Macroinvertebrates as Bioindicators of Stream Health

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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.

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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

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<tbody>
<tr>
<td><strong>Bacteria:</strong></td>
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<td>13.5</td>
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<td><strong>Plants:</strong></td>
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<td><strong>Carp, suckers, catfish:</strong></td>
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<td><strong>Bass, crappies:</strong></td>
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<td><strong>Snails, clams, mussels:</strong></td>
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<td><strong>Trout, aquatic invertebrates:</strong></td>
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*most mayfly, stonefly, and caddisfly nymphs*
Macroinvertebrate Life Cycle

Aquatic Eggs

Aquatic Larvae

Aquatic Pupae

Terrestrial Winged Adults

**Complete Metamorphosis**

*Ex.* Midge
<table>
<thead>
<tr>
<th>Macroinvertebrate Orders</th>
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<tbody>
<tr>
<td>Ephemeroptera  (Mayfly)</td>
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<tr>
<td>Plecoptera   (Stonelfy)</td>
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<tr>
<td>Trichoptera  (Caddisfly)</td>
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<tr>
<td>Megaloptera  (Dobsonfly / Hellgrammite)</td>
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<td>Coleoptera   (Aquatic Beetles)</td>
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<td>Diptera      (True Flies)</td>
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<td>Odonata      (Dragonfly &amp; Damselfly)</td>
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<td>Pelecypoda   (Clams)</td>
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<td>Gastropoda   (Snails)</td>
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<tr>
<td>Hemiptera    (True Bugs)</td>
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</tbody>
</table>
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.
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

Alderfly (Fishfly)
• Distinct, single tail
• Generally smaller

Group 2 – somewhat pollution tolerant
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)

Aquatic 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

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.