The purpose of this taxonomic key is to assist volunteer monitors, who are not trained in taxonomy, with the identification of benthic macroinvertebrates found in Indiana. This key is a simplified version of more complex keys. The taxonomic level of this key is intended for use by citizen monitoring groups. When using this key please note that each couplet offers two or three options. Each couplet is numbered and the numbers in bold refer to the next couplet (the next set of numbers that you proceed to).

Please be aware that some macroinvertebrates may have missing body parts so you should look at more than one organism!

**CHOSE ONE:**

(1)a Has a shell(s)  
(1)b Has no shell

(2)a Has a hinged double shell  
(2)b Has a single shell

(3)a Adult under 2 inches long  
(3)b About 2-4 inches long

(4)a Right-handed opening  
(4)b Left-hand opening

**GO BELOW TO:**

2  
5  
3  
4  
19  
MUSSEL  
RIGHT-HANDED SNAIL  
LEFT-HANDED SNAIL
**CHOOSE ONE:**

(5)a Has a segmented body or looks like a tiny tick

(5)b Has an unsegmented body and has an "arrow shaped" head; 2 pigment spots (eyes)

**GO BELOW TO:**

(6)a No obvious legs

(6)b Obvious legs

(7)a Has no obvious appendages (long, tubular body)

(7)b Has some appendages (small tubes, tiny bumps, or feathery structures)

(8)a Has a smooth body and suckers

(8)b Has a round body and a rat tail

(8)c Has a rounded body

**PLANARIA**

Planaria

**LEECH**

Leech

**LEECH**

Leech

**RAT-TAILED MAGGOT**

Rat-Tailed Maggot

**AQUATIC WORMS**

Aquatic Worms

**CRANE FLY LARVA**

Crane Fly Larva

**CRANE FLY LARVA**

Crane Fly Larva

**BLACK FLY LARVA**

Black Fly Larva

**BLACK FLY LARVA**

Black Fly Larva
**CHOOSE ONE:**

(10)b No difference in diameter along body

(11)a Bright red body

(11)b Grey Body

(12)a Has four pairs of legs

(12)b Has three pairs of legs

(12)c Has many pairs of legs

(13)a Has no wings or short wing pads on back

(13)b Has two pairs of wings that cover the abdomen

(14)a Has a flat, round body with legs underneath (wings are not obvious)

(14)b Not flat, has long body with legs

(15)a Lives in a tube or a case or has two hooks in its last segment and is green with 3 plates on back behind head. (The "green caddisfly" builds a net & tube, but will be washed into the kick net as "free living")

(15)b Free-living

**GO BELOW TO:**

11

BLOOD MIDGES

OTHER MIDGES

WATER MITE

13

WATER PENNY BEETLE LARVA

15

CADDISLY LARVA

16
CHOOSE ONE:

(16)a Abdomen possesses lateral filaments similar in size to legs

(16)b Abdomen does not have "leg-like" filaments (may have feathery "gills")

GO BELOW TO:

21

STONEFLY NYMPH

(17)a Always with only two tail appendages and no abdominal gills

STONEFLY NYMPH

(17)b Usually has three tail appendages, and with no lateral gills on abdominal segments

18

(17)c Tail has no appendages

25

(18)a Has long, bristle-like tail appendages, sometimes 2 or 3

MAYFLY NYMPH

(18)b Lower lip formed into extensible scoop-like structure and has leaf-like tail appendages

DAMSELFLY NYMPH

(19)a Small rounded shell (< 2 inches)

20

(19)b Small triangular shell with alternating cream and dark brown bands

ZEBRA MUSSEL (EXOTIC)

(20)a Numerous very fine concentric rows of elevated lines, white or cream colored, with smooth lateral teeth (ridge lines on inside near point)

FINGERNAIL CLAM

(20)b Numerous concentric elevated ridges, yellowish brown to black shell with serrated lateral teeth

ASIATIC CLAM (EXOTIC)
**CHOOSE ONE:**

(21)a Head narrower than widest body segments

(21)b Head as wide or wider than other body segments

(22)a Abdomen with single long filament at end

(22)b Abdomen ending with a pair of tiny hooked legs, large head with pincer-like jaws

(23)a Oval shaped body, legs with feathery swimming hairs

(23)b All legs smooth, without hairs, crawling

(25)a Lower lip formed into scoop like structure

(25)b Looks like a tiny millipede

(26)a Flattened top to bottom, crawling looks like "roly-poly" or a "pill bug"

(26)b Flattened side to side, swimming looks like tiny shrimp

**GO BELOW TO:**

BEETLE LARVA

22

ALDERFLY

DOBSONFLY OR FISHFLY

ADULT WATER BUGS AND WATER BEETLES

RIFFLE BEETLE ADULT

DRAGONFLY NYMPH

RIFFLE BEETLE LARVA

SOWBUG

SCUD
Key to Macroinvertebrate Life in the River

Sizes of illustrations are not proportional.

No Shells

Lungs

With Tentacles, Brush-like "Tails"

No Wings

Worm-like

Microscopic

No Obvious "Tails"

One or Two "Tails"

Three "Tails"

Ctenophora or "Mnemiopsis"

Crustacean, segmented body, no suckers

No Shells
# How to Complete the Biological Monitoring Data Sheet

The first portion of the Biological Monitoring Data Sheet is the information section. For instructions on how to complete this section, see pages 108-111 in Chapter 7 Data Reporting.

## Sampling Procedures

Equipment: Check one or both of the nets used to collect macroinvertebrates sample.

Habitat: Check each type of habitat sampled during this survey.

## Pollution Tolerance Index

The macroinvertebrate index is divided into Pollution Tolerance Groups (PT Group) 1, 2, 3 and 4. These PT groups represent the different levels of pollution tolerance. The higher the group number, the higher the pollution tolerance level. Record the number of macroinvertebrates you find here.

<table>
<thead>
<tr>
<th>PT GROUP 1</th>
<th>PT GROUP 2</th>
<th>PT GROUP 3</th>
<th>PT GROUP 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intolerant</td>
<td>Moderately Intolerant</td>
<td>Fairly Tolerant</td>
<td>Very Tolerant</td>
</tr>
<tr>
<td>Stonefly Nymph</td>
<td>6</td>
<td>Damselfly Nymph</td>
<td>Midge Larvae</td>
</tr>
<tr>
<td>Mayfly Nymph</td>
<td>5</td>
<td>Dragonfly Nymph</td>
<td>Black Fly Larvae</td>
</tr>
<tr>
<td>Caddis Fly Larvae</td>
<td>10</td>
<td>Sowbug</td>
<td>Planaria</td>
</tr>
<tr>
<td>Dobsonfly Larvae</td>
<td></td>
<td>Scud</td>
<td>Leech</td>
</tr>
<tr>
<td>Riffle Beetle</td>
<td></td>
<td>Crane Fly Larvae</td>
<td></td>
</tr>
<tr>
<td>Water Penny</td>
<td>30</td>
<td>Clams/Mussels</td>
<td></td>
</tr>
<tr>
<td>Right-Handed Snail</td>
<td></td>
<td>Crayfish</td>
<td></td>
</tr>
</tbody>
</table>

The next row is the # of Taxa. Insects that have the same body shape all belong to the same taxa (see the back of your PTI macroinvertebrate data sheet for general body shape/taxa). To find the total number of taxa for each PT Group you need to add the number of types of organisms. It is possible to have a particular PT group without any numbers, therefore it will score a zero.

**Do not make the mistake of adding the numbers of organisms together.**

<table>
<thead>
<tr>
<th># of TAXA</th>
<th># of TAXA</th>
<th># of TAXA</th>
<th># of TAXA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

The next row is the group scores. Multiply each # of taxa by its weighting factor.

<table>
<thead>
<tr>
<th># of TAXA</th>
<th># of TAXA</th>
<th># of TAXA</th>
<th># of TAXA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Weighting Factors:**

<table>
<thead>
<tr>
<th># of TAXA</th>
<th># of TAXA</th>
<th># of TAXA</th>
<th># of TAXA</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: The Volunteer Stream Monitoring Internet Database (described in Chapter 7) will perform these calculations for you when you submit data.
Other Biological Indicators

Check the appropriate box if you find native mussels, zebra mussels, rusty crayfish or submerged aquatic plants at your site. Estimate the percentage of rocks or the stream bottom covered by algae at your site. Write your Diversity Index score if you perform the procedures described on pages 95-96.

Other Biological Indicators

- Native Mussels
- Zebra Mussels
- Rusty Crayfish
- Aquatic Plants

Diversity Index Score

25 % Algae Cover
0.75

Example of a complete Pollution Tolerance Index:

**Pollution Tolerance Index (PTI)**

<table>
<thead>
<tr>
<th>PT GROUP 1</th>
<th>PT GROUP 2</th>
<th>PT GROUP 3</th>
<th>PT GROUP 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intolerant</strong></td>
<td><strong>Moderately Intolerant</strong></td>
<td><strong>Fairly Tolerant</strong></td>
<td><strong>Very Tolerant</strong></td>
</tr>
<tr>
<td>Stonefly Nymph</td>
<td>Damselfly Nymph</td>
<td>Midge Larvae</td>
<td>Left-Handed Snail</td>
</tr>
<tr>
<td>Mayfly Nymph</td>
<td>Dragonfly Nymph</td>
<td>Black Fly Larvae</td>
<td>Aquatic Worms</td>
</tr>
<tr>
<td>Caddis Fly Larvae</td>
<td>Sowbug</td>
<td>Planaria</td>
<td>Blood Midge</td>
</tr>
<tr>
<td>Dobsonfly Larvae</td>
<td>Scud</td>
<td>Leech</td>
<td>Rat-tailed Maggot</td>
</tr>
<tr>
<td>Riffle Beetle</td>
<td>Crane Fly Larvae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Penny</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right-Handed Snail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of TAXA</td>
<td># of TAXA</td>
<td># of TAXA</td>
<td># of TAXA</td>
</tr>
<tr>
<td>(x 4) 4</td>
<td>(x 3) 2</td>
<td>(x 2) 2</td>
<td>(x 1) 2</td>
</tr>
</tbody>
</table>

Weighting Factors:

23 or More   Excellent
17 - 22      Good
11 - 16      Fair
10 or Less   Poor

Pollution Tolerance Index Rating

28
BIOLOGICAL MONITORING DATA SHEET

Date _____/_____/____              Begin Time _____:_____ (am/pm)          # Adults __________________
End Time     _____:_____ (am/pm)         # Students  ________________

Certified Monitors’ Names____________________________________  Volunteer ID_______________

Organization Name ___________________________________________________________________

Watershed Name _______________________________________ Watershed # __ __ __ __ __ __ __
Stream/River Name ____________________________________________  Site ID ________________

(Please do not abbreviate.) (Above ID numbers are required.)

Check Methods Used
- Kick Seine Net (3 times)
- D-Net (20 jabs or scoops)

Check Habitats Sampled
- Riffles
- Undercut Banks
- Sediment
- Leaf Packs
- Snags/Vegetation
- Other

POLLUTION TOLERANCE INDEX (PTI)

PT GROUP 1       PT GROUP 2       PT GROUP 3       PT GROUP 4
Intolerant  Moderately Intolerant       Fairly Tolerant        Very Tolerant

Stonefly Nymph _______ Damselfly Nymph _______ Midges _______ Left-Handed Snail _______
Mayfly Nymph _______ Dragonfly Nymph _______ Black Fly Larvae _______ Aquatic Worms _______
Caddis Fly Larvae _______ Sowbug _______ Planaria _______ Blood Midge _______
Dobsonfly Larvae _______ Scud _______ Leech _______ Rat-tailed Maggot _______
Riffle Beetle _______ Crane Fly Larvae _______
Water Penny _______ Clams/Mussels _______
Right-Handed Snail _______ Crayfish _______

# OF TAXA _______ # OF TAXA _______ # OF TAXA _______ # OF TAXA _______

Weighting Factors: (x 4) _______ (x 3) _______ (x 2) _______ (x 1) _______

23 or More Excellent
17 - 22 Good
11 - 16 Fair
10 or Less Poor

POLLUTION TOLERANCE INDEX RATING
(Add the final index values for each group.)

Other Biological Indicators
- Native Mussels
- Zebra Mussels
- Rusty Crayfish
- Aquatic Plants

% Algae Cover

Diversity Index

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Macroinvertebrate Identification Key

GROUP 1 – Very Intolerant of Pollution

- **Stonefly Nymph**: 2 tails long antennae
- **Mayfly Nymph**: 3 tails fluttering gills
- **Riffle Beetle Adult & Larva**: large head & 2 pinchers
- **Caddisfly Larva**: 2 eye spots & very small

GROUP 2 – Moderately Intolerant of Pollution

- **Damsel Fly Nymph**: 3 paddle-like (feathery) tails
- **Dragonfly Nymph**: no tails, large eyes
- **Scud**: flattened side-ways & swims on side
- **Crayfish**: looks like a mini-lobster

GROUP 3 – Fairly Tolerant of Pollution

- **Midge Larva**: small, but visible head intense wiggler
- **Planaria**: 2 eye spots & very small
- **Black Fly Larva**: one end is swollen
- **Leech**: flattened & segmented

GROUP 4 – Very Tolerant of Pollution

- **Aquatic Worm**: segmented “earthwormy"
- **Left-Handed Snail**: must be alive to count
- **Rat-tailed Maggot**: must be alive to count
- **Blood Midge Larva**: bright red

www.HoosierRiverwatch.com
Once you have identified the macroinvertebrates in your river or stream samples and noted the number of each taxa, the data can easily be applied to more than one index. The metrics shown below were developed for the Virginia Save Our Streams program through an extensive research project by Sarah Engel and J. Reese Voshell at Virginia Tech. These examples are provided for Riverwatch volunteers purely for educational use. They provide an example of additional information that can be obtained from samples properly collected and counted for the Pollution Tolerance Index (PTI).

Since the final multimetric index rating values or "scores" were based on ecological conditions in Virginia streams, they do not apply in Indiana. The final metric is only valid for shallow, rocky-bottom streams in the mid-Atlantic region of the U.S. However, we hope to someday complete the research to develop a multimetric index for use in Indiana. If you want to "try out" this index with your data, your sample must contain at least 200 organisms for these metrics to be valid.

- Metric A scores better when higher, since these are Group 1 organisms.
- Metric B scores better when lower, since net spinners are more tolerant of pollution.
- Metric C scores better when lower, since these are Group 4 organisms.
- Metric D scores better when higher, since these are in Group 1.
- Metrics E & F score better when lower, since these are more tolerant organisms (mostly Group 3 & 4).

The final index combines the results of the six individual metrics and weights them accordingly. The multimetric index's final assessment of ecological condition in Virginia streams matched those of the professional biologist 95.5% of the time. (Information on this page modified from Engel and Voshell, 2002.)
### Individual Macroinvertebrate Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Number Counted</th>
<th>Total # of Organisms in the Sample</th>
<th>Final Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Mayflies + Stoneflies + Most Caddisflies</td>
<td>Divide by</td>
<td>Multiply by 100</td>
<td></td>
</tr>
<tr>
<td>B) Common Netspinner Caddisflies</td>
<td>Divide by</td>
<td>Multiply by 100</td>
<td></td>
</tr>
<tr>
<td>C) Lunged Snails - Orb + Left-handed + Limpets</td>
<td>Divide by</td>
<td>Multiply by 100</td>
<td></td>
</tr>
<tr>
<td>D) Riffle Beetles + Water Pennies</td>
<td>Divide by</td>
<td>Multiply by 100</td>
<td></td>
</tr>
</tbody>
</table>

### Virginia Save Our Streams Multimetric Index

**Disclaimer:** These indices can be used by Hoosier Riverwatch volunteers for educational use and practice in determining a multimetric biotic index. The rating scale used in the final multimetric index was developed for Virginia streams and is not valid for use in determining overall stream health in Indiana.

### E) % Tolerant Organisms

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damselflies</td>
<td></td>
</tr>
<tr>
<td>Dragonflies</td>
<td></td>
</tr>
<tr>
<td>Sowbugs</td>
<td></td>
</tr>
<tr>
<td>Scuds</td>
<td></td>
</tr>
<tr>
<td>Clams</td>
<td></td>
</tr>
<tr>
<td>All Midges</td>
<td></td>
</tr>
<tr>
<td>Black Flies</td>
<td></td>
</tr>
<tr>
<td>Planaria</td>
<td></td>
</tr>
<tr>
<td>Leeches</td>
<td></td>
</tr>
<tr>
<td>Lunged Snails</td>
<td></td>
</tr>
<tr>
<td>Aquatic Worms</td>
<td></td>
</tr>
<tr>
<td>Total Tolerant</td>
<td></td>
</tr>
<tr>
<td>Total Tolerant divided by the total number of organisms in the sample</td>
<td>Multiply by 100 (E)</td>
</tr>
</tbody>
</table>

### F) % Non-Insects

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damselflies</td>
<td></td>
</tr>
<tr>
<td>Dragonflies</td>
<td></td>
</tr>
<tr>
<td>Sowbugs</td>
<td></td>
</tr>
<tr>
<td>Scuds</td>
<td></td>
</tr>
<tr>
<td>Clams</td>
<td></td>
</tr>
<tr>
<td>All Midges</td>
<td></td>
</tr>
<tr>
<td>Black Flies</td>
<td></td>
</tr>
<tr>
<td>Planaria</td>
<td></td>
</tr>
<tr>
<td>Leeches</td>
<td></td>
</tr>
<tr>
<td>Lunged Snails</td>
<td></td>
</tr>
<tr>
<td>Aquatic Worms</td>
<td></td>
</tr>
<tr>
<td>Total Non-Insects</td>
<td></td>
</tr>
<tr>
<td>Total Non-Insects divided by the total number of organisms in the sample</td>
<td>Multiply by 100 (F)</td>
</tr>
</tbody>
</table>

### Virginia Save Our Streams Multimetric Index

<table>
<thead>
<tr>
<th>Metric</th>
<th>Your Metric Result</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Mayflies + Stoneflies + Most Caddisflies</td>
<td>Greater than 32.2</td>
<td>16.1-32.2</td>
<td>Less than 16.1</td>
<td></td>
</tr>
<tr>
<td>B) Common Netspinner Caddisflies</td>
<td>Less than 19.7</td>
<td>19.7-34.5</td>
<td>Greater than 34.5</td>
<td></td>
</tr>
<tr>
<td>C) Lunged Snails</td>
<td>Less than 0.3</td>
<td>0.3-1.5</td>
<td>Greater than 1.5</td>
<td></td>
</tr>
<tr>
<td>D) Riffle Beetles + Water Pennies</td>
<td>Greater than 6.4</td>
<td>3.2-6.4</td>
<td>Less than 3.2</td>
<td></td>
</tr>
<tr>
<td>E) % Tolerant</td>
<td>Less than 46.7</td>
<td>46.7-61.5</td>
<td>Greater than 61.5</td>
<td></td>
</tr>
<tr>
<td>F) % Non-Insects</td>
<td>Less than 5.4</td>
<td>5.4-20.8</td>
<td>Greater than 20.8</td>
<td></td>
</tr>
</tbody>
</table>

Add the 3 subtotals to get the Final Multimetric Index Score:
- ☐ Acceptable Ecological Condition (7-12)
- ☐ Unacceptable Ecological Condition (0-6)
**Macroinvertebrate Diversity Index**

The Diversity Index does not require benthic macroinvertebrate identification. This index measures stream water quality by distinguishing organisms by color, size and shape. The only distinction is made between the number of runs, and the number of different types (taxa) of organisms.

1. Collect macroinvertebrates using the Kick Seine or Dip Net sampling procedures and place them in a jar with water or a preservative and randomize them by swirling.

2. Make a grid of 4-6 cm squares on the bottom of a white tray.

3. Pour the sample from the jar into the white tray, spreading the macroinvertebrates evenly over the tray.

4. Randomly select a starting grid and begin picking out organisms in a random sequence. Pick out all the specimens from one square before moving to the next square. If you picked all of the specimens from one square and there were less than 50 organisms in the square, move to the next square and pick all of the organisms from that square to add to the first. You must have at least 50 organisms to complete the test procedures.

5. Place the selected organisms in another tray and compare them two at a time. You will be determining if the next insect is like or different from the previous organism. To complete the "Organism" row, place an "X" in the box if the organism you are comparing is like the previous organism and a "O" if it is different from the previous organism. Fill in the X and O boxes until you have compared 50 organisms.

6. To complete the "Run" row, record a number each time a change from "X" to "O", or "O" to "X" occurs. An example is shown below. **Note:** Always place an "X" in the first box for your first organism, and always begin with the number one for your first run.

<table>
<thead>
<tr>
<th>Run</th>
<th>Organism</th>
<th>X</th>
<th>O</th>
<th>X</th>
<th>O</th>
<th>X</th>
<th>O</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Calculations**

Determine the total number of runs and the total number of organisms (usually 50). Divide the number of runs by the number of organisms to determine the Diversity Index. **(Note: The diversity index is the same as the Sequential Comparison Index printed in the first edition of this manual).**

<table>
<thead>
<tr>
<th>Diversity Index</th>
<th>Number of runs</th>
<th>Number of organisms</th>
<th>Calculation</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>9</td>
<td>7 / 9 = .78</td>
<td>Good</td>
</tr>
</tbody>
</table>

**Diversity Index Results**

- 0.0 - 0.3 Poor
- 0.3 - 0.6 Fair
- 0.6 - 1.0 Good

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### Sample 1

<table>
<thead>
<tr>
<th>Organism</th>
<th>Run</th>
</tr>
</thead>
</table>

**Total Number of Runs:** __________  
**Total Number of Organisms:** __________  
**Divide __________ # Runs to get Diversity Index Results:** __________  
# Organisms

| Diversity Index Results | 0.0 - 0.3 Poor | 0.3 - 0.6 Fair | 0.6 - 1.0 Good |

---

### Sample 2

<table>
<thead>
<tr>
<th>Organism</th>
<th>Run</th>
</tr>
</thead>
</table>

**Total Number of Runs:** __________  
**Total Number of Organisms:** __________  
**Divide __________ # Runs to get Diversity Index Results:** __________  
# Organisms

| Diversity Index Results | 0.0 - 0.3 Poor | 0.3 - 0.6 Fair | 0.6 - 1.0 Good |