Macroinvertebrates as Bioindicators of Stream Health



By: Joan Schumaker Chadde, M.S. Water Resource Specialist
Western U.P. Center for Science, Mathematics & Environmental Educ.
105 Dillman Hall, Michigan Technological University,
1400 Townsend Dr., Houghton, MI 49931
Tel: (906)487-3341 or Email: jchadde@mtu.edu

Michigan's Clean Water Corps

This presentation was adapted from a Michigan Clean Water Corps (MiCorps) training presentation produced by Jo Latimore, Ph.D. Please visit the MiCorps website at www.micorps.net for the original presentation or further information on MiCorps sponsored monitoring. *MiCorps* is a network of volunteer citizen-monitoring programs in Michigan created by Governor Jennifer M. Granholm to assist the Department of Environmental Quality (DEQ) in collecting and sharing water quality data for use in water resources management and protection.

For More Information, contact:

Ric Lawson, Project Manager
Great Lakes Commission
Tel: 734-971-9135
Email: rlawson@glc.org
Website: http://www.micorps.net/

Jo Latimore, Ph.D., Watershed Ecologist
Huron River Watershed Council
1100 North Main Street, Ann Arbor, MI 48104
Tel: (734) 769-5123 ext. 14
Email: jlatimore@hrwc.org

What is a Macroinvertebrate?

- Large enough to be seen with the unaided eye.
- Without a backbone:
  In = no; vertebrate=backbone

Why are macroinvertebrates bioindicators of stream health?

- Spend up to one year in the stream.
- Have little mobility
- Generally abundant
- Primary food source for many fish
- Good indicators of localized conditions

- Diversity = healthy stream
- Easy sampling techniques
- Potential threats to macroinvertebrate diversity
  - Sedimentation
  - Habitat loss
  - Chemical pollution

Collection & Identification of Macroinvertebrates

How to Collect Macroinvertebrates

- Sample all habitats: pool, riffle, run/glide
- D-frame nets and kick nets
- Collect a total of 50-100 individuals
- Identify and count numbers of each type
- Complete data form

3 Categories of Stream Macroinvertebrates

(Note: some species of the Families listed below can have species in a *lower* group.)

Group 1 - pollution sensitive

(require higher DO, neutral pH, cold water)

Ex. mayflies, stoneflies, caddisflies

Group 2 – somewhat pollution tolerant

Ex. scuds, dragonflies, damselflies

Group 3 - pollution tolerant

(can tolerate low oxygen, lower / higher pH, warmer water)

Ex. aquatic worms, midge larva

Dissolved Oxygen Requirements for Aquatic Life

Trout spawning . . . . . >7 ppm

Trout growth and well-being . . ... >6 ppm

Bass growth and well-being . . . >5 ppm
(most mayfly, stonefly, and caddisfly nymphs)

pH Ranges that Support Aquatic Life

1 2 3 4 5 6 **7** 8 9 10 11 12 13 14

Bacteria: 1.5_____13.5

Plants: 6.5_____12.0

Carp,suckers,catfish: 6.0_____9.0

Bass, crappies: 6.5____8.5

Snails, clams, mussels: 7.5__9.0

Trout, aquatic invertebrates: 6.5_7.5
(most mayfly, stonefly, and caddisfly nymphs)

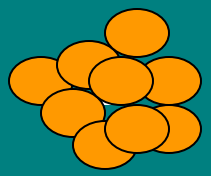
Aquatic Pupae

Terrestrial Winged Adults

Macroinvertebrate Life Cycle

Ex. Midge

Aquatic Larvae



Aquatic Eggs

Complete Metamorphosis

Macroinvertebrate Orders

Ephemeroptera (Mayfly)

Plecoptera (Stonefly)

Trichoptera (Caddisfly)

Megaloptera (Dobsonfly / Hellgrammite)

Coleoptera (Aquatic Beetles)

Diptera (True Flies)

Odonata (Dragonfly & Damselfly)

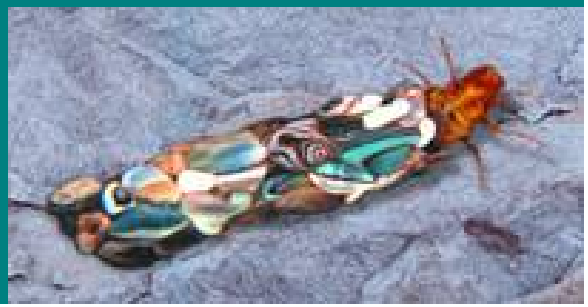
Pelecypoda (Clams)

Gastropoda (Snails)

Hemiptera (True Bugs)

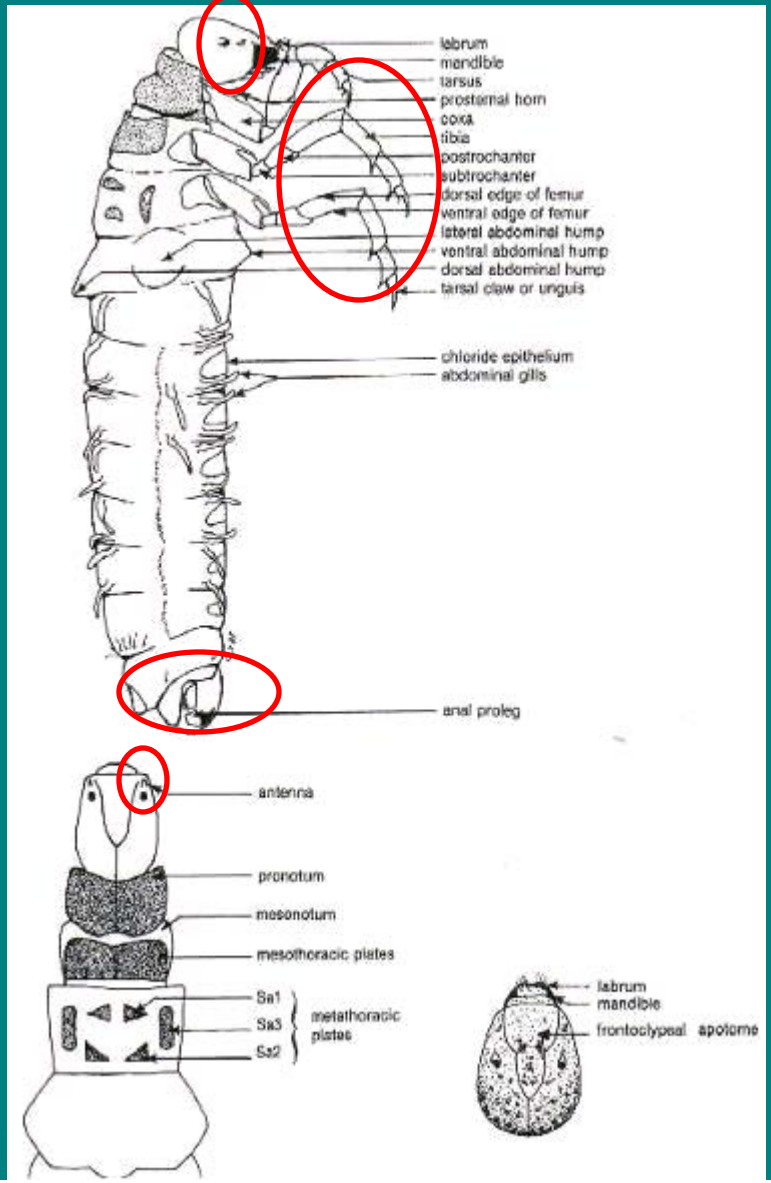
Group 1 - pollution sensitive

Caddisflies (Trichoptera)



Group 1 - pollution sensitive

Caddisflies



⇦ Very short antennae

⇦ 3 pairs of legs each with 1 tarsal claw

⇦ A pair of fleshy prolegs on last abdominal segment

Caddisfly cases – of wood, gravel, sand grains, etc.

Figure 14.58. *Dicosmoecus* larval case

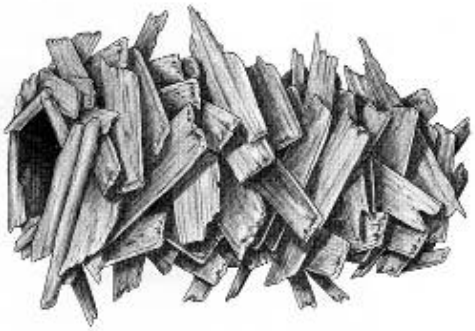


Figure 14.59. *Limnephilus* larval case

Figure 14.60. *Limnephilus* larval case

Figure 14.61. *Pycnopsyche* larval case

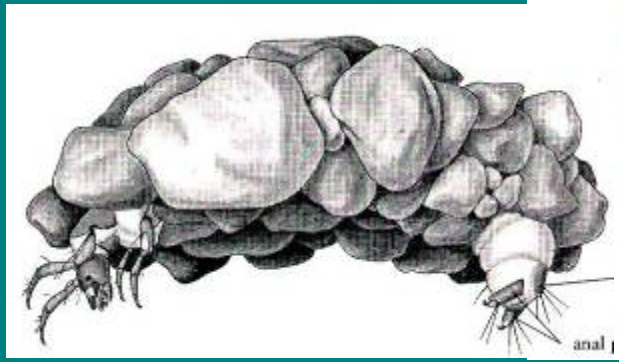
Figure 14.62. *Apatania* larval case

Figure 14.63. *Neophylax* larval case

Figure 14.64. *Farula* larval case

Figure 14.65. *Manophylax* larval case

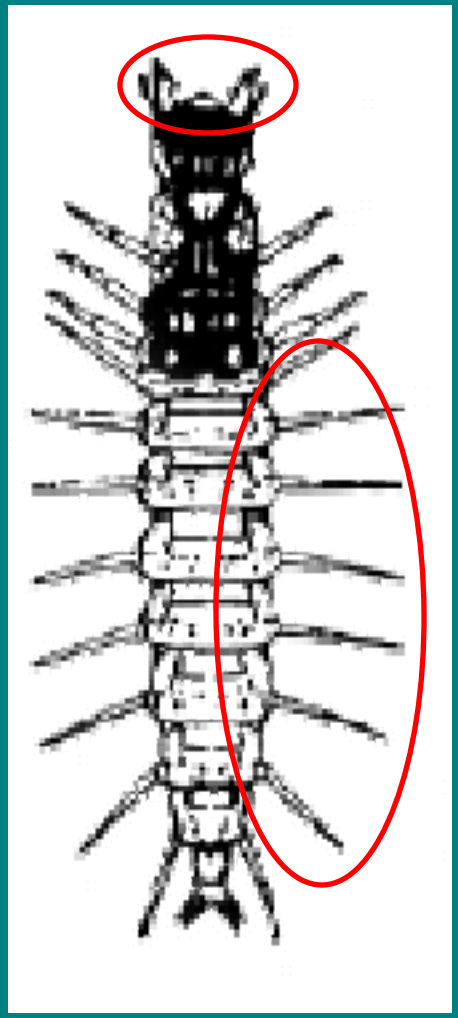
3mm



Caddisfly cases on a rock in the stream.

Group 1 - pollution sensitive

Hellgrammites (Megaloptera)



⇦ Large mandibles

⇦2-10 cm in length

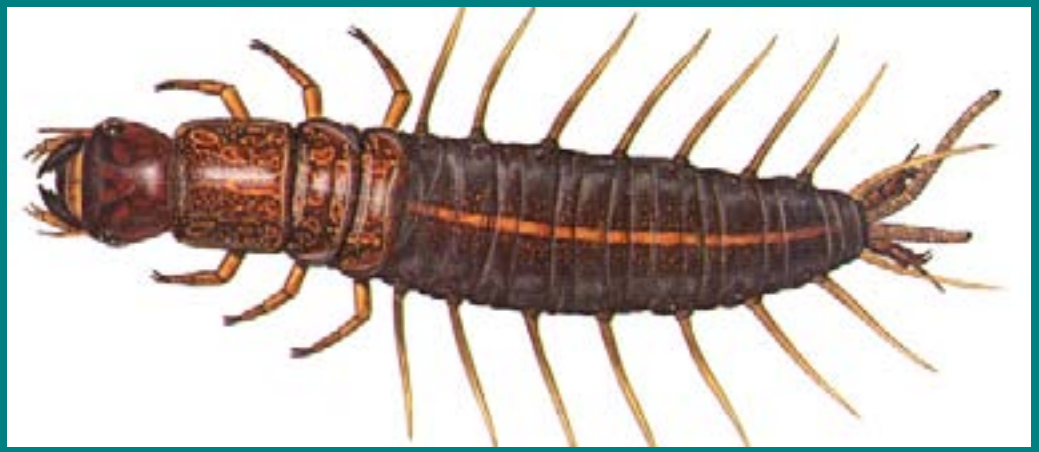
⇦7-8 pairs of lateral filaments

Group 1 - pollution sensitive

Hellgramites (Megaloptera)

Group 1 - pollution sensitive

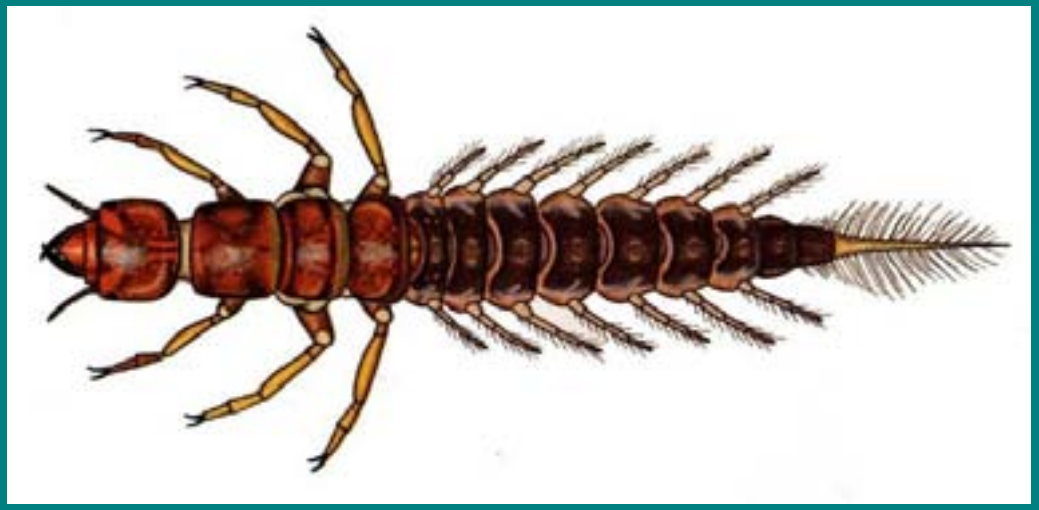
Two Megalopterans: Note the Differences!



Hellgrammite (Dobsonfly)

- No distinct, single tail
- Generally larger

Group 2 – somewhat pollution tolerant

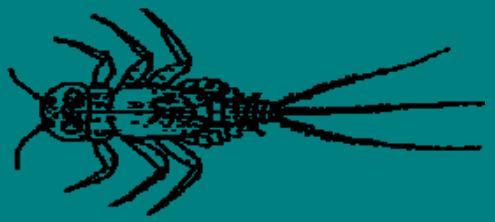


Alderfly (Fishfly)

- Distinct, single tail
- Generally smaller

Group 1 - pollution sensitive

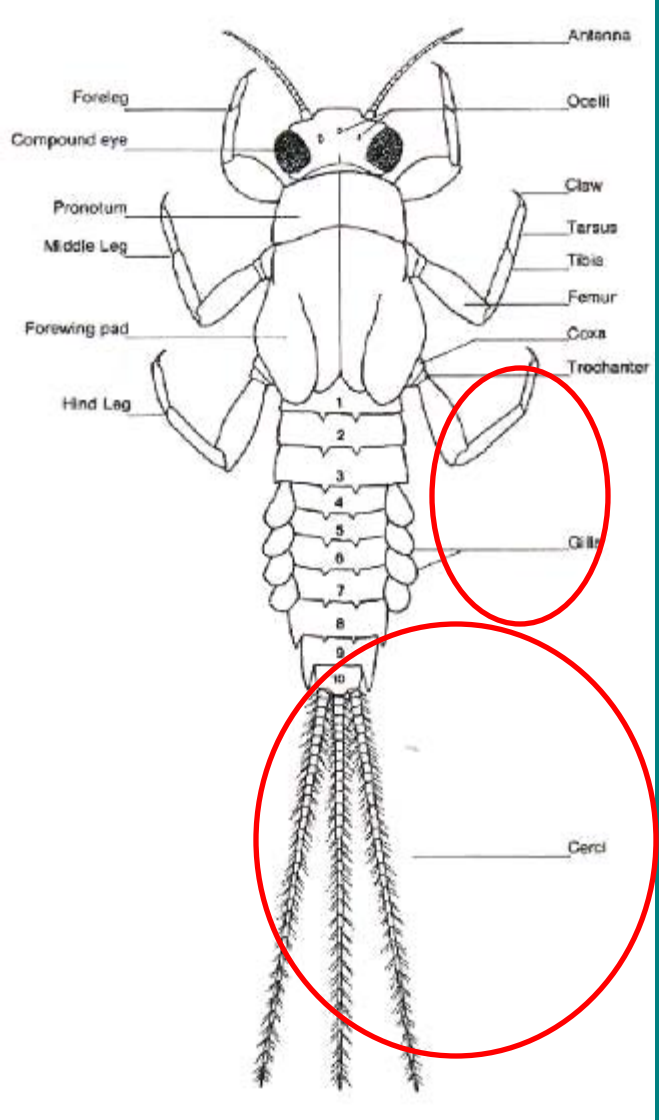
Mayflies (Ephemeroptera)



Mayfly nymph
.5-6 cm length, including tails.

Group 1 - pollution sensitive

Mayflies

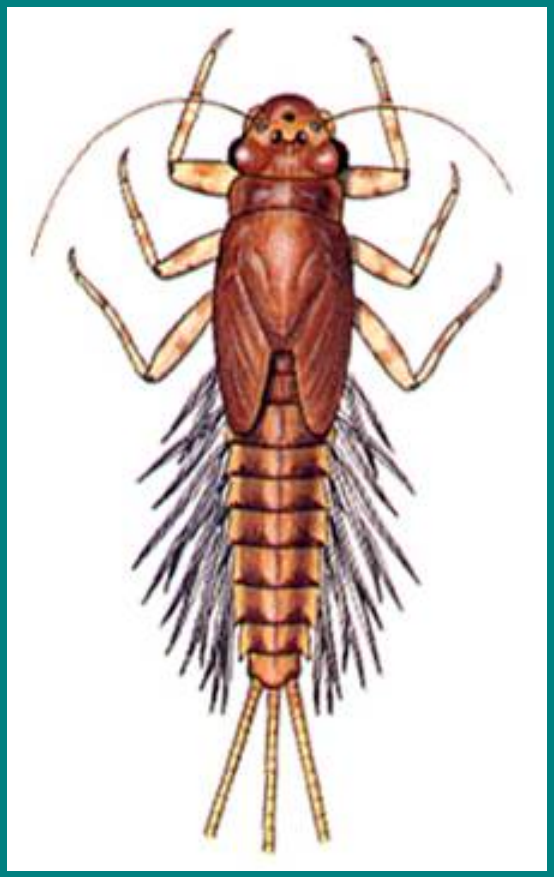


⇦ Gills on most of the 7 abdominal segments

⇦ Usually 3 tails

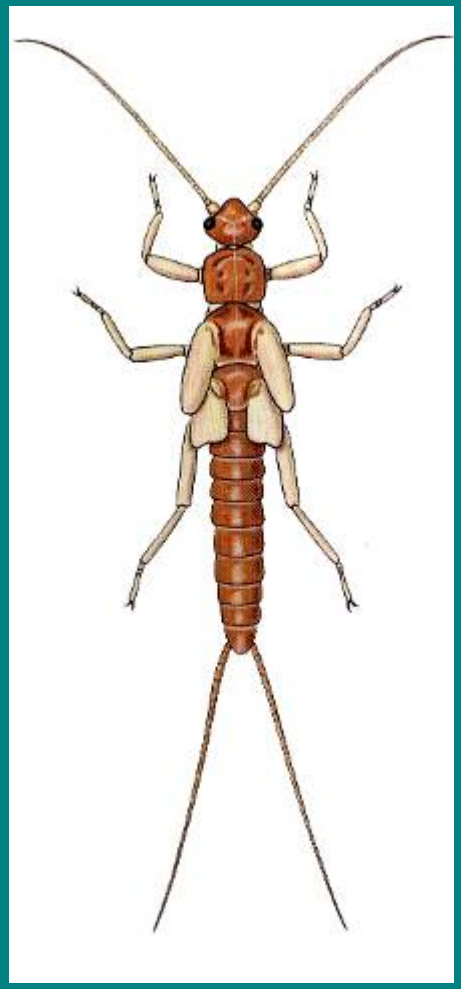
Group 1 - pollution sensitive

Mayflies

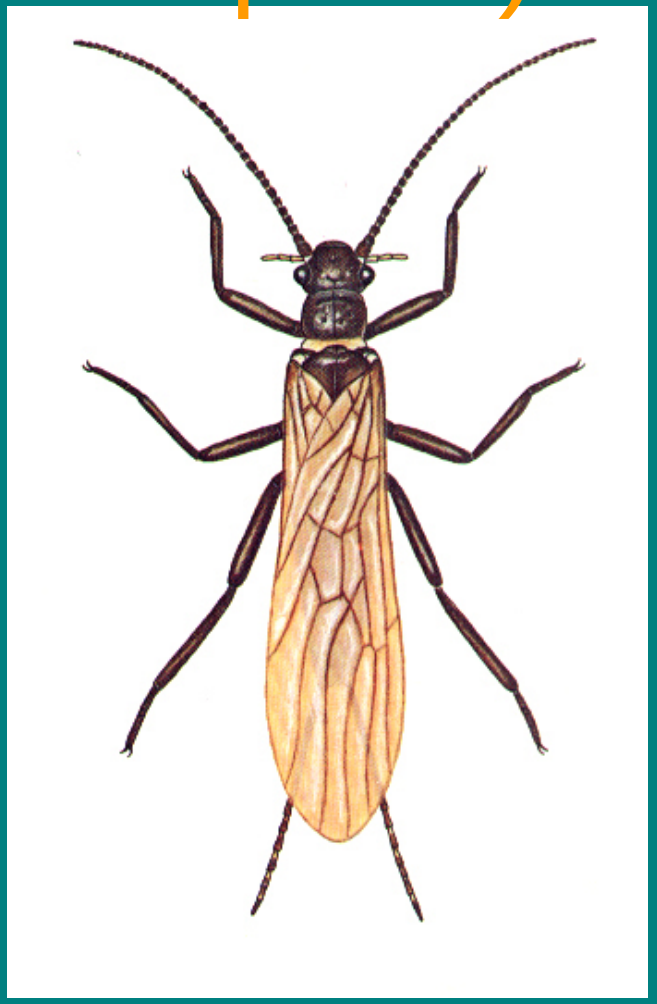


Group 1 - pollution sensitive

Stoneflies (Plecoptera)



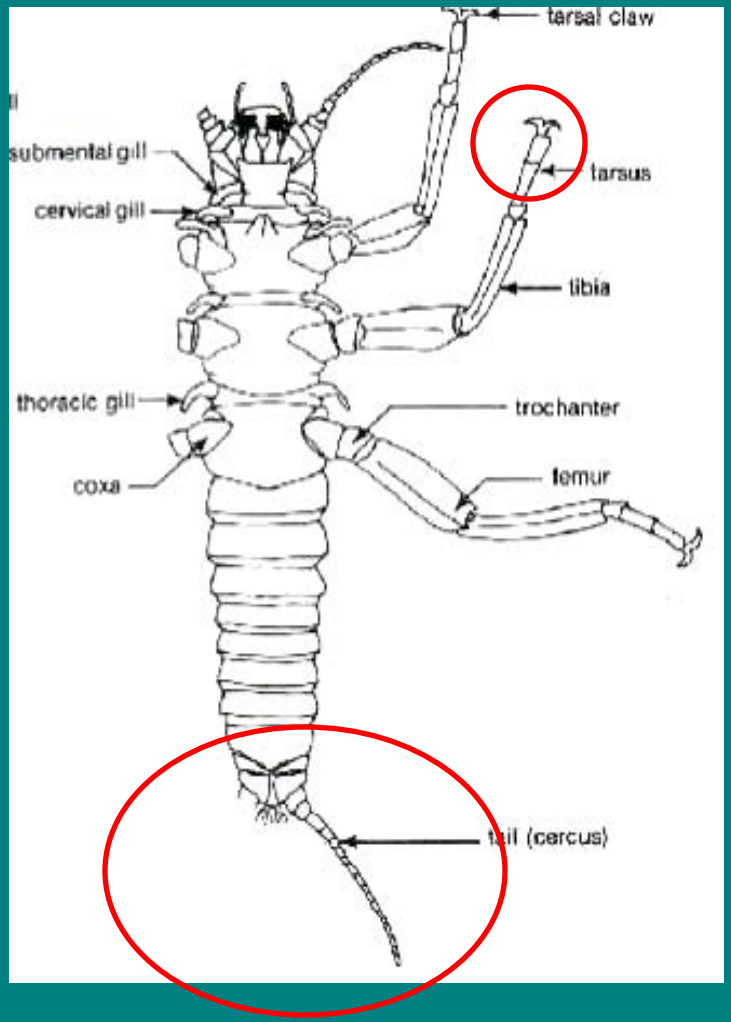
Auqatic Nymph



Terrestrial Adult

Group 1 - pollution sensitive

Stoneflies



⇦ 2 tarsal claws

⇦1-3 cm length

⇦ 2 long filamentous tails

Group 1 - pollution sensitive

Stoneflies

Group 1 – pollution sensitive

Water Penny larva

WATER PENNIES
(Psephenidae)

Figure 13.41. Eubriinae larva (ventral)

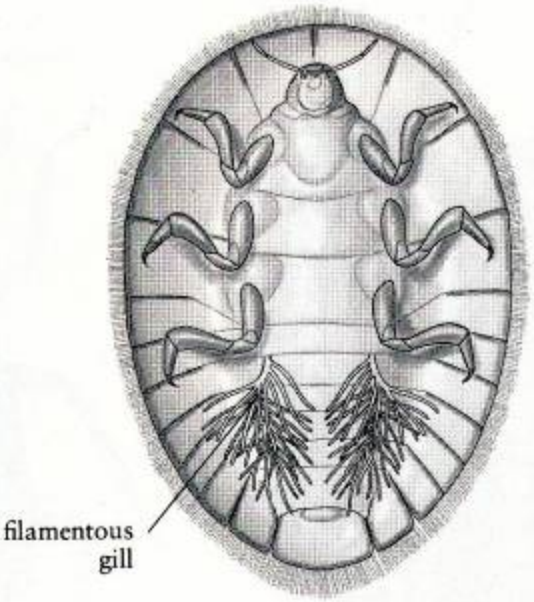


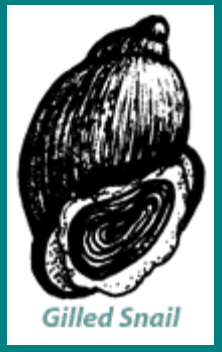
Figure 13.42. Psepheninae larva (ventral)

Figure 13.43. *Psephenus* adult

Group 1 - pollution sensitive

Gilled Snail

- Have an operculum or plate-like door that protects the opening of the shell and can be quickly closed to avoid predators.
- Coiled shells that usually open on the right-hand side.

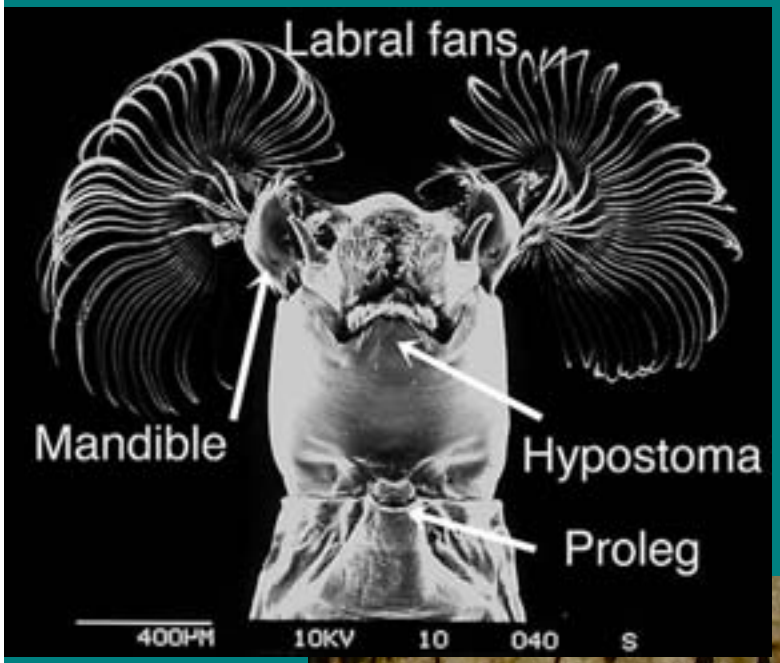


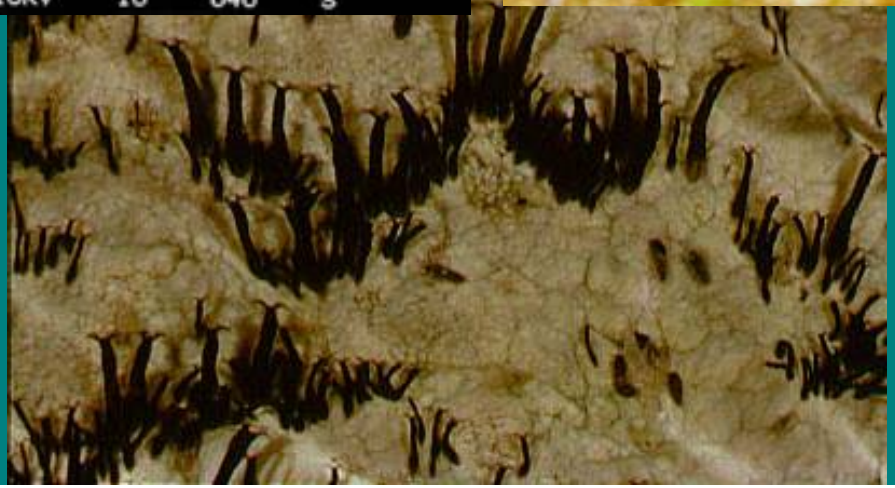
Group 2 – somewhat pollution tolerant

Alderflies (Megaloptera)
(also called fishfly)

Group 2 – somewhat pollution tolerant

Black Fly



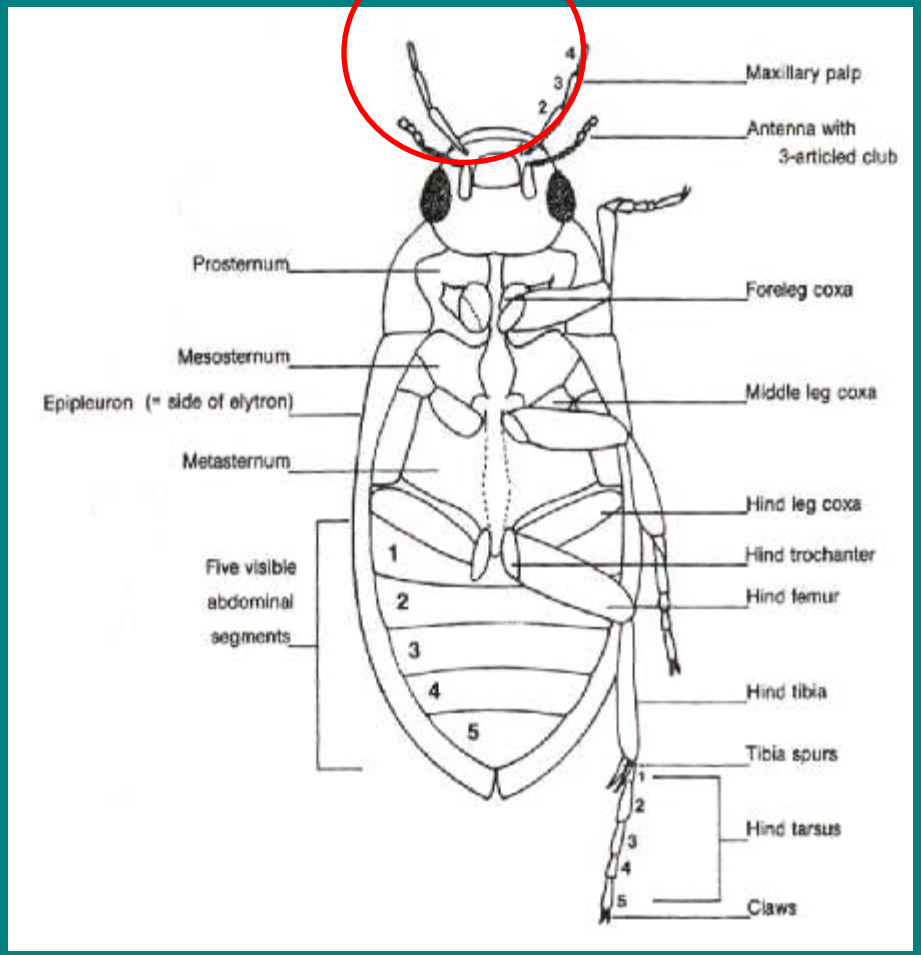


Group 2 – somewhat pollution tolerant

Adult Beetles (Coleoptera)

Group 2 – somewhat pollution tolerant

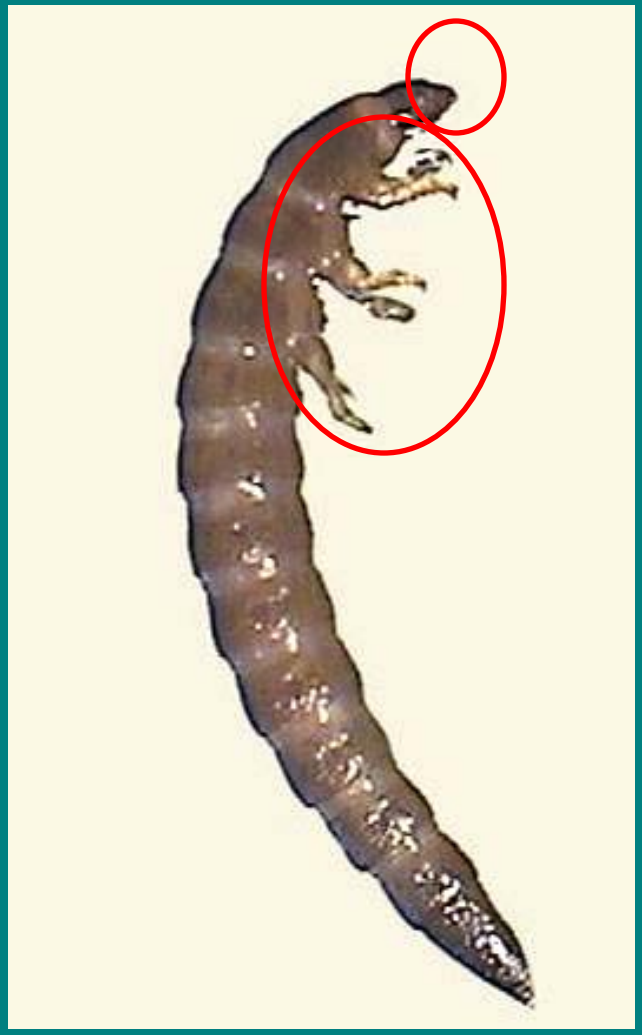
Adult Beetles



- Shell-like wings
- Chewing mouthparts

Group 2 – somewhat pollution tolerant

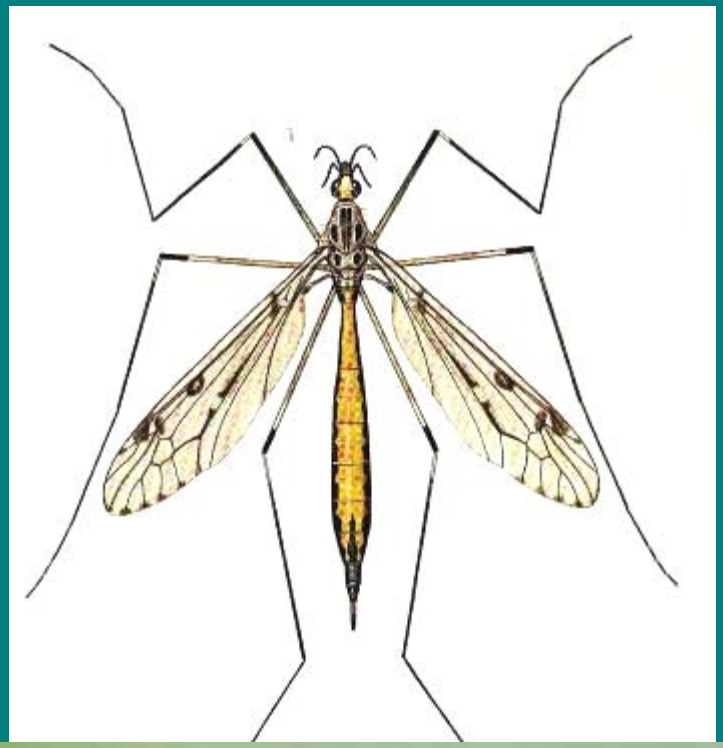
Beetle larvae



⇦ Chewing or biting mouthparts

⇦ 3 Pairs of legs

⇦ Generally well sclerotized



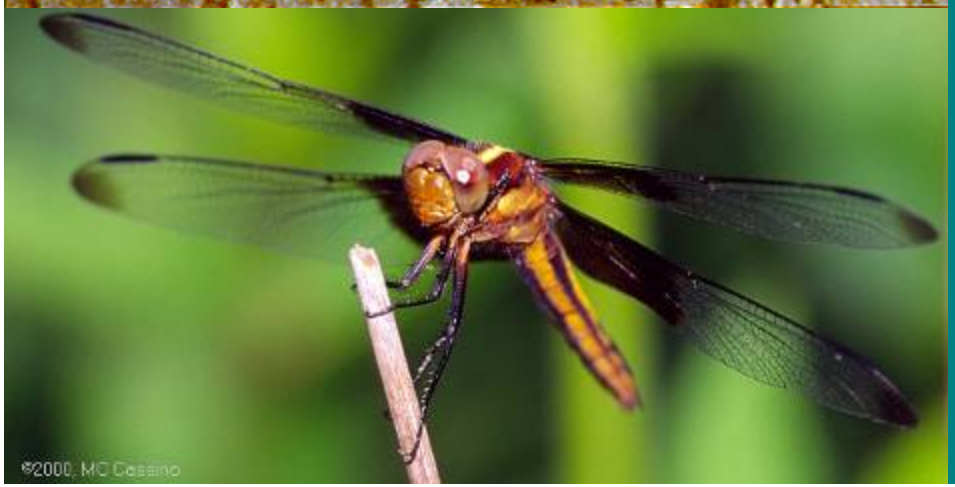
Group 2 – somewhat pollution tolerant

Crane Fly

- .8-5 cm length

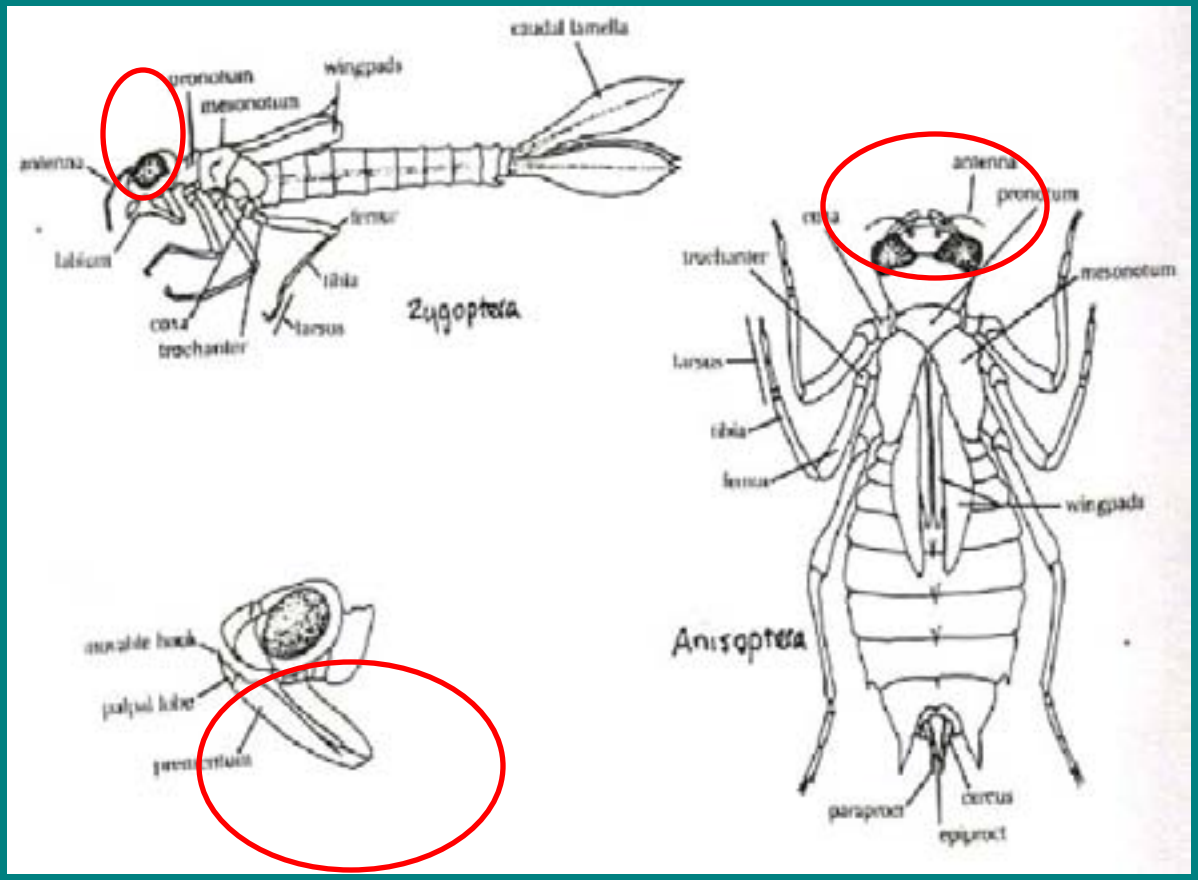
Group 2 – somewhat pollution tolerant

Dragonflies and Damselflies (Odonata)



Group 2 – somewhat pollution tolerant

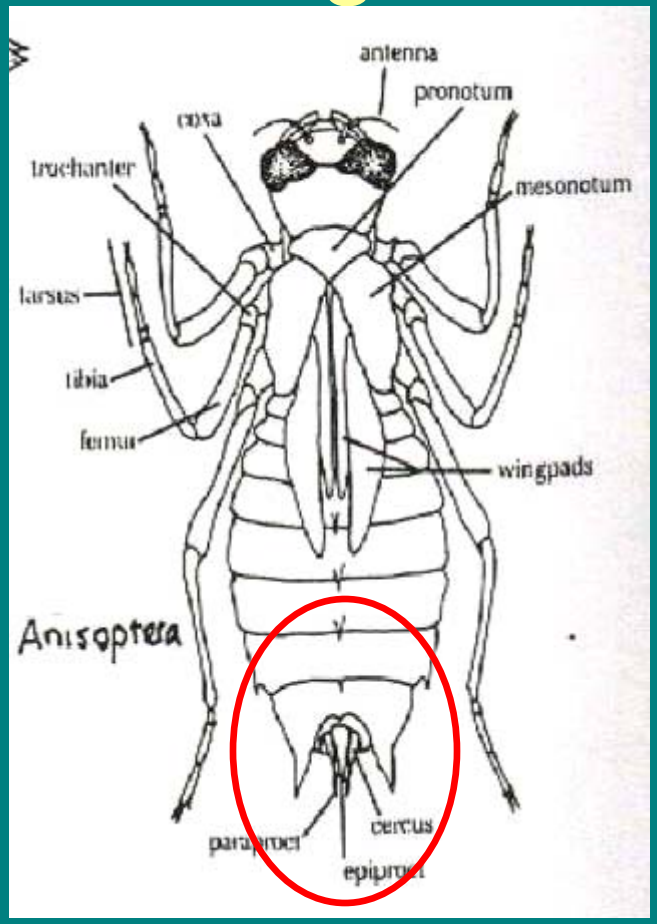
Dragonflies & Damselflies (Odonata)



- Distinctive antennae
- Large eyes
- 1-5 cm length
- Extendible lower jaw
- Short filamentous antennae
- Large compound eyes
- Elongate hinged mouth (labium)

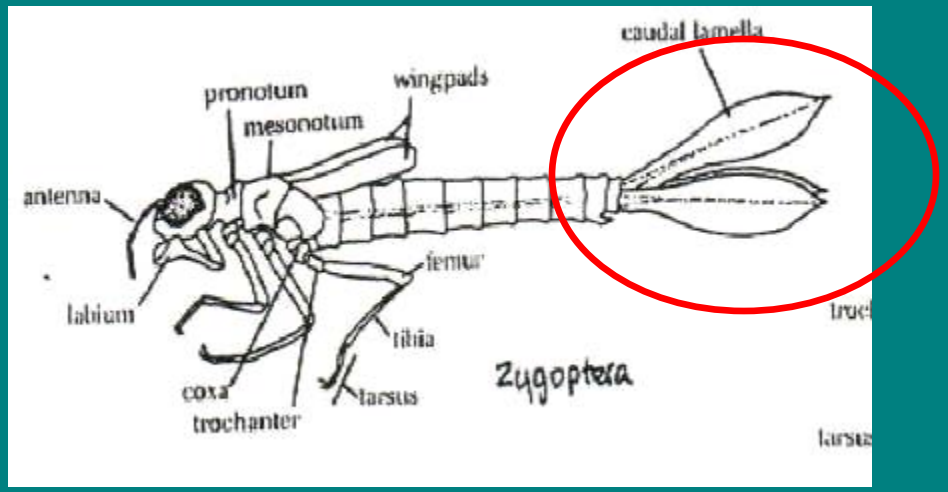
Group 2 – somewhat pollution tolerant

Dragonflies



- Stout body
- No tails

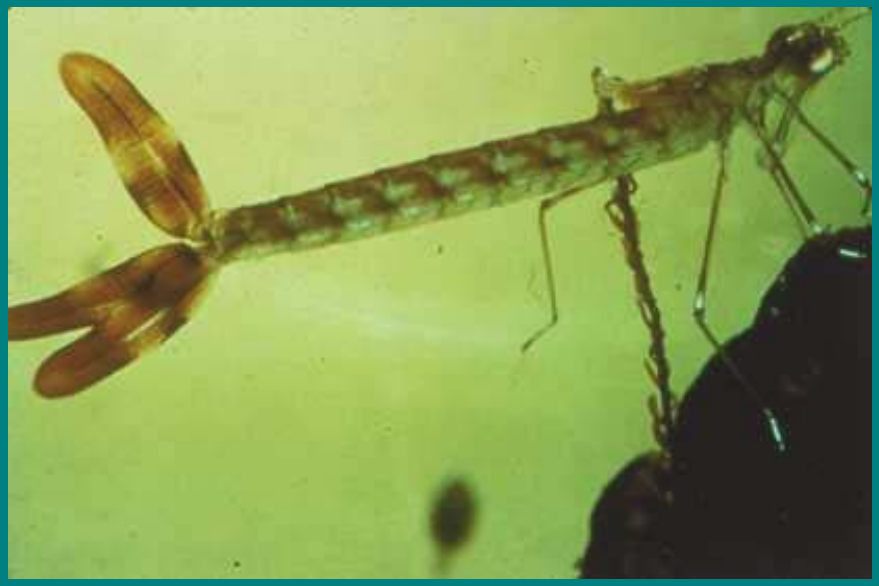
Damselflies



- Slender body
- Three tails

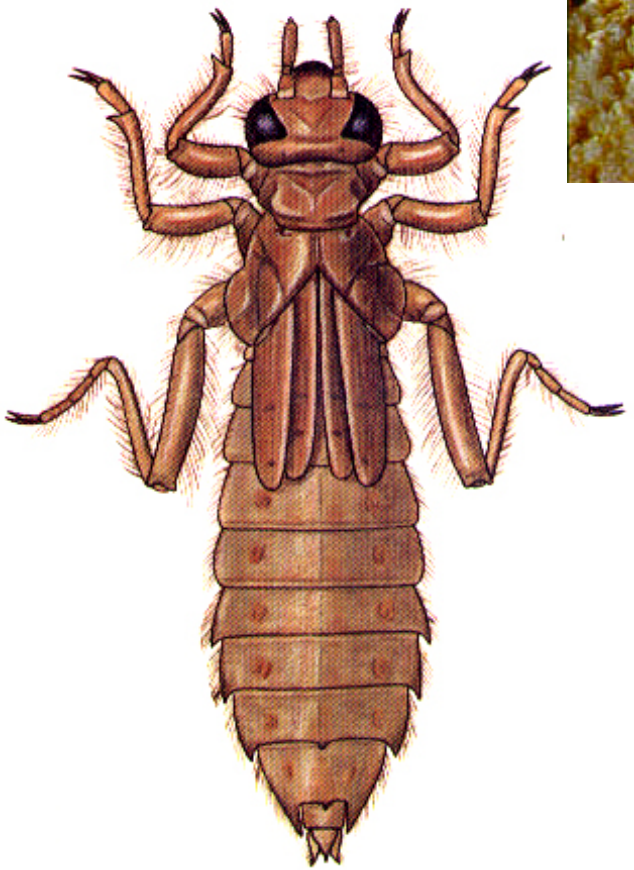
Group 2 – somewhat pollution tolerant

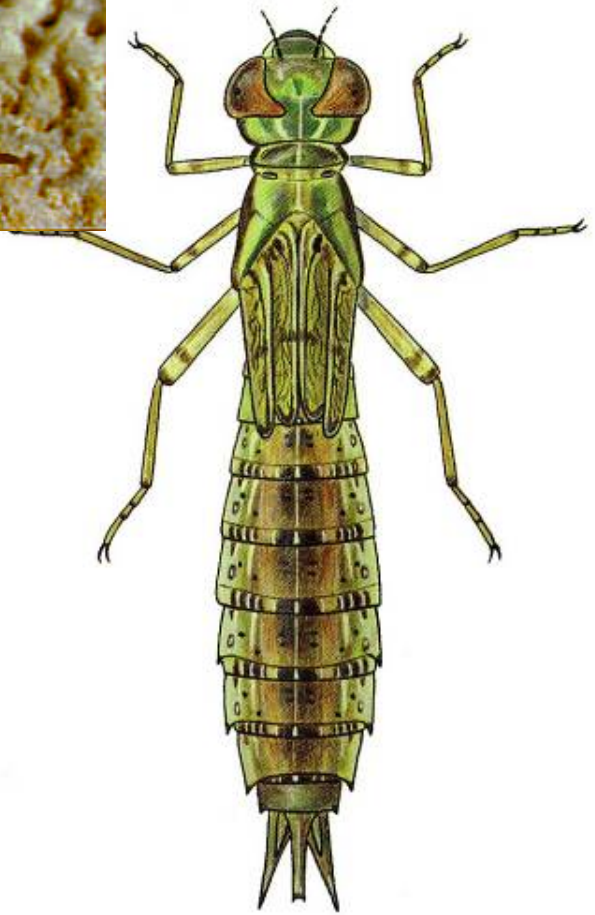
Damselflies

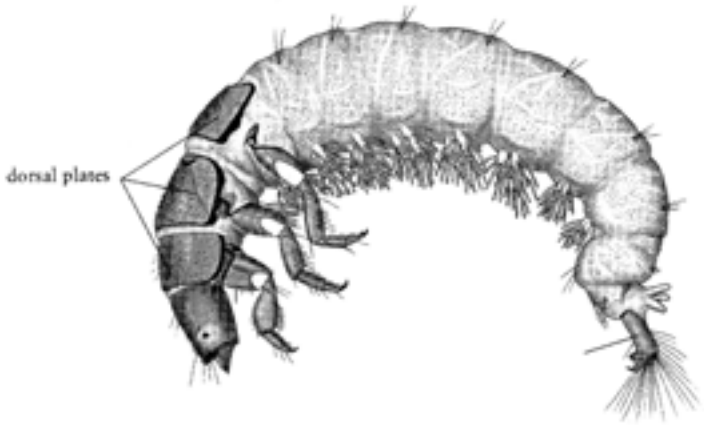


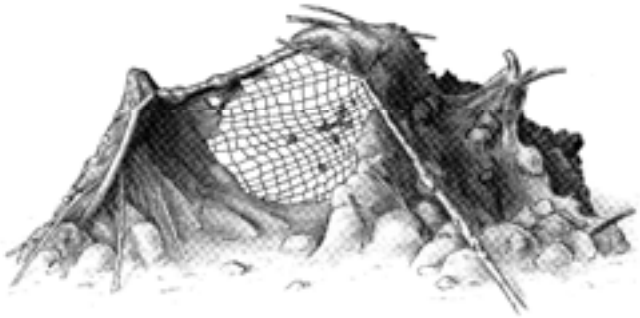
Group 2 – somewhat pollution tolerant

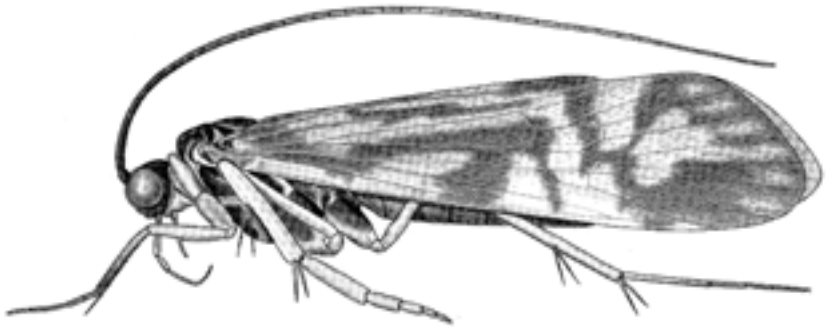
Dragonflies











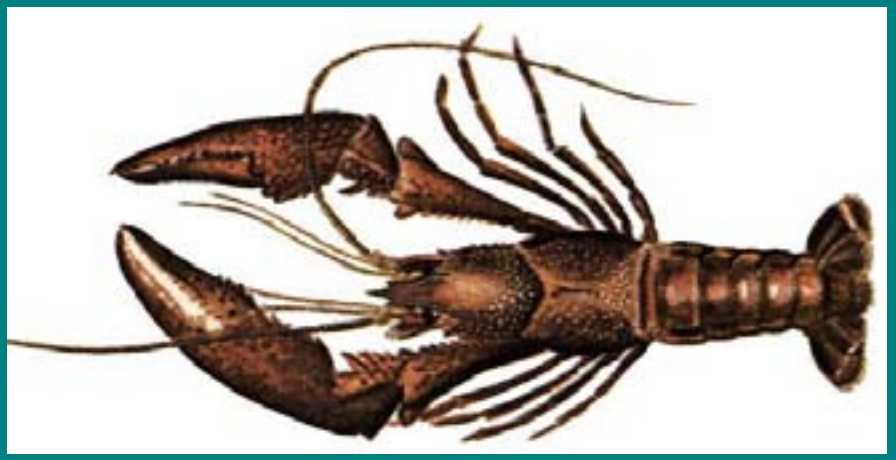
Group 2 – somewhat pollution tolerant

Common Net-spinning Caddisfly

Hydropsychidae

Group 2 – somewhat pollution tolerant

Crayfish



Group 2 – somewhat pollution tolerant

Scuds

- .5-1 cm length

Group 2 – somewhat pollution tolerant

Clams

Group 2 – somewhat pollution tolerant

Sow Bugs

- **,8-2 cm length**

Group 3 – pollution tolerant

True Bugs (Hemiptera)

⇦ Wings hardened near the base and membranous everywhere else

⇦ Adult beetles

⇦ Tube-like sucking mouthparts

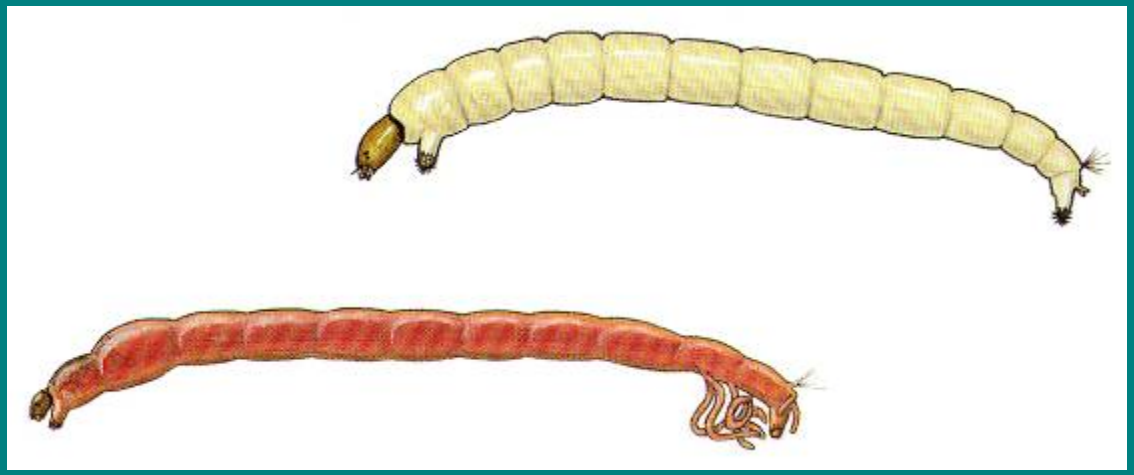
Group 3 - pollution tolerant

Water Striders, Backswimmers, Water Bugs **(counterclockwise)**

- Get oxygen from the air.
- Do not depend upon dissolved oxygen in the water.

Group 3 - pollution tolerant

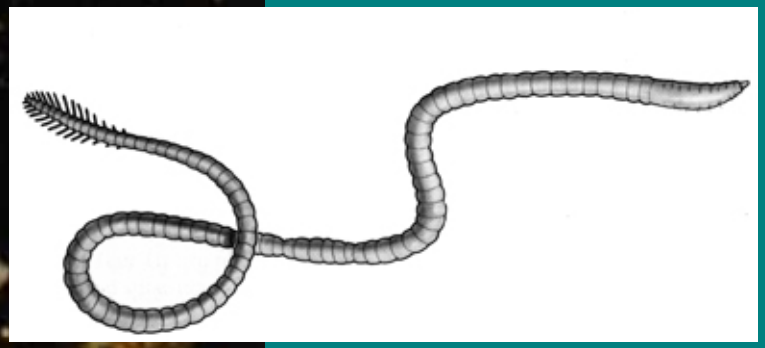
Midges



- Up to 1.5 cm in length.

Group 3 - pollution tolerant

Aquatic Worms (Oligochaeta)



Note the segments!

Group 3 - pollution tolerant

Leeches

Group 3 - pollution tolerant

Pouch Snails

- Do not have a plate-like covering over the shell opening.
- Has shell that spirals with opening usually on your left side, or shell that is coiled in one plane, or shell that is dome or hat shaped with no coils.