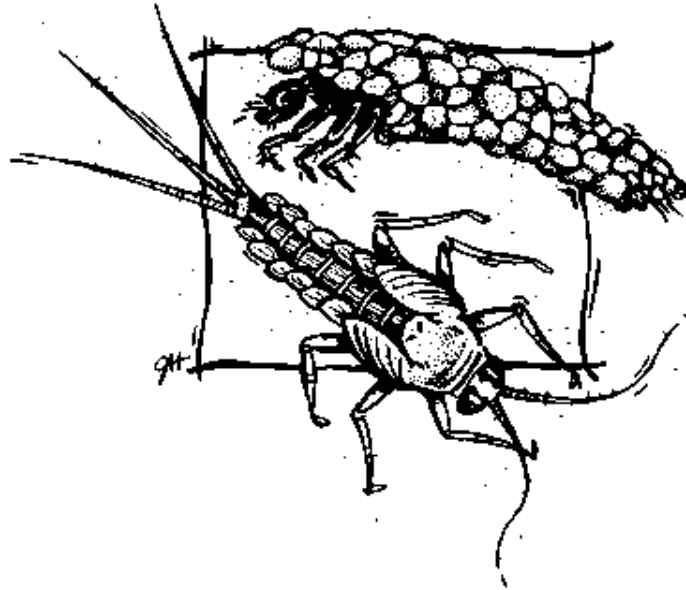


Macro-invertebrates

What are macros?

Macroinvertebrates are organisms that lack a spine and are large enough to be seen with the naked eye. Examples of macro-invertebrates include flatworms, crayfish, snails, clams and insects, such as dragonflies. Many aquatic insects live as juveniles, called **nymphs** or **larvae**, in the water, and become flying insects as adults.



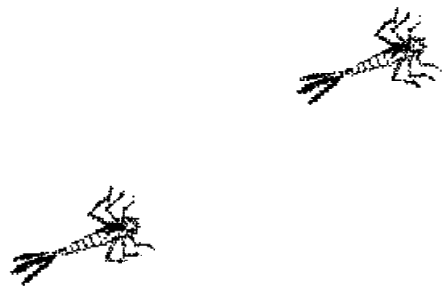
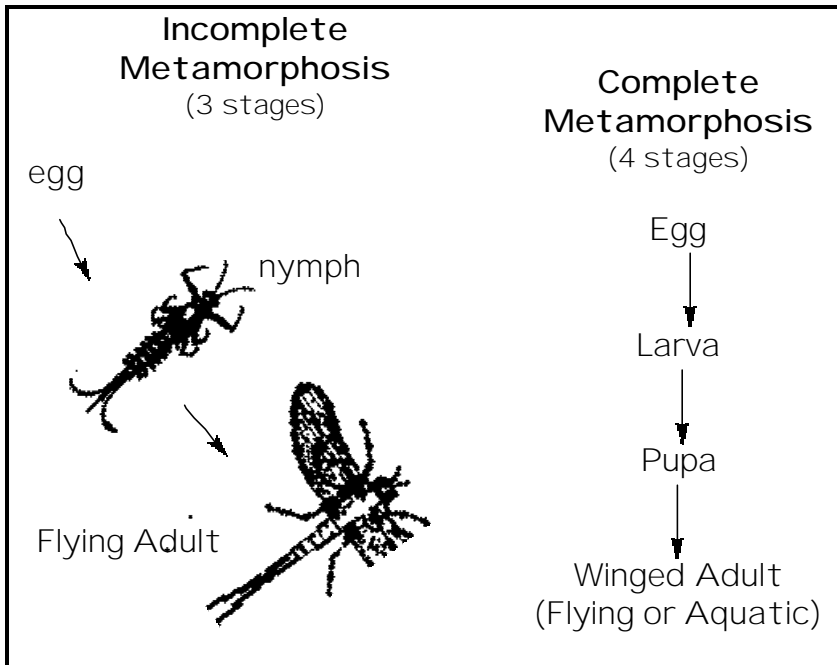
macro life cycles

Insects begin their life cycle as an egg, then go through physical changes with each stage in their life cycle (metamorphosis). Some insects, like Caddisflies, have four stages in their life cycle-called complete metamorphosis. The mayflies and stoneflies are examples of insects have only three stages in their life cycle. This is called incomplete metamorphosis. Insects look and exist differently at each stage.

Many aquatic insects lose their mouthparts as adults and some only live in that stage for a few hours.

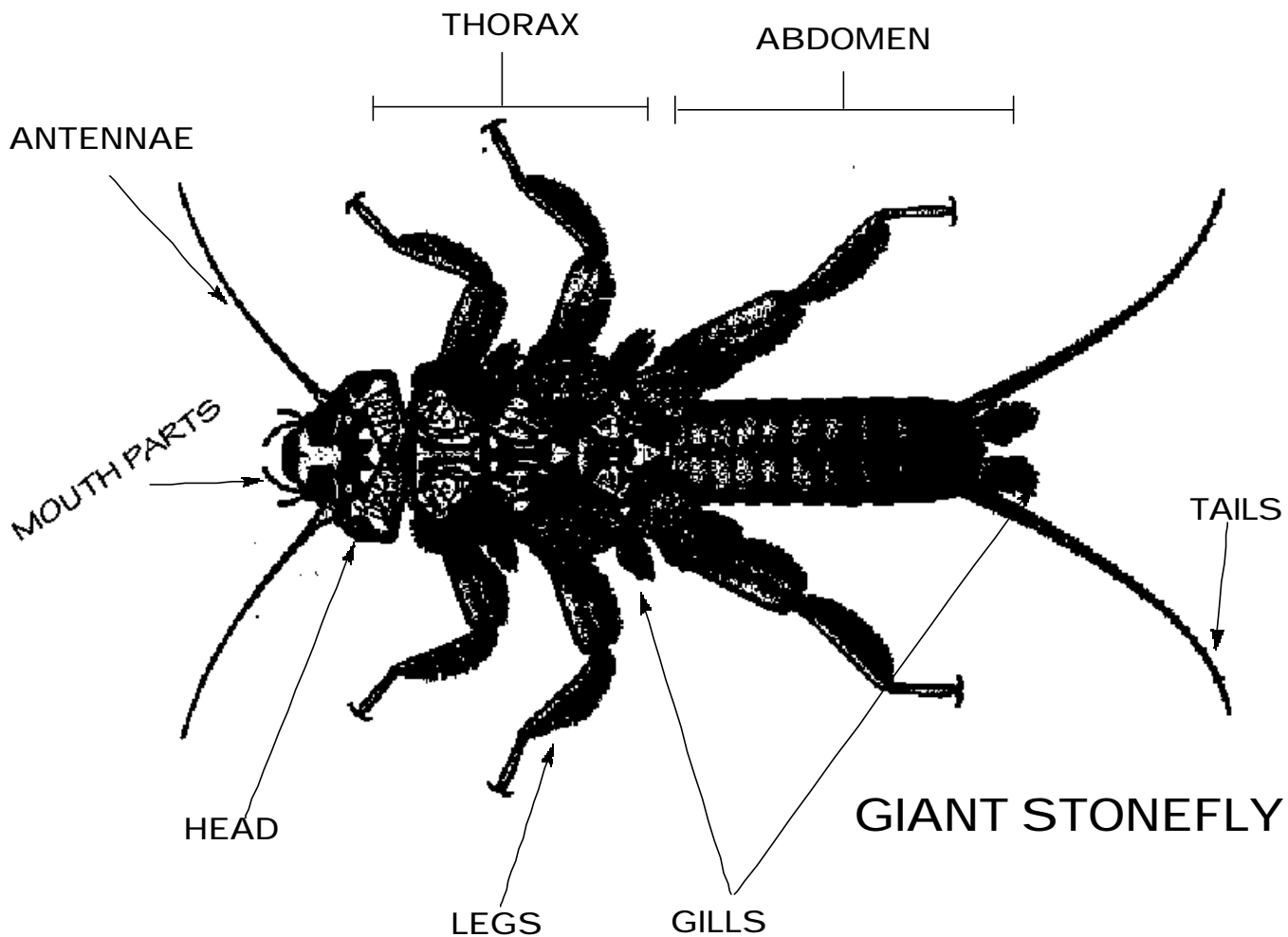
The waterstrider "walks" across the surface of water, using hydrophobic hairs on the end of its legs.

Prehistoric dragonflies were around 300 million years ago. The wingspan of this creature was often wider than 3 feet!



anatomy and classification

Many aquatic insects you see are nymphs or larvae (juveniles). Some of the body parts of these creatures are similar to terrestrial (land-based) insects. They have three body parts (head, thorax and abdomen), three pairs of legs and a set of antennae. Some larvae will have unique structures, like gills, tails and distinct mouthparts. These structures can help you distinguish different groups of insects. For instance, most stoneflies have two tails and gills at the base of the legs and between the tails, while most mayflies have three tails and gills on the abdominal segments.



Where macros live

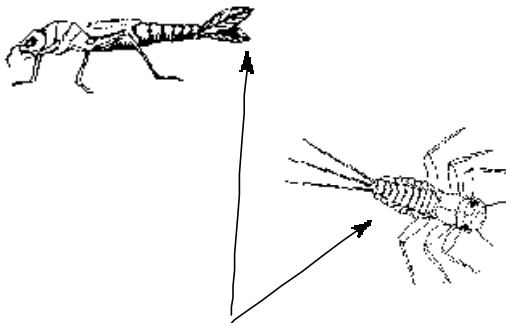
In its underwater environment, a macroinvertebrate must be able to navigate moving water as well as the substrate (stream bottom). Many macroinvertebrates found in riffles (fast, white water areas of the stream) stick to rocks with suction devices. Organisms found in glides (smooth, flowing water) may have a flat shape to prevent being swept downstream. In slow moving pools, many organisms have adapted to burrow in the sediments or developed bulky cases to provide protection from predators.



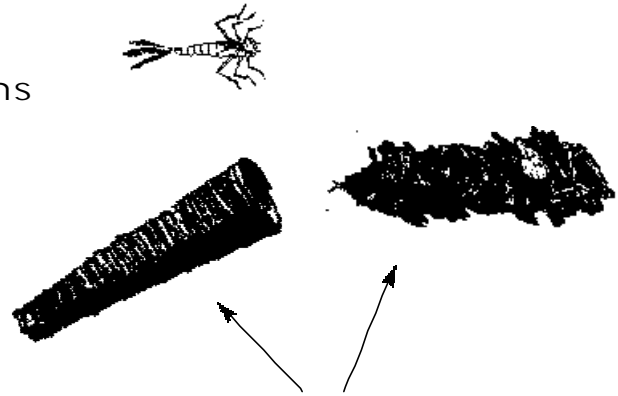
In addition to navigating, macroinvertebrates also need to take in oxygen from the water. Some have gills to breath oxygen dissolved in the water, others rise to the water's surface to breath oxygen from the atmosphere.



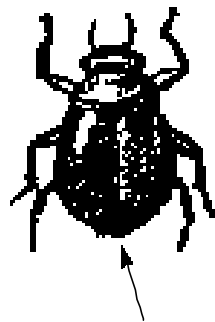
Examples of insect adaptations to Their environments:



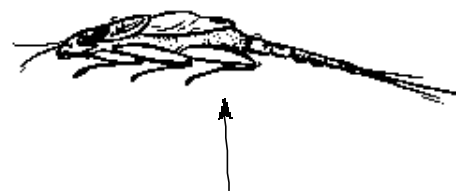
Some macros have large gill surface areas to help them breath.



Caddisflies build protective cases around their bodies out of stones, leaf material, or sticks.



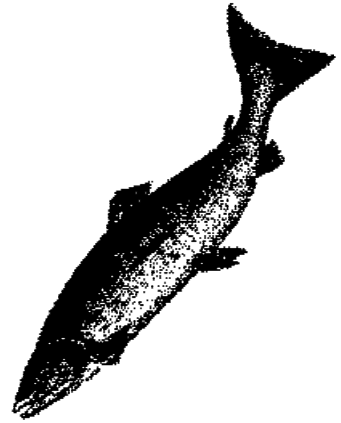
Some carry atmospheric oxygen with them in tiny bubbles attached to the end of their abdomen, like this riffle beetle.



Organisms found in fast moving waters may have a flattened, "streamlined" shape.

Macros and the Food Web

In addition to moving and breathing, a macroinvertebrate must also get food in its underwater environment in order to survive. Macroinvertebrates can be separated into four **feeding groups**. Each group has specific adaptations for obtaining and eating food. What a macroinvertebrate eats may determine its role in the food web. For instance, plant life is eaten by a herbivorous mayfly, who is eaten by a predacious stonefly. A fish, in turn, eats the stonefly and an osprey eats the fish.



| FEEDING GROUPS | HOW THEY EAT | WHAT THEY EAT | HABITAT |
|--|---|---|---|
| Collectors (caddisflies, mayflies) | Physically gather food, or construct net-like structures to catch food. | Dissolved organics, algae, bacteria, feces, and plants. | Stream bottom |
| Shredders (mayflies, stoneflies, caddisflies) | Use chewing mouthparts designed to shred, cut, bite, or bore. | Leaves and vegetation that have fallen into the water. | Areas in the stream with lots of tree canopy cover. |
| Scrapers (caddisflies, mayflies) | Use special razor-like mouthparts to scrape. | Scrape algae off of rocks. | Areas in the stream with enough light to make algae grow. |
| Predators (Stoneflies, beetles, dragonflies, alderflies) | Bodies designed to chase, capture and kill their prey. | Catch and eat live organisms. | All habitat types. |

What macros tell us about the water

Scientists often use macroinvertebrate populations to learn more about a system. Macroinvertebrates are used as **indicators** of water conditions for several reasons:

- 1) They are easy to collect.
- 2) Many, called **sensitive**, cannot survive changes in stream conditions such as the introduction of pollution, high levels of sediments, high water temperatures, or low levels of dissolved oxygen (environmental stressors). Other species of macroinvertebrates, called **tolerant**, can survive in waters with changes in stream conditions and environmental stressors.
- 3) Many stay in a small area most of their lives.

The sensitivity and feeding groups of macroinvertebrate samples offer clues to how the aquatic system is functioning. For example, a sample taken from a pool area with a sandy substrate is usually rich in insects that shred organic materials. This sample may indicate that the pool area is functioning as a holding spot for organic debris and sediments. The diversity of macroinvertebrates in a sample also informs aquatic biologists whether or not the ecosystem can support populations of amphibians, fish, birds, and other wildlife species.

| Sensitive | Somewhat Tolerant | Tolerant |
|-------------|-------------------|----------------|
| Caddisflies | Craneflies | Midges |
| Stoneflies | Aquatic Sowbug | Black Flies |
| Mayflies | Crayfish | Riffle Beetles |
| Dobsonflies | Clams | Boatman |
| Alderflies | Damselflies | Backswimmers |
| | Dragonflies | Leeches |
| | | Aquatic Worms |
| | | Scud |

The diagram includes several illustrations of macroinvertebrates: a caddisfly larva (top left), a stonefly larva (top center), a damselfly nymph (top right), a large riffle beetle (middle right), a large stonefly nymph (bottom left), and a dragonfly nymph (bottom center). Arrows point from the text 'Alderflies' in the table to the stonefly nymph illustration, and from 'Dragonflies' to the dragonfly nymph illustration. An arrow also points from 'Backswimmers' to the large riffle beetle illustration.