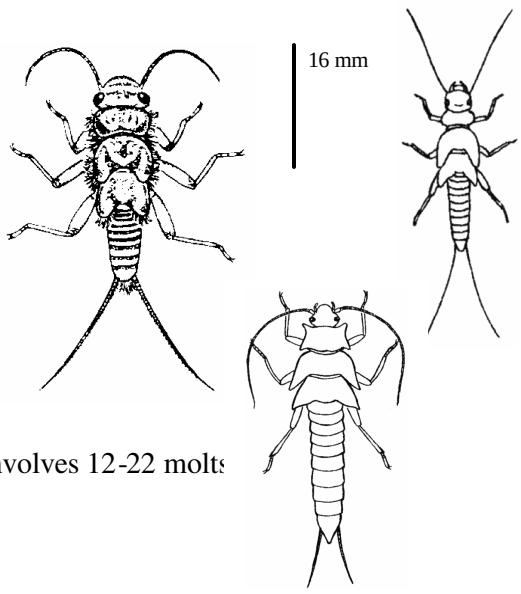
Group 1 ~ Intolerant to Pollution

(Average Actual Size)

Stonefly nymph



Order Plecoptera

Where to find Underside of rocks, in debris, in algal mats

Body shape Elongated, resembles adult

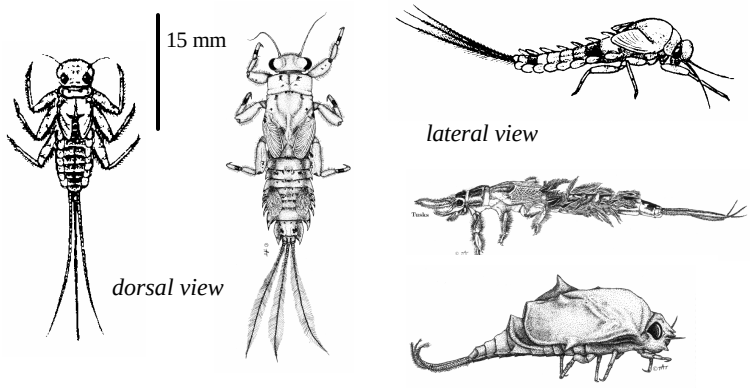
Size 5 - 35 mm

Feeding Group Predator or shredder

Lifecycle Incomplete metamorphosis
Larval development: 3 months to 3 years, involves 12-22 molts

Distinguishing Characteristics
Abdomen ends in two hair-like tails
No gills visible on abdomen
2 tarsal claws
Antennae long (longer than head)
Only found crawling on surfaces, not swimming
**Distinguished from mayfly by two tails and lack of feathery gills*

Mayfly nymph



Order Ephemeroptera

Where to find Underside of rocks and logs, some species free-swimming

Body shape Elongated and flattened, resemble adults

Size 3 - 30 mm

Feeding Group Gathering collector

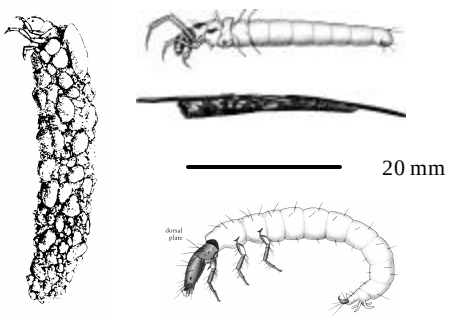
Lifecycle Incomplete metamorphosis, with additional sub-adult stage unique to mayflies
Larval development lasts 3 months to 3 years
Adults often form large mating swarms over water following emergence

Distinguishing Characteristics
Abdomen usually ends in three filamentous, hair-like tails (some species have two)
Tails may appear webbed
Tails are fragile and may break off during collection, examine carefully
Feathery gills line sides of abdomen
Often swim in collection bin – rather than crawling
**Distinguished from stoneflies by presence of three tails and feathery gills*

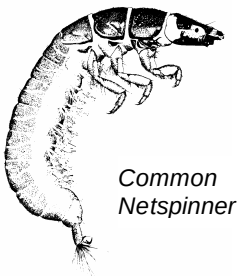
Group 1 ~ Intolerant to Pollution

(Average Actual Size)

Caddisfly larva



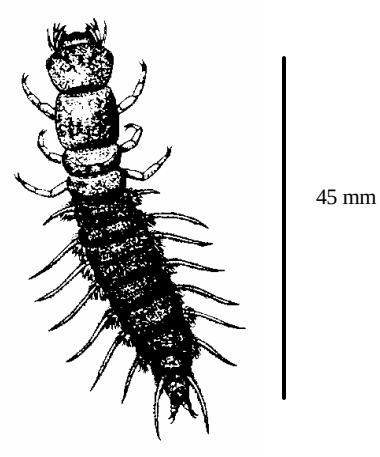
Order	Trichoptera
Where to find	Underside of rocks, on plant materials
Body shape	Usually cylindrical and "C"-shaped, 6 legs near head
Size	2 - 40 mm
Feeding Group	Shredder
Lifecycle	Complete metamorphosis, which occurs while sealed in "cases" or "houses"
Distinguishing Characteristics	Often found in "houses" made of pebbles, wood, sticks, leaves, sand, or shells Cases constructed using glue-like secretion from end of abdomen; leave holes in ends of "houses" to serve as breathing tubes prior to metamorphosis Abdomen ends in 2 prolegs, each with a claw May have darker, harder plates on top of thorax Move with characteristic wiggling – back and forth then up and down through the water



Common Netspinner

Special Family of Interest – Hydropsychidae or "Common Netspinner Caddisfly" – do not build cases; they build fine mesh nets to filter food from the water current – are slightly more tolerant to pollution, especially organic wastes or nutrients, which they utilize for food – have hair-like gills all along their abdomen, and are often green in color – important to distinguish family for use in multi-metric biotic index on pages 97-98.

Dobsonfly larva (Hellgrammite)

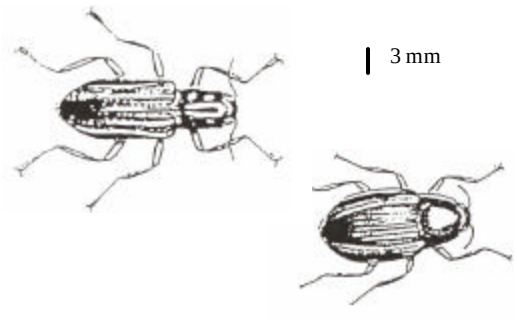


Order	Megaloptera
Family	Corydalidae
Where to find	Soft substrate; soft, rotting logs and stumps; between rocks
Body shape	Large, long and slightly flattened
Size	10 - 90 mm
Feeding Group	Predator
Lifecycle	2 – 5 years
Distinguishing Characteristics	Large pinchers on head; 7 - 8 pairs of lateral filaments on abdomen; these are not legs 3 pairs of legs on middle portion of body (thorax) with tiny pinchers at the end of each Abdomen ends in pair of short, spiny prolegs, each with 2 hooks

Group 1 ~ Intolerant to Pollution

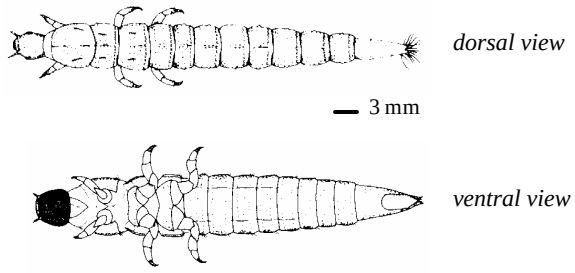
Riffle Beetle (adult)

(Average Actual Size)



Order	Coleoptera
Family	Elmidae
Where to find	Crawling on stream bottom; often collected with kick seine in riffles
Body shape	Oblong, oval, hard
Size	1 – 6 mm
Feeding Group	Gatherer collector
Lifecycle	Complete metamorphosis Both adults and larvae are aquatic
Distinguishing Characteristics	Tiny Black in color Walks very slowly underwater Hardened, stiff appearance of entire body True "beetle" appearance with 6 legs Adult found more often than larvae

Riffle Beetle (larva)

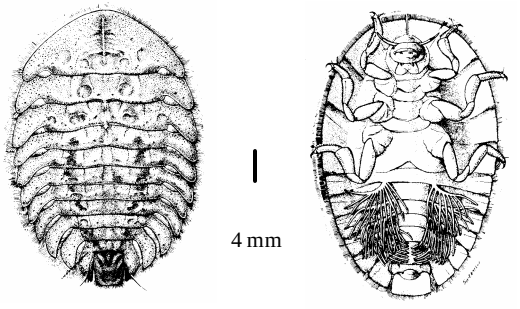


Order	Coleoptera
Family	Elmidae
Where to find	Crawling on stream bottom
Shape	Elongate, hard-bodied
Size	Usually 1- 6 mm
Feeding Group	Gatherer collector or grazer
Lifecycle	Complete metamorphosis Both adults and larvae are aquatic
Distinguishing Characteristics	Hardened, stiff appearance of entire body Resemble tiny torpedoes with circular rings around body Grey or brown in color

Group 1 ~ Intolerant to Pollution

(Average Actual Size)

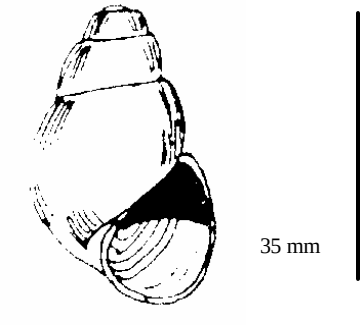
Water penny beetle larva



dorsal view *ventral view*

Order	Coleoptera
Family	Psephenidae
Where to find	Stones and other substrate
Body shape	Disk (flat)
Size	3 - 5 mm
Feeding group	Grazer
Lifecycle	Complete metamorphosis; Lifecycle from 21 to 24 months
Distinguishing Characteristics	Round – resemble pennies Brown, black, or tan colored Often difficult to remove – resemble suction cups 3 pairs of tiny legs on underside of body

Right-Handed (Gilled) snail

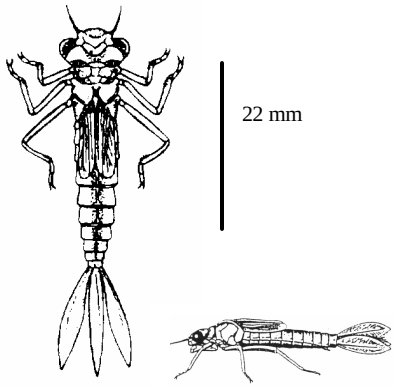


Phylum	Mollusca
Class	Gastropoda
Order	Mesogastropoda
Where to find	Grazing on a variety of substrates
Body shape	Hard, spiraled shell
Size	2 - 70 mm
Feeding group	Grazer
Distinguishing Characteristics	With point held up, opening (aperture) is on your right and faces you (right = good = gilled) Respire via gills, so require oxygenated water Plate-like covering over shell opening Shells coiling in one plane are counted as Left-Handed (Pouch) Snails (see page 95) Only **live** snails may be counted in determining water quality

Group 2 ~ Moderately Intolerant to Pollution

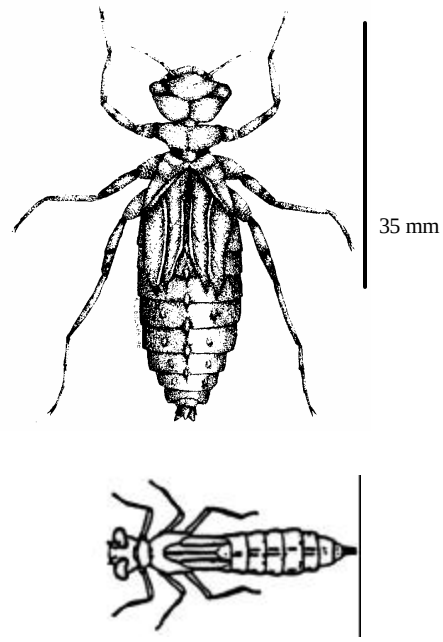
(Average Actual Size)

Damselfly nymph



Order	Odonata
Suborder	Zygoptera
Where to find	Overhanging/emergent aquatic vegetation
Body shape	Elongated, narrow, tapering rearward, resemble adults
Size	15 - 30 mm
Feeding group	Predator
Lifecycle	Incomplete metamorphosis, maturation in 1 to 4 years
Distinguishing Characteristics	No gills present on sides of abdomen Abdomen ends in 3 wide, oar-shaped gill-plates resembling tails Large eyes and long legs Grey, green, or brown in color **May be confused with mayflies, but damselflies have no abdominal gills and "tails" are more paddle-shaped or feather-shaped* **May be confused with dragonflies, but bodies are thin and narrow with long, spindly legs, and dragonflies have no tails*

Dragonfly nymph

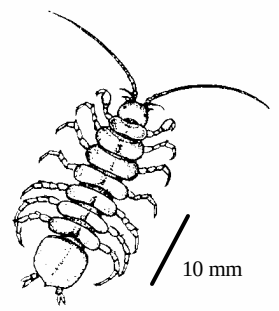


Order	Odonata
Suborder	Anisoptera
Where to find	Bottom substrate, mud, vegetation
Body shape	Wide abdomen, oval, flattened, robust, large eyes, resemble adults
Size	20 - 50 mm
Feeding group	Predator
Lifecycle	Incomplete metamorphosis, maturation in 1 – 4 years
Distinguishing Characteristics	Large eyes No external gills Distinct scooping mouthparts that extend to catch prey Grey, green, or brown in color Body is generally rough No tails **May be confused with damselflies, but distinguishable by wide, oval abdomen and no tails*

Group 2 ~ Moderately Intolerant to Pollution

(Average Actual Size)

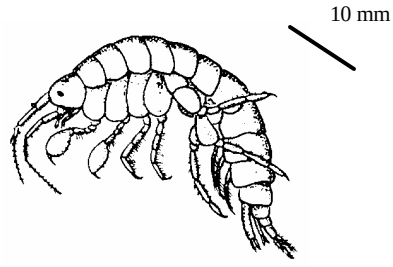
Aquatic sowbug



Class	Crustacea
Order	Isopoda
Where to find	Crawling on substrate, vegetation, and debris
Body shape	Hard bodied and flattened dorso-ventrally (top to bottom)
Size	5 – 20 mm
Feeding group	Collector

**May be confused with scuds, but sowbugs are wider than high, and walk slowly along surfaces*

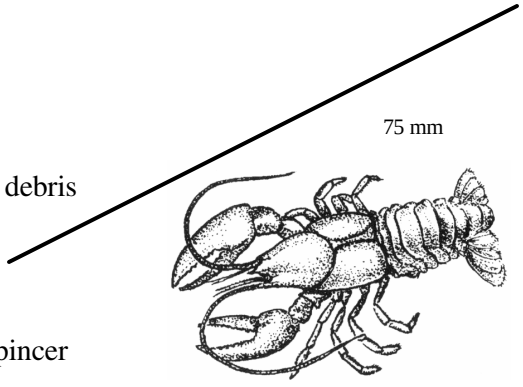
Scud



Class	Crustacea
Order	Amphipoda
Where to find	Aquatic vegetation
Body shape	Flattened laterally (side to side)
Size	5 – 20 mm
Feeding group	Filtering collector
Distinguishing Characteristics	7 pairs of legs and swims on side Shrimp-like, white to clear to pink in color with distinct black eyes

**May be confused with sowbugs, but are taller than wide and they swim rapidly on their side*

Crayfish

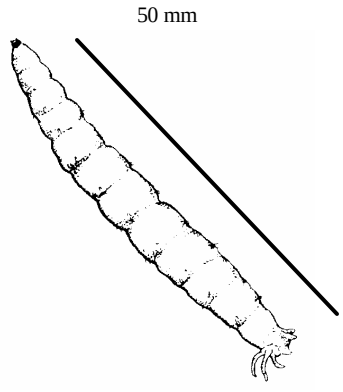


Class	Crustacea
Order	Decapoda
Where to find	Under stones, dense mats of vegetation, and debris
Body shape	Lobster-like, hard body with fan shaped tail
Size	3-15 cm
Feeding group	Grazer, predator
Distinguishing Characteristics	5 pairs walking legs, 1st pair enlarged with pincer claws. Eyes on stalks Well-developed antennae Yellow, green, white, pink or dark brown in color.

Group 2 ~ Moderately Intolerant to Pollution

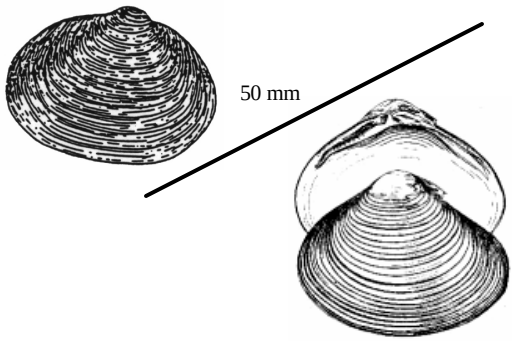
Cranefly larvae

(Average Actual Size)



Order	Diptera (True Flies)
Family	Tipulidae
Where to find	Under rocks, on aquatic vegetation, in leaf-packs
Body shape	Caterpillar-like, "juicy" and segmented
Size	10 – 100 mm
Feeding group	Shredder
Lifecycle	Complete metamorphosis, spends 6 weeks – 5 years in aquatic stage
Distinguishing Characteristics	No true legs or wing buds Milky, light brown, or greenish in color with digestive tract often visible Prolegs may be visible as small lobes **Distinguished from other fly larvae by finger-like appendages that extend from posterior end (if no appendages on hind end, probably a deer or horse fly larvae)*

Clams and Mussels

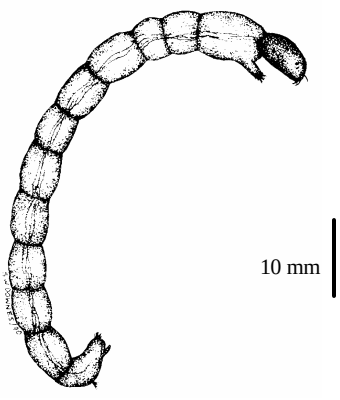


Class	Bivalvia
Where to find	Substrate
Body shape	Two shells attached by a hinge
Size	Varies (very small to very large)
Feeding group	Filtering collector
Distinguishing Characteristics	Only **live** clams and mussels may be counted in determining water quality If live native mussels or exotic zebra mussels are found, remember to mark the box at the bottom of the Biological Monitoring Data Sheet. In addition, remember to replace live native mussels exactly as you found them as described on page 83.

Group 3 ~ Fairly Tolerant to Pollution

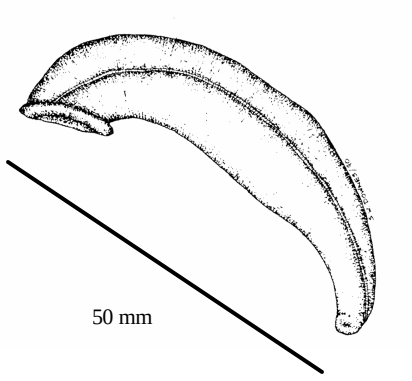
(Average Actual Size)

Midge larvae



Order	Diptera (True Flies)
Family	Chironomidae
Where to find	Sediment, vegetation, leaf pack
Body shape	Cylindrical, thin, soft, and often curled
Size	2 - 20 mm
Feeding group	Gathering collector or grazer
Lifecycle	Complete metamorphosis
Distinguishing Characteristics	No true legs, but very small anterior and posterior prolegs Hardened head capsule **Often confused with aquatic worms, but midge has small, but visible head and prolegs* **Blood Midges (Very Tolerant to Pollution – Group 4) are a group of midges that are red in color – they are discussed separately on page 7*

Leech

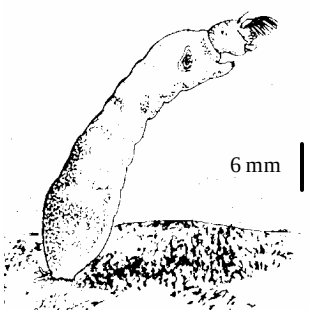


Phylum	Annelida
Class	Hirudinea
Where to find	Sediment, leaf pack, vegetation, attached to host animal (maybe you!)
Body shape	Flattened dorso-ventrally (top to bottom), many segments
Size	5 – 100 mm
Feeding group	Predaceous, collector
Distinguishing Characteristics	Anterior and posterior suckers Usually much wider than aquatic worm Usually tan to brown in color, though can be patterned and brightly colored **May be confused with planarians but are usually larger with segments and suckers*

Group 3 ~ Fairly Tolerant to Pollution

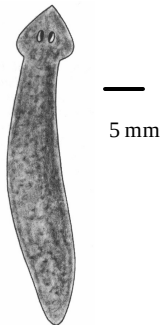
(Average Actual Size)

Blackfly larvae



Order	Diptera (True Flies)
Family	Simuliidae
Where to find	In swift current on rocks, and submerged vegetation Often attached by disk on end of abdomen
Body shape	Bowling pin shaped with sucker on wide end
Size	3 - 12 mm
Feeding group	Filtering collector
Lifecycle	Incomplete metamorphosis
Distinguishing Characteristics	Soft body Single proleg directly under head - no true legs Fan-like mouth bristles may be present Head usually black, less often brown, tan, or green Move downstream by drifting on silken threads extended from abdomen **Distinguished from other fly larvae by swollen back end, which it will often stick to the bottom of your collection bin*

Planaria (Flatworm)



Class	Turbellaria
Order	Platyhelminthes
Where to find	Bottom of rocks, leaf litter
Body shape	Soft, flattened dorso-ventrally (top to bottom), arrow-shaped head
Size	Usually <1mm, range to 30mm
Feeding groups	Gathering collector, predator
Distinguishing Characteristics	Flat body Arrow-shaped head with white eyespots Body slides smoothly along surfaces **May be confused with aquatic worms or leeches, but slides along surfaces rather than moving end to end (leeches) or by stretching part of body and pulling the rest (worms) also, planarians are unsegmented*

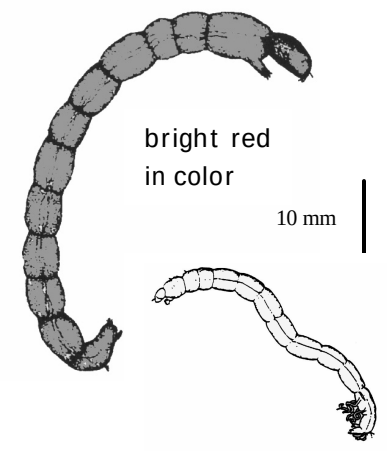
Group 4 ~ Very Tolerant to Pollution

(Average Actual Size)

Aquatic worms

Phylum	Annelida
Class	Oligochaeta
Where to find	Silty sediment, organic debris
Body shape	Long, thin, cylindrical, segmented
Size	1 – 70 mm
Feeding groups	Shredder, collector, grazer
Distinguishing Characteristics	Often similar to earthworm in appearance Red, tan, black, or brown in color **Distinguished from leeches, midges, and planarians by long, thin body and worm-like movement (stretching and pulling body along)*

Blood Midge larva



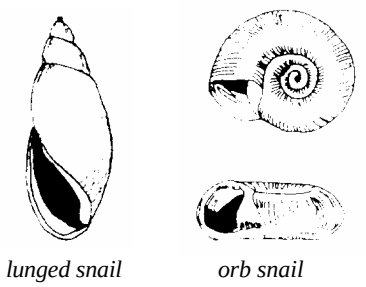
Order	Diptera (True Flies)
Family	Chironomidae
Where to find	Silty sediment, often in organically polluted water
Body shape	Cylindrical, thin, soft, and often curled
Size	2 - 20 mm
Feeding group	Collector gatherer
Lifecycle	Complete metamorphosis
Distinguishing Characteristics	Red in color No true legs, but very small anterior and posterior prolegs Hardened head capsule **Distinguished from red aquatic worms with small, but visible head and prolegs*

Group 4 ~ Very Tolerant to Pollution

(Average Actual Size)

Left-Handed (Lunged) snail

50 mm

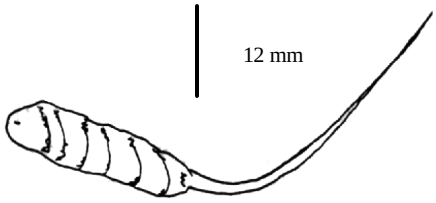


lunged snail *orb snail*

also, limpets

Phylum	Mollusca
Class	Gastropoda
Order	Prosobranchia
Where to find	Grazing on a variety of substrates
Body shape	Hard shell usually spiral, but may be flattened
Size	2 - 70 mm
Food source	Grazer
Distinguishing Characteristics	With point held up and shell opening facing you, opening is on your left Snails with shells coiling in one plane (orb snail) are also counted as Left-Handed No plate-like covering over shell opening Respire via lung-like structures, so not dependent on dissolved oxygen in the water – they can obtain oxygen from the atmosphere Only **live** snails may be counted on Biological Monitoring Data Sheet

Rat-tailed maggot



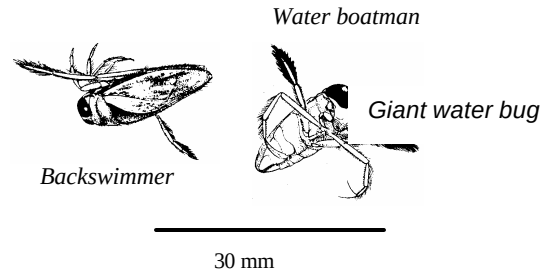
Order	Diptera (True Flies)
Family	Syrphidae
Where to find	Silty sediments of organically enriched water
Body shape	Soft, worm-like with long tail
Size	Usually 4 - 14mm, may exceed 70mm
Feeding group	Collector
Lifecycle	Complete metamorphosis
Distinguishing Characteristics	Maggot-like, wrinkled body Anglers call them "mousies" Long tail (can be 3 – 4x body length), which is actually a snorkel-like breathing tube Tail is extended above surface of the water allowing rat-tailed maggot to obtain oxygen from the atmosphere

Other Organisms

There is a possibility that you will discover insects and other organisms that are not listed on the Pollution Tolerance Index (e.g., adult dragonflies, water striders, water bugs). They are not counted in the PTI. These organisms are not as useful as indicators of water quality because they are less dependent on local stream conditions for habitat requirements.

True bugs

(Backswimmer, Giant water bug, Water boatmen, Water strider)



Order Hemiptera

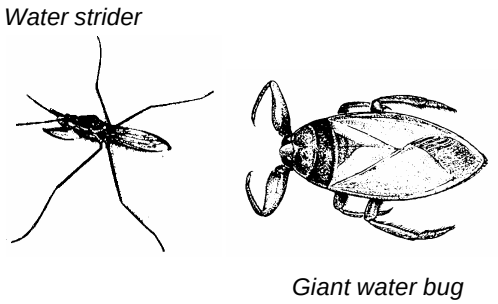
Where to find Often seen skimming or walking along water surface

Body shape Hard, oval, and somewhat flattened

Size 1 – 65 mm

Feeding group Predator. Injects chemicals that dissolve the internal parts of prey.

Lifecycle Incomplete metamorphosis, adults and larvae are quite similar



Distinguishing Characteristics Head and eyes often well developed
3 pairs of legs may be dissimilar (hindlegs may be flattened and hinged)
Forewings, when at rest, are held close over the back and overlap
Because adults are mobile, they are not a good indicator of water quality
**May be confused with adult water beetle, but beetle's wings do not overlap*

Waterboatman - swims right side up, back is black

Backswimmer - swims on back, back is white

Water Strider - lives on surface, walks on water

Giant Water Bug - grasping front legs, up to three inches in length

Information in this section was modified from the following sources:

An Introduction to the Aquatic Insects of North America, Second Ed., Edited by R.W. Merritt and K.W. Cummins
Aquatic Entomology, Patrick McCafferty
Clinton River Watershed Council *Teacher Training Manual*, Michigan, Meg Larson
Field Manual for Water Quality Monitoring, 10th Ed., Mark K. Mitchell and William B. Stapp
Macroinvertebrate Identification Flash Cards, GREEN/Earth Force, Ann M. Faulds, et al.
Pond and Stream Safari, Karen Edelstein, Cornell Cooperative Extension
Save Our Streams Monitor's Guide to Aquatic Macroinvetebrates, Loren Larkin Kellogg