

Bioindicators of Water Quality

Quick-Reference Guide

Authors: Julie Speelman and Natalie Carroll | Photographer (unless otherwise noted): Julie Speelman | Design and Layout: Jennifer Mazonas

This publication shows aquatic insects that can be used as bioindicators of water quality in Indiana waterways. Bioindicators are biological systems that are sensitive to environmental changes and, therefore, can indicate when pollution is present in the water.

A tolerance score is included for each insect in this publication. The tolerance score, ranging from 0–10, represents the insect’s sensitivity to pollution and can be used to estimate the quality of the water in which the insect was found. Insects with a score of 0 are intolerant to pollution, meaning they cannot tolerate any water pollution, while insects with a score of 10 are very tolerant of polluted water.

Materials Needed

- dip net
- white plastic pail, bowl, or dishpan (Note: The white color makes it easier to see the insects.)
- 2–3 white styrofoam egg cartons or plastic ice cube trays
- data sheet—available online at: www.four-h.purdue.edu/natural_resources/ (select “Resources for Educators” and “Bioindicators”)

Instructions

- Locate a body of water (e.g., stream, pond, lake) to sample. The water should only be at most knee deep and allow easy access for obtaining the sample. Make sure you have permission to sample the water.
- Dip the pail in the water to be sampled.
- Collect insect samples from all habitats within a 200-foot section of that body of water, and place them in the pail. Jab your dip net against the vegetation and into mud or sand at the bottom to collect insects. Scrape the underside of rocks and logs into the net.
- Collect insects for 45 minutes.
- Using the ice cube tray, sort the insects that look the same into the different compartments of the tray using your hand or forceps. Be sure to put some water in the ice cube tray first to keep the insects from drying out.
- Use the bioindicator flash cards or quick reference guide to identify the insects. Record the number of insects from each insect family you identify on the data sheet.
- Place the insects back in the water when you are finished.
- Complete the calculations described in the next section to determine the quality rating.

Resources

- U.S. Environmental Protection Agency (EPA)
- About Biological Integrity and Indicators: www.epa.gov/bioindicators/html/about.html
- Invertebrates as Indicators (look for Bugs as Indicators of Water Quality): www.epa.gov/bioindicators/html/invertebrate.html
- Bugguide.net (hosted by Iowa State University Entomology): www.bugguide.net

Biotic Index	Water Quality Rating	Degree of Organic Pollution
0.00–3.75	excellent	organic pollution unlikely
3.76–4.25	very good	slight organic pollution possible
4.26–5.00	good	some organic pollution probable
5.01–5.75	fair	fairly substantial pollution likely
5.76–6.50	fairly poor	substantial pollution likely
6.51–7.25	poor	very substantial pollution likely
7.26–10.0	very poor	severe organic pollution likely

Assessing the Water Quality of a Site

For each insect family group:

- Record the number of insects found for each species listed.
- Multiply the Tolerance Value by the Number Found, and enter the result under Family Tolerance Score.
- Sum the Number Found and Family Tolerance Score columns (Order Totals).

For each insect order:

- Transfer the Order Totals to the Order Summary section.
- Sum the Number Found and Order Tolerance Score columns (Grand Total).
- Determine the Biotic Index by dividing the Grand Total Tolerance Score by the Grand Total Number Found.
- Use the biotic index in the table provided to estimate the water quality rating and degree of organic pollution.

- Hoosier Riverwatch (provides training on this and many other water-related topics): <http://www.in.gov/dnr/nrec/3046.htm>
- Volunteer Stream Monitoring Training Manual (download, 13.7 MB): http://www.in.gov/dnr/nrec/files/nc-Riverwatch_Manual.pdf; Chapter 5 covers biological monitoring.
- Hoosier Riverwatch events calendar: <http://www.in.gov/dnr/nrec/>

Coleoptera
Beetles



Dryopidae
Long-toed Water Beetle



Dytiscidae (larvae)
Predaceous Diving Beetle



Dytiscidae (adult)
Predaceous Diving Beetle



Elmidae (larvae)
Riffle Beetle



Elmidae (adult)
Riffle Beetle



Gyrinidae (larvae)
Whirligig Beetle



Gyrinidae (adult)
Whirligig Beetle



Haliplidae (larvae)
Crawling Water Beetle



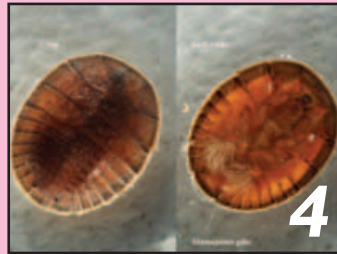
Haliplidae (adult)
Crawling Water Beetle



Hydrophilidae (larvae)
Water Scavenger Beetle



Hydrophilidae (adult)
Water Scavenger Beetle



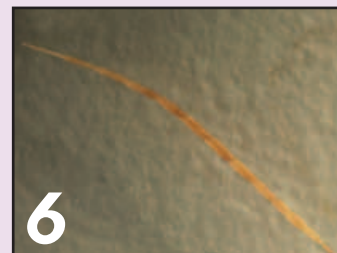
Psephenidae (larvae)
Water Penny



Athericidae
Aquatic Snipe Fly



Blephariceridae
Net-winged Midge



Ceratopogonidae
Biting Midge



Chaoboridae
Phantom Midge



Chironomidae
Non-biting Midge



Culicidae
Mosquito



Dixidae
Dixid Midge



Empididae
Aquatic Dance Fly



Ephydriidae
Shore Fly



Muscidae
House Fly, Stable Fly,
Green Bottle Fly

Diptera
Flies



10

Psychodidae
Moth Fly



3

Tipulidae
Crane Fly



4

Ephemeroidea
Common Burrowing Mayfly



4

Potamanthidae
Hacklegill Mayfly



6

Sciomyzidae
Marsh Fly

Ephemeroptera Mayflies



4

Baetidae
Small Minnow Mayfly



4

Heptageniidae
Flat-headed Mayfly



7

Siphonuridae
Primitive Minnow Mayfly



6

Simuliidae
Black Fly



3

Baetiscidae
Armored Mayfly



2

Isonychiidae
Brushed-legged Mayfly

Hemiptera Aquatic Bugs



10

Belostomatidae
Giant Water Bug



8

Stratiomyidae
Soldier Fly



7

Caenidae
Small Square-gill Mayfly



4

Leptohyphidae
Little Stout Crawler Mayfly



9

Corixidae
Water Boatman



10

Syrphidae
Rattailed Maggot



1

Ephemerellidae
Spiny Crawler Mayfly



2

Leptophlebiidae
Prong-gilled Mayfly



Undetermined

Gelastocoridae
Toad Bug



6

Tabanidae
Horse Fly, Deer Fly

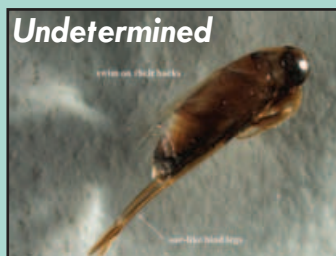


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Polymitarcyidae
Pale Burrowing Mayfly



Gerridae
Water Strider



Notonectidae
Backswimmer



Hebridae
Velvet Water Bug



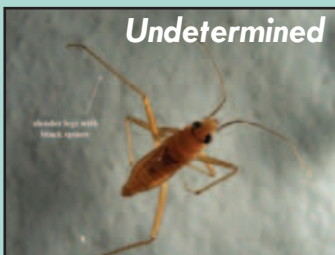
Pleidae
Pygmy Backswimmer



Hydrometridae
Water Measurer



Saldidae
Shore Bug



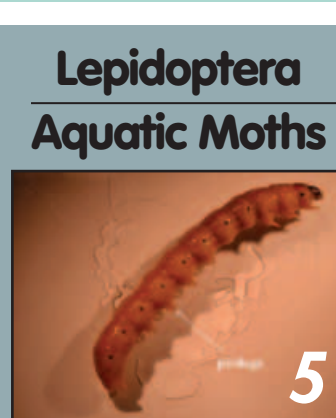
Mesoveliidae
Water Treader



Veliidae
Broad-shouldered Water Strider



Naucoridae
Creeping Water Bug



Pyralidae
Aquatic Caterpillar



Nepidae
Water Scorpion

Lepidoptera Aquatic Moths

Megaloptera Alderflies, Dobsonflies, and Fishflies



Corydalidae
Dobsonfly

Photo: Dr. Jonathan Neal



Sialidae
Alderfly

Photo: Dr. Jonathan Neal



Coenagrionidae
Narrow-winged Damselfly

Odonata Damselflies and Dragonflies



Aeshnidae
Darner



Gomphidae
Club-tailed Dragonfly



Lestidae
Spread-winged Damselfly



Calopterygidae
Broad-winged Damselfly



Libellulidae
Common Skimmer

Photo: Dr. Jonathan Neal

Plecoptera

Stoneflies



Capniidae

Small Winter Stonefly



Leuctridae

Roll-winged Stonefly



Nemouridae

Brown Stonefly



Perlidae

Common Stonefly



Perlodidae

Patterned Stonefly



Brachycentridae

Humpless Casemaker Caddisfly



Glossosomatidae

Saddle Casemaker Caddisfly



Helicopsychidae

Snail Casemaker Caddisfly



Pteronarcyidae

Giant Stonefly

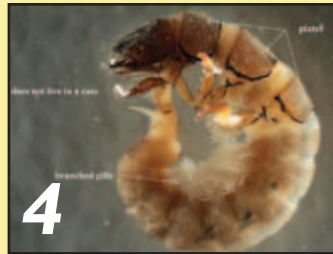


Taeniopterygidae

Winter Stonefly

Trichoptera

Caddisflies



Hydropsychidae

Common Net Spinner Caddisfly



Hydroptilidae

Micro Caddisfly



Lepidostomatidae

Lepidostomatid Casemaker



Leptoceridae

Long Horned Casemaker



Limnephilidae

Northern Casemaker Caddisfly



Philopotamidae

Finger Net Caddisfly



Phryganeidae

Giant Casemaker Caddisfly

Using this guide with the data sheets

Coleoptera Beetles



Dryopidae

Long-toed Water Beetle



Dytiscidae (larvae)

Predaceous Diving Beetle



Dytiscidae (adult)

Predaceous Diving Beetle

Common
Name

Family
Name

Tolerance
Value

Coleoptera (Beetles)

Family	Tolerance Value	Number Found	Family Tolerance Score
Dryopidae	5	0	0
Dytiscidae	5	2	10
Elmidae	5	0	0
Gyrinidae	4	0	0
Haliplidae	7	0	0
Hydrophilidae	5	3	15
Psephenidae	4	0	0
Order Total		5	25

Order Summary

Order Total	Number Found	Order Tolerance
Coleoptera	5	25
Diptera	6	38
Ephemeroptera	8	28
Hemiptera	5	27
Lepidoptera	2	0
Megaloptera	0	0
Odonata	3	13
Plecoptera	0	0
Trichoptera	6	24
Grand Total	35	155

$$\text{Biotic Index} = [\text{Grand Total Tolerance}] / [\text{Grand Total Number Found}] = 155/35 = 4.43$$

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