# Benthic Macroinvertebrates - the briefest of overviews

## What are BMIs?

*Benthic* = stream bottom  *Macro* = see with the naked eye  *Invertebrates* = spineless animals

"BMIs" = spineless animals large enough to be seen with the naked eye that live in virtually all freshwater habitats; commonly, though inaccurately, called "aquatic bugs". They include larval and adult aquatic insects, worms, snails, crawdads, etc. They are frequently used to assess water quality in creeks and rivers.

BMIs occupy widely diverse habitats. A sample collection of BMIs can provide information on the health of the watershed, based on the type, abundance, and diversity of BMIs in the sample.

## Why sample/monitor them?

- BMIs are an important part of the food chain found in and around water.
  In most streams, energy stored by plants is available to animals either in the form of leaves that fall in the water or as algae that grows on the stream bottom. The algae and leaves are eaten by BMIs, which are in turn eaten by larger animals such as fish.

- BMIs differ in their sensitivity to water pollution.
  BMIs are very diverse and potentially occupy all kinds of habitats. Some BMIs cannot survive in polluted water, while others thrive in it. In a healthy stream, the BMI community will include a variety of pollution-sensitive BMIs. In an unhealthy stream there may be only a few types of sensitive BMIs or none at all.

- BMIs provide information about the quality of a stream over long periods of time (several months to a year).
  It may be difficult to identify stream pollution with water analysis such as pH and dissolved oxygen that only provide information at the time of sampling. Fish can move away to avoid polluted water and then return when conditions improve. However, most BMIs cannot move to avoid pollution, and some larvae live 3-5 years. A BMI sample may provide information about pollution that is not present at the time of sample collection.

## How do they get oxygen?

Breathing tube (mosquito larvae), take air bubble underwater with them (diving beetle), gills (mayflies and stoneflies), lungs (pouch snail), etc.

## How/what do they eat?

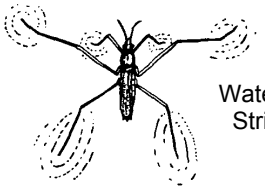
- Shredders = feed on larger plant material in the stream mostly from streamside vegetation (some stonefly larvae, some case-building caddisfly larvae, cranefly larvae, crayfish)
- Scrapers = feed on algae attached to stones, sticks, and other debris, usually in the current. Have a flattened streamlined body that allows them to withstand the current while they browse (some mayfly larvae, some case-building caddisfly larvae, riffle beetles, snails).
- Collectors = feed on decomposing matter that includes animal waste as well as tiny pieces of decaying animals and plants that lived upstream. Two types: 1) 'Filterers' obtain particles by using nets (free-living caddisfly larvae) or hairy appendages (blackfly larvae), and 2) 'Gatherers' eat mostly on the bottom of the stream bed and collect deposits of small dead organic material (some mayfly larvae, some midge larvae).
- Predators = specially adapted bodies to capture live prey. Two types: 1) 'Engulfers' have special jaws to devour whole prey (dragonfly larvae, some stonefly larvae), and 2) 'Piercers' attack their prey by piercing the tissues of the animal and sucking out the fluids (water striders, aquatic beetle larvae).

## Where do they live?

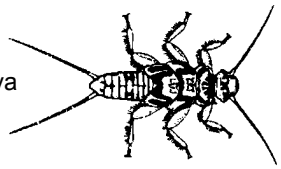
Headwater = mostly shredders and collectors (lots of vegetative cover → lots of leaves → shredders)
Midreach = mostly collectors and scrapers (more light → more algae → scrapers)
Larger rivers = mostly collectors

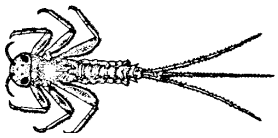
## What pollutants are they sensitive to?

- Excessive sediment
- Excessive nutrients
- Insufficient dissolved oxygen
- Excessively high water temperatures
- Toxics such as pesticides



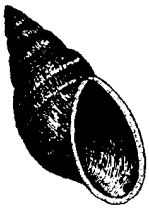
## "Pollution-Sensitive" BMIs*

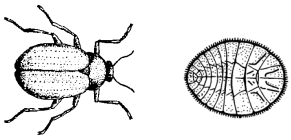

Stonefly larva

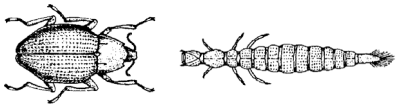

Mayfly larva


Caddisfly larva in case


free-living Caddisfly larva

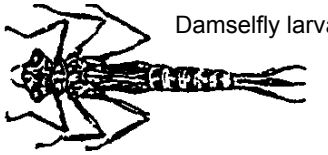

Gilled Snail

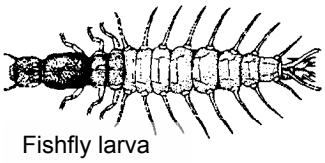

Water Penny adult & larva

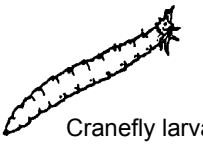

Riffle Beetle adult & larva

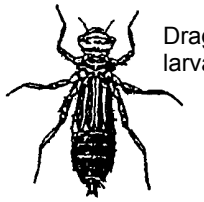
## "Somewhat-Pollution-Tolerant" BMIs*


Clam

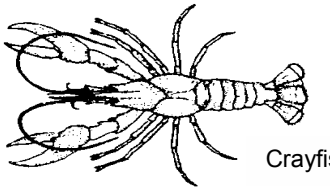

Damselfly larva


Fishfly larva

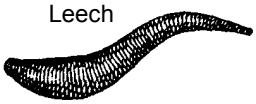

Cranefly larva


Dragonfly larva

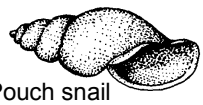

net-spinning Caddisfly larva

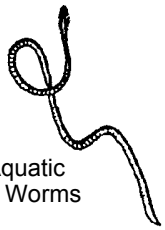

Crayfish

## "Pollution-Tolerant" BMIs*

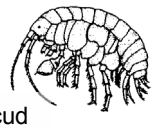

Leech


Black Fly Larva


Pouch snail


Aquatic Worms


Midge larva


Scud

*These are general categories. For instance, in the Pacific Northwest there are roughly 180 species of stoneflies, 150 species of mayflies, and 300 species of caddisflies. With this diversity, some species of these generally sensitive BMIS will tolerate pollution. In addition, some BMIs may tolerate certain pollutants but be sensitive to others.

The drawings are not to scale!