BIOLOGICAL MONITORING

Chapter 5
Habitats
BIOLOGICAL MONITORING

THREE NET SETS

Three microhabitats

TWICE PER YEAR

- Late winter/early spring
- Late summer/early autumn
STREAM HABITATS

Ozark
- Riffles
- Root Mats

Prairie & Lowland
- Root Mats
- Snags & Woody Debris
- Non-flow & Pools
INSTRUCTIONS FOR BIOLOGICAL MONITORING

1. Riffles
2. Root mats
3. Snags
4. Non-flow
Habitats

Methods

Macroinvertebrates

Sensitive ID

Somewhat Tolerant ID

Tolerant ID

North Fork of the White River, DNR photo
Sampling Methods

- Riffle
- Root Mat
- Snag
- Non-flow
1. Place net in riffle
2. Ensure bottom of net is on stream bottom
3. Weigh down bottom of net with large rocks
4. Remove and rub large rocks over net, then set aside.
5. Do the *Benthic Boogie* in 3’x3’ area, disturbing substrate 3-6” deep
6. Rub and remove large rocks from net
7. Slowly lift net from stream, ensuring water does not pour over sides
8. Move to land to pick and sort invertebrates from net
STREAM HABITATS

**Ozark Streams**
- Riffles
- Root Mats

**Prairie & Lowland Streams**
- Root Mats
- Snags/Woody Debris
- Non-Flow

Habitats Methods Macroinvertebrates Sensitive ID Somewhat Tolerant ID Tolerant ID
Root Mats

**Root Mat** - Matted roots of vegetation hanging into the water or growing out of the streambank.
ROOT MATS

Root Mat - Matted roots of vegetation hanging into the water or growing out of stream bank
ROOT HAIRS

MDC Photo
1. Place net under root mat
2. Kick and swirl the water to dislodge the invertebrates from the root mat into the net
3. Slowly lift net from stream, ensuring water does not pour over sides
4. Move net to land to pick and sort invertebrates
STREAM HABITATS

Ozark Streams
- Riffles
- Root Mats

Prairie & Lowland Streams
- Root Mats
- Snags/Woody Debris
- Non-Flow
Snag – Woody debris such as tree limbs, logs, and sticks that have fallen in water and started to decay.
LARGE WOODY DEBRIS, SNAG

Habitats
Methods
Macroinvertebrates
Sensitive ID
Somewhat Tolerant ID
Tolerant ID
1. Place net under woody debris
2. Use a brush to scrub woody debris
3. Move net to land to pick and sort invertebrates
STREAM HABITATS

Ozark Streams
- Riffles
- Root Mats

Prairie & Lowland Streams
- Root Mats
- Snags/Woody Debris
- Non-Flow

Habitats
Methods
Macroinvertebrates
Sensitive ID
Somewhat Tolerant ID
Tolerant ID
1. Shuffle feet while moving backward and sweeping D-net through water
2. Empty net contents into sorting tray on land
3. Pick and sort invertebrates
# MACROINVERTEBRATE DATA SHEET

Please check the box next to the “Site #” if this is a new site and please be sure to attach a map. (PLEASE PRINT)

- Site #
- Stream
- County
- Site Location:
- Date:
- Time (military time):
- Rainfall (inches in last 7 days):
- Water Temp. (°C):
- Trained Data Submitter (responsible volunteer):
- Stream Team Number:
- Participants:

## Invertebrate Type

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Net Set #1</th>
<th>Net Set #2</th>
<th>Net Set #3</th>
<th>Score</th>
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<tbody>
<tr>
<td></td>
<td>Kick Net or D-Net</td>
<td>Kick Net or D-Net</td>
<td>Kick Net or D-Net</td>
<td></td>
</tr>
</tbody>
</table>

After entering the number(s) of organisms collected, circle the number below for every type of organism collected. Add the numbers circled and record the totals as your Water Quality Rating.

## Sensitive

<table>
<thead>
<tr>
<th>Organism Type</th>
<th># of Organisms</th>
<th># of Organisms</th>
<th># of Organisms</th>
<th>Circle Types Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caddisfly Larvae</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hellgrammites</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Mayfly Nymphs</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gilled Snails (right)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riffle Beetles</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stonedly Nymphs</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Penny Larvae</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

## Somewhat Tolerant

<table>
<thead>
<tr>
<th>Organism Type</th>
<th># of Organisms</th>
<th># of Organisms</th>
<th># of Organisms</th>
<th>Circle Types Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Beetle Larvae</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clams/Mussels</td>
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<tr>
<td>Crane Fly Larvae</td>
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</tr>
<tr>
<td>Crayfish</td>
<td>2</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Dragonfly Nymphs</td>
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</tr>
<tr>
<td>Damsel Fly Nymphs</td>
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<td></td>
</tr>
<tr>
<td>Scuds</td>
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<td></td>
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</tr>
<tr>
<td>Sowbugs</td>
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<tr>
<td>Fishfly Larvae</td>
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<tr>
<td>Alderfly Larvae</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Watersnipe Fly</td>
<td>2</td>
<td></td>
<td></td>
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## Tolerant

<table>
<thead>
<tr>
<th>Organism Type</th>
<th># of Organisms</th>
<th># of Organisms</th>
<th># of Organisms</th>
<th>Circle Types Present</th>
</tr>
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<tbody>
<tr>
<td>Aquatic Worms</td>
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<td>Black Fly Larvae</td>
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<tr>
<td>Leechees</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Midge Larvae</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posuch Snails (left)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Snails (flat)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Water Quality Rating

- < 12 = Poor
- 12-17 = Fair
- 18-23 = Good
- > 23 = Excellent

Comments (mention any changes from your usual readings):

Fish Present (Please Mark) Yes or No

Water Quality Rating: Excellent
Instructions for Biological Monitoring

- Collect three net sets of invertebrates from three different microhabitats. This ensures a more complete picture of what lives in your stream and more accurately reflects health. Adequate sampling requires two people and the use of a kick net. If sampling by yourself, a D-frame net may be needed.
- If possible, take all three net sets from different areas within a stable riffle. Microhabitats to sample include differences in: rock size, flow, leaf packs and emergent vegetation.
- Be sure to note which type of net you use to sample; kick net or D-frame net.
- Always work in an upstream direction so sampling activities do not disturb portions of the riffle to be sampled later.
- If, and only if, you do not have enough riffle habitat with in your 300 ft. sampling site to collect three net sets, you may also want to sample alternative microhabitats.
  - Prioritize sampling of habitat types as follows:
    - Riffle
    - Root mat
    - Snags
    - Non-flow
  - Whatever habitats you decide to sample at your site (e.g., two riffle net sets and one root mat), always sample those same three habitats at the site every time you sample there and list the habitat type for each sample. This will ensure that the data you collect remains consistent over time.

Sampling Streams With Riffles

Adequate sampling requires two people, one to hold the net and the other to dislodge invertebrates from the substrate.
1. Place the net in the riffle facing upstream, and tilt it enough to provide a “pocket”.
2. Ensure the bottom of the net is on the stream bottom leaving no room between the net and the substrate. This prevents organisms from washing under the net.
3. Rub all large stones in the 3-foot by 3-foot (3’x3’1”) area immediately upstream of the net to dislodge invertebrates and wash them into the net.
4. “Douse and Kick” with your feet in the 3’x3’ area until you have disturbed all the substrate 3 inches to 6 inches deep to dislodge the invertebrates into the net.

Streams Without Riffles (or without riffles large enough for 3 net sets)

Sample Collection from Root Mats - Adequate sampling requires two people.
1. Have one person place the side of the kick net against the bank on the downstream side of the root mat.
2. Make sure that the net is anchored to the stream bed.
3. The other person will then kick the root mat in a swirling motion with one foot to create a circular current in order to dislodge the invertebrates from the root mat. The circular motion of the sampler's foot will drive the invertebrates into the net, even if there is no current.

Sample Collection from Snags - Adequate sampling requires two people.
1. Have one person hold the net horizontal position about 6-12 inches under the water.
2. The 2nd volunteer will remove the snag from the water. When removing the snag from the water pull the snag out of the water quickly. If the snag is removed too slowly, the invertebrates may swim off.
3. Brush the snag down with a brush above the net to dislodge invertebrates.
4. Sample approximately 3-5 snags for one net set.

Sample non-flow areas in the same manner as a riffle, collecting three separate samples. However, the sampler will need to use a swirling motion with the foot to create a current to move debris into the net. Although this habitat can be sampled using a kick net, it is easier with a D-frame net. If using a D-frame net, you will need to disturb the substrate and sweep the net in a circular motion over the disturbed substrate to collect the organisms. Be sure to run two passes with the D-frame net to equal one net set.

PLEASE KEEP A COPY AND SEND ORIGINAL DATA TO:

Stream Team Coordinator/Water Protection Program
Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Volunteer Monitoring - 07/15
MACROINVERTEBRATES

Spend up to 99% of their lives in the water as nymphs or larvae
INCOMPLETE METAMORPHOSIS (NYMPHS)

- Ephemeroptera (mayflies)
- Plecoptera (stoneflies)
- Odonata (dragon flies and damselflies)
- Hemiptera (backswimmers - water boatmen)

Drawing from McCafferty: *Aquatic Entomology*
Trichoptera (caddisflies)

Coleoptera (water pennies, riffle beetles)

Diptera (crane flies, black flies, midges, watersnipe flies)

Megaloptera (dobsonflies/hellgrammites, alderflies, fishflies)

Neuroptera (spongillaflies)

Lepidoptera (aquatic caterpillars and moths)

Drawing from McCafferty: *Aquatic Entomology*
Morphology = “The biological study of form, shape and structure of living organisms”
THE BLUE BUG CARD

- A visual key
- Utilizes a size bar
- Help match organism to drawings
- Similar to “field guide approach”
INVERTEBRATE ID
POLLUTION SENSITIVE
Save Our Streams
MAYFLY NYMPHS

Characteristics of MAYFLIES (Order Ephemeroptera):
- One hook (claw) at the end of each leg
- Three pairs of segmented legs on the middle part of the body
- Plate-like or feathery gills on the side of the abdomen
- Wing pads on the middle part of the body
- 2 or 3 tails on abdomen

Examples of Common MAYFLY Families (Order Ephemeroptera) in Freshwater Rivers:
- Baeticidae
- Heptageniidae
- Leptophlebiidae
- Baeotidae
- Heptageniidae
- Leptophlebiidae
- Baetidae
- Ephemeroptera
- Potamanthidae
- Tricorythidae

Habitats | Methods | Macroinvertebrates | Sensitive ID | Somewhat Tolerant ID | Tolerant ID
MAYFLY NYMPHS

- Feathery or plate-like gills on abdomen
- Usually three tails
- Six legs each ending in one hook

NABS Photos
MAYFLY NYMPHS

NABS Photos
MAYFLY ADULT

- Short lived

- No functioning mouth parts

Habitats
Methods
Macroinvertebrates
Sensitive ID
Somewhat Tolerant ID
Tolerant ID

NABS Photos
BLUE BUG CARD
(STONEFLY NYMPHs)

Stream Insects & Crustaceans

GROUP ONE TAXA

1. Slightly longer, Order Plecoptera. 10" - 1 1/2". Sides with yellow tinge. 2 black tails. Sensitive ID. Tolerant ID. May have wings in forest under low light.

2. Caddisfly larvae. Order Trichoptera. Up to 1". 1 large or 3, 2 black dots of each side of abdomen. May be in a silk, rock, or leaf case with its head shaking. May have tiny gift to the lower half.

3. Mud skipper. Order Ephemeroptera. 1/8" - 1/2". Inner, moving plate, or feathers glued on abdomen. 2 large hooked legs anteriorly, 2 or 3, long, hunchback tails. Tails may be walked together.


6. Gilled fly. Order Diptera. Black, spiny, covered by the plate called opisthosoma, wings pointed up, and spiny fan-like pons, the shell comes in right. Do not count eggs, adults.

7. Unidentified burrowing fly. Family Sciaridae. 1/8" - 1/4". Insects. Dark, hanging, green. Lighter colored wings or lower half of body with fine plant collection. Gills along undersides of dorsal filaments, 2 or 3 pairs of spots or back end.

GROUP TWO TAXA


Save Our Streams
STONEFLY NYMPHs

Characteristics of STONEFLIES (Order PLECOPTERA)

- Three pairs of segmented legs on the middle part of the body.
- 2 hooks (claws) at the end of each leg.
- Wing pads often on the body.
- No gills on the side of the abdomen or, if present, are filament-like.
- 2 tails on abdomen.

“Hairy armpits”

Examples of Common STONEFLY Families (Order PLECOPTERA) in Earthwater Rivers.

- Hemoperleidae
- Chryoperleidae
- Perlidae
- Perlodidae
- Petaluridae
- Not in Missouri

River Watch Network 1/1/93

Habitats - Methods - Macroinvertebrates - Sensitive ID - Somewhat Tolerant ID - Tolerant ID
STONEFLY NYMPHS

- No gills on the abdomen – may have gills on thorax
- Usually two tails
STONEFLY ADULTS

- Not very strong fliers
- Spends most of time in streamside vegetation
BLUE BUG CARD
(CADDISFLY LARVAE)

Stream Insects & Crustaceans

GROUP ONE TAXA
Some sensitive organisms found in good quality streams:

1. Tanytarsus nymph, Order Ephemeroptera, 10’ - 1.5’.
- 3 legs with rounded tips, 2 halteres. Terminal pro-legs in abdomen (true anal). May leave gills or thorax anterior to the legs.

2. Hexagenia nymph, Order Plecopteran, Up to 1’
- 3 legs on thorax. 2 hooks at end of abdomen. May be in a rock, root, crevice, or on reed, sticking out. May have bulky gills on lower half of thorax.

3. Mayfly nymph, Order Ephemeroptera, 1” - 1.5’
- Throat, thoracic pleurae, and coxae yellow on abdomen near anus. Long hooked legs, antennae 2 or 3 long, white, hair-like. May be washed together.

4. Water Striders, Order Coleoptera, Adult, 1’
- 6 legged, blue, muscle visible on the bottom. Larvae: Even length of body covered with hard, thick, 5 legs on thorax, orange, brown color. Contains number of adults & larvae when opening tail part.

5. Callibaetis, Order Odonata, Adult, 1”
- Body opening covered by the gills. A pair of proboscis. When protected by the gills opening forms, so the larvae are safe. May not eat many fish.

GROUP TWO TAXA
Some tolerant or resistant organisms found in good quality streams:

6. Oligochaete, Order Naididae, 1” - 2’
- Large eyes, 5 forked legs, White root in need of abdomen, consistent body length.

7. Trichoptera, Order Plecopteran, 1” - 3”
- Gray or brown, body weight in the high to 4 or 5 legs, thin, antennae, looks like a small worm.

Save Our Streams
“Mmm, Cream Filled!”
CADDISFLY LARVAE

Examples of Common CADDISFLY Families (Order TRICHOPTERA) in Freshwater Rivers

Netspinners

HYDROPSYCHIDAE
PHILOPOTAMIDAE
POLYCENTROIDAE

Freeliving

RHYACOPHILIDAE
Casebuilders

LIMNEPHILIDAE

Examples of Common CADDISFLY Families (Order TRICHOPTERA) in Freshwater Rivers

Casebuilders

LEPTOPTERIDAE
BRACHYCENTRIDAE
GLOSSOSOMATIDAE

HELICOPHYIDAE
ODONTOCRISTIDAE
PHYGARIDAE

MOLANNIDAE
LEPTOCRISTIDAE
HYDROPTERIDAE

Habitats  Methods  Macroinvertebrates  Sensitive ID  Somewhat Tolerant ID  Tolerant ID
CADDISFLY LARVAE

- **Thorax** – “crunchy”
- **Abdomen** – “cream-filled”
- May have gills
- **Two hooks on abdomen**
CADDISFLY LARVAE
(FREE LIVING)
CADDISFLY LARVAE
(NET SPINNING)

NABS Photos
CADDISFLY LARVAE
(CASE-BUILDERS)

NABS Photos

MDC Photos

Habitats Methods Macroinvertebrates Sensitive ID Somewhat Tolerant ID Tolerant ID
WATER PENNY

- Flat like a penny
- Saucer shaped
- Segmented
- Legs underneath

![MDC Photo]
Gilled Snails

- When holding the snail with the point up and the opening facing you, the shell opens to the right.

- **DO NOT COUNT EMPTY SHELLS**
Larvae have six legs and covered with hard plates over entire length of body.

Adult is tiny aquatic beetle, has six legs.
Often confused with caddisfly larvae or midge fly larvae

Covered with hard plates over entire length of body

Six legs
Aquatic as an adult

Six legs

On data sheet, combine # of adult and larval riffle beetles!
DOBSONFLY LARVAE
(HELLGRAMMITE)

- Up to 4 inches long (see size bar)
- Gills under abdominal filaments!
- Large mandibles
DOBSONFLY LARVAE
(HELLGRAMMITE)

- Gills under the abdominal lateral filaments
- Large mandibles
DOBSONFLY PUPA

Photo courtesy of J. Abbott, U of Texas
INVERTEBRATE ID
SOMEWHA T P O L U T I O N T O L E R A N T
CRAYFISH

Looks like a small lobster

MDC Photos
SOW BUG

- Looks like a “roly poly”
- Flattened “top to bottom”
SCUD

- Swim sideways
- Many appendages on abdomen
- Flattened “side to side”
- Often mistaken for freshwater shrimp
ALDERFLY LARVAE

- Lateral filaments
- No visible gills
- One long hair-like tail
- Tail filaments may resemble capital letter “A”

Photo courtesy of J. Abbott, U of Texas

NABS Photo
ALDERFLY ADULT
FISHFLY LARVAE

- Similar to dobsonfly larvae
  - Lateral filaments
  - Mandibles
  - Generally smaller

- No visible gills on abdomen!

- Breathing tubes

Habitats  Methods  Macroinvertebrates  Sensitive ID  Somewhat Tolerant ID  Tolerant ID

MDC Photos
FISHFLY ADULT

NABS (www.benthos.org)
Six spindly legs

Long, slender body

Three broad oar-shaped tails

Positions like a tripod when in water
DAMSELFLY ADULTS

Photo Courtesy of B. Blake

MDC Photo
DAMSELFLY ADULTS

(MATING)

NABS Photo
DRAGONFLY NYMPHS

- Six legs
- Wide, oval to round abdomen
- Large eyes
- Scoop-like lower labium

Habitats
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Macroinvertebrates
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Somewhat Tolerant ID
Tolerant ID

MDC Photo
NABS Photo
WATERSNIPE FLY LARVAE

Caterpillar like

Two feathery “horns” on end of abdomen
WATERSNIPE FLY ADULT

Wiki Commons
CRANE FLY LARVAE

- Caterpillar like
- Up to 4” long
- May have enlarged lobe or fleshly finger like extensions at end of abdomen

Habitats
Methods
Macroinvertebrates
Sensitive ID
Somewhat Tolerant ID
Tolerant ID

MDC Photo
CRANE FLY ADULT

MDC Photo
**“OTHER” BEETLE LARVAE**

- Six legs
- Obvious mouth parts
- Diverse group
- Process of elimination

<table>
<thead>
<tr>
<th>Habitats</th>
<th>Methods</th>
<th>Macroinvertebrates</th>
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<th>Somewhat Tolerant ID</th>
<th>Tolerant ID</th>
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</tbody>
</table>

NABS Photo

15
MUSSELS AND CLAMS

- >70% of species threatened or endangered
- Count and put back hinge side up
- DO NOT COUNT EMPTY SHELLS

Photo by Dr. Chris Barnhart, Missouri State University
INVERTEBRATE ID
POLLUTION TOLERANT
AQUATIC WORMS

Aquatic earthworms

Horsehair worms
MIDGE FLY LARVAE

- No jointed legs
- Prolegs behind head and end of abdomen
- Very small (<1/4")

NABS Photo
Swollen abdomen ("fat butt") for attachment

Fan-like projections on head for filtering

Very small

Habitats  Methods  Macroinvertebrates  Sensitive ID  Somewhat Tolerant ID  Tolerant ID
BLACK FLY ADULT

NABS Photo
Muscular

Suction disks on both head and end of abdomen

LEECHES

NABS Photo

Photo by Jim Rathert, MDC
When holding the snail and the point up, the shell opens to the left.

- **DO NOT COUNT EMPTY SHELLS**
OTHER SNAILS

- Has no spiral point
- Flat/pond snails or limpets
- **DO NOT COUNT EMPTY SHELLS**

MDC Photos
A SAMPLE PICTURE KEY

A Simple Picture Key:
Major Groups of Benthic Macroinvertebrates
Commonly Found In Freshwater New England Streams

Prepared by:
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January 18, 1993

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from W. Patrick McCafferty
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Jones & Bartlett Publishers, 1983
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