

# ***Taxonomic Key to Benthic Macroinvertebrates***

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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!**

**CHOOSE ONE:**

**GO BELOW TO:**

**(1)a** Has a shell(s)

**2**

**(1)b** Has no shell

**5**

**(2)a** Has a hinged double shell

**3**

**(2)b** Has a single shell

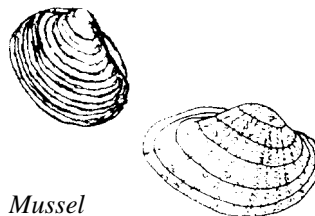
**4**

**(3)a** Adult under 2 inches long

**19**

**(3)b** About 2-4 inches long

**MUSSEL**



*Mussel*

**(4)a** Right-handed opening

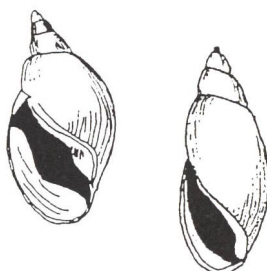
**RIGHT-HANDED SNAIL**



*Right-Handed Snail*

**(4)b** Left-hand opening

**LEFT-HANDED SNAIL**



*Left-Handed Snail*

**CHOOSE ONE:**

**GO BELOW TO:**

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

**6**

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



**PLANARIA**

*Planaria*

**(6)a** No obvious legs

**7**

**(6)b** Obvious legs

**12**

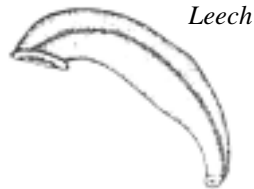
**(7)a** Has no obvious appendages (long, tubular body)

**8**

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

**9**

**(8)a** Has a smooth body and suckers



*Leech*

**LEECH**

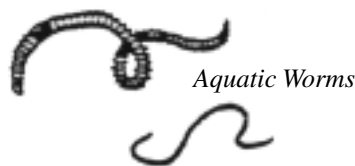
**(8)b** Has a round body and a rat tail



*Rat-Tailed Maggot*

**RAT-TAILED MAGGOT**

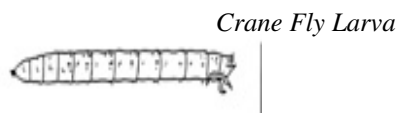
**(8)c** Has a rounded body



*Aquatic Worms*

**AQUATIC WORMS**

**(9)a** Body black or brown; more than 1/3 inch long; plump and caterpillar-like



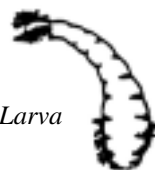
*Crane Fly Larva*

**CRANE FLY LARVA**

**(9)b** Has a distinct head

**10**

**(10)a** One end of body wider than other end; two tiny feather structures on smaller end



*Black Fly Larva*

**BLACK FLY LARVA**

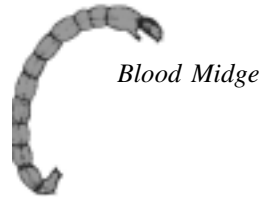
**CHOOSE ONE:**

**GO BELOW TO:**

**(10)b** No difference in diameter along body

**11**

**(11)a** Bright red body



BLOOD MIDGES

**(11)b** Grey Body

OTHER MIDGES

**(12)a** Has four pairs of legs



WATER MITE

**(12)b** Has three pairs of legs

**13**

**(12)c** Has many pairs of legs

**26**

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

**14**

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

**23**

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



WATER PENNY BEETLE LARVA

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

**15**

**(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")



CADDISLY LARVA



**(15)b** Free-living

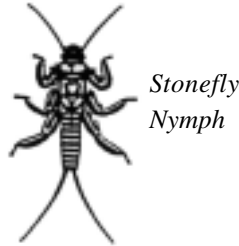
**16**

**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")

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

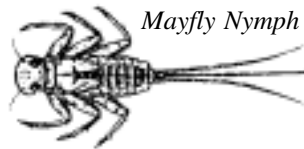


*Stonefly Nymph*

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

**(17)c** Tail has no appendages

**(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)

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



*Zebra Mussel*

**(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*

**GO BELOW TO:**

**21**

**17**

STONEFLY NYMPH

**18**

**25**

MAYFLY NYMPH

DAMSELFLY NYMPH

**20**

ZEBRA MUSSEL (EXOTIC)

FINGERNAIL CLAM

ASIATIC CLAM (EXOTIC)

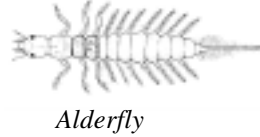
**CHOOSE ONE:**

**(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



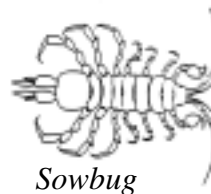
**(25)a** Lower lip formed into scoop like structure



**(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**

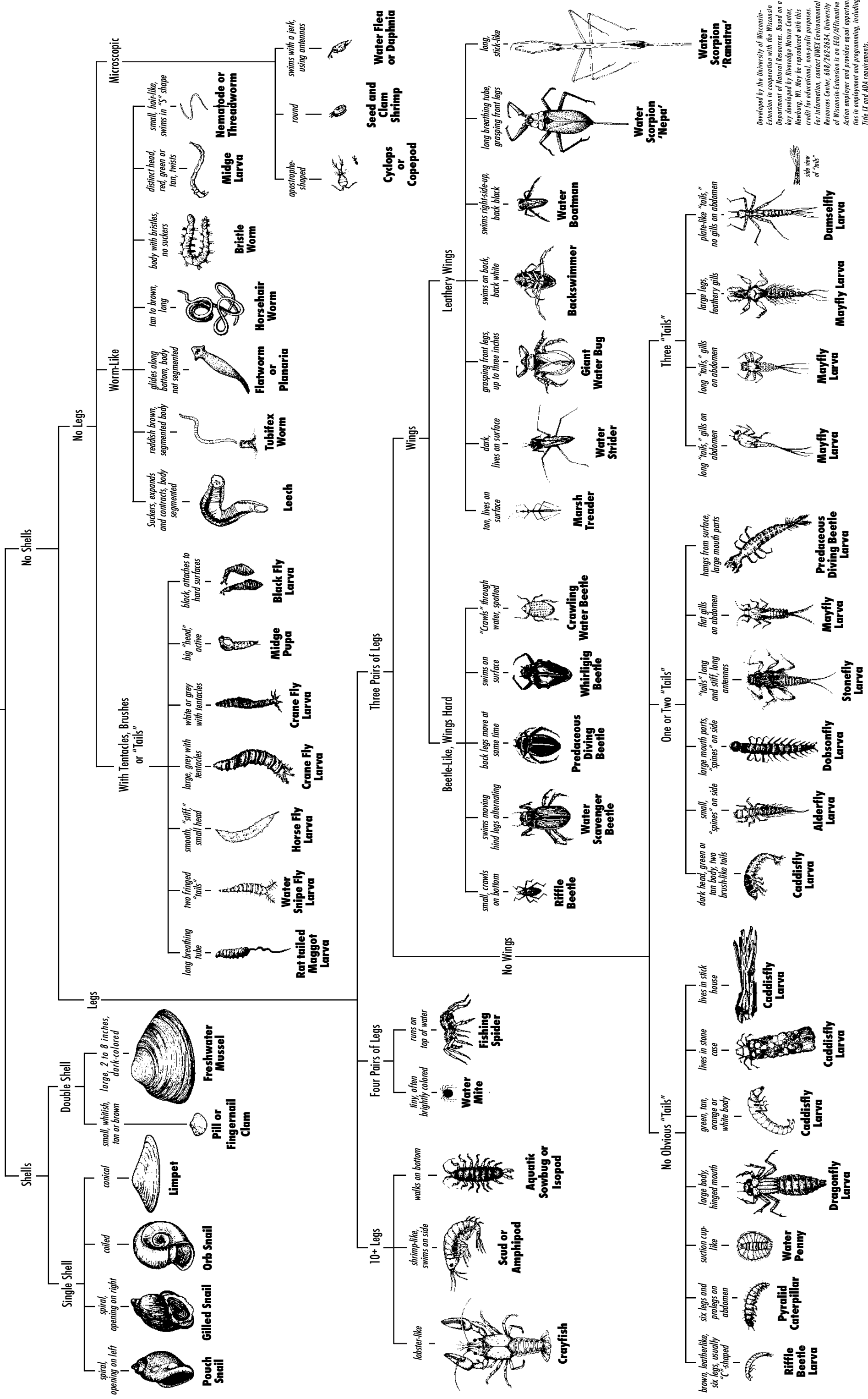
**RIFFLE BEETLE LARVA**

**SOWBUG**

**SCUD**

# Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)



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# 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 macroinvertebrate 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.

<b>PT GROUP 1</b> <i>Intolerant</i>	<b>PT GROUP 2</b> <i>Moderately Intolerant</i>	<b>PT GROUP 3</b> <i>Fairly Tolerant</i>	<b>PT GROUP 4</b> <i>Very Tolerant</i>
Stonefly Nymph <u>6</u>	Damselfly Nymph _____	Midge Larvae <u>&gt;100</u>	Left-Handed Snail <u>1</u>
Mayfly Nymph <u>5</u>	Dragonfly Nymph <u>15</u>	Black Fly Larvae _____	Aquatic Worms <u>25</u>
Caddis Fly Larvae <u>10</u>	Sowbug _____	Planaria <u>16</u>	Blood Midge _____
Dobsonfly Larvae _____	Scud _____	Leech _____	Rat-tailed Maggot _____
Riffle Beetle _____	Crane Fly Larvae _____		
Water Penny <u>30</u>	Clams/Mussels _____		
Right-Handed Snail _____	Crayfish <u>2</u>		

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.*

# of TAXA <u>4</u>	# of TAXA <u>2</u>	# of TAXA <u>2</u>	# of TAXA <u>2</u>
--------------------	--------------------	--------------------	--------------------

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

# of TAXA <u>4</u>	# of TAXA <u>2</u>	# of TAXA <u>2</u>	# of TAXA <u>2</u>
Weighting (x 4) <u>16</u>	(x 3) <u>6</u>	(x 2) <u>4</u>	(x 1) <u>2</u>
<small>Factors:</small>			

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

Then total all of the group scores to get the POLLUTION TOLERANCE INDEX RATING.

# of TAXA 4 # of TAXA 2 # of TAXA 2 # of TAXA 2  
 (x 4) 16 (x 3) 6 (x 2) 4 (x 1) 2

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

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

**28**

### 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    25 % Algae Cover    0.75 Diversity Index

### Example of a complete Pollution Tolerance Index:

#### POLLUTION TOLERANCE INDEX (PTI)

PT GROUP 1 <i>Intolerant</i>	PT GROUP 2 <i>Moderately Intolerant</i>	PT GROUP 3 <i>Fairly Tolerant</i>	PT GROUP 4 <i>Very Tolerant</i>
Stonefly Nymph <u>6</u>	Damselfly Nymph _____	Midge Larvae <u>&gt;100</u>	Left-Handed Snail <u>1</u>
Mayfly Nymph <u>5</u>	Dragonfly Nymph <u>15</u>	Black Fly Larvae _____	Aquatic Worms <u>25</u>
Caddis Fly Larvae <u>10</u>	Sowbug _____	Planaria <u>16</u>	Blood Midge _____
Dobsonfly Larvae _____	Scud _____	Leech _____	Rat-tailed Maggot _____
Riffle Beetle _____	Crane Fly Larvae _____		
Water Penny <u>30</u>	Clams/Mussels _____		
Right-Handed Snail _____	Crayfish <u>2</u>		
# of TAXA <u>4</u>	# of TAXA <u>2</u>	# of TAXA <u>2</u>	# of TAXA <u>2</u>
Weighting Factors: (x 4) <u>16</u>	(x 3) <u>6</u>	(x 2) <u>4</u>	(x 1) <u>2</u>

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.)

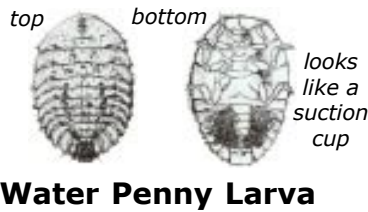
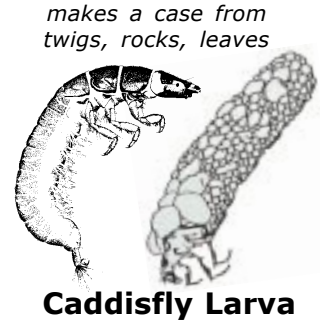
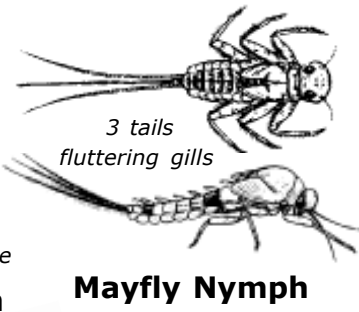
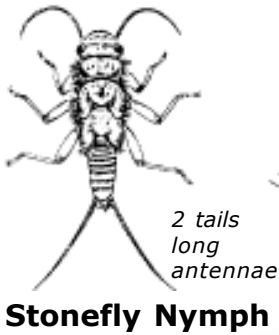
**28**



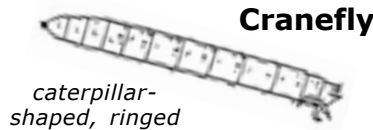
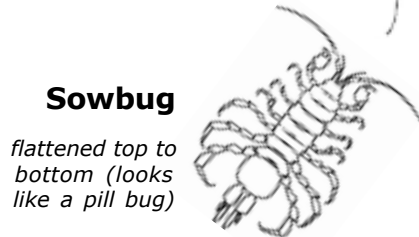
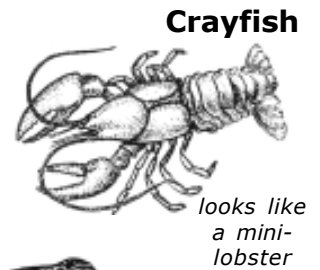
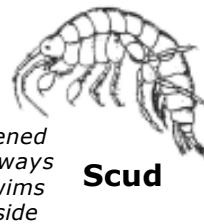
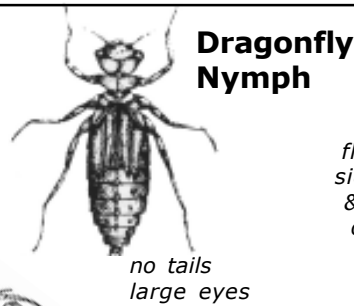
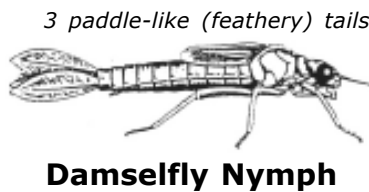


# Macroinvertebrate Identification Key

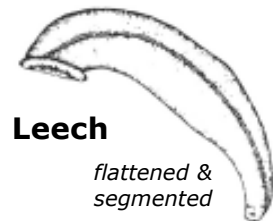
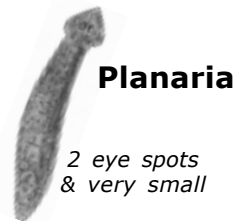
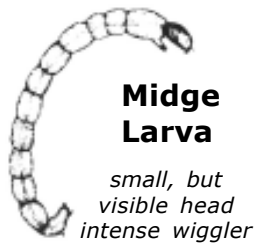
## GROUP 1 – Very Intolerant of Pollution



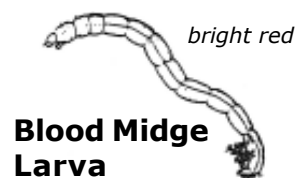
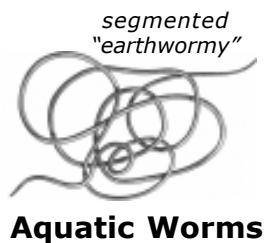
## GROUP 2 – Moderately Intolerant of Pollution



## GROUP 3 – Fairly Tolerant of Pollution



## GROUP 4 – Very Tolerant of Pollution



# Other Macroinvertebrate Indices

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).

**Individual Macroinvertebrate Metrics**

Metric	Number Counted		Total # of Organisms in the Sample		Final Percent
A) Mayflies + Stoneflies + Most Caddisflies	16	Divide by	210	Multiply by 100	7.62
B) Common Netspinner Caddisflies	5	Divide by	210	Multiply by 100	2.38
C) Lunged Snails - Orb + Left-handed + Limpets	1	Divide by	210	Multiply by 100	0.48
D) Riffle Beetles + Water Pennies	30	Divide by	210	Multiply by 100	14.29

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.)*

**E) % Tolerant Organisms**

Taxon	Number
Damselflies	
Dragonflies	15
Sowbugs	
Scuds	
Clams	
All Midge	>100
Black Flies	
Planaria	16
Leeches	
Lunged Snails	1
Aquatic Worms	25
Total Tolerant	157
Total Tolerant divided by the total number of organisms in the sample	210
Multiply by 100 (E)	74.76

**F) % Non-Insects**

Taxon	Number
Right-handed snails	
Sowbugs	
Scuds	
Clams	
Crayfish	2
Planaria	16
Leeches	
Lunged Snails	1
Aquatic Worms	25
Total Non-Insects	157
Total Non-Insects divided by the total number of organisms in the sample	210
Multiply by 100 (F)	20.95

**Virginia Save Our Streams Multimetric Index**

Metric	Your Metric Result	2	1	0
A) Mayflies + Stoneflies + Most Caddisflies	7.62	Greater than 32.2	16.1-32.2	Less than 16.1 ✓
B) Common Netspinner Caddisflies	2.38	Less than 19.7	19.7-34.5	Greater than 34.5 ✓
C) Lunged Snails	0.48	Less than 0.3	✓ 0.3-1.5	Greater than 1.5
D) Riffle Beetles + Water Pennies	14.29	Greater than ✓ 6.4	3.2-6.4	Less than 3.2
E) % Tolerant	74.76	Less than 46.7	46.7-61.5	Greater than ✓ 61.5
F) % Non-Insects	20.95	Less than 5.4	5.4-20.8	Greater than ✓ 20.8
		Total # of 2s:	Total # of 1s:	Total # of 0s:
		1	1	4
		Multiply by 2:	Multiply by 1:	Multiply by 0:
		2	1	0
<b>Add the 3 subtotals to get the Final Multimetric Index Score:</b>				<b>3</b>
<input type="checkbox"/> Acceptable Ecological Condition (7-12) <input checked="" type="checkbox"/> Unacceptable Ecological Condition (0-6)				

# Virginia Save Our Streams Multimetric Index

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

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.

## Virginia Save Our Streams Multimetric Index

Metric	Your Metric Result	2	1	0
A) Mayflies + Stoneflies + Most Caddisflies		Greater than 32.2	16.1-32.2	Less than 16.1
B) Common Netspinner Caddisflies		Less than 19.7	19.7-34.5	Greater than 34.5
C) Lunged Snails		Less than 0.3	0.3-1.5	Greater than 1.5
D) Riffle Beetles + Water Pennies		Greater than 6.4	3.2-6.4	Less than 3.2
E) % Tolerant		Less than 46.7	46.7-61.5	Greater than 61.5
F) % Non-Insects		Less than 5.4	5.4-20.8	Greater than 20.8
		Total # of 2s: Total # of 1s:		Total # of 0s:
		subtotals:		Multiply by 1:
				Multiply by 0:
<b>Add the 3 subtotals to get the Final Multimetric Index Score:</b>				
<input type="checkbox"/> Acceptable Ecological Condition (7-12) <input type="checkbox"/> Unacceptable Ecological Condition (0-6)				

### E) % Tolerant Organisms

Taxon	Number
Damselflies	
Dragonflies	
Sowbugs	
Scuds	
Clams	
All Midges	
Black Flies	
Planaria	
Leeches	
Lunged Snails	
Aquatic Worms	
Total Tolerant	
Total Tolerant divided by the total number of organisms in the sample	
Multiply by 100 (E)	

### F) % Non-Insects

Taxon	Number
Right-handed snails	
Sowbugs	
Scuds	
Clams	
Crayfish	
Planaria	
Leeches	
Lunged Snails	
Aquatic Worms	
Total Non-Insects	
Total Non-Insects divided by the total number of organisms in the sample	
Multiply by 100 (F)	

# 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.**

Organism	X	O	X	O	O	X	O	X	X
Run	1	2	3	4		5	6	7	

## 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.*)

$$\text{Diversity Index} = \frac{\text{Number of runs}}{\text{Number of organisms}} = \frac{7}{9} = .78 = \text{Good}$$

**Diversity Index Results**

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

## Sample 1

Organism																			
Run																			

Organism																			
Run																			

Organism																			
Run																			

**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

Organism																			
Run																			

Organism																			
Run																			

Organism																			
Run																			

**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