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The Biotic Index was developed by William M. Beck, Jr. in response to the need for a simple biological measure of stream pollution. This method is based on the classification of selected aquatic invertebrates into categories depending on their response to organic pollution (sewage and other oxygen demanding wastes). General experience has indicated that the Biotic Index is also useful in classifying other types of pollution. Extensive study of the distribution of invertebrates in relation to water quality enabled Beck to divide these organisms into three groups on the basis of their ability to tolerate organic pollution:

Class I – pollution sensitive ***Class II – moderately tolerant*** ***Class III – pollution tolerant***

Invertebrates collected during stream surveys are identified and assigned to the appropriate Class and the following computation performed:

Biotic Index = 2(n Class I) + (n Class II)
where n = number of taxa (different organisms based on appearance)

EXAMPLE OF BIOTIC INDEX CALCULATION:

A sample of bottom fauna from stream X reveals the following different kinds of invertebrates –

Organism	# Taxa	Class	Organism	#Taxa	Class
Mayfly	4*	I	Net Spinning Caddisfly	2	II
Stonefly	3	I	Aquatic Sowbug	1	II
Case building caddisfly	2	I	Dragonfly nymph	1	II
Crayfish	1	I	True flies (Diptera)	5	III
			Snail	1	III

RESULT:

Biotic Index = 2(n Class I) + (n Class II)
= 2(10) + (4)
= 24 = Clean Stream

*Note: This number represents the different kinds (taxa) of mayflies found not the number of individuals

BIOTIC INDEX RANGES

Clean Streams	*Moderate Pollution*	*Gross Pollution*
10 or greater	3 – 9	0 – 2

The Biotic Index becomes more powerful as the investigator increases his proficiency in the identification of the individual organism to its lowest taxonomic group (species if possible). It also has built-in flexibility as it allows a given species to be classified to the appropriate category as information becomes available on its tolerance to organic pollution. The following scheme groups the commonly encountered aquatic invertebrates into their respective classes:

Class I – Pollution Sensitive Taxa

A. Mayflies (Ephemeroptera)
   1. Climbers and free rangers – body laterally compressed, platelike gills, usually three fringed tails, rapid movements.
   2. Clingers and bottom sprawlers – body broad and flat, two or three tails, clinging to underside of rocks or in vegetable matter
   3. Burrowers – usually two large forward – projecting tusks, three tails, gills dorsal, burrow in mud
B. Stoneflies (Plecoptera) – two tails, body color brown to yellow and dark areas on dorsal surface, active crawlers out of water.
C. Caddisflies (Trichoptera) – wormlike bodies, pair of prolegs at rear which bear hooks, live freely or in cases constructed of mineral and/or vegetable matter.
D. Crayfish (Decapoda)
E. Fingernail Clam (Pelecypoda) – tiny tan-colored or brown shells

Class II – Moderately Tolerant Taxa

A. Net-spinning caddisflies (Trichoptera) – as previously described, but without cases.
B. Water penny (Coleoptera) – body round or oval and strongly flattened, legs rarely visible from above.
C. Aquatic sow bug (Isopoda) – flattened grayish bodies, resemble pill bug often seen under rotting logs.
D. Scud (Amphipoda) – laterally compressed gray body, resembles miniature shrimp.
E. Hellgrammite (Megaloptera) – body wormlike with projections along sides, large pincer-like jaws.
F. Dragonfly nymph (Odonata)
G. Damselfly nymph (Odonata)

Class III – Pollution Tolerant Taxa

A. True flies (Diptera) – most belong in this class, but there are exceptions; wormlike bodies, legs absent, various forms and colors.
B. Snails (Gastropoda)
C. Flatworm (Tricladida) – small flat wormlike bodies, eyes on dorsal surface of “head”.
D. Aquatic earthworms (Oligochaeta)
E. Leeches (Hirudinea)
F. Adult aquatic beetles (Coleoptera)
G. Surface film insects (Hemiptera)

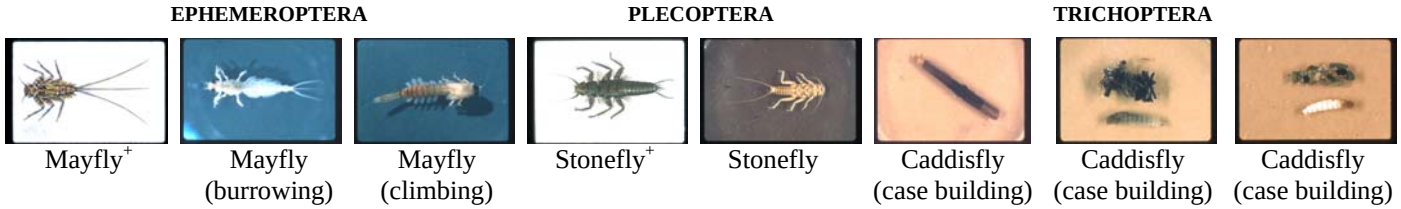
**Note: Amphipoda, Decapoda, Gastropoda, Isopoda, Oligochaeta, Pelecypoda, Hirudinea, and Tricladida are not insects.*

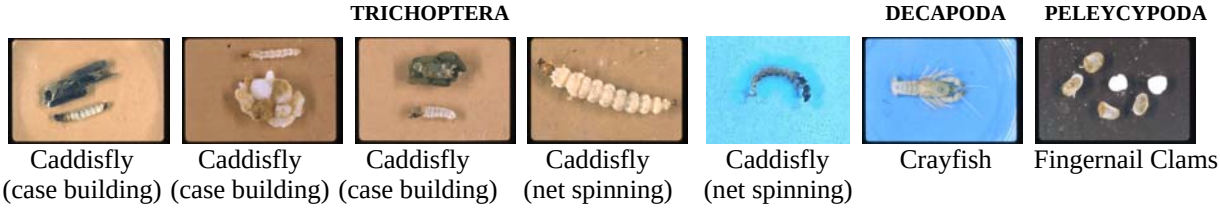
KEY TO ORDERS OF AQUATIC INSECTS

1a. Thorax with 3 pairs of segmented legs ***3***
1b. Thorax without segmented legs ***2***
2a. Mummy-like, in a case, often silk-cemented and containing vegetable or mineral matter….pupae (not keyed)
2b. Not in a case; mobile larvae, mostly with prolegs or pseudopods on one or more more segments……DIPTERA (true flies)
3a. With wings or external wing pads (may be inconspicuous) ***4***
3b. Wings or external wing pads absent ***10***
4a. With large, functional wings ***5***
4b. With wings pads or brachypterous wings ***7***
5a. Both pairs of wings completely membranous, with numerous veins…not aquatic, adults of Plecoptera or Trichoptera that may enter water to oviposit
5b. Front wings hardened, leather-like in basal half, or shell-like ***6***
6a. Front wings hard, opaque, shell-like, and without veination ……COLEOPTERA adults (beetles)
6b. Front wings hardened only in basal half, mostly membranous and with conspicuous veination near apex HEMIPTERA (true bugs)
7a. With 2 or 3 long, filamentous terminal appendages ***8***
7b. Terminal appendages absent or not filamentous ***9***
8a. Sides of abdomen with plate-like, feather-like, or leaf-like gills; usually with 3 tail filaments, occasionally only 2…… EPHEMEROPTERA (mayflies)
8b. Gills absent from middle abdominal segments; 2 tail filaments…….PLECOPTERA (stoneflies)
9a. Labium forming on elbowed, extensile grasping organ ODONATA (dragonflies)
9b. Mouthparts sucking, formed into a broad or narrow tube… HEMIPTERA
10a. Mouthparts sucking, formed into a narrow tube ***11***
10b. Mouthparts not formed into a narrow tube ***12***
11a. Parasitic on sponges; all tarsi with one claw ……..NEUROPTERA
11b. Free-living, walking on surface of water or swimming mesotarsi with two claws…….HEMIPTERA
12a. Ventral abdominal prolegs each with a ring of fine hooks (crochets)……..LEPIDOPTERA (moths)
12b. Abdomen without ventral prolegs, except on terminal segment ***13***
13a. Antennae extremely small, inconspicuous, one-segmented ……TRICHOPTERA (caddisflies)
13b. Antennae elongate, with 3 or more segments ***14***
14a. A single claw on each tarsus……COLEOPTERA larvae
14b. Each tarsus with 2 claws ***15***
15a. With conspicuous lateral filaments ***16***
15b. Without conspicuous lateral filaments…COLEOPTERA larvae
16a. Abdomen terminating in 2 slender filaments or a median proleg with 4 hooks ……COLEOPTERA larvae
16b. Abdomen terminating in a single slender filament or in 2 prolegs, each with 2 hooks……MEGALOPTERA (hellgrammites)

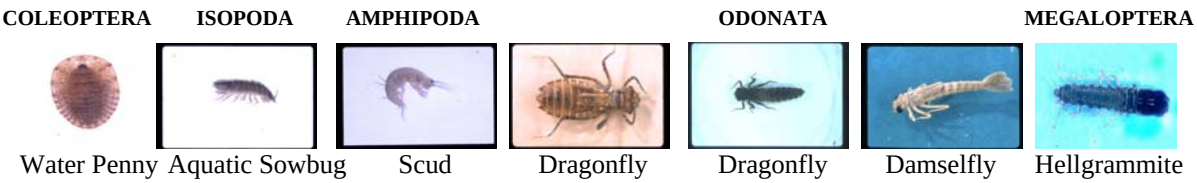
Hilsenhoff, W.L. 1975. Aquatic Insects of Wisconsin. Tech. Bull. 89. Department of Natural Resources. Madison, Wisconsin. 52pp.

Some Class I Organisms





Some Class II Organisms



Some Class III Organisms

+Drawings by Stan Crilly

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