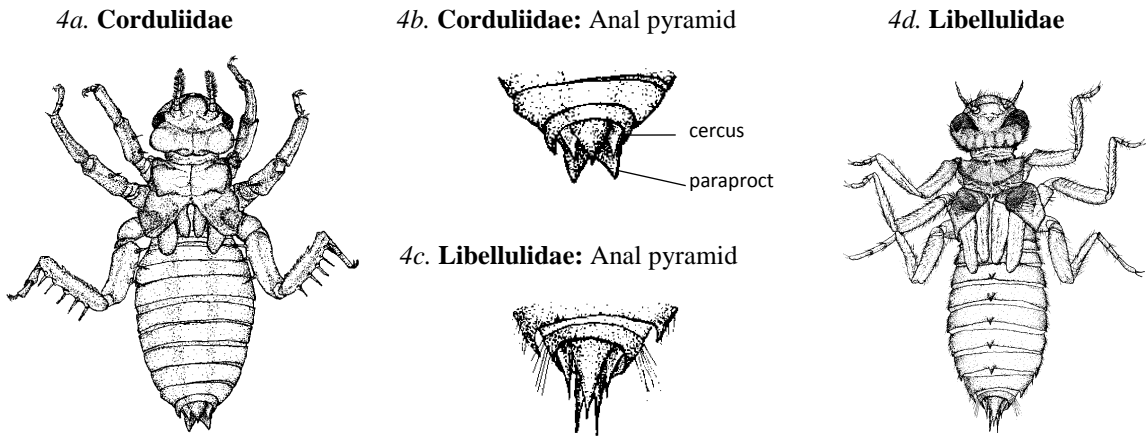
3e. Labium extended



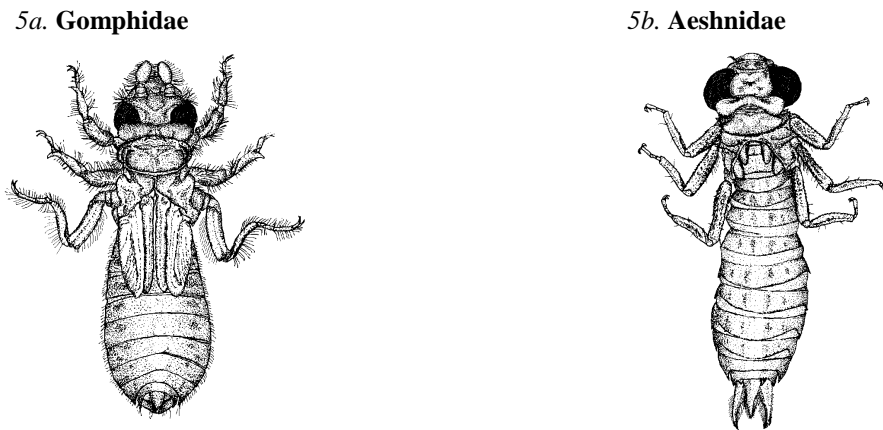
3f. Flat labium



4. Labial palps toothed distally; anal pyramid short; cerci usually at least half as long as paraprocts (4b) **Corduliidae** (4a)
- Labial palps not toothed distally or, if toothed, then anal pyramid long; cerci usually less than half as long as paraprocts (4c) **Libellulidae** (4d)
- Note: It is very difficult to distinguish between these two families.*



5. Antennae 4-segmented, usually flattened; fore-tarsi 2-segmented **Gomphidae** (5a)
- Antennae 6 or 7-segmented, with distal segments thread like; all tarsi 3-segmented **Aeshnidae** (5b)



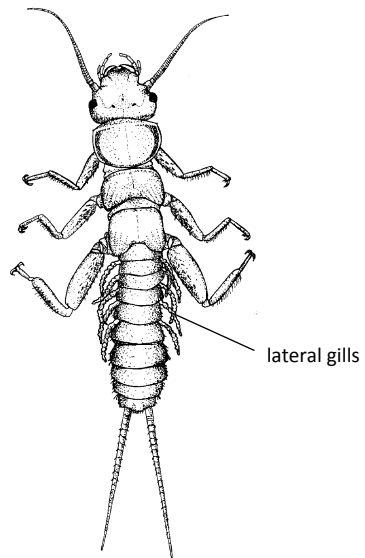
Gomphidae



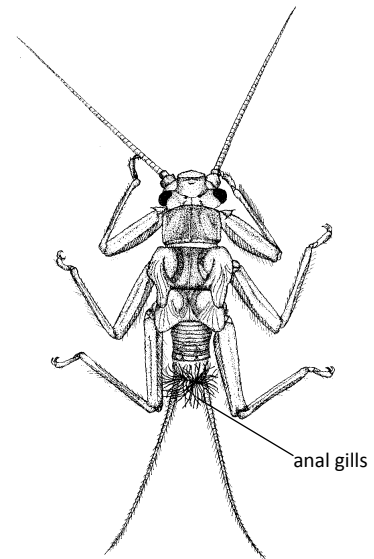
6. Larval Plecoptera (stoneflies) (based on Williams 1980)

- 1. With 5 or 6 pairs of lateral filamentous gills on abdomen **Eustheniidae (1a)**
- With tuft or rosette of anal gills **Gripopterygidae (1b)**

1a. Eustheniidae



1b. Gripopterygidae



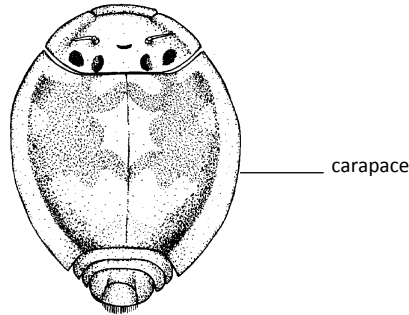
Gripopterygidae



7. Larval Ephemeroptera (mayfly nymphs) (based on Dean and Suter 1996)

1. Nymph (larva) oval in dorsal view, upper surface strongly convex, carapace enclosing thorax and anterior segments of abdomen..... **Prosopistomatidae (1a)**

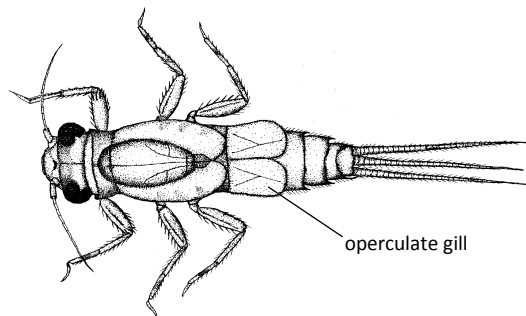
1a. Prosopistomatidae



- Nymph not as above.....**2**

2. Abdomen with gills on segments 1-6; operculate gills present on segment 2, covering more posterior gills **Caenidae (2a)**

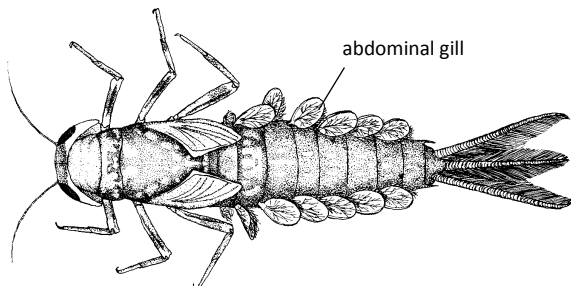
2a. Caenidae



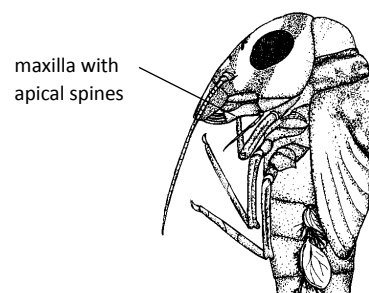
- Abdomen without operculate gills; all abdominal gills exposed**3**

3. Abdominal gills oval, plate-like, with tuft of filaments on lower inner margin; maxillae with four long, needle-like apical spines **Ameletopsidae (3a,b)**

3a. Ameletopsidae: *Mirawara* sp.



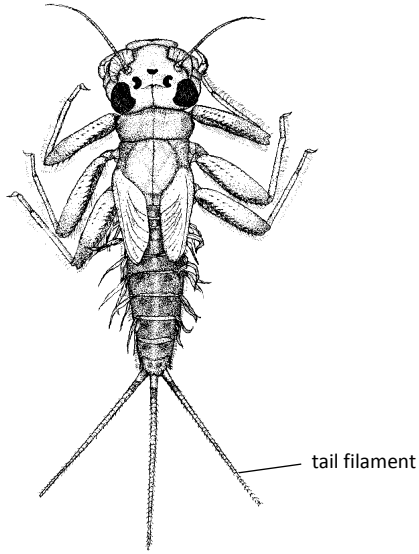
3b. Ameletopsidae: head and thorax



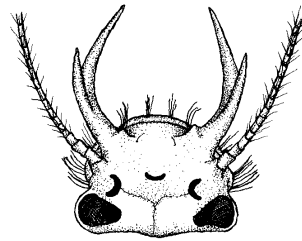
- Abdominal gills not as above; maxilla without long apical spines**4**

4. Head prognathous; tail filaments with a whorl of setae at apex of each segment, never with setal fringe.....
**Leptophlebiidae** (4a,b,c)

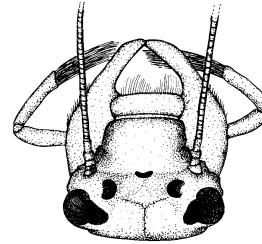
4a. **Leptophlebiidae:**
Austrophlebioides sp.



4b. **Leptophlebiidae:** *Jappa* sp. Head

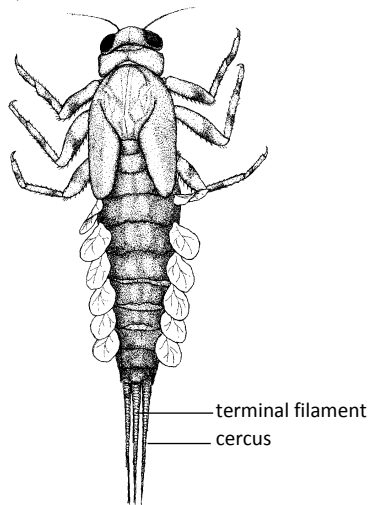


4c. **Leptophlebiidae:** *Kalbaybaria* sp. Head

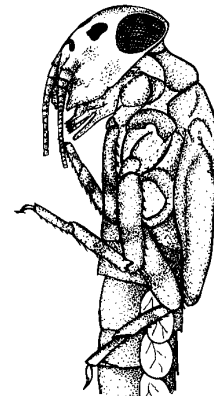


- Head hypognathous; tail filaments usually fringed with setae, terminal filament with setal fringe on both lateral margins, cerci with inner margin fringed **Baetidae** (4d,e)

4d) **Baetidae**



4e) **Baetidae:** Head and thorax



Baetidae



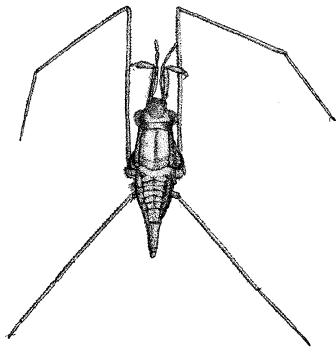
Caenidae



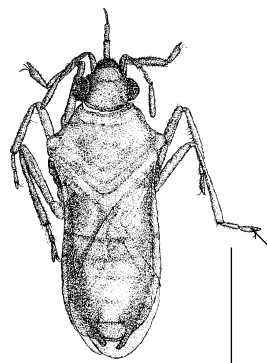
8. Hemiptera (true bugs) (based on Williams 1980)

1. Claws (at least on first pair of legs) inserted before tip of last tarsal segment (see 2b, c).....2
 - Claws inserted at tip of tarsal segments3
2. Femoral segment of posterior pair of legs extending well beyond tip of abdomen; beak 4-jointed; body usually longer than 5 mm water striders, **Gerridae** (2a)
 - Femoral segment of posterior pair of legs not extending well beyond tip of abdomen; beak 3-jointed; body usually shorter than 5 mm..... **Veliidae** (2b,c)

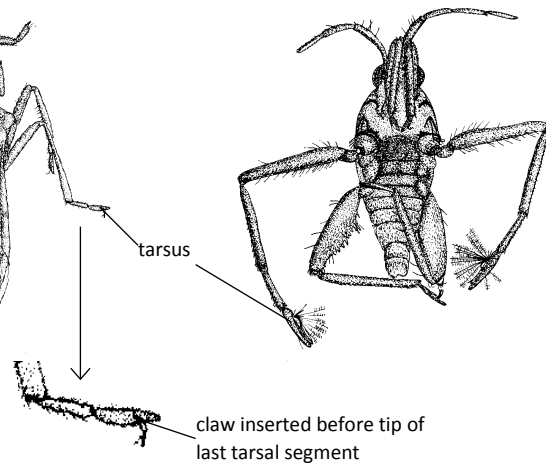
2a. **Gerridae**



2b. **Veliidae: Microvelia** sp.

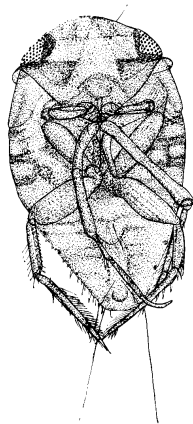


2c. **Veliidae: Rhagovelia** sp.

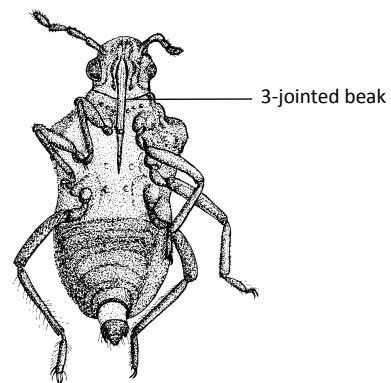


3. Antennae hidden, forelegs much shorter than other legs and with spatulate or blade-like tarsi; mouthparts triangular, not beak-like; swims with dorsal surface uppermost lesser water boat-men, **Corixidae** (3a)
 - Antennae clearly visible, length and form of forelegs similar to other two pairs of legs; mouthparts a 3-jointed beak..... velvet water-bugs, **Hebridae** (3b)

3a. **Corixidae**: ventral view



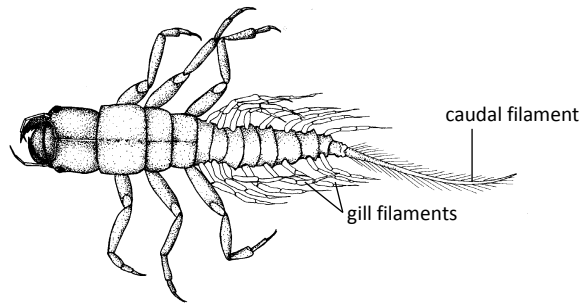
3b. **Hebridae**: ventral view



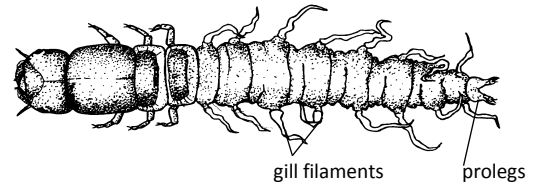
9. Larval Megaloptera (alderflies) (based on CSIRO 1991)

1. Pair of long unbranched segmented gill filaments on abdominal segments 1-7; each filament with many long setae; with single long caudal filament **Sialidae (1a)**
- Pair of long unbranched segmented gill filaments on abdominal segments 1-8; each filament with a few short setae; segment 10 with pair of large prolegs, each with a lateral filament and two large claws.....
..... **Corydalidae (1b)**

1a. Sialidae



1b. Corydalidae

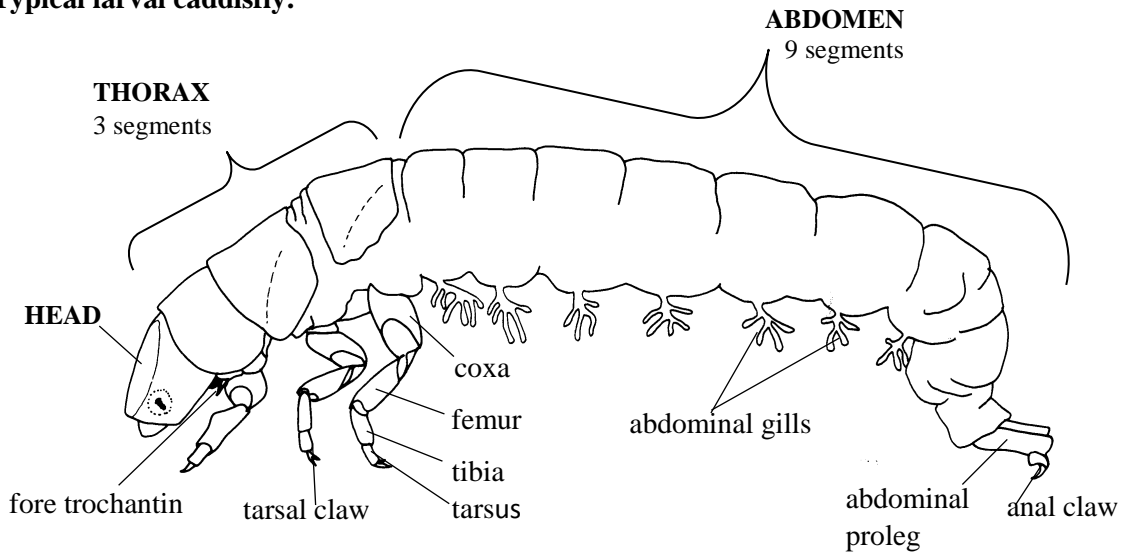


Corydalidae



10. Larval Trichoptera (caddisflies) (based on Dean *et al.* 1995, Wells 1997, Jackson 1998)

Typical larval caddisfly:



Key to Trichopteran Larvae

1. Larvae free-living or in fixed retreats; abdomen often dorso-ventrally flattened; first abdominal segment without lateral pads or hump-like processes; anal claws large, on long and slender prolegs (e.g. see 3a ,3b)... 2
- Larvae constructing portable cases made from sand, plant material, or secretion (e.g.1a-e); abdomen usually cylindrical; first abdominal segment often with dorsal and/or lateral humps; anal claws small, on generally short abdominal prolegs (e.g. see 14b, 16a).....8

1a. Plant material:
eg. Leptoceridae



1b. Secretion:
Conoesucidae



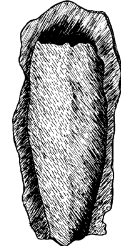
1c. Sand:
Helicopsychidae



1d. Sand:
eg. Leptoceridae

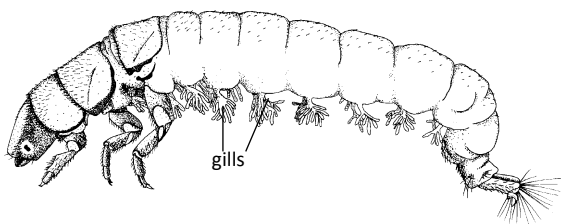


1e. Leaf fragments:
Calamoceratidae

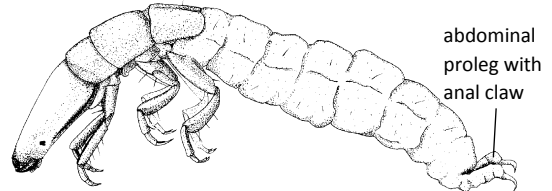


2. Dorsal sclerotisation on all three thoracic segments, although sometimes incomplete on meso- and metanotum 3
- Dorsal sclerotisation on first thoracic segment only4
3. Abdominal gills present **Hydropsychidae (3a)**
- Abdominal gills absent..... **Ecnomidae (3b)**

3a. **Hydropsychidae**

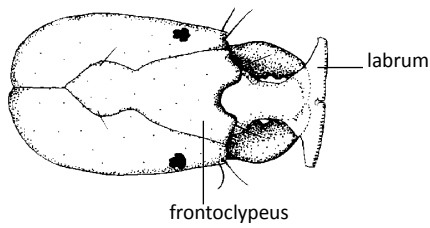


3b. **Ecnomidae**

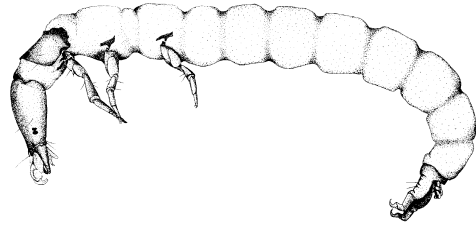


4. Labrum membranous; frontoclypeus often with central notch (4a) **Philopotamidae** (4a,b)

4a. **Philopotamidae**: head, dorsal view



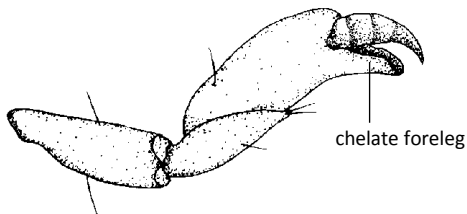
4b. **Philopotamidae**



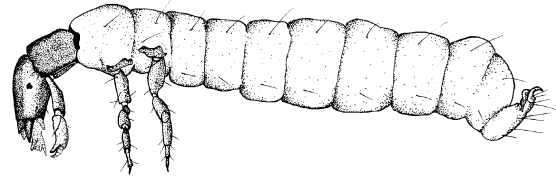
- Labrum sclerotised; frontoclypeus without central notch.....5

5. Foreleg modified, either chelate or with femur broadened (5a); fore trochantin reduced **Hydrobiosidae** (5b)

5a. **Hydrobiosidae**: foreleg



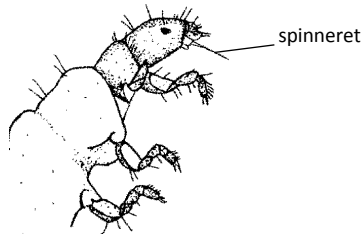
5b. **Hydrobiosidae**



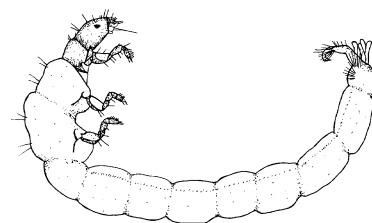
- Foreleg not modified; fore trochantin well-developed.....6

6. Labium modified to form elongate spinneret, longer than head capsule (6a); frontoclypeus extending to posterior of head capsule (as in 4a)..... **Dipseudopsidae** (6b)

6a **Dipseudopsidae**: Head and thorax



6b. **Dipseudopsidae** (after Dean *et al.* 1995)

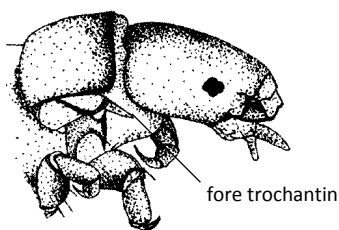


- Spinneret, if present, considerably shorter than head capsule; frontoclypeus not extending to posterior of head capsule7

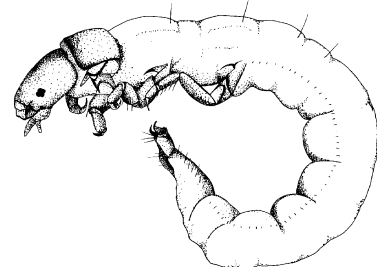
7. Fore trochantin tapered..... **Polycentropodidae** (7a,b)

- Fore trochantin blade-like **Psychomiidae** (no specimen)

7a. **Polycentropodidae**: head and prothorax

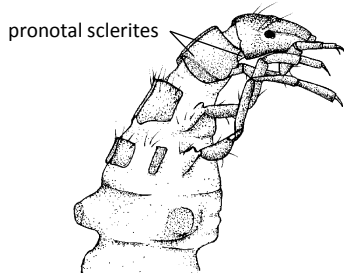


7b. **Polycentropodidae**



8. Head small; pronotum with two pairs of sclerites on anterior half; posterior half membranous and retractable into mesonotum; meso- and metanotum broader than pronotum **Atriplectididae** (8a)

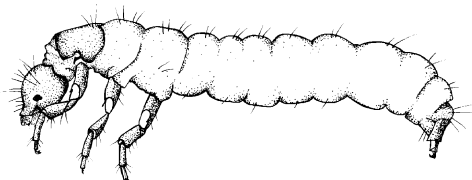
8a. **Atriplectididae**: head and thorax



- Head not reduced; pronotum completely sclerotised, not retractable.....**9**

9. Mesonotum and metanotum each with one pair of very small sclerites; abdominal prolegs medium length, fused in basal half only; body setae numerous; case of sand, saddle-shaped **Glossosomatidae** (9a)

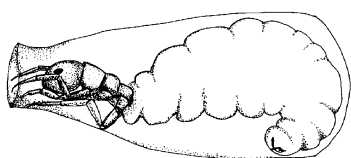
9a. **Glossosomatidae**



- Mesonotum with moderate to strong sclerotisation, metanotum with relatively large sclerites or membranous; abdominal prolegs short, fused to the side of the body**10**

10. Abdomen usually swollen, broader and deeper than thorax; case purse-like, constructed from silk and may incorporate sand and/or filamentous algae; larvae small.....**Hydroptilidae** (10a-e)

10a. *Oxyethira* sp.



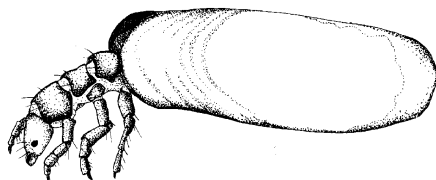
10b. *Orthotrichia* sp.



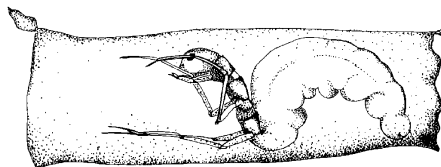
10c. *Maydenoptila* sp.
(without case)



10d. *Orthotrichia* sp.



10e. *Hellyethira* sp.



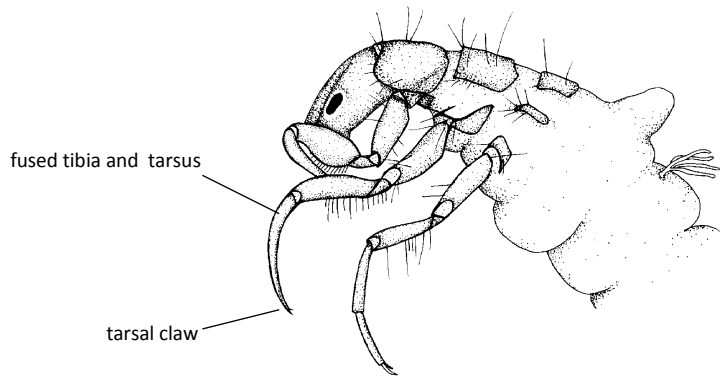
- Abdomen not as above; case not purse-like**11**

11. Larval case helical, constructed from sand grains (see 1c) **Helicopsychidae**

- Larval case not helical.....**12**

12. Middle leg with tibia and tarsus fused.....**Philorheithridae (12a)**

12a. **Philorheithridae**: head, thorax and upper abdomen

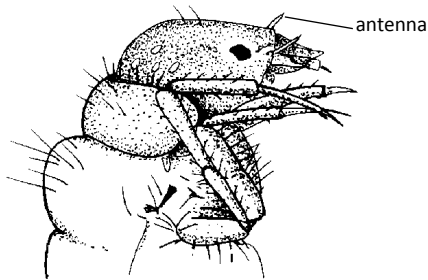


– Middle leg with tibia and tarsus not fused.....13

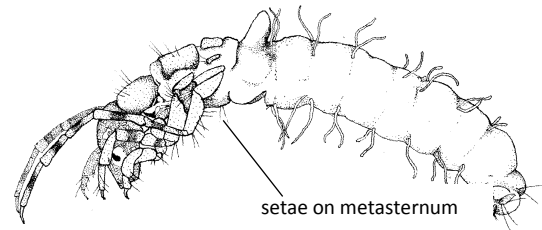
13. Metasternum with two or more setae; antennae often long and prominent; hind legs long, often with tibia in 2 sections; pronotum usually not covered with setae on anterior half but if dense setae are present then metasternum bears small sclerites; case of sand, leaf fragments or hollow stick **Leptoceridae (13a,b)**

– Metasternum without setae.....14

13a. **Leptoceridae**: Head and thorax



13b. **Leptoceridae**



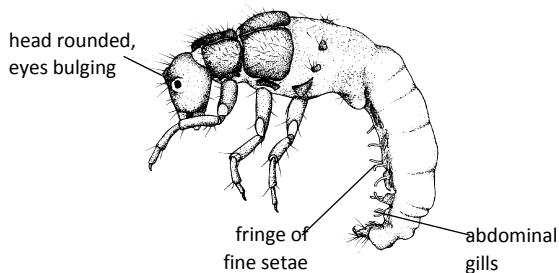
14. Abdominal segments with conspicuous lateral fringe of fine setae.....15

– Abdominal segments without conspicuous lateral fringe of fine setae.....16

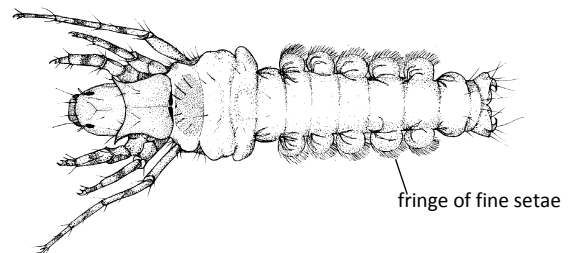
15. Hind legs and fore legs approximately equal in length; case of sand/gravel..... **Tasimiidae (16a)**

– Hind legs twice length of fore legs; case of 2 leaf pieces (see 1e) **Calamoceratidae (16b)**

16a. **Tasimiidae**

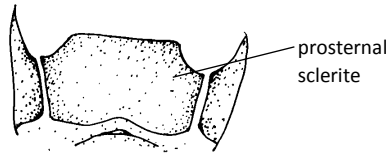


16b. **Calamoceratidae**



16. Prosternum with large sclerite or sclerites.....**Odontoceridae** (16a,b)

16a. **Odontoceridae:** prosternum



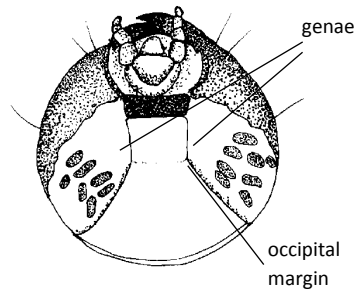
16b. **Odontoceridae:** head and thorax



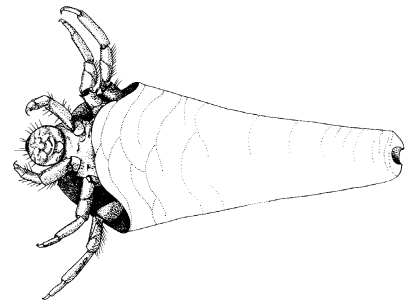
– Prosternum membranous.....17

17. Ventral surface of head capsule with genae widely separated at occipital margin (except Genus Con B)
.....**Conoesucidae** (17a,b)

17a. **Conoesucidae:** head, ventral view



17b. **Conoesucidae:** Genus Con B



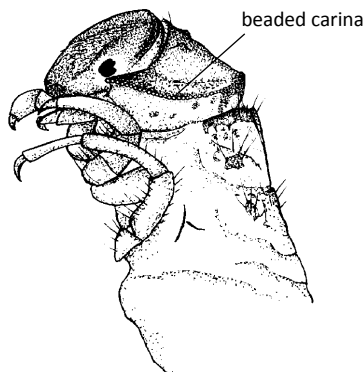
Morphology very different from others in the family. Genae almost abutting at occipital margin. Case triangular, made from bands of thick secretion, flattened with dorsal hood.

– Ventral surface of head capsule with genae close together and almost abutting at occipital margin.....18

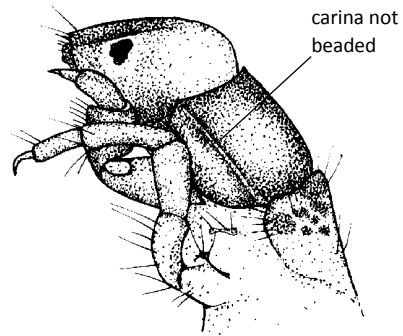
18. Strong beaded carina extending obliquely across pronotum, terminating in a pointed and dorso-ventrally flattened projection at each antero-lateral corner **Antipodoeciidae** (19a)

– Carina (if present) not beaded, not terminating in pointed projections **Calocidae / Helicophidae**(19b)
Note: Currently, calocid and helicophid larvae cannot be separated.

19a. **Antipodoeciidae:** head and thorax



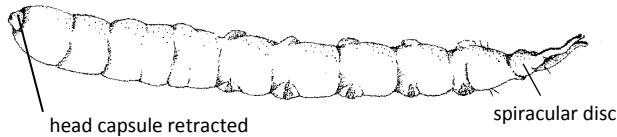
19b. **Calocidae/Helicophidae:** head and thorax



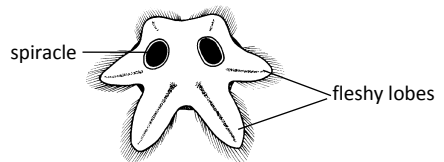
11. Larval Diptera (true flies) (based on Cranston 1995, Merritt and Cummins 1984)

- 1. Head capsule retracted into thorax, usually reduced, rarely complete2
 - Head capsule fully exerted from thorax, always complete3
- 2. Abdomen with 9 segments; head capsule retractile into thorax; paired spiracles of last body segment (spiracular disc) often with fleshy lobes (anal gills)..... **Tipulidae** (2a,b)

2a. Tipulidae



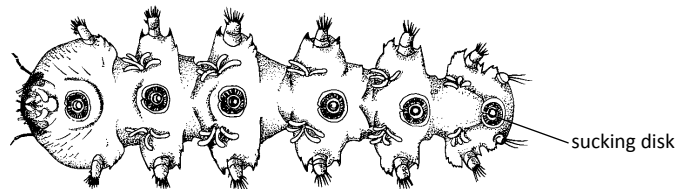
2b. Tipulidae: spiracular disc



- Abdomen with 8 segments12

- 3. Head, thorax and 1st abdominal segment fused; this and following five body divisions bearing ventral sucking disk; attached to rocks in fast-flowing water**Blephariceridae** (3a)

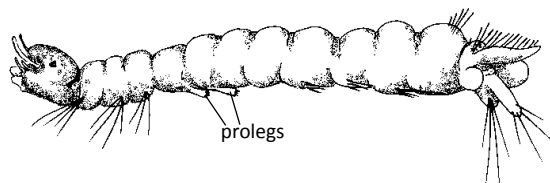
3a. Blephariceridae



- Not as above.....4
- 4. Prolegs present (see 6a, 7a).....5
 - Prolegs absent10
- 5. Head directed forwards6
 - Head dorso-ventrally directed.....9

- 6. Paired prolegs on 1st and 2nd abdominal segments; posterior abdomen bearing lateral, frequently setose lobes on each side of conical anal process**Dixidae** (6a)

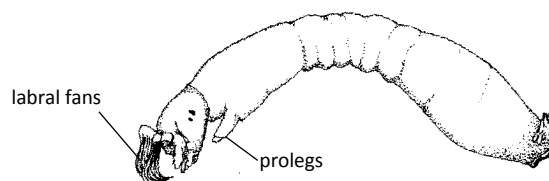
6a. Dixidae



- Prolegs present on thorax and/or posterior abdomen7

- 7. Larva with swollen posterior abdomen; head capsule with labral fans and conspicuous mouth-brushes; sessile on rocks or aquatic vegetation, or movements leech-like**Simuliidae** (7a)

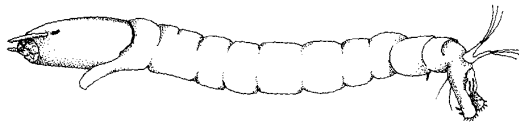
7a. Simuliidae



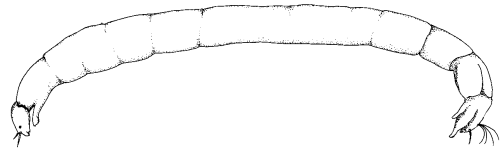
- Not as above.....8

8. Paired prolegs present on first and last body segments; segment length less than twice segment width
 **Chironomidae** (8a,b)

8a. **Chironomidae**

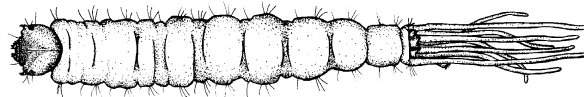


8b. **Chironomidae**



- Posterior of body with 3 pairs of elongate filaments; prolegs on posterior segment only **Tanyderidae** (8c)

8c. **Tanyderidae**



9. Spiracles present on prothoracic and terminal abdominal segments; often with a single dark bristle on right and left dorsum of meso- and meta-thoracic segment **Thaumaleidae** (9a)
 – Body segments bearing long fleshy tubercles and usually bearing setae some **Ceratopogonidae** (9b)

9a. **Thaumaleidae**



9b. **Ceratopogonidae: Forcipomyiinae**



10. Thoracic and abdominal segments similar; body slender, with bead-like segments often more than twice as long as wide most **Ceratopogonidae** (10a)

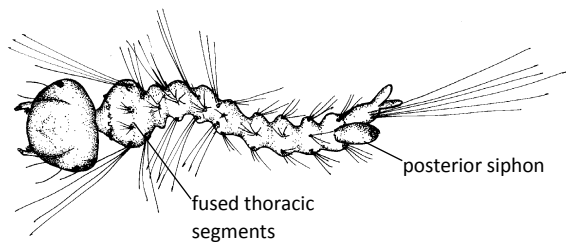
10a. **Ceratopogonidae**



- Thoracic segments differentiated from abdominal segments; abdominal segment length often less than segment width **11**

11. Three thoracic segments fused and enlarged, broader than abdominal segments **Culicidae** (11a)
 – Three thoracic segments distinctly separated; each thoracic and abdominal segment subdivided with many subdivisions bearing sclerotised area **Psychodidae** (11b)

11a. **Culicidae**

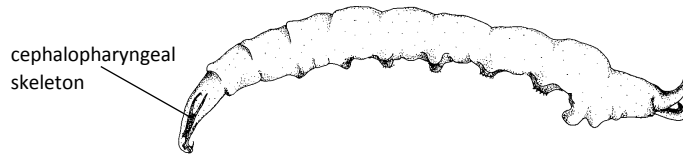


11b. **Psychodidae**



12. Head capsule with some sclerotisation visible and extruded from thorax, palps and antennae distinguishable; without 'cephalopharyngeal skeleton'13
 – Head capsule with no external visible sclerotisation; palps small or absent; antennae small or absent; with 'cephalopharyngeal skeleton'**Muscidae (12a)**

12a. **Muscidae**

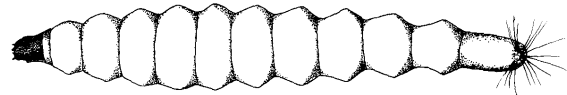


13. Posterior spiracles close together and concealed within terminal fissure of last segment14
 – Posterior spiracles quite widely separated, not concealed, on last segment15
14. Terminal fissure vertical; head capsule reduced, weakly sclerotised and retractile; body soft
**Tabanidae (14a)**
 – Terminal fissure horizontal; head capsule complete, strongly sclerotised and non-retractile; body leathery
**Stratiomyidae (14b)**

14a. **Tabanidae**

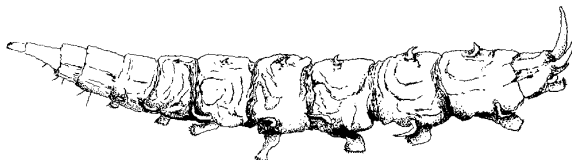


14b. **Stratiomyidae**

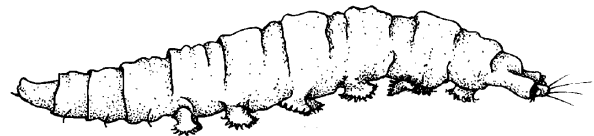


15. Larva slightly dorso-ventrally flattened, with lateral and dorso-lateral tubercles on abdominal segments
**Athericidae (15a)**
 – Larva not flattened, without lateral tubercles on abdominal segments**Empididae (15b)**
Note: The Dolichopodidae may also key out here but are hard to separate from the Empididae.

15a. **Athericidae**



15b. **Empididae**



Ceratopogonidae

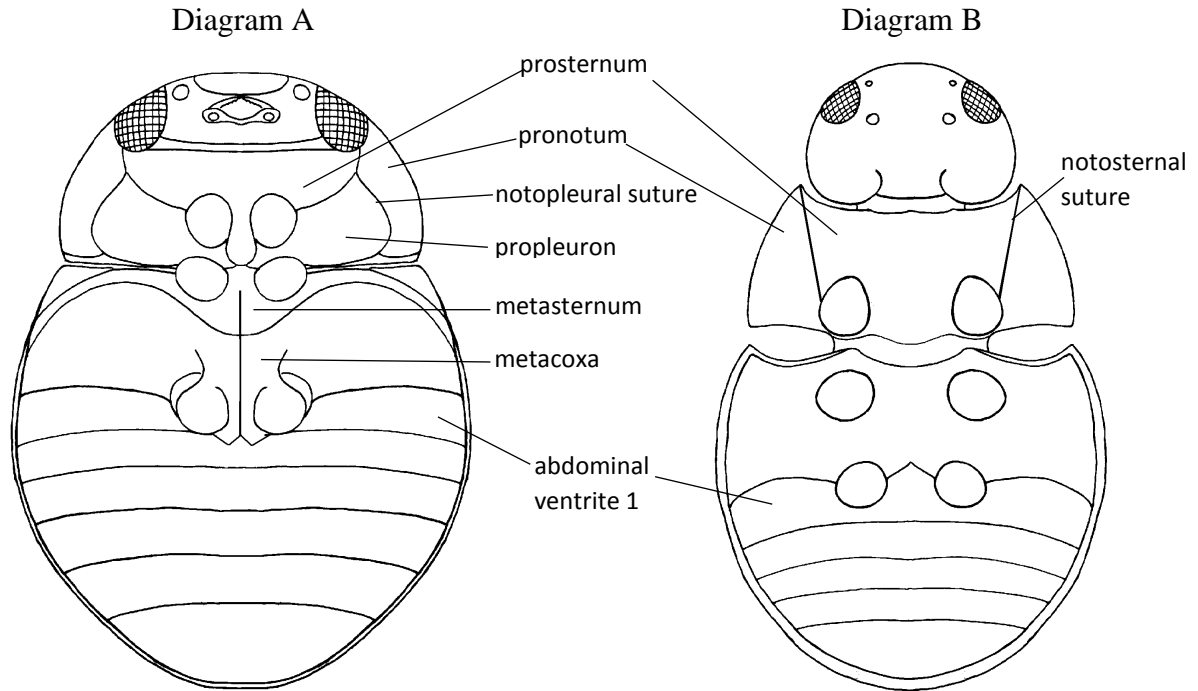


Chironomidae



12. Coleoptera (beetles) (based on Lawrence 1995, CSIRO 1991)

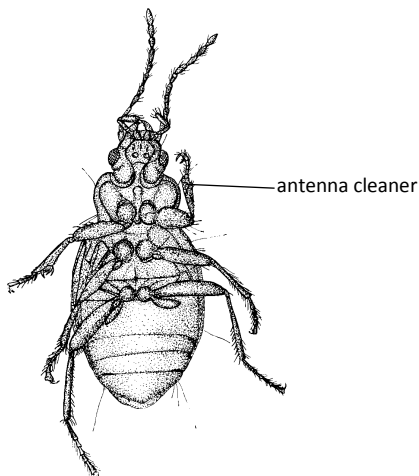
Anatomy of typical adult beetles (ventral views)



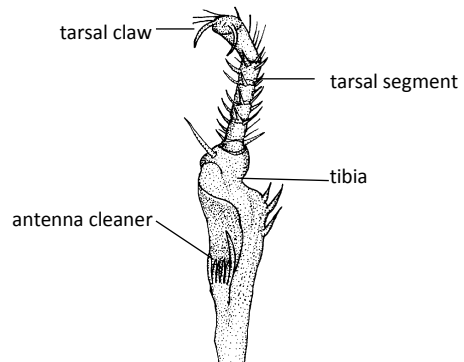
12A. Adult Beetles

1. First abdominal ventrite divided into 2 or 3 parts by hind coxae; 4 complete ventrites (or 3 in the Carabidae) visible (last triangular abdominal segment not included in count); with notopleural sutures between pronotum and propleuron (see diagram A above) **2**
- First abdominal ventrite not divided in two by hind coxae; 4 complete ventrites visible (last triangular segment not included in count); without notopleural sutures (pleuron reduced) (see diagram B above) **6**
2. Fore-tibia with notch and comb-like structure forming antennae-cleaner; mandibles prominent, antennae setose for most of length; sensory setae in fixed positions on dorsal surface **Carabidae (2a,b)**

2a. Carabidae



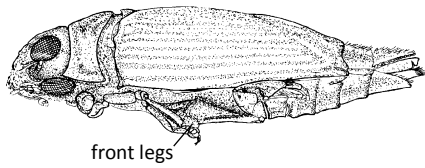
2b. Carabidae: foreleg



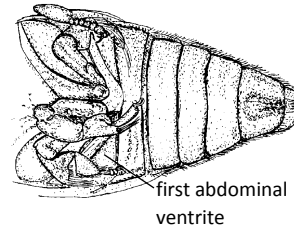
- Fore-tibia without antenna cleaner; mandibles not prominent **3**

3. Eyes completely divided into distinct upper and lower portions; front legs long and raptorial
 **Gyrinidae (3a,b)**

3a. **Gyrinidae**



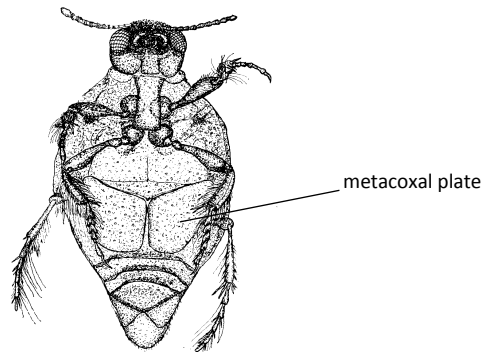
3b. **Gyrinidae: ventral view**



- Eyes not completely divided into distinct upper and lower portions; front legs not long and raptorial4

4. Most of hind femora hidden by very large metacoxal plates which extend outwards to meet elytra
 **Haliplidae (4a)**

4a. **Haliplidae**

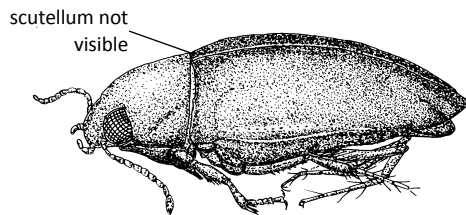


- Hind femora not concealed beneath large metacoxal plates, metacoxal plates not extending outwards to meet elytra.....5

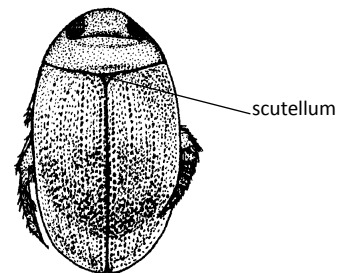
5. Ventral side of beetle flattened, dorsal side convex; junction between metasternum and metacoxae angulate; scutellum not visible..... **Noteridae (5a,b)**

- Ventral side of beetle not flat, mid-ventral line of beetle keeled, junction between metasternum and metacoxae arcuate (curved, see diagram A); scutellum usually visible **Dytiscidae (5c,d)**

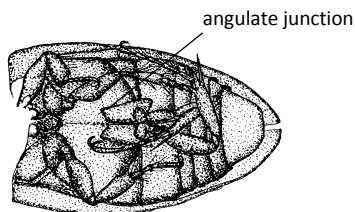
5a. **Noteridae**



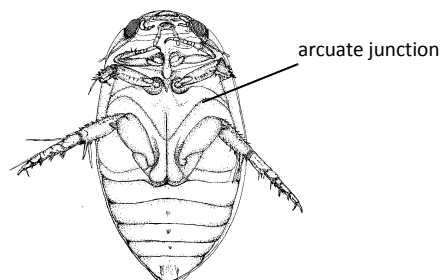
5c. **Dytiscidae: dorsal view**



5b. **Noteridae: ventral view**

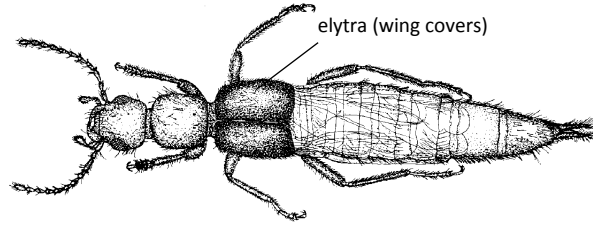


5d. **Dytiscidae: ventral view**



6. Elytra very short, exposing more than 4 complete abdominal segments.....**Staphylinidae (6a)**

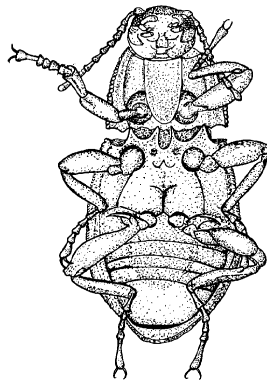
6a. **Staphylinidae**



- Elytra covering abdomen entirely or almost entirely 7

7. Maxillary palps short, not conspicuous; antennae 11-segmented, not usually clubbed and not usually concealed beneath head **Elmidae (7a)**

7a. **Elmidae**

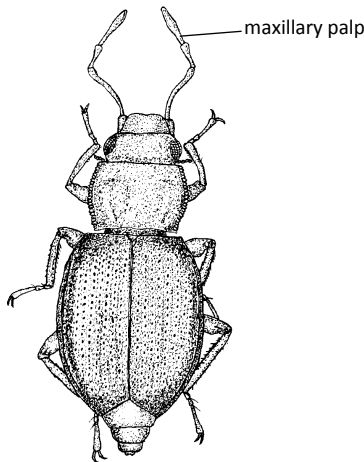


- Maxillary palps conspicuous and usually extending in front of head (may be mistaken for antennae); clubbed antennae tucked backwards beneath head **8**

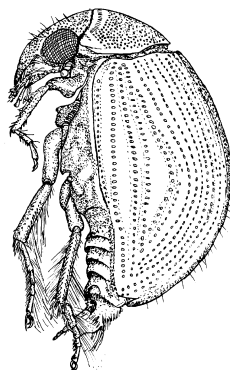
8. Maxillary palps longer than head; antennae 8 or 9-segmented with a 5-segmented club; segment preceding club sometimes forms a cupule **Hydraenidae (8a)**

- Maxillary palps not longer than head; antennae with 7-9 segments and with a distinct club consisting of 1-7 (usually 3) segments, always preceded by a glabrous cupule **Hydrophilidae (8b,c)**

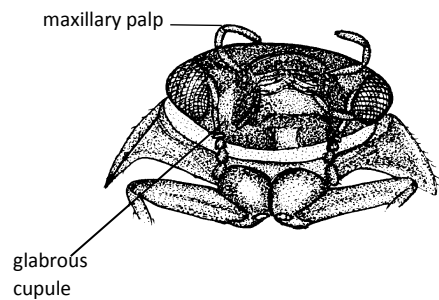
8a. **Hydraenidae**



8b. **Hydrophilidae**

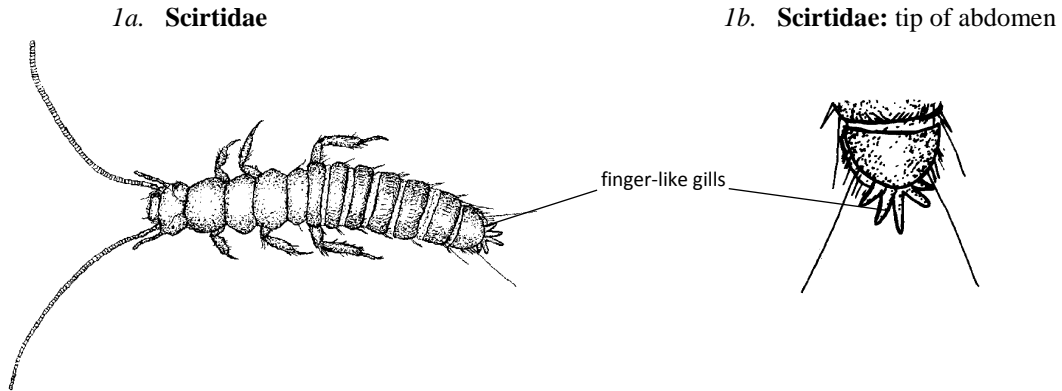


8c. **Hydrophilidae: head**



12B. Larval Beetles

- 1. Antennae long, with 10 or more segments (these are easily lost); fan of pale finger-like gills emerging from cleft across tip of abdomen.....**Scirtidae (1a)**

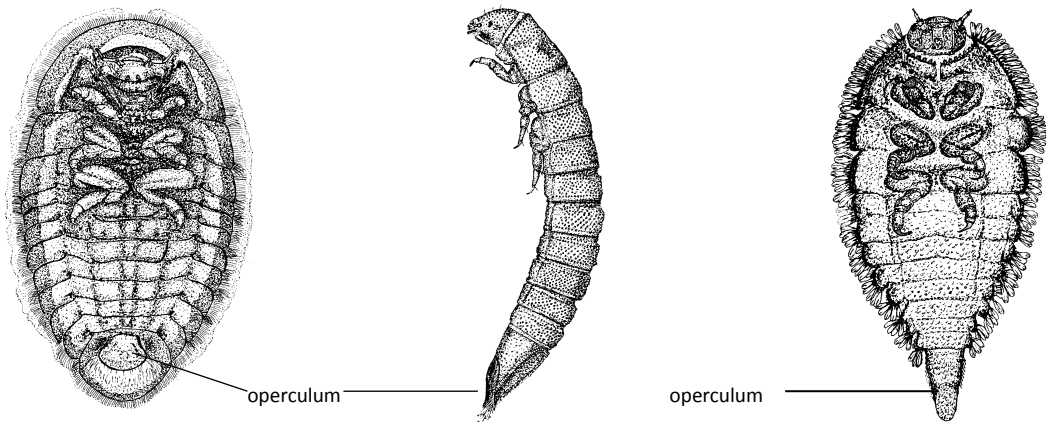


- Antennae with only 2 to 5 segments.....2
- 2. Abdominal apex with hinged operculum housing tufts of gills, mouthparts hypognathous (under head)3
- Abdominal apex without hinged operculum, mouthparts usually prognathous (to the front)4
- 3. Head concealed beneath prothorax in dorsal view; thoracic and abdominal tergites expanded laterally; body flattened and disc-like; tip of abdomen not projecting outside disc**Psephenidae (3a)**
- Head not concealed; body cylindrical or laterally expanded towards the front; tip of abdomen pointed.....**Elmidae (3b,c)**

3a. **Psephenidae**

3b. **Elmidae: *Simsonia* sp.**

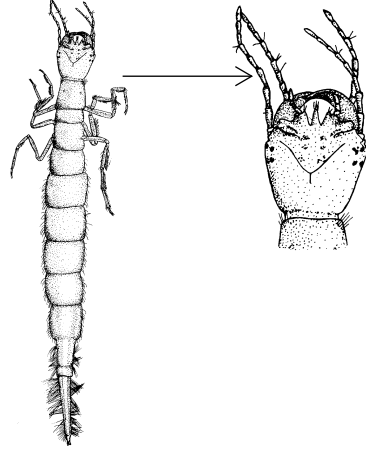
3c. **Elmidae: *Kingolus* sp.**



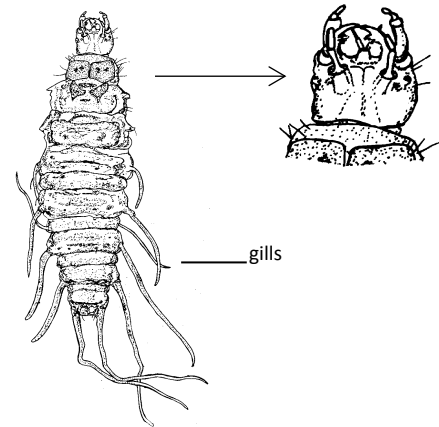
- 4. With 8 or 9 abdominal segments.....5
- With 10 abdominal segments6

- 5. Antennae with 4 or 5 segments; mandibles grooved, sickle shaped and without teeth; eighth abdominal segment always terminal, usually with paired cerci or a single median process bearing spiracles; abdomen never with abdominal gills or gill chamber **Dytiscidae (5a)**
- Antennae 3-segmented; mandibles with teeth; eighth abdominal segment may be terminal or subterminal; abdominal segments 1-7 may have lateral gills, otherwise spiracles are housed in chamber formed by fused 8th and 9th segments **Hydrophilidae (5b)**

5a. **Dytiscidae**

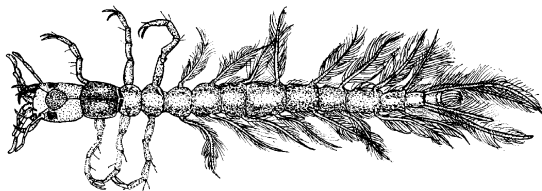


5b. **Hydrophilidae**

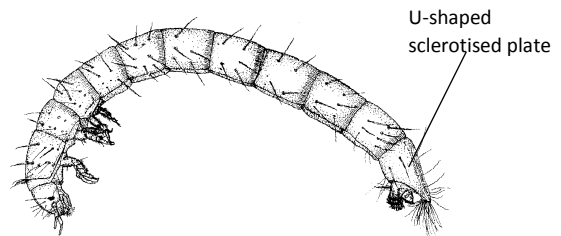


- 6. Urogomphi (projections near tip of abdomen) absent (prolegs, hooks or gills may be present) **7**
- Ninth abdominal segment with urogomphi **8**
- 7. With paired feathery lateral gills on first 9 abdominal segments **Gyrinidae (7a)**
- Ninth abdominal segment with concave posteriorly projecting U-shaped sclerotised plate; segment 10 with a pair of ventrally directed lobes bearing several hooks; antennae 3-segmented, more than half as long as head width; maxillary palps 4-segmented; postmentum divided longitudinally into 3 parts; body cylindrical with pale setae scattered along length of abdomen **Ptilodactylidae (7b)**

7a. **Gyrinidae**

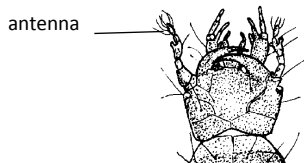


7b. **Ptilodactylidae**

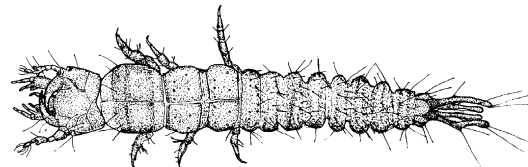


- 8. Urogomphi well developed, may be segmented; mandibles without teeth and without grooves; labrum fused to head capsule; legs 6-segmented, tarsi two-clawed; antennae 4-segmented and prominent with last segment out of line with other segments **Carabidae (9a)**

9a. **Carabidae: Head**



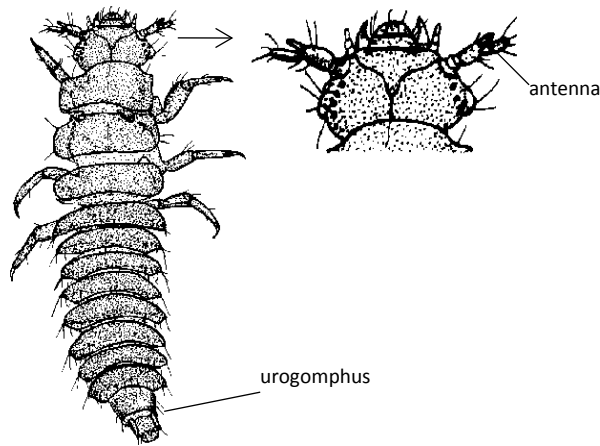
9b. **Carabidae**



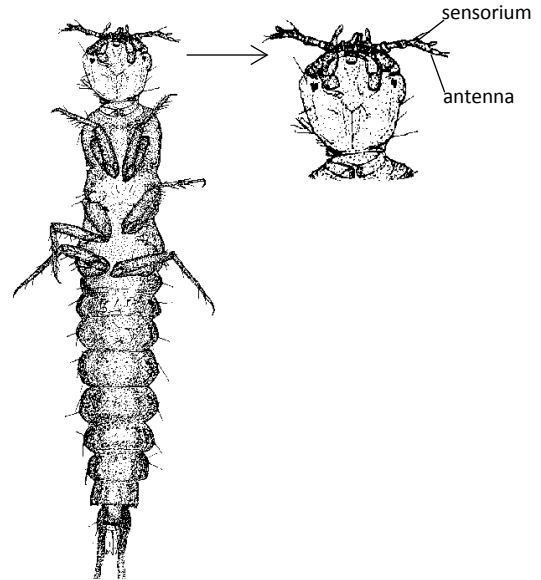
- Urogomphi various; mandibles with or without teeth; labrum may or may not be fused to head capsule **9**

9. Tenth abdominal segment with curved hooks; ninth abdominal segment bearing 2-segmented articulated urogomphi; mandibles with tooth; maxillae with 2 apical lobes; labrum separated from head by complete suture; antennae 3-segmented **Hydraenidae (10a)**
- Tenth abdominal segment without hooks; ninth abdominal segment bearing urogomphi which may be articulated or fixed; mandibles without teeth; maxillary palp 3-segmented without digitiform appendage on segment 1; labrum free or fused; antennae 3 or 4-segmented, apex of antennal segment 2 oblique, so that sensorium arises proximal to segment 3..... **Staphylinidae (10b)**

10a. **Hydraenidae**



10b. **Staphylinidae**



Hydrophilidae larva



Psephenidae larva



Glossary of terms

abdomen	part of the insect posterior to the thorax
anal claws	claws on last abdominal segment
anal/preanal segment	pertaining to the last/last but one abdominal segment (which bears the anus)
angulate	angled
antennae (sing. antenna)	jointed feelers on head of various invertebrates
antennule	the first antenna of Crustacea
antero-lateral corner	pertaining to front corners of the pronotum
arcuate	curved like an arch; bow-like
articulated	able to be moved in different directions, hinged
bivalved	with two valves or parts; clam-like
carapace	a hard covering consisting of fused dorsal plates
carina	ridge or keel
caudal	of the tail
cerci (sing. cercus)	pair of terminal appendages on abdomen
chaetae (sing. chaeta)	retractable bristles projecting from body wall in oligochaete worms; sensory bristles on body and appendages of insects (also, setae)
chelate	pincer-like; having opposable claws
clypeus	a sclerite on the lower part of the face (see Trichoptera: <i>4a</i>)
commensalism	association between two organisms of different species, one species benefiting from the association and the other not being harmed; a commensal is usually the one that benefits in the association
compound eyes	eye characteristic of insects and crustaceans, made up of many identical units or facets
coxa	basal segment of the leg
cupule	cup-like cavity
digitiform	finger-like
distal	that part of an appendage or segment that is furthest from the body
dorsal	pertaining to the upper side or back of an organism
ecdysial lines	lines or sutures in the exoskeleton associated with moulting
ecto-commensal	commensal living on the surface of another organism
elytra	thickened, leathery, or horny front wing of some insects
femur (pl. femora)	third leg segment, between the trochanter and the tibia
filamentous	slender, thread-like
fore trochantin	small sclerite immediately anterior to the base of the coxa
fore wings	front wings, attached to mesothoracic segments
gill	outward folds of the body wall or hindgut, functioning in gaseous exchange
glabrous	without hairs
helical	spiral
hypognathous	with the head vertical and mouthparts located ventrally
keeled	with an elevated ridge
labium	the lower lip of insects

labral fans	fan-like feeding structures associated with the labrum (the upper lip)
labrum	the upper lip, lying just below the clypeus
macroinvertebrate	invertebrate, visible with the naked eye
mandible	jaw; one of the anterior pair of the paired mouthparts
mandibulate	having mandibles
maxillae	paired mouthparts adjacent to mandibles, and arising on either side of the labium
membranous wings	in Coleoptera forewings are modified to form elytra; hind wings are membranous and used for flight.
mesonotum	dorsal part of the mesothorax
mesothorax	second of the three thoracic segments.
metacoxae	first segment of hind or third pair of legs
metanotum	dorsal part of the metathorax
metasternum	sternum, or ventral part of the metathorax
metathorax	third of the three thoracic segments
mouth-brushes	part of the feeding apparatus
operculum	lid or cover
palp	segmented process borne by the maxillae or labium
paraproct	one of a pair of lobes that border the anus latero-ventrally
postmentum	basal part of the labium
prementum	distal part of the labium
procoxae	first segment of first pair of legs
prognathous	with the head horizontal and mouthparts projecting forwards
prolegs	fleshy, not jointed, thoracic or abdominal legs of certain insect larvae
pronotum	dorsal part of the prothorax
prosternum	the lower or ventral surface of the first thoracic segment
prothorax	the anterior of the three thoracic segments
proximal	nearer to the body or to the base of an appendage
pubescent	hairy
raptorial	adapted for seizing and grasping prey
retractile	capable of being pushed out or retracted
sclerite	a hardened body wall plate bounded by sutures or membranous areas
sclerotised	hardened and darkened exoskeleton
scutellum	the third division of the thorax as seen from above; shield-shaped part, showing between the elytra in beetles
segmented	body or limb divided into series of segments
sessile	attached or fastened; incapable of moving from place to place
setae	bristles
setose	bristly
spatulate	spoon shaped; broad apically and narrowed basally, and flattened
spinneret	a structure in which silk is spun, usually finger-like in shape
spiracle	an external opening of the tracheal system; a breathing pore
sucker	an organ adapted to attach to a surface by creating a vacuum, in some animals for the purpose of feeding, in others to assist locomotion or attachment

subcylindrical	almost cylindrical
subterminal	second last
suture	line where plates of exoskeleton abut one another
tarsus (plur. tarsi)	that part of the leg beyond the tibia, consisting of one or more segments or subdivisions
tentacle	slender, flexible sensory organ on head
tergum or tergite	dorsal sclerotised plate
thoracic legs	legs attached to thorax
thorax	the middle body region, behind the head, which bears the legs and wings in insects
tibia	the fourth segment of the leg, between the femur and the tarsus
tracheal gills	small filamentous or flap-like respiratory outgrowths from the abdomen of some aquatic insect larvae
tubercle	a small knob-like or rounded protuberance
urogomphi	projections originating near to or at tip of abdomen
ventrite	abdominal plate on underside of an insect

Ephemeroptera, Leptophlebiidae: *Jappa* – a form with long gills and ‘tusks’



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Diptera: Simuliidae – common in fast current; sometimes mistaken for leeches

