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Pond Meadow Stream: Monitoring Stream Health Using Benthic Macroinvertebrates

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Monitoring Stream Health Using Benthic
Macro-invertebrates

POND MEADOW STREAM

East Middle School
Braintree MA

Pond Meadow Stream is a headwater stream in Braintree, Massachusetts.



- It has its source in a wetland south of Pond Meadow.

Water from the surrounding watershed collects in the wetland, and is carried away by Pond Meadow Stream.

Pond Meadow Stream is only about 1 mile long.



As it leaves the wetland, the stream flows under Route 3 through a large conduit.



Pond Meadow Stream then travels through thick woods and underbrush.



2009-03-26

The stream finally flows into
Pond Meadow.



2009-03-28

Habitat

(You can see Route 3 through the trees.)



The stream measured 16 feet across just North of the foot bridge. Its flood width is 32 feet.



There are a lot of trees and underbrush growing along the banks, and many places are muddy.



A walking path crosses over the stream where we did our study.

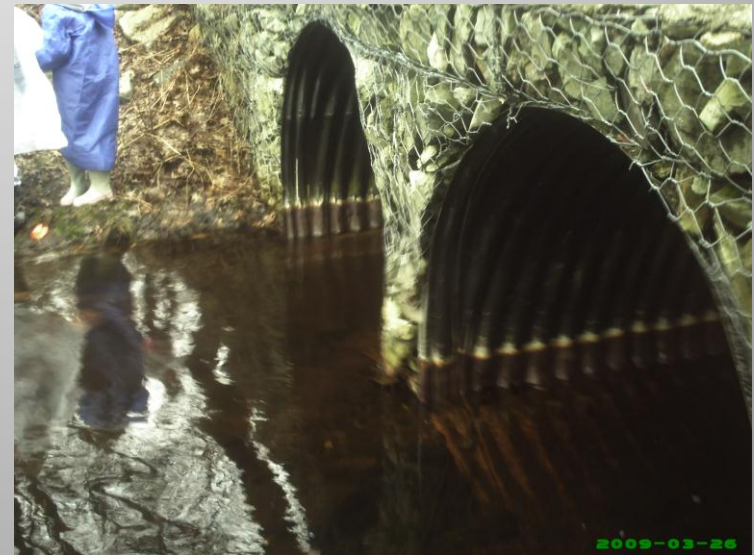


We did our insect sampling in the stream just above the bridge, which was made up of two metal culverts



Water depth and flow was measured just below the bridge.

- Average Water Depth: 0.97 ft
- Flow (ft^3/sec): 2.07 CFS
- Stream consisted of 5% boulders, 50% rubble, and 45% organic debris



Macro-invertebrate Sampling



The stream had one small riffle where the water flowed between the bank and a hummock in the middle of the stream.



This is where we did most of our insect collecting.



We did some of our collecting at the small riffle.



To collect the bugs we had to kick up the dirt in front of the net.



The bugs were then collected in a large pail.
These bugs were later put in alcohol to preserve
their bodies.



Classifying the bugs



We classified the macro-invertebrates in their
Order and Family.



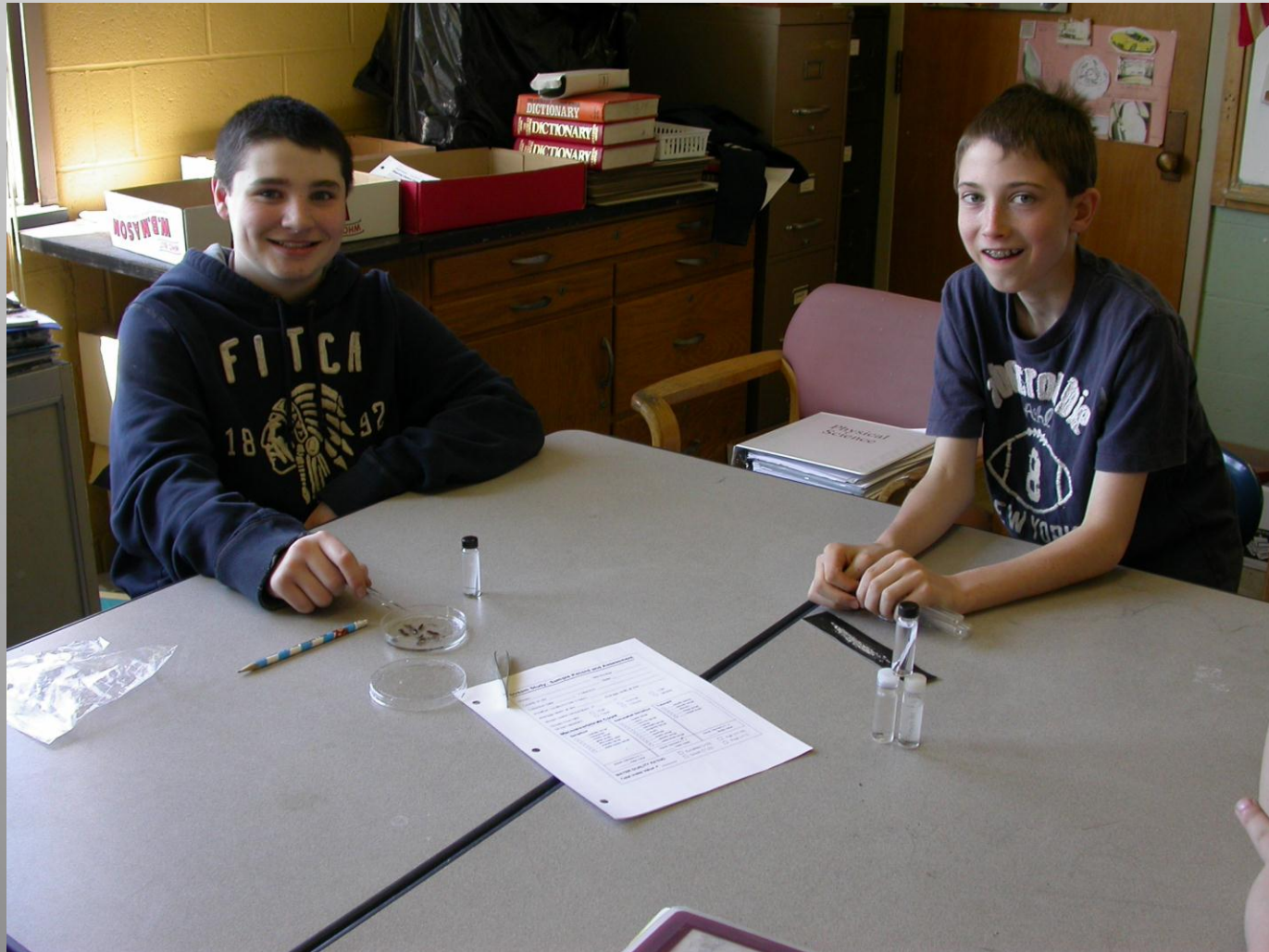
Classified macro-invertebrates were then counted and put into vials.



The entire class participated in classifying the macro-invertebrates.



Some of our insects were difficult to classify.
We had a hard time identifying the aquatic
sowbugs.



A moment of fun.



Insects of Pond Meadow Stream.

- After classifying the benthos in the stream, we determined that the stream was in *Poor condition*.
 - We found an abundance of midge larvae, which are found in Group III, or tolerant benthos.
 - We also found many leeches and aquatic worms, which are tolerant to pollution.
 - There were also Group II tolerant benthos, such as alderfly larvae, aquatic sowbugs, crane fly larvae, clams, and scuds, but their numbers were small compared to the midge larvae.

Midge (Chironomid)

Order: Diptera Family: Chironomidae

Number of species in North America: 2,000



CREEK CONNECTIONS,
Allegheny College

Size: 2-20 mm (larva) / 8-9 mm (adult)

Hardened head capsule
usually a different color
than body (sometimes yellowish)

Small, slender, slightly curved body

Sometimes has brush
like structure at
rear



Proleg

LARVA

BODY COLOR: white gray



MIDGE: Bloodworm

BODY COLOR: bright red



ADULT

SIMILAR LOOKING FAMILIES

Phantom Midge larva



Biting Midge larva and adult



DON'T CONFUSE WITH:

Aquatic Worms, Crane Fly Larva, Watersnipe Fly Larva, Blackfly Larva

Diet: Fine detritus, microorganisms, plant parts, decaying wood, insect parts, algae.

Food for: Fish, especially trout, predaceous water insects.

Habitat: Bottom dweller in the mud, stones or plants, most widely adapted to any freshwater environment.

Movement: Can float in water or scurry along bottom, some swim in still water.

Breathing: Through skin or by obtaining surface air through a breathing tube. Some types have gills.

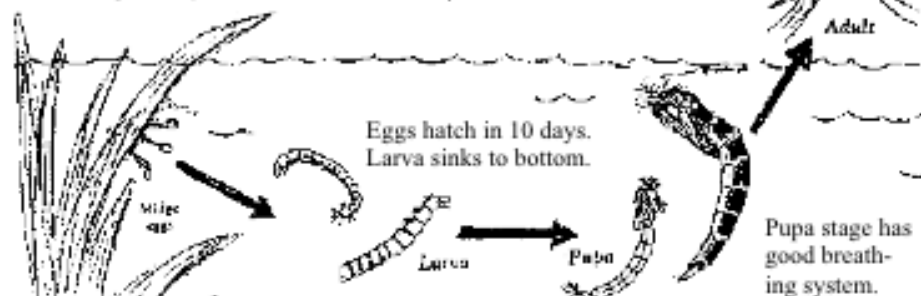
Water Quality Indicator: Group III- can tolerate polluted waters.

Credits: McCafferty, W. Patrick. *Aquatic Entomology*, 1981.
and
Reid, K. George. *A Golden Guide to Pond Life*, 1995.

Life Cycle Corner

Eggs layered in a tear shaped mass in a long ribbon of clear mucus attached to underwater plants, logs, and rocks.

Complete metamorphosis



Leech

Class: Hirudinia Order: Rhynenobdella



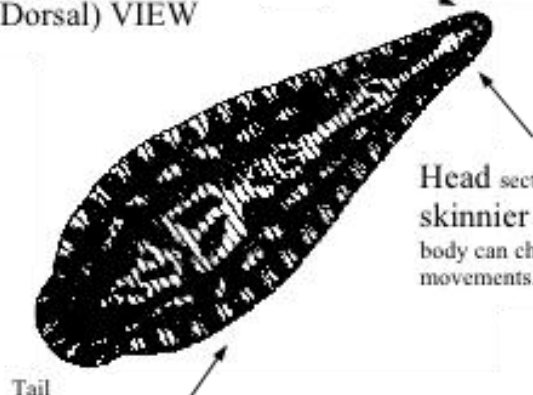
CREEK CONNECTIONS,
Allegheny College

Size: 5-100 mm (adult)

Number of species in North America: 63

Eyes may be visible and are located
in various places depending on the species.

TOP (Dorsal) VIEW



Tail

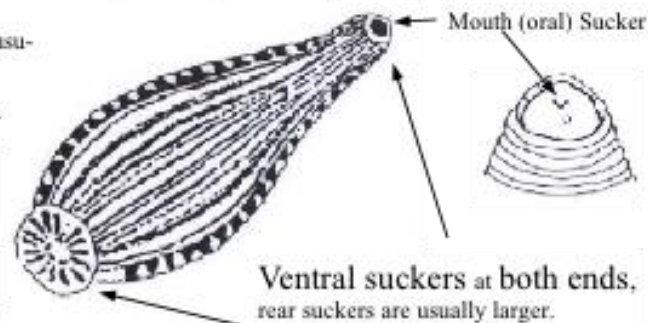
Flat, segmented body sometimes
with patterns and/or bright colors

Head section is usually
skinnier than rear, but
body can change with
movements.

BOTTOM (Ventral) VIEW

Ventral side is usu-
ally paler in color
than dorsal side.

Rear Sucker



Mouth (oral) Sucker

Ventral suckers at both ends,
rear suckers are usually larger.



Sometimes attach to and feed
off of living organisms
such as fish amphibians and reptiles.

SIMILAR TO: Planarian

- Planarian do not have suckers, leeches have suckers.
- Planarian do not have body segments, leeches have body segments.

Diet: Through suckers they scavenge or prey on insects, mollusks, and worms. Some are blood suckers to fish, amphibians, reptiles and water fowl.

Food for: Some fish and predaceous water insects.

Habitat: Bottom dweller along rocks and leaves or attach to other animals in ponds, streams, lakes, and rivers. Prefer slow stagnant waters.

Movement: Suckers used for movement, slide around, some may swim.

Breathing: Open breathing system, breath through skin and may move in wave-like motion to increase oxygen intake.

Water Quality Indicator: Group III- can exist under a wide range of water quality conditions including polluted waters.

Credits:
Headstrom, Richard. *Adventures with Freshwater Animals*. 1964.

Reid, K. George. *A Golden Guide to Pond Life*. 1995.

Foshell, J. Reese Jr. *A Guide to Common Freshwater Invertebrates of North America*. 2002.

Life Cycle Corner

Ring-like structures
form a cocoon
around eggs. These structures
can be found laying on the
stream bottom or slightly buried under
sediment.

Incomplete Metamorphosis

Eggs are carried
in a sac cocoon on
the underside of the female. Young
hatch and remain attached to the
mother, feeding on her mucus.



OR



Scud (Sideswimmer)

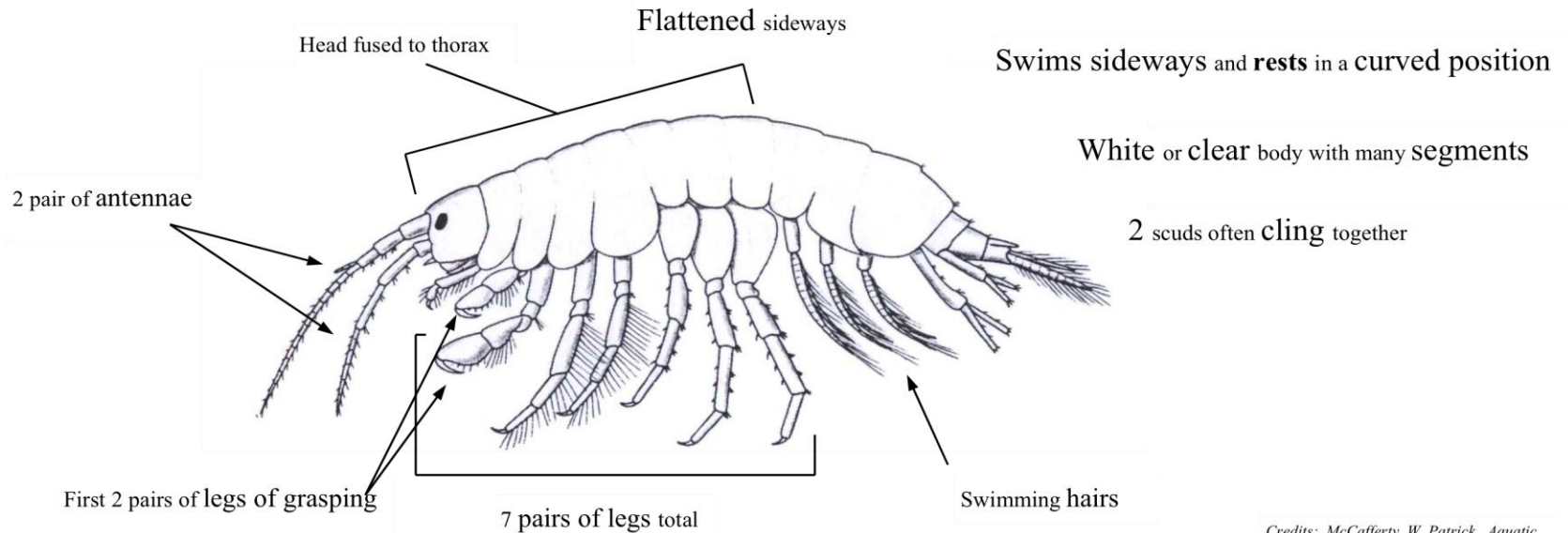
Size: 5-20mm

Order: Amphipoda Family: Gammaridae

Number of species in North America: 150



CREEK CONNECTIONS,
Allegheny College



Credits: McCafferty, W. Patrick. *Aquatic Entomology*, 1981.

SIMILAR TO: Aquatic Sowbug

- Body flattened side to side (scud) vs. body flattened top to bottom (aquatic sowbug).

Diet: Detritus (dead animal and plant pieces or other organic matter). Some may filter feed.

Food for: Fish, predaceous water insects.

Habitat: Open water and rests on bottom and on debris in shallow water environments.

Movement: Swims on side. Also crawls and walks. Often will swim in circles. More active at night.

Breathing: Movement of swimming hairs pushes oxygen into the gills under its body.

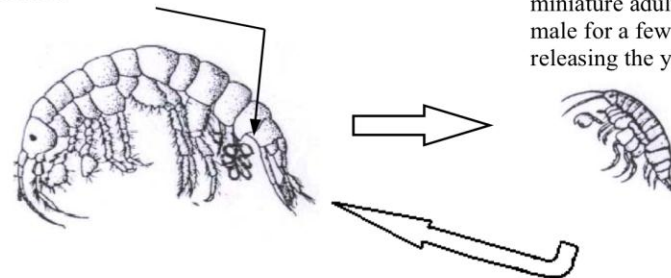
Water Quality Indicator: Group II – Can tolerate some water pollution.

Life Cycle Corner

Eggs kept with female in portions of a shedded skeleton.

Incomplete metamorphosis

Eggs hatch in 9 - 30 days revealing miniature adults that stay with female for a few days until she molts releasing the young.



Alderfly Larvae

Order: Megaloptera Family: Sialidae

Number of species in North America: 24



CREEK CONNECTIONS,
Allegheny College

Size: 10-25mm (larvae) / < 20mm (adult)

Prominent chewing
mouthparts on head

Thick, hardened
skin on head and thorax

Wing pads absent on thorax

Thin, soft skin on abdomen

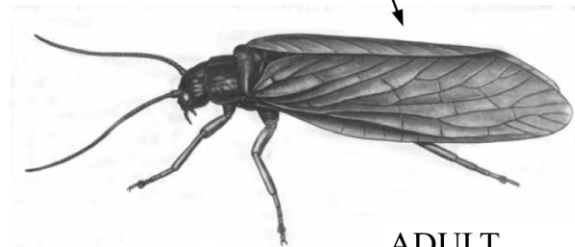
7-8 pairs of stout, tapering
filaments on sides of abdomen

3 pairs of segmented
legs extend from thorax

One sticklike tail with
hairs

LARVA

Blackish-dark brown wings



ADULT

Adult alderflies are awkward fliers, but
good runners.

Credits: McCafferty, W. Patrick. *Aquatic Entomology*,
1981.

Life Cycle Corner

Complete metamorphosis



After crawling
out of cell, adults live only a
few days (females: 3 days/
males: 8-10).

Dig cell in soil using
jaws and legs to pupate.



Swim to shore,
crawl out of water.

Masses of dark-brown eggs are
deposited onto the underside of
overhanging leaves and
twigs at nighttime.



Newly hatched larvae have a
gas-bubble in their butts
which enables larvae in this
stage to float.



Diet: Actively roam for small prey; search in mud and on bottom.

Food for: Game fish, predaceous water insects.

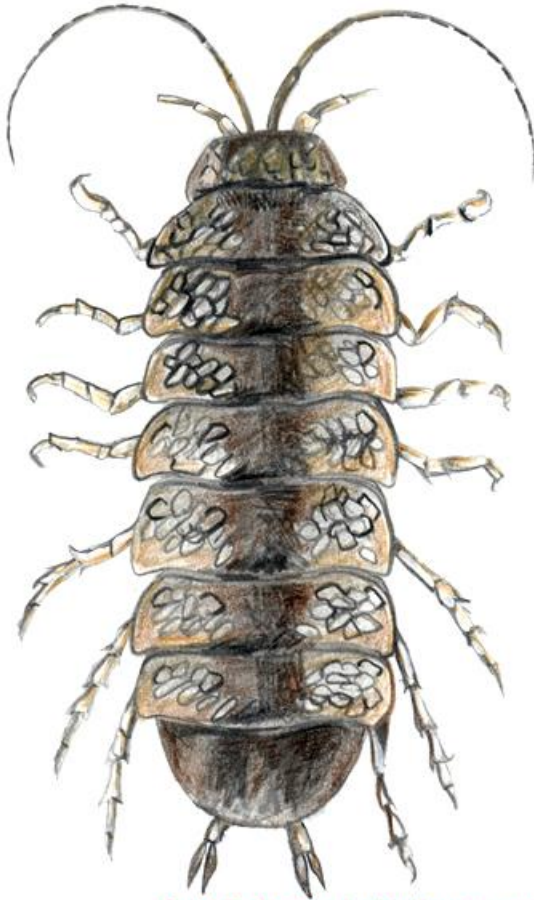
Habitat: Standing water or slow parts of moving water. Found on soft bottom.

Movement: Burrowers; dig in upper 10cm of substrate.

Breathing: Open breathing system— diffusion across soft, fleshy tissues.

Water Quality Indicator: Group II— can exist under a wide range of water.
quality conditions; a large number indicates MODERATE water quality.

Group II: Can exist under a wide range of water quality conditions.
Large numbers of these organisms, in the absence of Group I organisms, normally indicate MODERATE



Gina Mikel, www.scientificillustrator.com

Aquatic sowbugs are also referred to as water lice.

Order: Isopoda
Family: Asellidae

Stream Profile

Width of stream = 16 ft.

Segment #	Segment Distance	Depth A	Depth B	Average Depth	Area of Segment (ft ²)	Average Flow at 0.6	Flow ft ³ /sec. (CFS)
1	2.00	0.25	0.40	0.33	0.65	0.11	0.07
2	2.00	0.40	0.70	0.55	1.10	0.16	0.18
3	2.00	0.70	0.90	0.80	1.60	0.17	0.27
4	2.00	0.90	1.30	1.10	2.20	0.16	0.35
5	2.00	1.30	1.50	1.40	2.80	0.11	0.31
6	2.00	1.50	1.25	1.38	2.75	0.15	0.41
7	2.00	1.25	1.80	1.53	3.05	0.09	0.27
8	2.00	1.80	0.20	1.00	2.00	0.07	0.14

Q = total discharge

Q in CFS 2.01

Q in L/s 56.82

Weather Conditions

- Water temperature: 45 ° Fahrenheit
- Air temperature: 43 ° Fahrenheit
- Weather: ☐ rain ☒ cloudy ☐ clear

☐ rain in last 24 hours

☒ rain in last 12 hours.

☐ rain in last 6 hours.

Advantages of using BMI to monitor water quality.

- Benthos cannot move around much so can't move away from polluted areas like fish can.
- They are small and easy to collect.
- Different benthos have different tolerances to pollution so make good indicators.

Macroinvertebrate Count

R (rare) = 1-9 organisms; C (common) = 10-99 organisms; or D (dominant) = 100 or more organisms

GROUP I – SENSITIVE

_____ (____) Gilled Snails	_____ (____) Riffle Beetle Adults
_____ (____) Mayfly Nymphs	_____ (____) Stonefly Nymphs
_____ (____) Non-Net-Spinning	_____ (____) Water Penny Larvae
_____ (____) Caddisfly Larvae	_____ (____) Hellgrammites

GROUP II –SOMEWHAT SENSITIVE

___2___ (___R___) Alderfly Larvae	_____ (____) Damselfly Nymphs
___9___ (___R___) Aquatic Sowbugs	_____ (____) Fishfly Larvae
_____ (____) Beetle Larvae	_____ (____) Net-Spinning
___12___ (___C___) Clams & Mussels	___43___ (___C___) Scuds
___1___ (___R___) Crane-fly Larvae	
_____ (____) Crayfish	

GROUP III – TOLERANT

___15___ (___C___) Aquatic Worms	___232___ (___D___) Midge Larvae
_____ (____) Blackfly Larvae	_____ (____) Snails
___8___ (___R___) Leeches	

Water Quality Rating

To calculate the index value, add the number of **letters** (not numbers of macros) found in the three groups on the other side and multiply by the indicated weighing factor.

Group I - Sensitive

$$(\# \text{ of R's}) \times 5.0 = \underline{\hspace{2cm}}$$

$$(\# \text{ of C's}) \times 5.6 = \underline{\hspace{2cm}}$$

$$(\# \text{ of D's}) \times 5.3 = \underline{\hspace{2cm}}$$

$$\text{Sum of Index Value for Group I} = \underline{\hspace{2cm}}$$

Group II - Somewhat Sensitive

$$(\# \text{ of R's}) \times 3.2 = \underline{\hspace{1cm}}9.6\underline{\hspace{1cm}}$$

$$(\# \text{ of C's}) \times 3.4 = \underline{\hspace{1cm}}6.8\underline{\hspace{1cm}}$$

$$(\# \text{ of D's}) \times 3.0 = \underline{\hspace{2cm}}$$

$$\text{Sum of Index Value for Group II} = \underline{\hspace{1cm}}16.4\underline{\hspace{1cm}}$$

Group III - Tolerant

$$(\# \text{ of R's}) \times 1.2 = \underline{\hspace{1cm}}1.2\underline{\hspace{1cm}}$$

$$(\# \text{ of C's}) \times 1.1 = \underline{\hspace{1cm}}1.1\underline{\hspace{1cm}}$$

$$(\# \text{ of D's}) \times 1.0 = \underline{\hspace{1cm}}1.0\underline{\hspace{1cm}}$$

$$\text{Sum of Index Value for Group III} = \underline{\hspace{1cm}}3.3\underline{\hspace{1cm}}$$

To calculate the water quality score for the stream site, add together the index values for each pollution tolerance group. The sum of these values equals the water quality score.

Water Quality Score = _____**19.7**_____

Compare this score to the following number ranges to determine the quality of your Stream site:

Good > 40

Fair 20 - 40

Poor < 20

Note: The tolerance groupings (Group I, II, III) and the water quality rating categories were developed for streams in the Mid-Atlantic states.