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.
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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 inside .......... 3

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**: Ancylidae
       (< 6 mm)

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

3. Body not divided into a series of segments ................................................................. 4
   - Body divided into a series of segments ................................................................. 7

4. Body flattened and soft ......................................................................................... 5
   - Body cylindrical ................................................................................................. 6

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 segments ................................................................. 10
8. Body soft and worm-like with numerous segments; no obvious appendages (legs etc.) .........................
    - 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 ..........
    - 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 ...........................................................................................................
    - 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 ........................................................................................................
    - 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)

1. Shell coiled ....................................................................................................................................................... 2
   – Shell not coiled ........................................................................................................................................... freshwater 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)


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 carapace ............................... seed shrimps, *Ostracoda* (1a)
   - Body of animal not completely enclosed in bivalved carapace ............................................................ 2

2. Very small animals with characteristic upside-down teardrop shape; distinctive antennae; single eyespot ......
   .............................................................................................................................. copepods, *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 chelate ....................... 5

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 setae............................
   .............................................................................................................................. prawns, *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 segments
   - Wings absent or small, not covering all abdominal segments

2. Forewings overlap along mid-dorsal line, hardened at base and membranous towards tip; mouthparts beak-like for piercing and sucking
   - Forewings not overlapping, meeting in mid-line; forewings hardened and covering second (membranous) pair of wings; mouthparts mandibulate for chewing

2a. Hemiptera: Veliidae

2b. Coleoptera: Hydraenidae

3. Jointed legs absent; stumpy prolegs may be present
   - Three pairs of jointed legs present on first three segments behind head

3a. Diptera: Empididae

3b. Diptera: Chironomidae

4. Without wings; compound eyes with few facets
   - With wings partly developed; compound eyes with many facets

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
   - Not as above

5a. Lepidoptera: Pyralidae
6. Mouthparts long and slender ................................................................. larval lacewings, **Neuroptera** (6a)

   6a. **Neuroptera**: Neurorthidae

   - Mouthparts with well-developed, short mandibles ................................................................. 7

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-like ............................................ 10
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)*

- 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)*

- 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)*

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10a. **Plecoptera**: Eustheniidae

10b. **Plecoptera**: Gripopterygidae

11a. **Ephemeroptera**: Leptophlebiidae

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.

4a. Corduliidae

4b. Corduliidae: Anal pyramid

4c. Libellulidae: Anal pyramid

4d. Libellulidae

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)

5a. Gomphidae

5b. Aeshnidae

Gomphidae

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........................................................................................................... Prospistomatidae (1a)

   1a. Prospistomatidae

   - 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: *Kalhaybaria* 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 segments ...........................................................................................................3

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)

![Diagram of Sialidae and Corydalidae larvae]
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) …

   - 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) …

   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 …

   - Dorsal sclerotisation on first thoracic segment only …

3. Abdominal gills present …

   - Abdominal gills absent …

   3a. Hydropsychidae

   3b. Ecnomidae
4. Labrum membranous; frontoclypeus often with central notch (4a) ................................. **Philopotamidae** (4a,b)

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

   ![Philopotamidae head, dorsal view](image1)

   - 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

   ![Hydrobiosidae foreleg](image2)

   - 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

   ![Dipseudopsidae head and thorax](image3)

   - Spinneret, if present, considerably shorter than head capsule; frontoclypeus not extending to posterior of head capsule ........................................................................................................7

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

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

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

   ![Polycentropodidae head and prothorax](image4)

   7b. **Polycentropodidae**

   ![Polycentropodidae](image5)
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. *Atriplectidae*: head and thorax

8a. Atriplectidae: 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

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.

10. Abdomen usually swollen, broader and deeper than thorax; case purse-like .............................................................. 11

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

11. Larval case helical ............................................................................................................................... 12

- 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

1. Head capsule retracted into thorax, usually reduced, rarely complete ................................................................. 2
   - Head capsule fully exerted from thorax, always complete ..................................................................................... 3

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 ......................................................................................................................................................... 2
   2b. Tipulidae: spiracular disc

   - Abdomen with 8 segments ..................................................................................................................................... 12

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 .................................................................................................................................................. 3

   - Not as above .......................................................................................................................................................... 4

4. Prolegs present (see 6a, 7a) ...................................................................................................................................... 5
   - Prolegs absent ....................................................................................................................................................... 10

5. Head directed forwards .............................................................................................................................................. 6
   - 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 .............................................................................................................................................................. 6

   - Prolegs present on thorax and/or posterior abdomen .......................................................................................... 7

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 .......................................................................................................................................................... 7

   - 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'.

- Head capsule with no external visible sclerotisation; palps small or absent; antennae small or absent; with 'cephalopharyngeal skeleton'.

\[\text{Muscidae (12a)}\]

\[\text{cephalopharyngeal skeleton}\]

13. Posterior spiracles close together and concealed within terminal fissure of last segment

- Posterior spiracles quite widely separated, not concealed, on last segment

14. Terminal fissure vertical; head capsule reduced, weakly sclerotised and retractile; body soft

- Terminal fissure horizontal; head capsule complete, strongly sclerotised and non-retractile; body leathery

\[\text{Tabanidae (14a)}\]

\[\text{Stratiomyidae (14b)}\]

15. Larva slightly dorso-ventrally flattened, with lateral and dorso-lateral tubercles on abdominal segments

- Larva not flattened, without lateral tubercles on abdominal segments

\[\text{Athericidae (15a)}\]

\[\text{Empididae (15b)}\]

\[\text{Note: The Dolichopodidae may also key out here but are hard to separate from the Empididae.}\]

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

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

   2b. Carabidae: foreleg

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

Diagram A

Diagram B

- prosternum
- pronotum
- notopleural suture
- propleuron
- metasternum
- metacoxa
- abdominal ventrite 1
- notosternal suture

- antenna cleaner
- tarsal claw
- tarsal segment
- tibia
- antennae-cleaner
- mandibles
- sensory setae
- dorsal surface
3. Eyes completely divided into distinct upper and lower portions; front legs long and raptorial ..........................  
   \[ \text{Gyrinidae (3a,b)} \]

   \[ \text{3a. Gyrinidae} \]

   \[ \text{3b. Gyrinidae: ventral view} \]

   – Eyes not completely divided into distinct upper and lower portions; front legs not long and raptorial ........  

4. Most of hind femora hidden by very large metacoxal plates which extend outwards to meet elytra ..........  
   \[ \text{Haliplidae (4a)} \]

   \[ \text{4a. Haliplidae} \]

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

5. Ventral side of beetle flattened, dorsal side convex; junction between metasternum and metacoxae angulate; scutellum not visible.................................................................  
   \[ \text{Noteridae (5a,b)} \]

   – 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 .................................  
   \[ \text{Dytiscidae (5c,d)} \]

   \[ \text{5a. Noteridae} \]

   \[ \text{5b. Noteridae: ventral view} \]

   \[ \text{5c. Dytiscidae: dorsal view} \]

   \[ \text{5d. Dytiscidae: ventral view} \]
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)

   1a. Scirtidae

   1b. Scirtidae: tip of abdomen

   – 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 segments ..................................................................................................................... 6
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

- 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

5a. Dytiscidae

5b. Hydrophilidae

6. Uregomphi (projections near tip of abdomen) absent (prolegs, hooks or gills may be present)

- Ninth abdominal segment with uregomphi

7. With paired featherly lateral gills on first 9 abdominal segments

- 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

7a. Gyrinidae

7b. Ptilodactylidae

8. Uregomphi 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

- Uregomphi various; mandibles with or without teeth; labrum may or may not be fused to head capsule
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](image1)

![10b. Staphylinidae](image2)

**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: 4a)
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
eytra | 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
uromophi 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’
REFERENCES CITED


BIBLIOGRAPHY OF ECOLOGICAL STUDIES INVOLVING AUSTRALIAN WET TROPICS STREAM INVERTEBRATES


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