PURDUE UNIVERSITY

PURDUE EXTENSION

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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.

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.

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
- 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

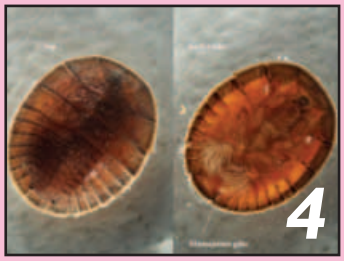
Gyrinidae (adult)
Whirligig Beetle

Haliplidae (larvae)
Crawling Water Beetle

Haliplidae (adult)
Crawling Water Beetle

Hydrophilidae (larvae)
Water Scavenger Beetle

Hydrophilidae (adult)
Water Scavenger Beetle



Psephenidae (larvae)
Water Penny

Diptera
Flies

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

Ephydridae
Shore Fly

Muscidae
House Fly, Stable Fly,
Green Bottle Fly

Psychodidae
Moth Fly

Tipulidae
Crane Fly

Sciomyzidae
Marsh Fly

Simuliidae
Black Fly

Stratiomyidae
Soldier Fly

Syrphidae
Rattailed Maggot

Tabanidae
Horse Fly, Deer Fly

Ephemeroptera
Mayflies

Baetidae
Small Minnow Mayfly

Baetiscidae
Armored Mayfly

Caenidae
Small Square-gill Mayfly

Ephemerellidae
Spiny Crawler Mayfly

Ephemeridae
Common Burrowing Mayfly

Potamanthidae
Hacklegill Mayfly

Heptageniidae
Flat-headed Mayfly

Siphlonuridae
Primitive Minnow Mayfly

Isonychiidae
Brushed-legged Mayfly

Leptohyphidae
Little Stout Crawler Mayfly

Leptophlebiidae
Prong-gilled Mayfly

Polymitarcyidae
Pale Burrowing Mayfly

Hemiptera
Aquatic Bugs

Belostomatidae
Giant Water Bug

Corixidae
Water Boatman

Gelastocoridae
Toad Bug

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

Photo: Dr. Jonathan Neal

Nepidae
Water Scorpion

Lepidoptera
Aquatic Moths

Pyralidae
Aquatic Caterpillar

Megaloptera
Alderflies, Dobsonflies, and Fishflies

Photo: Dr. Jonathan Neal

Corydalidae
Dobsonfly

Photo: Dr. Jonathan Neal

Sialidae
Alderfly

Odonata
Damselflies and Dragonflies

Aeshnidae
Darner

Calopterygidae
Broad-winged Damselfly

Coenagrionidae
Narrow-winged Damselfly

Gomphidae
Club-tailed Dragonfly

Lestidae
Spread-winged Damselfly

Libellulidae
Common Skimmer

Plecoptera
Stoneflies

Capniidae
Small Winter Stonefly

Leuctridae
Roll-winged Stonefly

Nemouridae
Brown Stonefly

Perlidae
Common Stonefly

Perlodidae
Patterned Stonefly

Trichoptera
Caddisflies

Brachycentridae
Humpless Casemaker Caddisfly

Glossosomatidae
Saddle Casemaker Caddisfly

Helicopsychidae
Snail Casemaker Caddisfly

Pteronarcyidae
Giant Stonefly

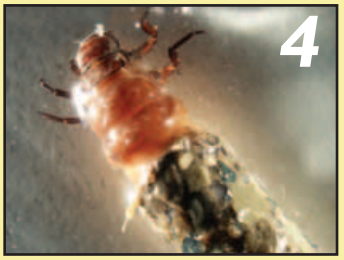
Taeniopterygidae
Winter Stonefly

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

Biotoic Index = [Grand Total Tolerance] / [Grand Total Number Found] = 155/35 = 4.43

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