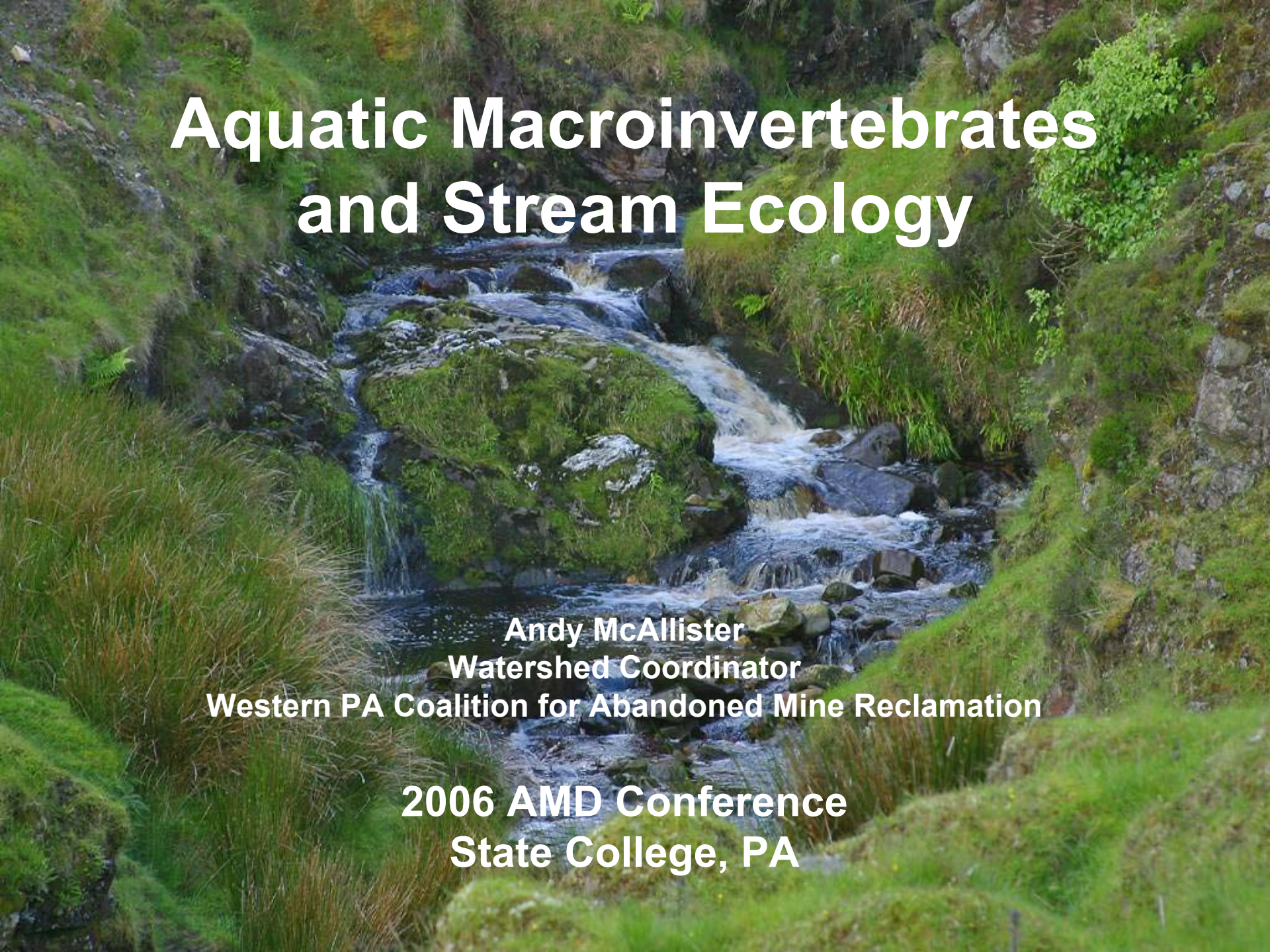

Aquatic Macroinvertebrates and Stream Ecology

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What are macroinvertebrates and why do we use them?

- Larger (≥ 500 microns)
- Invertebrates (animals without backbones)
- Not as mobile as fish
- Fairly easily collected
- Fairly easily identified (at least to Order and often Family)
- Since a large portion (or all) of their life cycle is in the stream, they reflect changes (snapshot vs video)
- Many are sensitive to environmental degradation.

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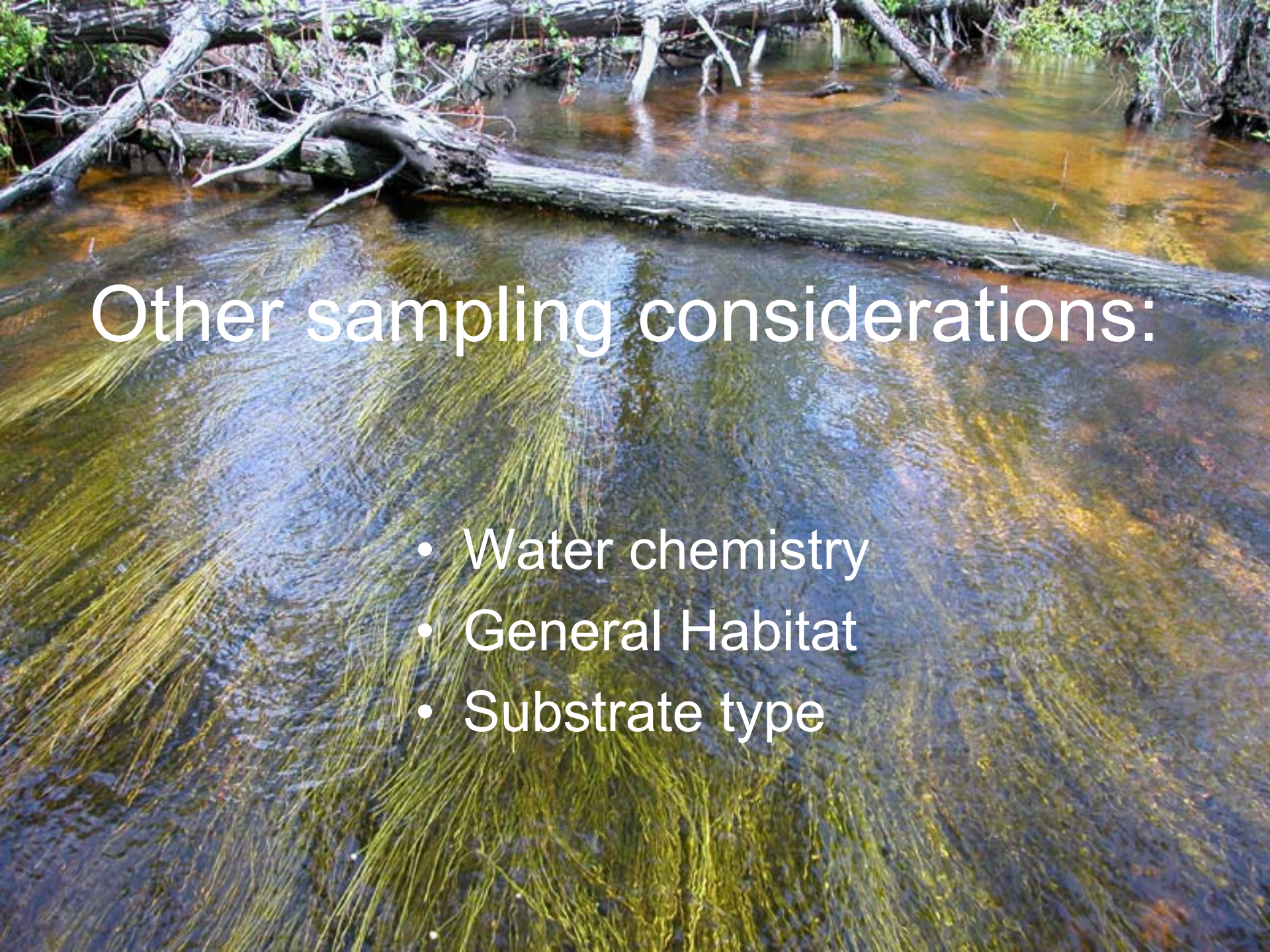
Stream Ecology

- Study of the stream, it's processes, and the relationship of plants and animals (community structures) with the stream.

- Community structures are determined by many factors, such as:
  - Water Quality
  - Food types
  - Habitat/Substrate

Questions

- What do I want to know?
- Will the macroinvertebrates alone give me the answer I’m after?
- What other information will help?
- What will I do with the data?

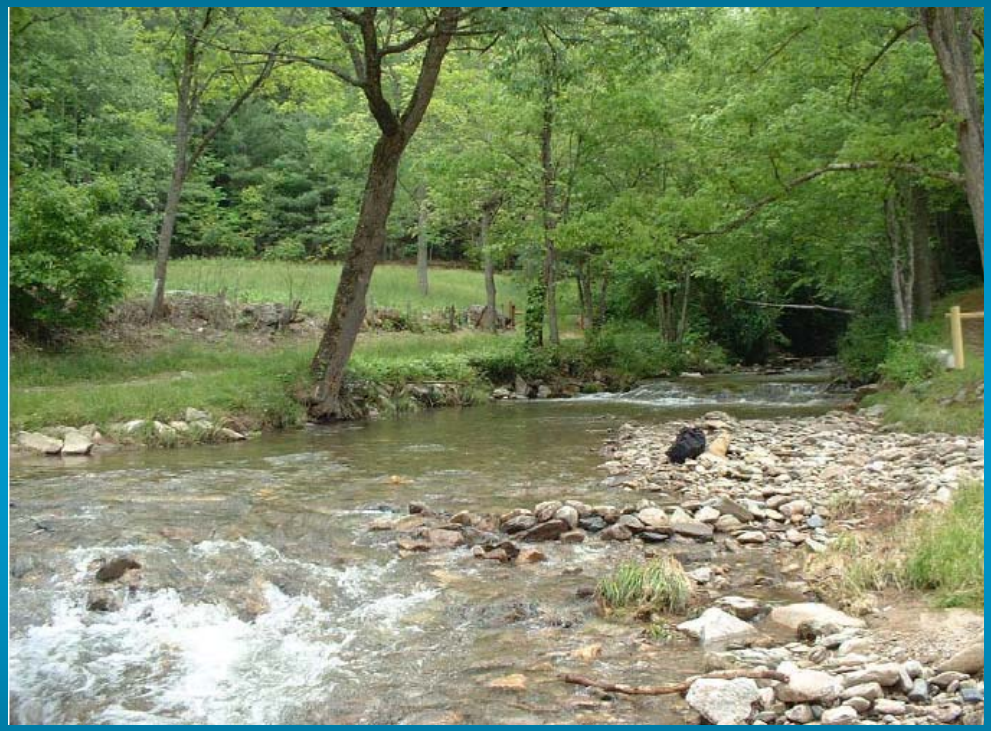


Other sampling considerations:

- Water chemistry
- General Habitat
- Substrate type

Site Selection for Macroinvertebrates

- Choosing the most productive area(s) in your stream.



Productive areas for Macroinvertebrates

- Riffles
- Leaf Packs
- Roots/Bank Habitat
- Soft Sediment

Sampling methodology

- **Kick Net**
  - **Used primarily in streams that are dominated by riffle habitat.**
  - **Usually a 2 person job with one holding the net (aimed upstream) and one kicking/disturbing the substrate just upstream of the net so bugs float into the net.**
  - **Sample is either placed in a pan for picking or put into jar and preserved for later analysis.**

- Dip Net
  - Most often used in streams dominated by soft substrate (sand/silt) and in streams not dominated by riffle. But, can also be used for riffle sampling.
  - A one person job consisting of sweeping or jabbing the selected habitat (bank, roots, or sediment).
  - Sample is then placed into a pan for picking or into a jar and preserved for later analysis.

Macroinvertebrate Taxonomy
(Who's Who)

Kingdom (eg. Animalia)

Phylum/Superphylum (eg. Arthropoda)

Class (eg. Insecta)

Order (eg. Ephemeroptera)

Family (eg. Baetiscidae)

Genus (eg. Baetisca)

Species (eg. lacustris)

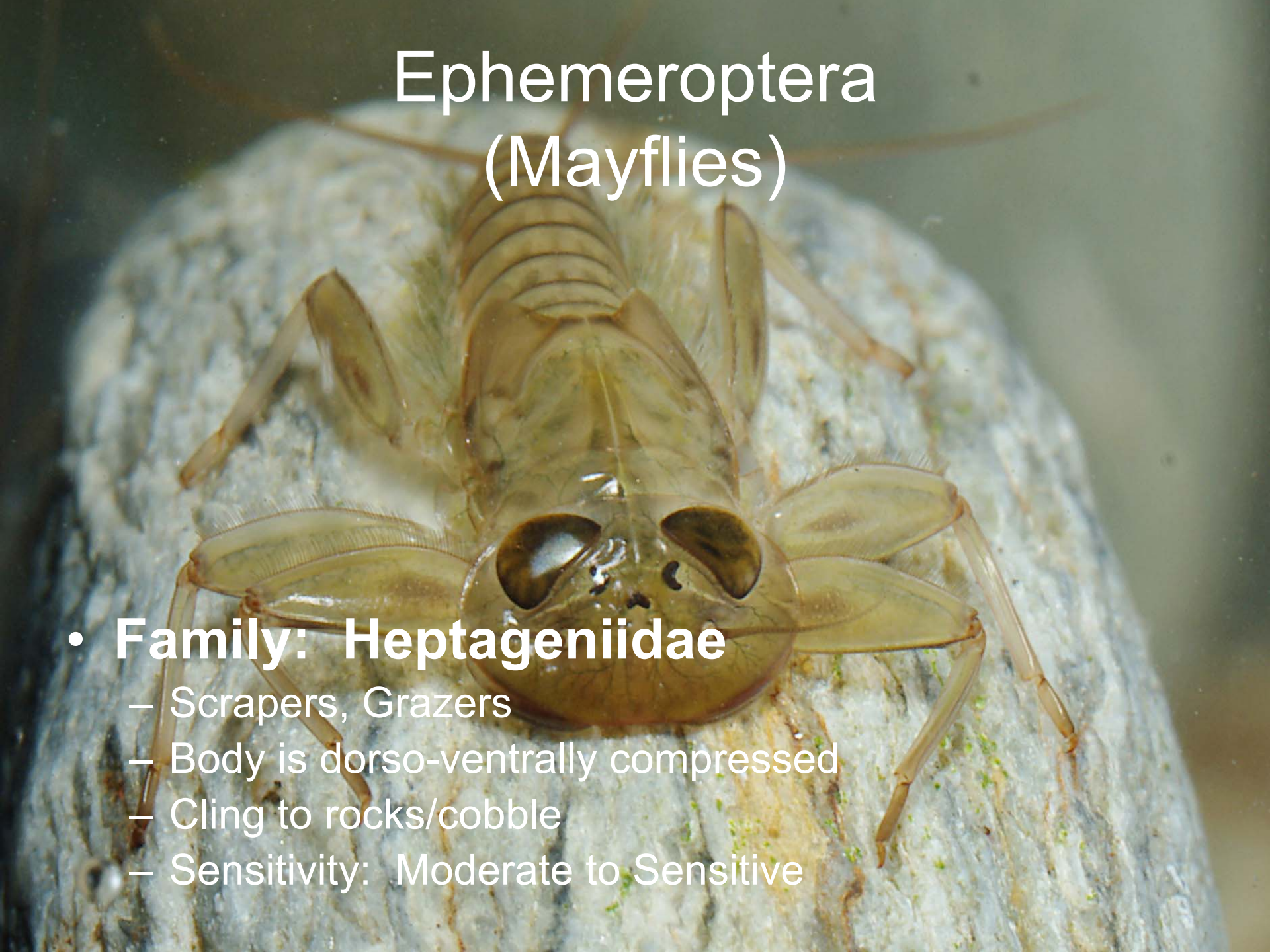
What can I expect to find?

- Mollusca
  snails/clams/mussels
- Crustacea
  crawfish/amphipods/
  isopods
- Insecta
  mayflies/stoneflies/
  caddisflies/dragonflies/
  horseflies/ beetles, etc
- Annelida
  vermiform or “wormy”
  things, leeches, etc

Indicator Organisms

- Animals that, by their presence/absence or abundance, can tell you about their environment.
- Most commonly used sensitive indicator organisms:
  - **E**phemeroptera (Mayflies)
  - **P**lecoptera (Stoneflies)
  - **T**richoptera (Caddisflies)

Ephemeroptera (Mayflies)



- **Family: Heptageniidae**
  - Scrapers, Grazers
  - Body is dorso-ventrally compressed
  - Cling to rocks/cobble
  - Sensitivity: Moderate to Sensitive

Family: Ephemerellidae

- Scrapers,Grazers and Collector/Gatherers
- Body is more cylindrical than heptageniids.
- Abdominal gills separate or can overlap.
- Most live on rocks/cobble/gravel, many readily swim.
- Sensitivity: Generally Sensitive

Mayflies

Family: Baetidae

Collector/Gatherer

Sensitivity: range from tolerant to somewhat sensitive

Substrate type: All

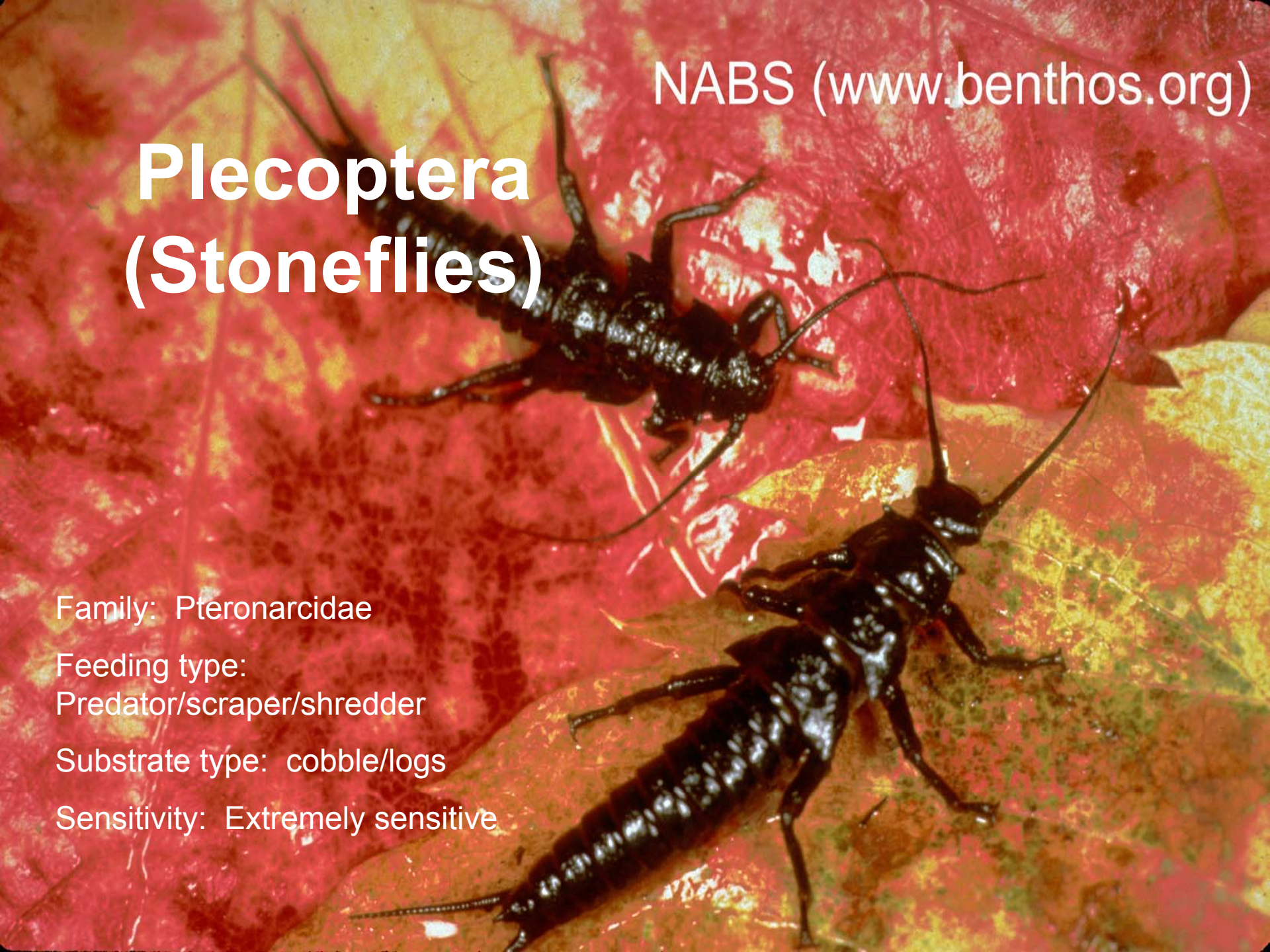
Family: Isonychiidae

Filter feeder

Sensitivity: Somewhat sensitive

Substrate type: rocks/cobble/swift water

Mayfly Adult



Plecoptera (Stoneflies)

Family: Pteronarcidae

Feeding type: Predator/scraper/shredder

Substrate type: cobble/logs

Sensitivity: Extremely sensitive

Family: Perlidae
Feeding type:Predators
Substrate type: cobble
Sensitivity: Sensitive

Trichoptera (Caddisflies)

- Family: Hydropsychidae
  - Common
  - Feathery abdominal gills
  - Net spinners
  - Feeding type: filter feeders
  - Sensitivity: can range from sensitive to moderately sensitive.

- Family: Hydroptilidae (micro caddisflies)

  Hard to see.

  Generally prefer finer substrate

  Feeding type:
  Scrapers/collectors/piercers

  Sensitivity: moderately sensitive

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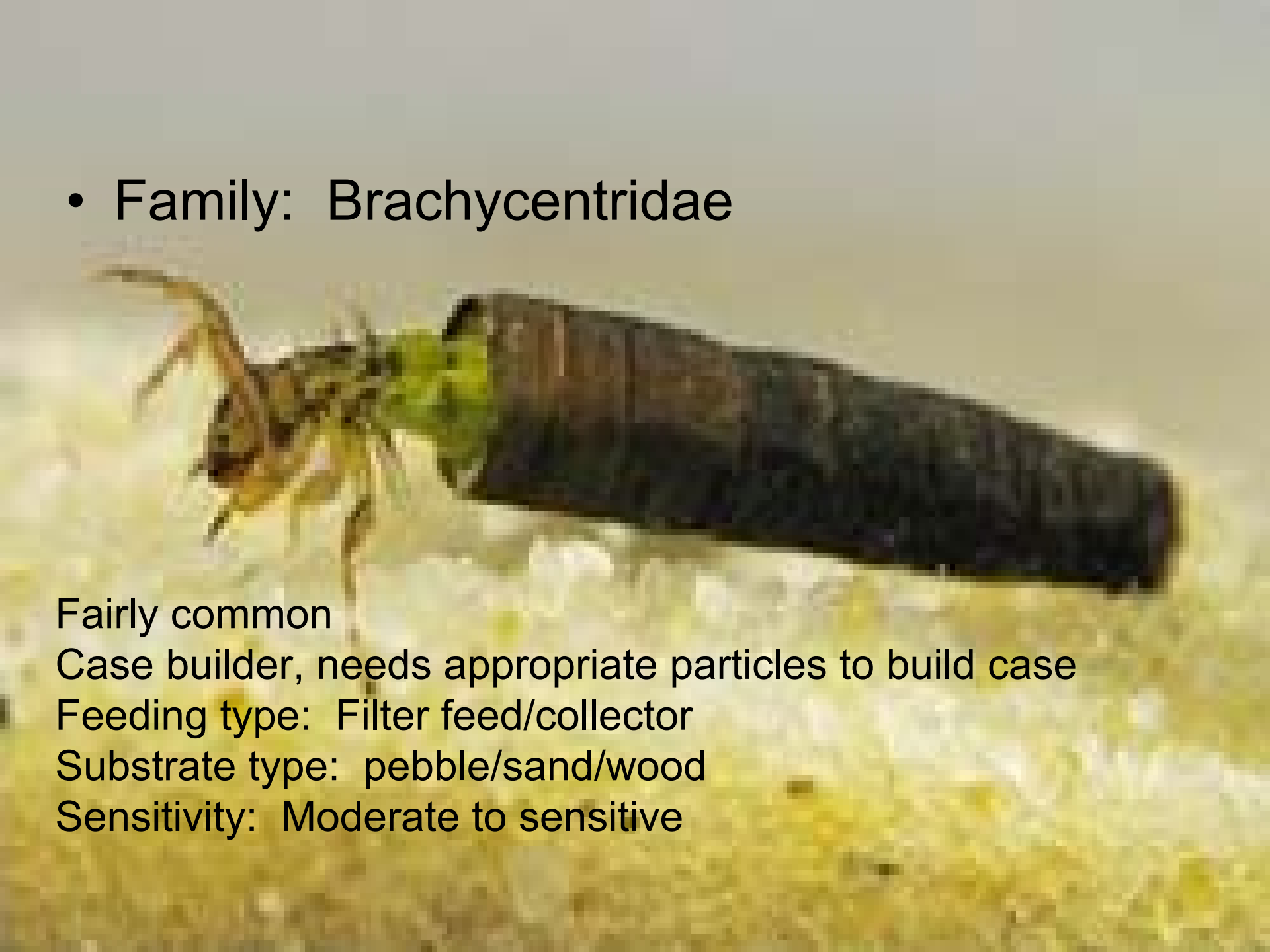
- Family: Brachycentridae



Fairly common
Case builder, needs appropriate particles to build case
Feeding type: Filter feed/collector
Substrate type: pebble/sand/wood
Sensitivity: Moderate to sensitive

Got Data?

- **Data analysis**
  - **Takes on different forms depending on how rigorous your identification.**
  - **Depends on what your known stressors are in the stream.**
  - **Hinges upon on your original question.**

Some Common Types of Analyses

- EPT Index
- Richness (eg. Number of Families/Genera/Species)
- Trophic (feeding) groups
- Percent dominance

EPT Index

The number of:

- Mayfly families
- Stonefly families
- Caddisfly families

The higher the index, the better the stream condition.

Richness

- The higher the number of different kinds of animals, the better the stream.
- Can be calculated on Families, or Genera, or Species

Feeding Groups

- Scrapers
- Shredders
- Collector/Gatherers
- Predators

The proportions of these groups add an extra dimension of understanding to what's going on.

AMD and your bugs

- AMD affects your bug fauna in several ways:
  - The water is too alkaline or too acidic, limiting what species you'll find, if any.
  - The dissolved metals can be toxic to the bugs.
  - The metals that are precipitating are physically smothering the benthic (bottom) habitat so bugs can't live there.

Sedimentation and your bugs

- Sedimentation, whether from AMD or field runoff or erosional areas in the streambank, covers the bottom habitat.
- Sedimentation from soils can be an indicator of higher nutrient levels in the water which can spur rampant algae growth.

Acid Rain and your bugs

- Acidic condition in stream erodes integument.
- Acidic conditions can make toxins such as some metals, more available to the bugs.
- Several species are very sensitive to acidic conditions in the stream.

Nutrients and your bugs

- **Nutrients in and of themselves do not harm the bugs. Rather, they contribute to excessive algae growth which decreases oxygen at night, interferes with bug feeding habits, and coats important habitat.**

The End Product

Taking in all the information about what has happened and addressing it in the “here and now” as a unified “whole”.

Some helpful literature:

- Larken, L.L. **Monitor's Guide to Aquatic Macroinvertebrates.** Isaak Walton League Save Our Streams Program.

- McCafferty, W.P. 1983. **Aquatic Entomology: The Fishermen's and Ecologist's Illustrated Guide to Insects and Their Relatives.** Jones and Bartlett Publishers.
  Technical book directed at the layman. Taxonomy may be out-of-date, but the flow charts for classifying organisms are great.

- Merritt, R.W. and K.W. Cummins. 1996. **An introduction to the aquatic insects of North America (Third Edition)** Kendall/Hunt Publishing Company, Dubuque, IA.
  Technical book. Using this publication requires at least a dissecting microscope and a thorough understanding of aquatic insect morphology. An absolute "must" for the professional.

- Thorp & Covich. 1991. **Ecology and Classification of North American Freshwater Invertebrates.** Academic Press.

- Voshell, J.R. 2002. **A Guide to Common Freshwater Invertebrates of North America.** McDonald & Woodward Pub Co., Blacksburg, VA.
  A good references to see the differences between groups of organisms, but not actually a taxonomic key. Good pictures.