BIOLOGICAL MONITORING

Chapter 5

BIOLOGICAL MONITORING

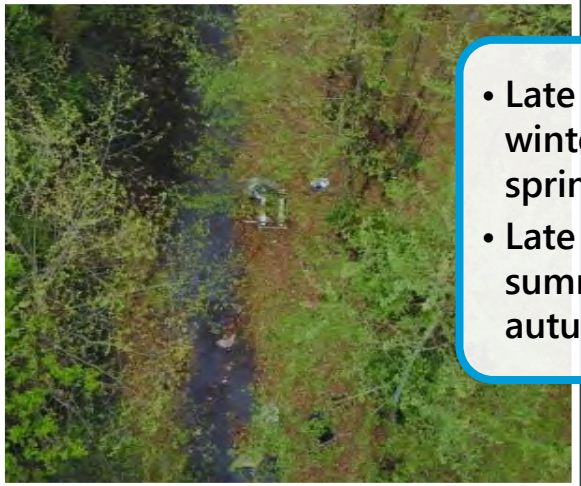
Habitats

BIOLOGICAL MONITORING

THREE NET SETS

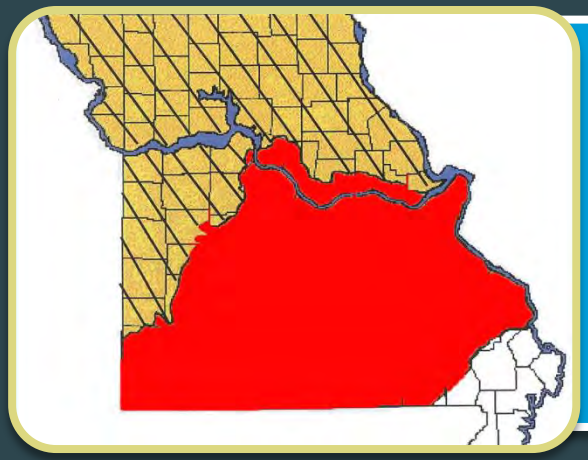
Three microhabitats

TWICE PER YEAR



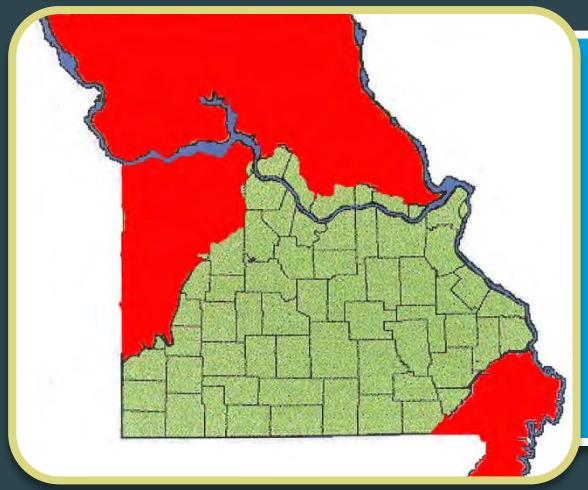
- Late winter/early spring
- Late summer/early autumn

STREAM HABITATS



Ozark

- Riffles
- Root Mats



Prairie & Lowland

- Root Mats
- Snags & Woody Debris
- Non-flow & Pools

INSTRUCTIONS FOR BIOLOGICAL MONITORING

1. Riffles
2. Root mats
3. Snags
4. Non-flow

DNR Photo

North Fork of the White River, DNR photo

RIFFLE

Sampling Methods

Riffle
Root Mat
Snag
Non-flow

1. Place net in riffle
2. Ensure bottom of net is on stream bottom
3. Weigh down bottom of net with large rocks

4. Remove and rub large rocks over net, then set aside.
5. Do the *Benthic Boogie* in 3'x3' area, disturbing substrate 3-6" deep

6. Rub and remove large rocks from net
7. Slowly lift net from stream, ensuring water does not pour over sides

8. Move to land to pick and sort invertebrates from net

STREAM HABITATS

Ozark Streams

Riffles

Root Mats

Prairie & Lowland Streams

Root Mats

Snags/Woody Debris

Non-Flow

SAMPLING NON-RIFFLE AREAS

Root Mats

Root Mat - Matted roots of vegetation hanging into the water or growing out of the streambank.

ROOT MATS

Root Mat - Matted roots of vegetation hanging into the water or growing out of stream bank

ROOT HAIRS

1. Place net under root mat
2. Kick and swirl the water to dislodge the invertebrates from the root mat into the net

3. Slowly lift net from stream, ensuring water does not pour over sides
4. Move net to land to pick and sort invertebrates

STREAM HABITATS

Ozark Streams

Riffles

Root Mats

Prairie & Lowland Streams

Root Mats

Snags/Woody Debris

Non-Flow

SAMPLING NON-RIFFLE AREAS

- A SNAG -

Snag – Woody debris such as tree limbs, logs, and sticks that have fallen in water and started to decay.

LARGE WOODY DEBRIS, SNAG

1. Place net under woody debris

2. Use a brush to scrub woody debris
3. Move net to land to pick and sort invertebrates

STREAM HABITATS

Ozark Streams

Riffles

Root Mats

Prairie & Lowland Streams

Root Mats

Snags/Woody Debris

Non-Flow

1. Shuffle feet while moving backward and sweeping D-net through water
2. Empty net contents into sorting tray on land
3. Pick and sort invertebrates

MACROINVERTEBRATE DATA SHEET

Please check the box next to the "Site #" ***if this is a new site and please be sure to attach a map.*** (PLEASE PRINT)

☐ Site # _____ Stream _____ County _____

Site Location _____

Date _____ Time (military time) _____ Rainfall (inches in last 7 days) _____ Water Temp. (°C) _____

Trained Data Submitter (responsible volunteer) _____ Stream Team Number _____

Participants

Invertebrate Type	*Net Set #1*	*Net Set #2*	*Net Set #3*	*Score*
Habitat type →				
Net Type *(circle type)* →	*Kick Net* **or** *D-Net*	*Kick Net* **or** *D-Net*	*Kick Net* **or** *D-Net*	*After entering the* ***number(#) of organisms collected****, circle the number below for every type of organism collected. Add the numbers circled and record the totals as your Water Quality Rating.*
Time Spent Picking (Minutes picking x number of people picking)	min. picking ____ × # people ____ = total min. ____	min. picking ____ × # people ____ = total min. ____	min. picking ____ × # people ____ = total min. ____	
Sensitive	**# of Organisms**	**# of Organisms**	**# of Organisms**	**Circle Types Present**
Caddisfly Larvae				3
Hellgrammites				3
Mayfly Nymphs				3
Gilled Snails (right)				3
Riffle Beetles				3
Stonefly Nymphs				3
Water Penny Larvae				3
Somewhat Tolerant	**# of Organisms**	**# of Organisms**	**# of Organisms**	**Circle Types Present**
Other Beetle Larvae				2
Clams/Mussels				2
Crane Fly Larvae				2
Crayfish				2
Dragonfly Nymphs				2
Damselfly Nymphs				2
Scuds				2
Sowbugs				2
Fishfly Larvae				2
Alderfly Larvae				2
Watersnipe Fly				2
Tolerant	**# of Organisms**	**# of Organisms**	**# of Organisms**	**Circle Types Present**
Aquatic Worms				1
Black Fly Larvae				1
Leeches				1
Midge Larvae				1
Pouch Snails (left)				1
Other Snails (flat)				1
< 12 = Poor	12-17 = Fair	18-23 = Good	>23 = Excellent	**Water Quality Rating** ___

Comments (mention any changes from your usual readings) _____

Fish Present (Please Mark) **Yes**☐ **or No**☐

Instructions for Biological Monitoring

- Collect three net sets of invertebrates from three different microhabitats. This ensures a more complete picture of what lives in your stream and more accurately reflects health. Adequate sampling requires two people and the use of a kick net. If sampling by yourself, a D-frame net may be needed.
- If possible, take all three net sets from different areas within a stable riffle. Microhabitats to sample include differences in: rock size, flow, leaf packs and emergent vegetation.
- Be sure to note which type of net you use to sample: kick net or D-frame net.
- Always work in an upstream direction so sampling activities do not disturb portions of the riffle to be sampled later.
- *If, and only if, you do not have enough riffle habitat with in your 300 ft. sampling site* to collect three net sets, you may also want to sample alternative microhabitats.
  - Prioritize sampling of habitat types as follows:
    - Riffle
    - Root mat
    - Snags
    - Non-flow
  - Whatever habitats you decide to sample at your site (e.g., two riffle net sets and one root mat), always sample those same three habitats at the site every time you sample there and list the habitat type for each sample. This will ensure that the data you collect remains consistent over time.

Sampling Streams With Riffles

Adequate sampling requires two people, one to hold the net and the other to dislodge invertebrates from the substrate.

1. Place the net in the riffle facing upstream, and tilt it enough to provide a "pocket."
2. Ensure the bottom of the net is on the stream bottom leaving no room between the net and the substrate. This prevents organisms from washing under the net.
3. Rub all large stones in the 3-foot by 3-foot (3'x3') area immediately upstream of the net to dislodge invertebrates and wash them into the net.
4. "Dance and Kick" with your feet in the 3'x3' area until you have disturbed all the substrate 3 inches to 6 inches deep to dislodge the invertebrates into the net.

Streams Without Riffles (or without riffles large enough for 3 net sets)

Sample Collection from Root Mats - Adequate sampling requires two people

1. Have one person place the side of the kick net against the bank on the downstream side of the root mat.
2. Make sure that the net is anchored to the stream bed.
3. The other person will then kick the root mat in a swirling motion with one foot to create a circular current in order to dislodge the invertebrates from the root mat. The circular motion of the sampler's foot will drive the invertebrates into the net, even if there is no current.

Sample Collection from Snags - Adequate sampling requires two people.

1. Have one person hold the net horizontal position about 6-12 inches under the water.
2. The 2nd volunteer will remove the snag from the water. When removing the snag from the water pull the snag out of the water quickly. If the snag is removed too slowly, the invertebrates may swim off.
3. Brush the snag down with a brush above the net to dislodge invertebrates.
4. Sample approximately 3-5 snags for one net set.

Sample non-flow areas in the same manner as a riffle, collecting three separate samples. However, the sampler will need to use a swirling motion with the foot to create a current to move debris into the net. Although this habitat can be sampled using a kick net, it is easier with a D-frame net. If using a D-frame net, you will need to disturb the substrate and sweep the net in a circular motion over the disturbed substrate to collect the organisms. Be sure to run two passes with the D-frame net to equal one net set.

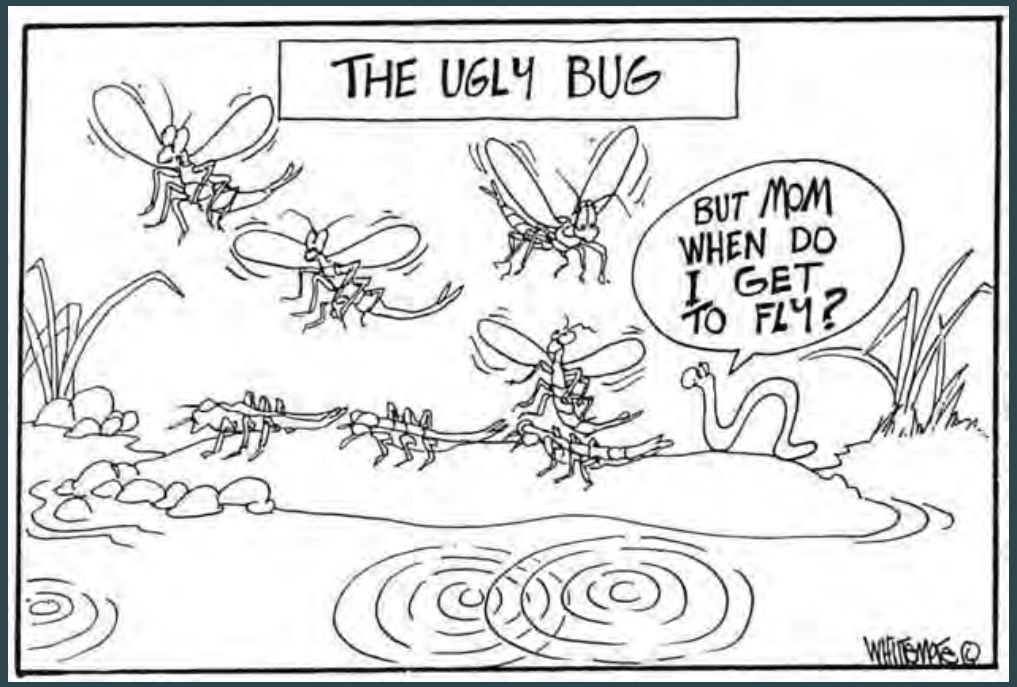
PLEASE KEEP A COPY AND SEND ORIGINAL DATA TO:

Stream Team Coordinator/Water Protection Program
Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Water Quality Volunteer

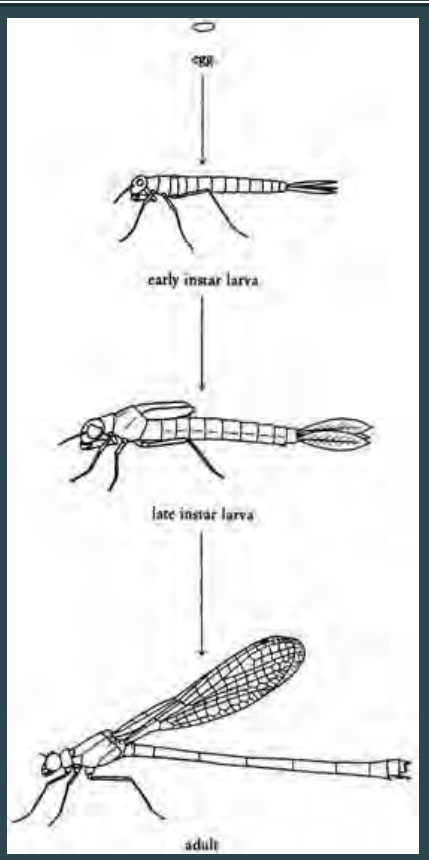
MACROINVERTEBRATES

Spend up to 99% of their lives in the water as nymphs or larvae



INCOMPLETE METAMORPHOSIS
(NYMPHS)

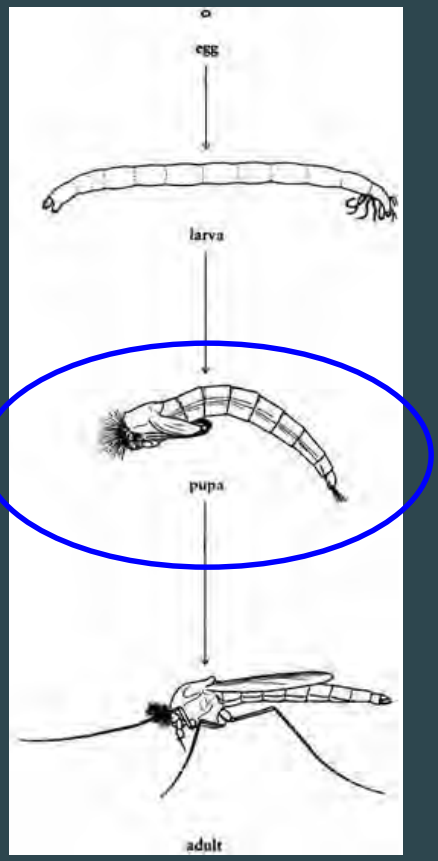
- Ephemeroptera (mayflies)
- Plecoptera (stoneflies)
- Odonata (dragon flies and damselflies)
- Hemiptera (backswimmers - water boatmen)



Drawing from McCafferty: *Aquatic Entomology*

COMPLETE METAMORPHOSIS
(LARVAE)

- Trichoptera (caddisflies)
- Coleoptera (water pennies, riffle beetles)
- Diptera (crane flies, black flies, midges, watersnipe flies)
- Megaloptera (dobsonflies/hellgrammites, alderflies, fishflies)
- Neuroptera (spongillaflies)
- Lepidoptera (aquatic caterpillars and moths)



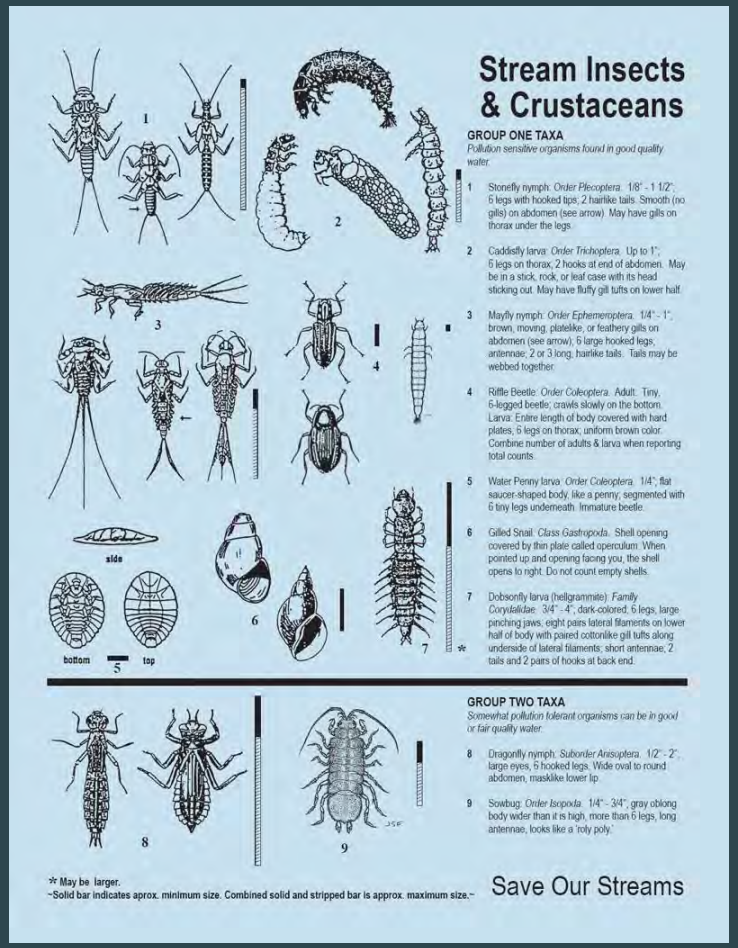
Drawing from McCafferty: *Aquatic Entomology*

INVERTEBRATE MORPHOLOGY

- Morph = "Body structure"
- -ology = "The study of"
- Morphology = "The biological study of form, shape and structure of living organisms"

THE BLUE BUG CARD

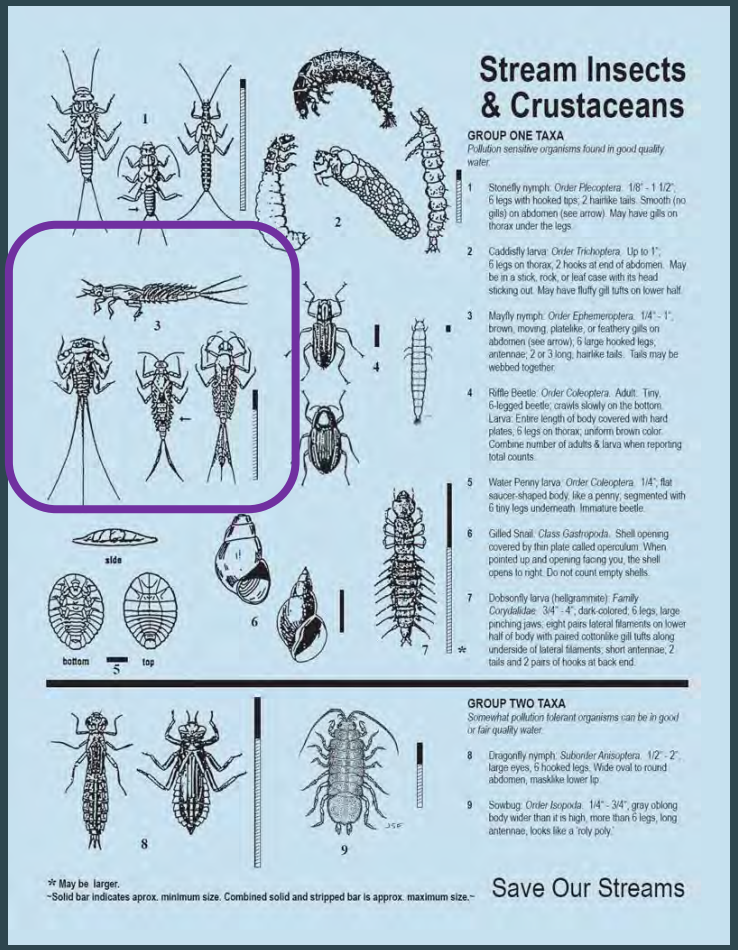
- A visual key
- Utilizes a size bar
- Help match organism to drawings
- Similar to “field guide approach”

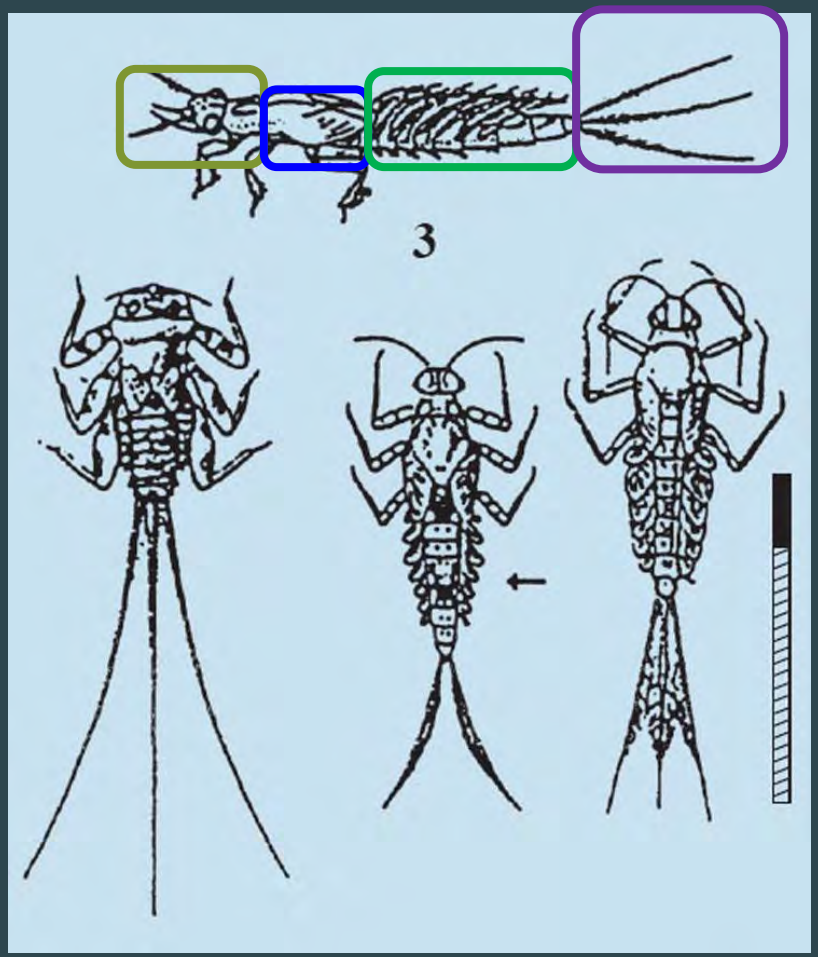


INVERTEBRATE ID
POLLUTION SENSITIVE

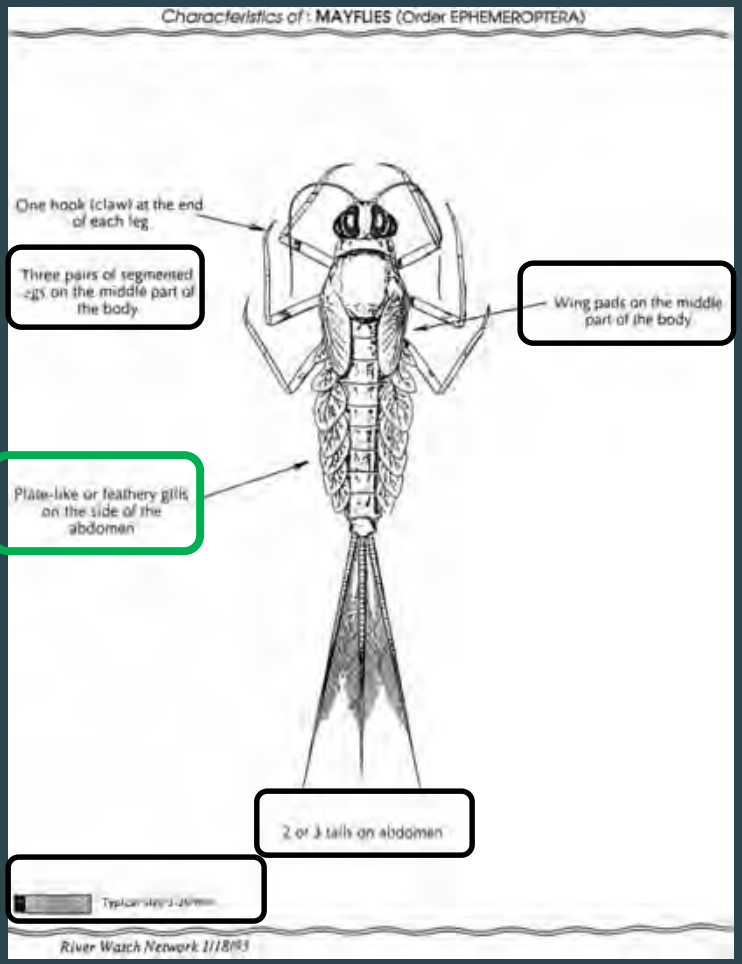
BLUE BUG CARD

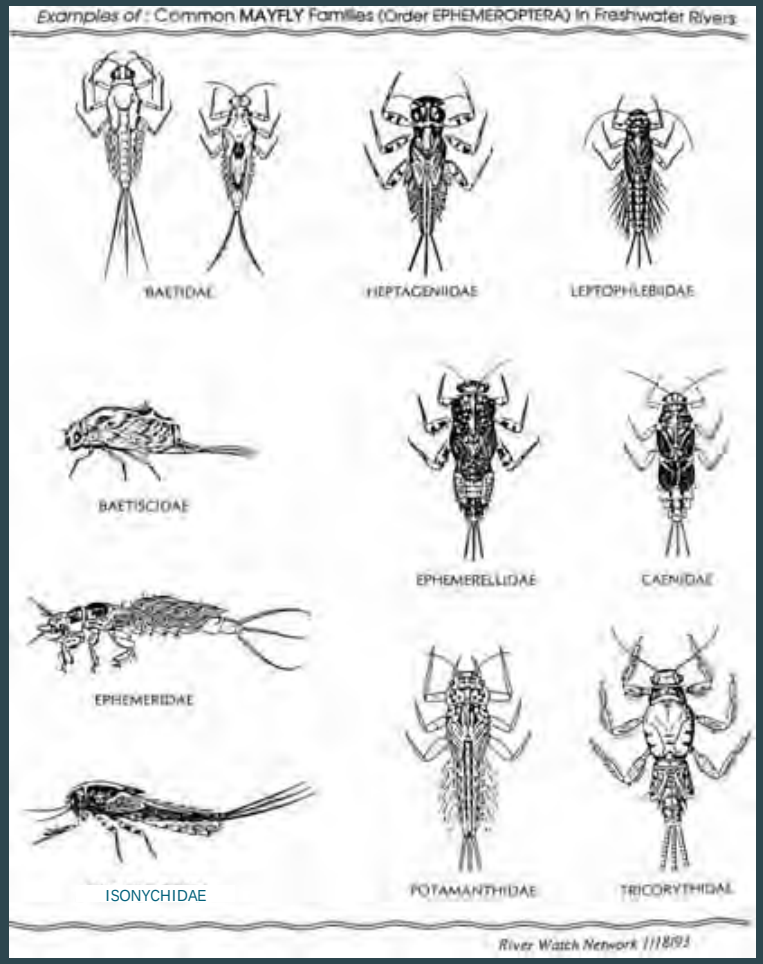
(MAYFLY NYMPHS)





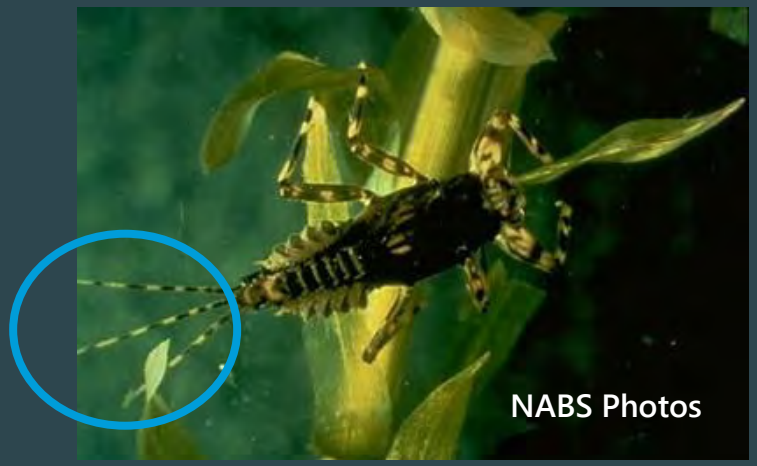
MAYFLY NYMPHS





MAYFLY NYMPHS

- Feathery or plate-like gills on abdomen
- Usually three tails
- Six legs each ending in one hook



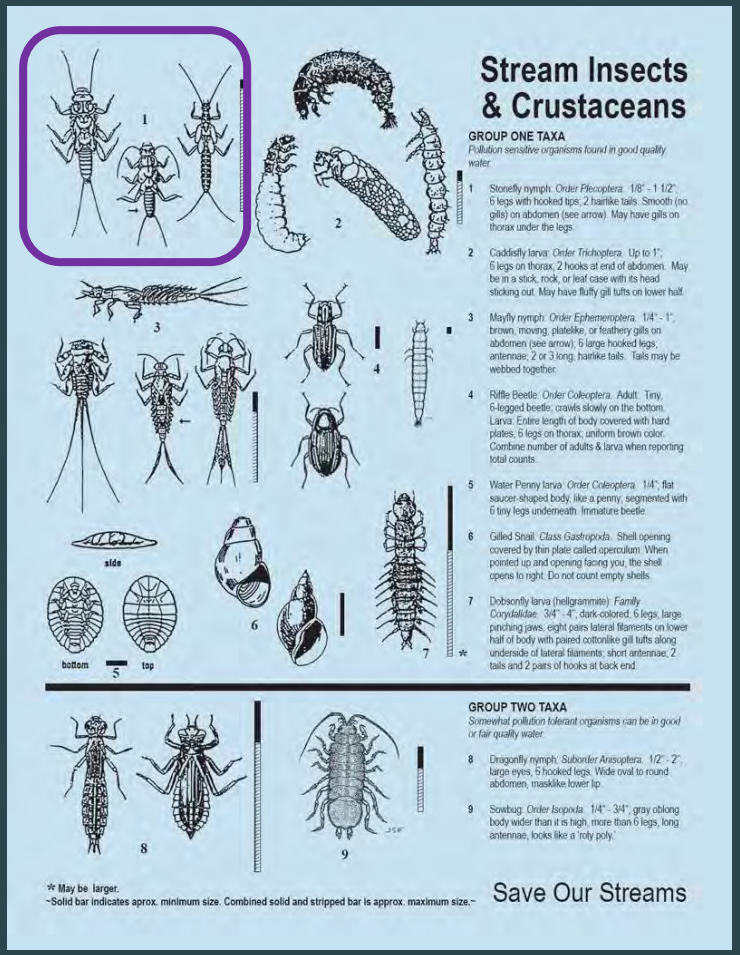
MAYFLY NYMPHS

MAYFLY ADULT

- Short lived
- No functioning mouth parts

BLUE BUG CARD

(STONEFLY NYMPHS)



Stream Insects & Crustaceans

GROUP ONE TAXA

Pollution sensitive organisms found in good quality water.

1 Stonefly nymph: *Order Plecoptera*. 1/8" - 1 1/2"; 6 legs with hooked tips; 2 hairlike tails. Smooth (no gills) on abdomen (see arrow). May have gills on thorax under the legs.

2 Caddisfly larva: *Order Trichoptera*. Up to 1"; 6 legs on thorax, 2 hooks at end of abdomen. May be in a stick, rock, or leaf case with its head sticking out. May have fluffy gill tufts on lower half.

3 Mayfly nymph: *Order Ephemeroptera*. 1/4" - 1"; brown, moving, platelike, or feathery gills on abdomen (see arrow); 6 large hooked legs; antennae; 2 or 3 long, hairlike tails. Tails may be webbed together.

4 Riffle Beetle: *Order Coleoptera*. Adult: Tiny, 6-legged beetle; crawls slowly on the bottom. Larva: Entire length of body covered with hard plates; 6 legs on thorax; uniform brown color. Combine number of adults & larva when reporting total counts.

5 Water Penny larva: *Order Coleoptera*. 1/4"; flat saucer-shaped body, like a penny, segmented with 6 tiny legs underneath. Immature beetle.

6 Gilled Snail: *Class Gastropoda*. Shell opening covered by thin plate called operculum. When pointed up and opening facing you, the shell opens to right. Do not count empty shells.

7 Dobsonfly larva (hellgrammite): *Family Corydalidae*. 3/4" - 4"; dark-colored, 6 legs, large pinching jaws; eight pairs lateral filaments on lower half of body with paired cottonlike gill tufts along underside of lateral filaments; short antennae; 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

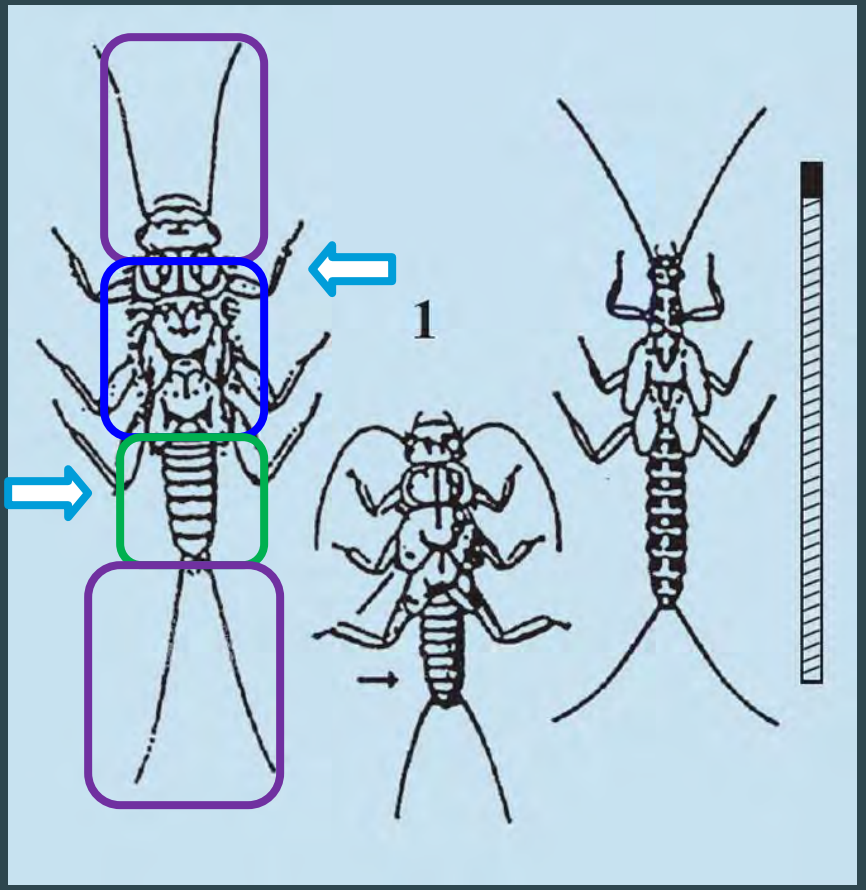
Somewhat pollution tolerant organisms can be in good or fair quality water.

8 Dragonfly nymph: *Suborder Anisoptera*. 1/2" - 2"; large eyes, 6 hooked legs. Wide oval to round abdomen, masklike lower lip.

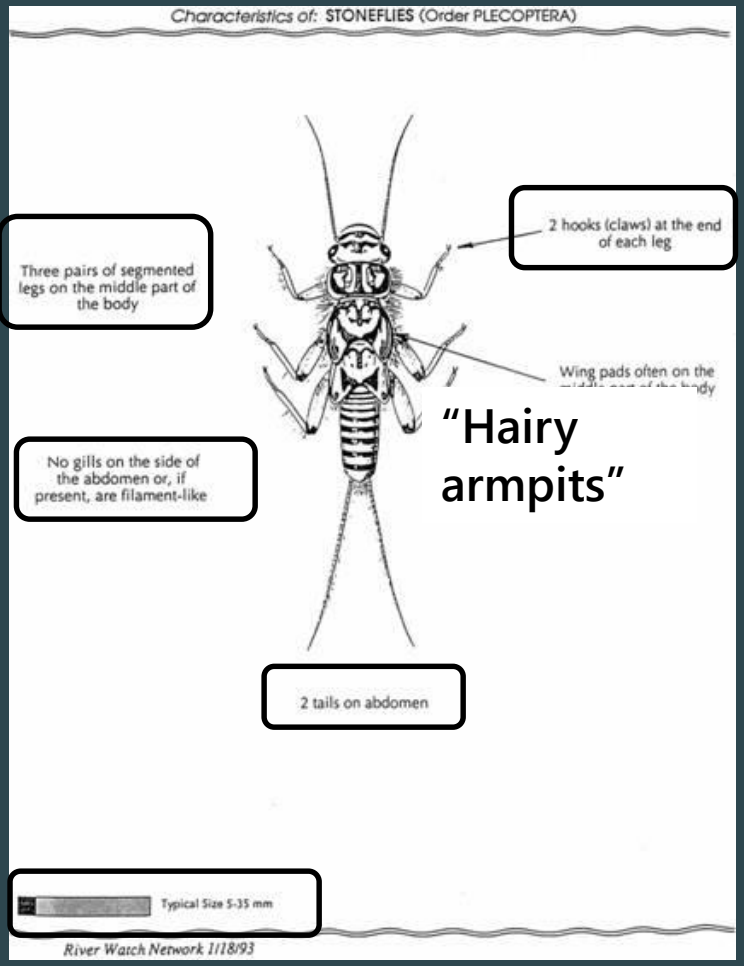
9 Sowbug: *Order Isopoda*. 1/4" - 3/4"; gray oblong body wider than it is high, more than 6 legs, long antennae, looks like a 'roly poly.'

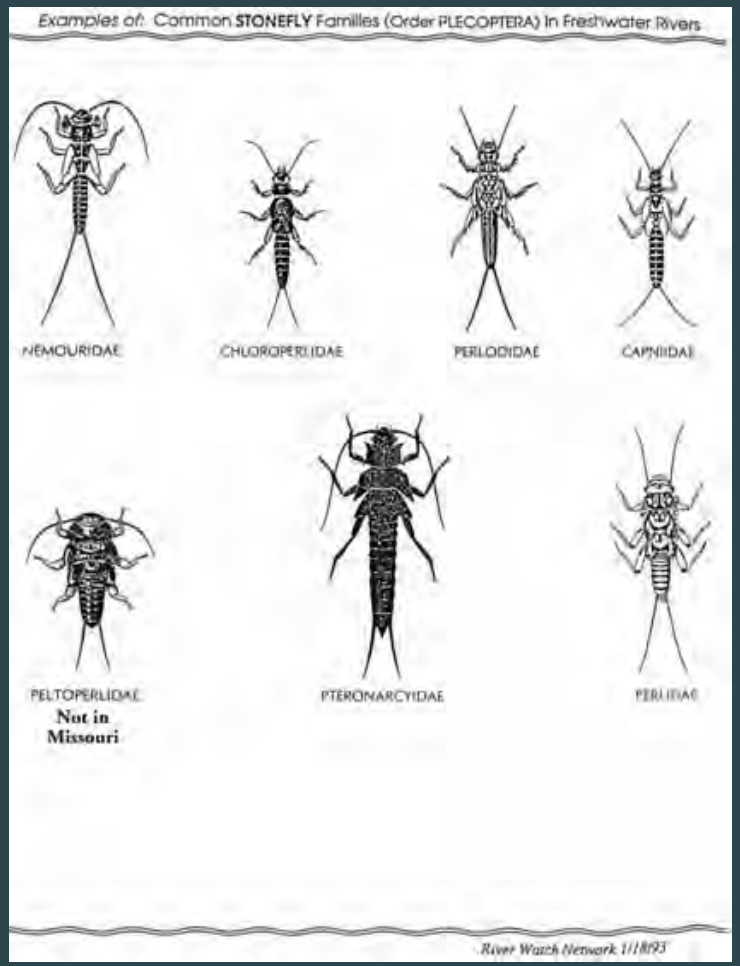
☆ May be larger.
~Solid bar indicates aprox. minimum size. Combined solid and stripped bar is approx. maximum size.~

Save Our Streams



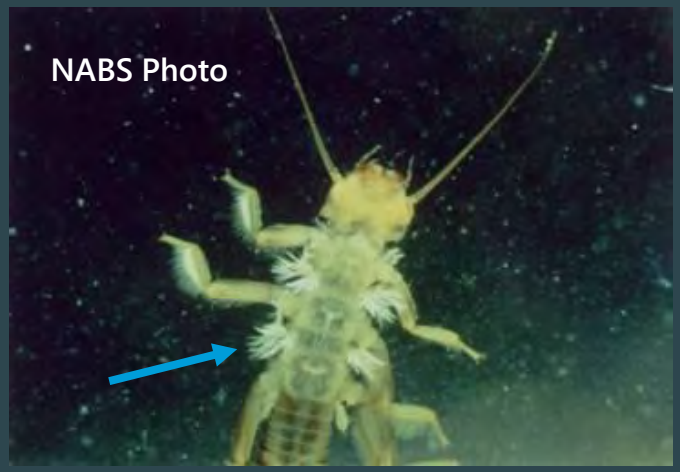
STONEFLY NYMPHS





STONEFLY NYMPHS

- No gills on the abdomen – may have gills on thorax
- Usually two tails

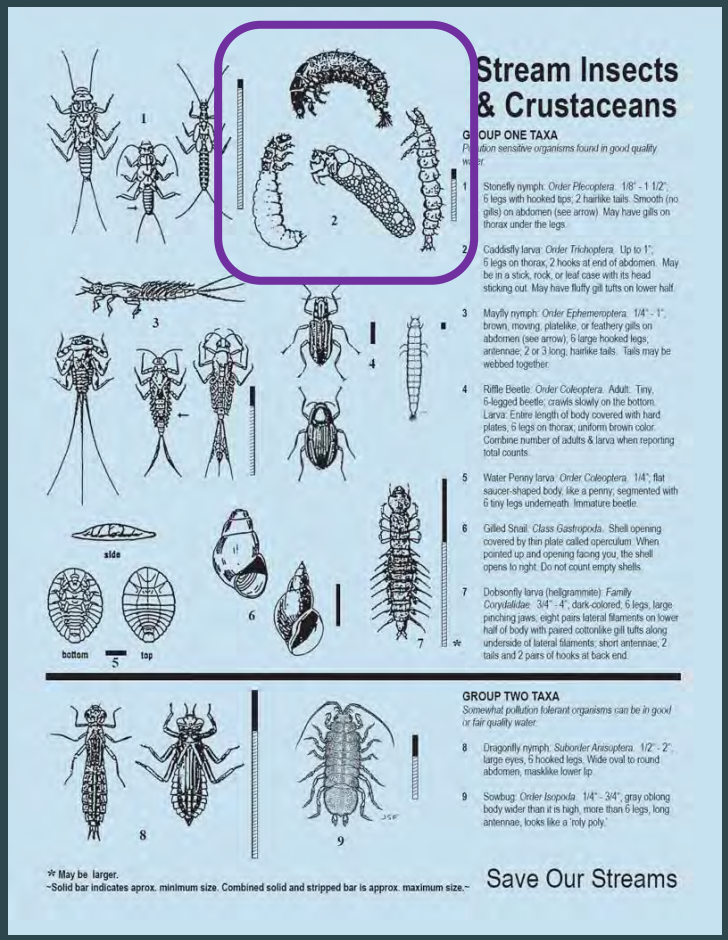


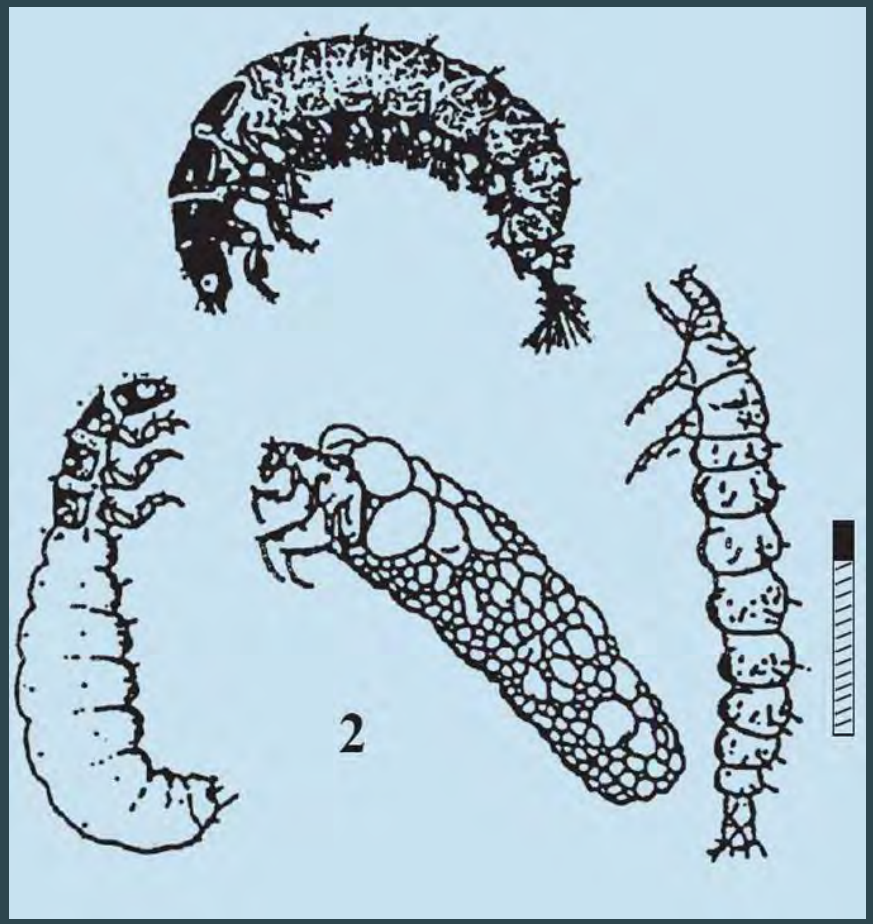
STONEFLY ADULTS

- Not very strong fliers
- Spends most of time in streamside vegetation

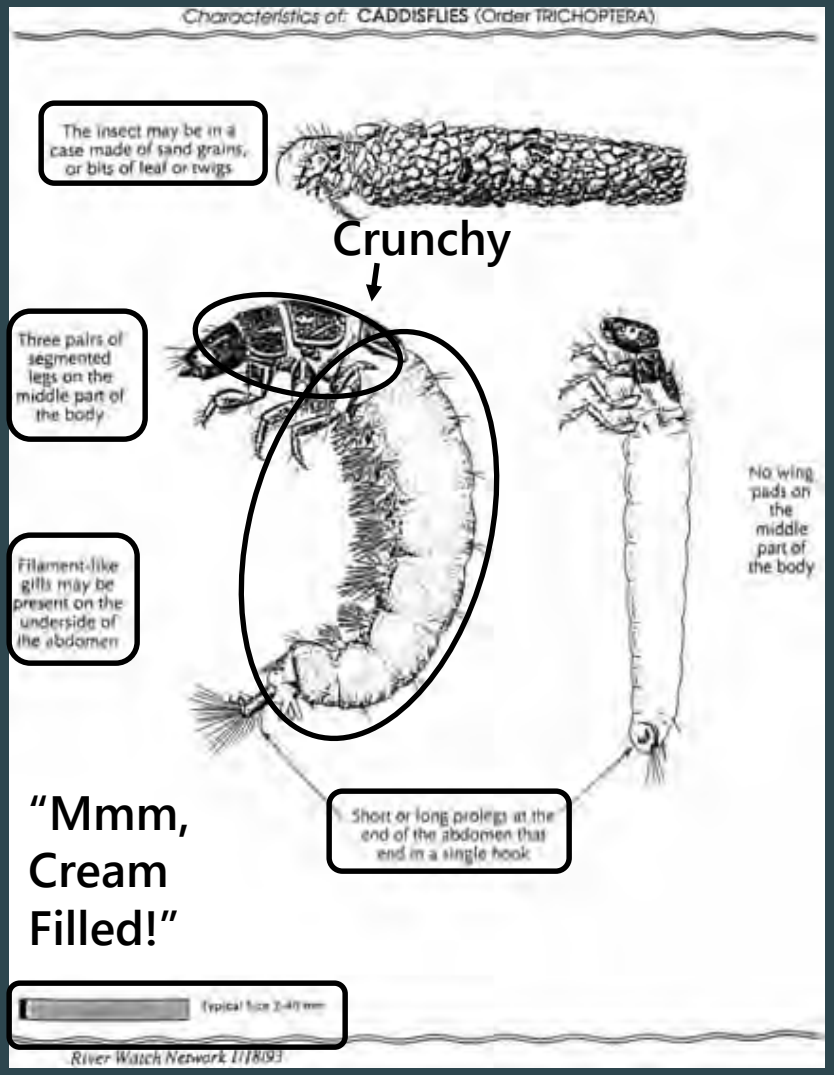
BLUE BUG CARD

(CADDISFLY LARVAE)

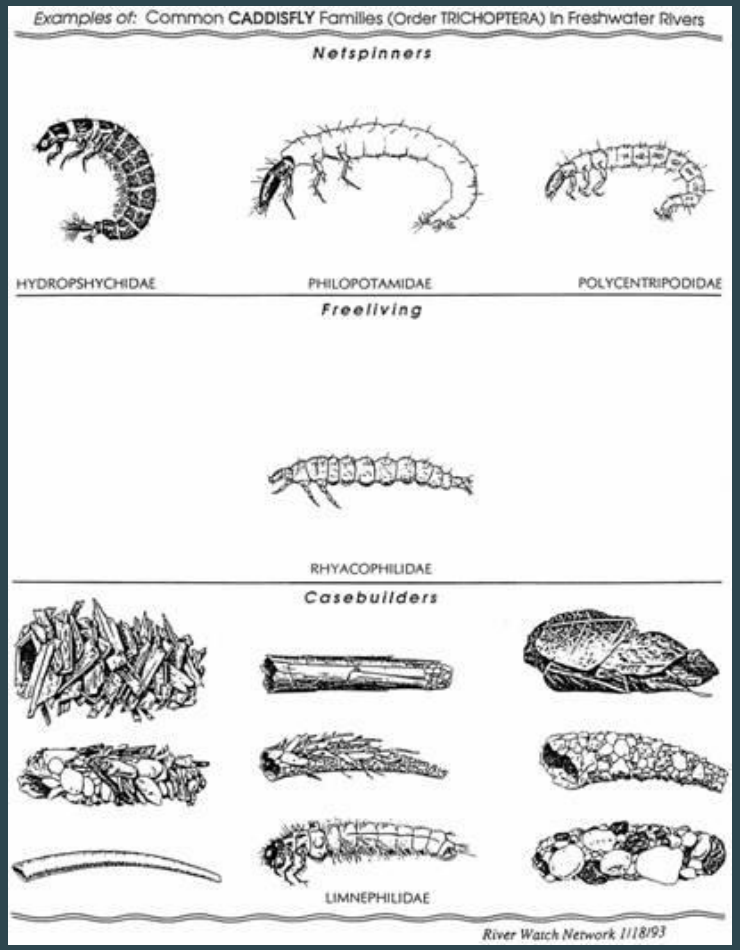


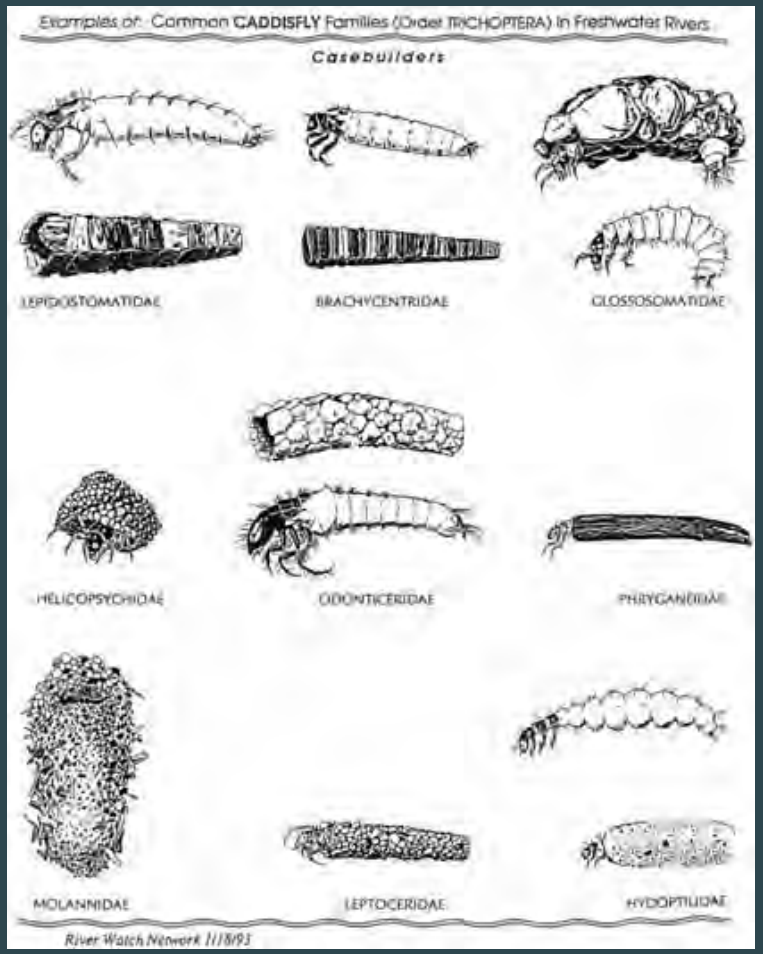


CADDISFLY LARVAE



CADDISFLY LARVAE



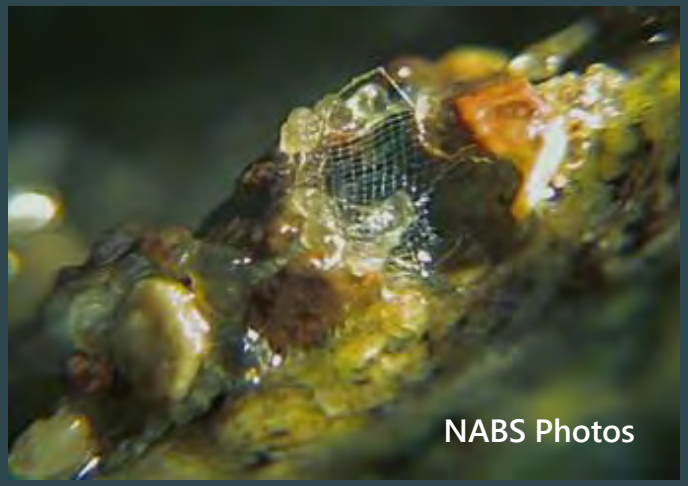


CADDISFLY LARVAE

- Thorax – "crunchy"
- Abdomen – "cream-filled"
- May have gills
- Two hooks on abdomen

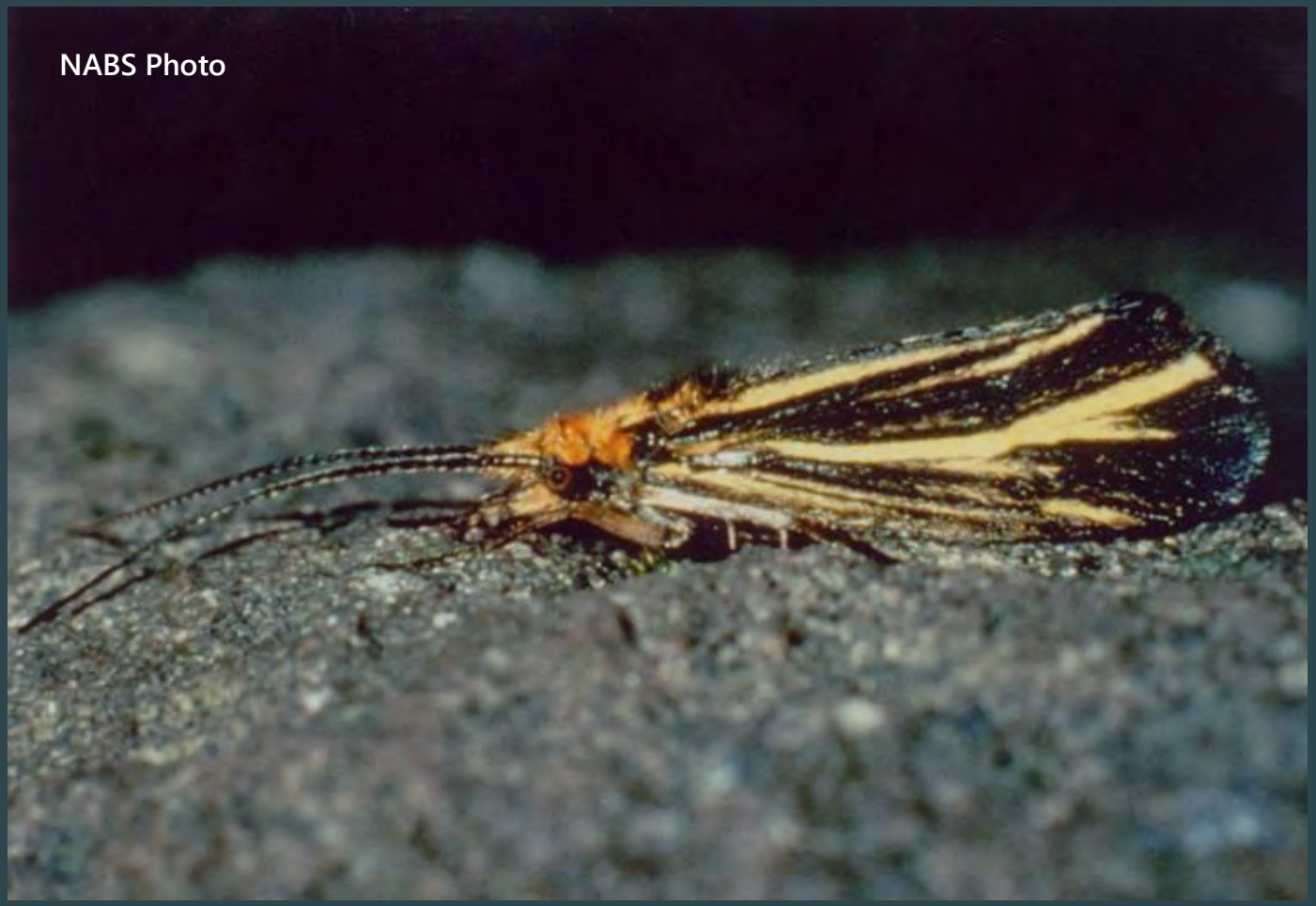
CADDISFLY LARVAE
(FREE LIVING)

CADDISFLY LARVAE
(NET SPINNING)



CADDISFLY LARVAE
(CASE-BUILDERS)

CADDISFLY ADULT



WATER PENNY

- Flat like a penny
- Saucer shaped
- Segmented
- Legs underneath

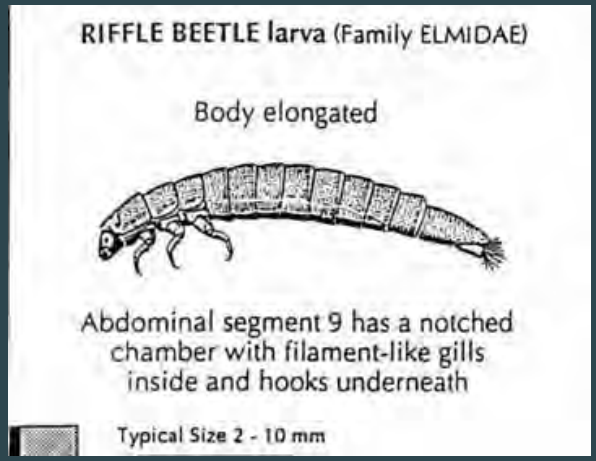
GILLED SNAILS

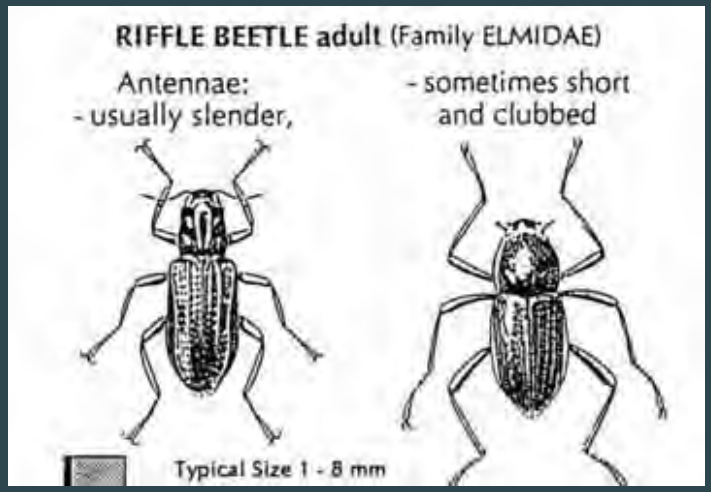
- When holding the snail with the point up and the opening facing you, the shell opens to the right

- DO NOT COUNT EMPTY SHELLS

RIFFLE BEETLES

- Larvae have six legs and covered with hard plates over entire length of body
- Adult is tiny aquatic beetle, has six legs





RIFFLE BEETLE
(LARVAE)

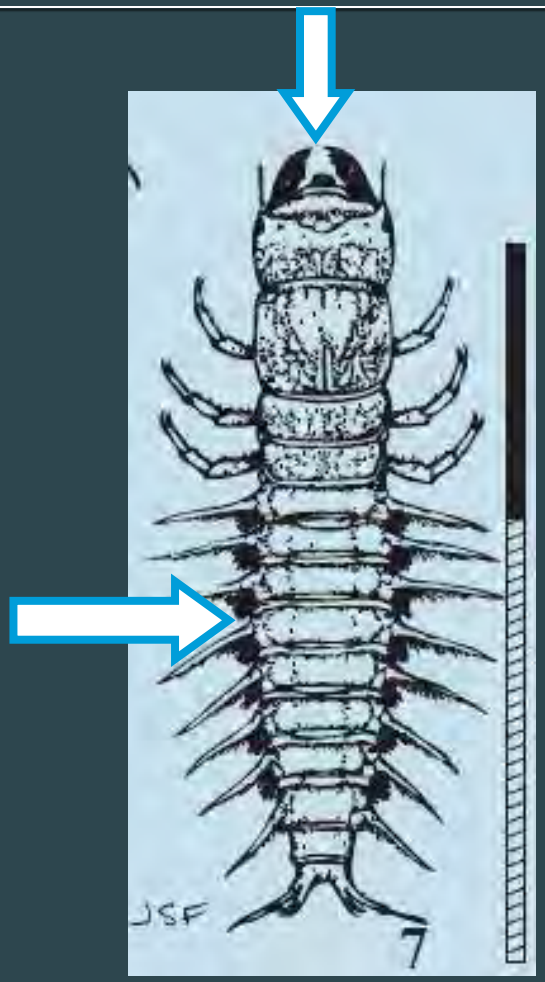
- Often confused with caddisfly larvae or midge fly larvae
- Covered with hard plates over entire length of body
- Six legs

RIFFLE BEETLE
(ADULTS)

- Aquatic as an adult
- Six legs
- On data sheet, combine # of adult and larval riffle beetles!

DOBSONFLY LARVAE
(HELLGRAMMITE)

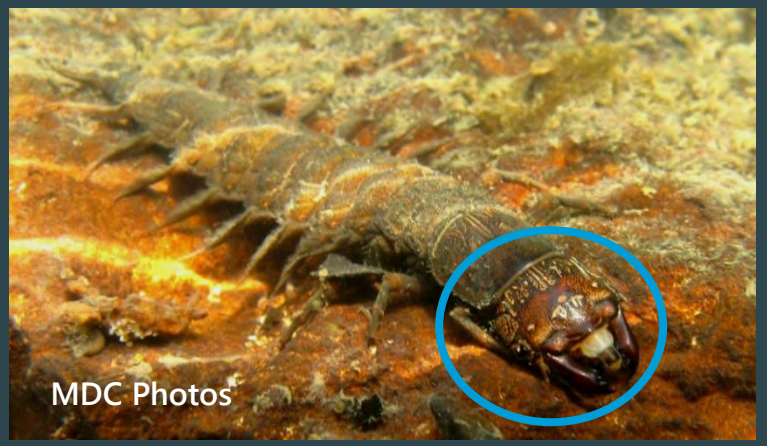
- Up to 4 inches long (see size bar)
- Gills under abdominal filaments!
- Large mandibles



DOBSONFLY LARVAE
(HELLGRAMMITE)

- Gills under the abdominal lateral filaments

- Large mandibles



DOBSONFLY PUPA

Photo courtesy of J. Abbott, U of Texas

DOBSONFLY ADULT

Adult Male

Adult Female

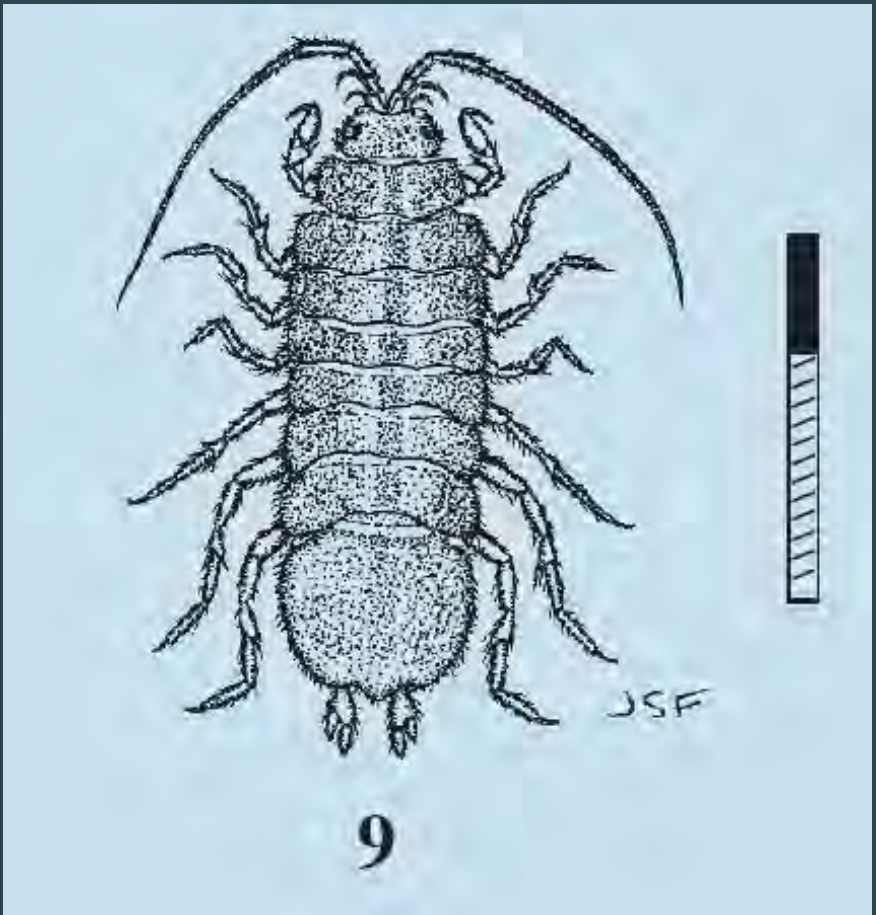
INVERTEBRATE ID
SOMEWHAT POLUTION TOLERANT

CRAYFISH

Looks like a small lobster

SOW BUG

- Looks like a "roly poly"
- Flattened "top to bottom"



SCUD

- Swim sideways
- Many appendages on abdomen
- Flattened "side to side"
- Often mistaken for freshwater shrimp

ALDERFLY LARVAE

- Lateral filaments
- No visible gills
- One long hair-like tail
- Tail filaments may resemble capital letter "A"

Photo courtesy of J. Abbott, U of Texas

NABS Photo

ALDERFLY ADULT

FISHFLY LARVAE

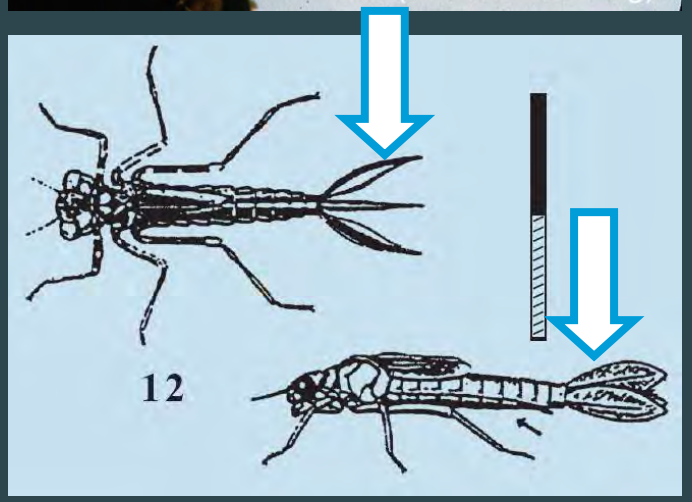
- Similar to dobsonfly larvae
  - Lateral filaments
  - Mandibles
  - Generally smaller
- No visible gills on abdomen!
- Breathing tubes

MDC Photos

FISHFLY ADULT

DAMSELFLY NYMPHS

- Six spindly legs
- Long, slender body
- Three broad oar-shaped tails
- Positions like a tripod when in water



DAMSELFLY ADULTS

Photo Courtesy of B. Blake

MDC Photo

DAMSELFLY ADULTS
(MATING)

DRAGONFLY NYMPHS

- Six legs
- Wide, oval to round abdomen
- Large eyes
- Scoop-like lower labium

MDC Photo

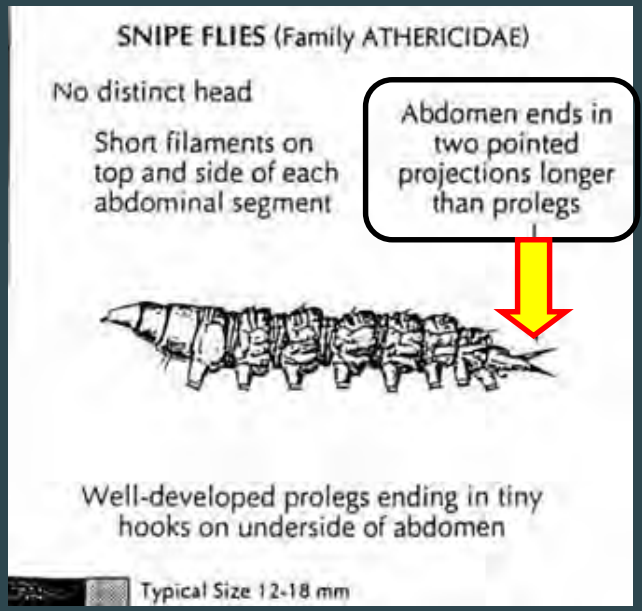
NABS Photo

DRAGONFLY ADULT

WATERSNIPE FLY LARVAE

Caterpillar like

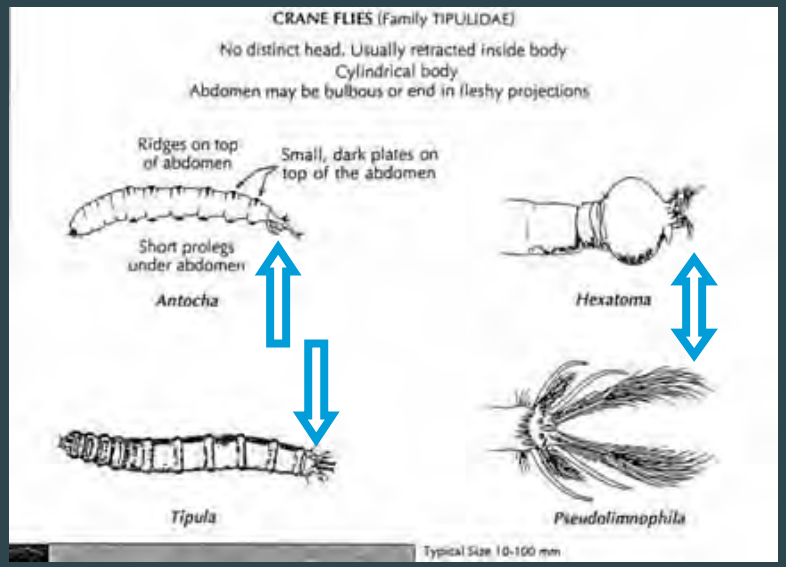
Two feathery "horns" on end of abdomen



WATERSNIPE FLY ADULT

CRANE FLY LARVAE

- Caterpillar like
- Up to 4” long
- May have enlarged lobe or fleshly finger like extensions at end of abdomen

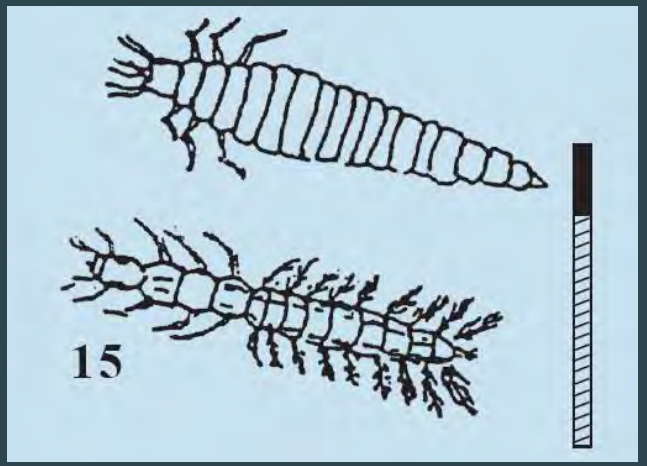


CRANE FLY ADULT

MDC Photo

"OTHER" BEETLE LARVAE

- Six legs
- Obvious mouth parts
- Diverse group
- Process of elimination



MUSSELS AND CLAMS

- >70% of species threatened or endangered
- Count and put back hinge side up
- DO NOT COUNT EMPTY SHELLS

Photo by Dr. Chris Barnhart, Missouri State University

INVERTEBRATE ID
POLLUTION TOLERANT

AQUATIC WORMS

Aquatic earthworms

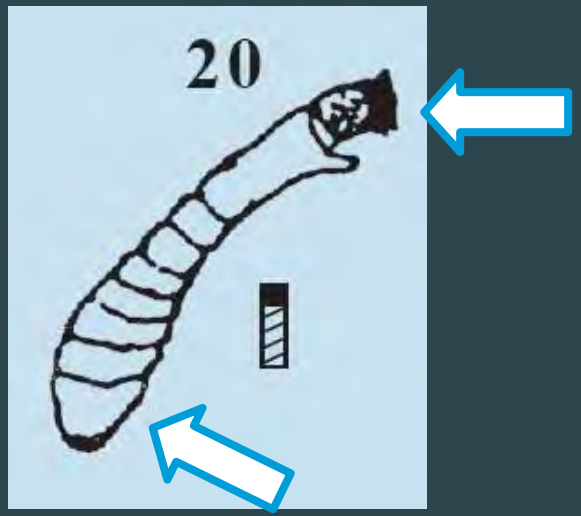
Horsehair worms

MIDGE FLY LARVAE

- No jointed legs
- Prolegs behind head and end of abdomen
- Very small (<1/4")

BLACK FLY LARVAE

- Swollen abdomen ("fat butt") for attachment
- Fan-like projections on head for filtering
- Very small



BLACK FLY ADULT

NABS Photo

LEECHES

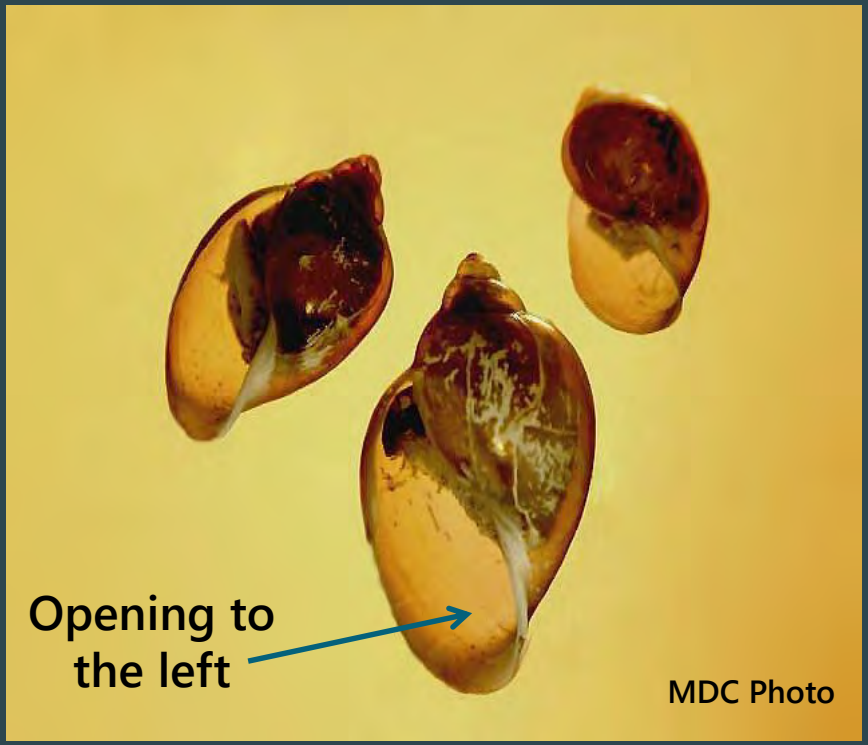
Muscular

Suction disks on both head and end of abdomen

POUCH SNAILS

- When holding the snail and the point up, the shell opens to the left

- DO NOT COUNT EMPTY SHELLS

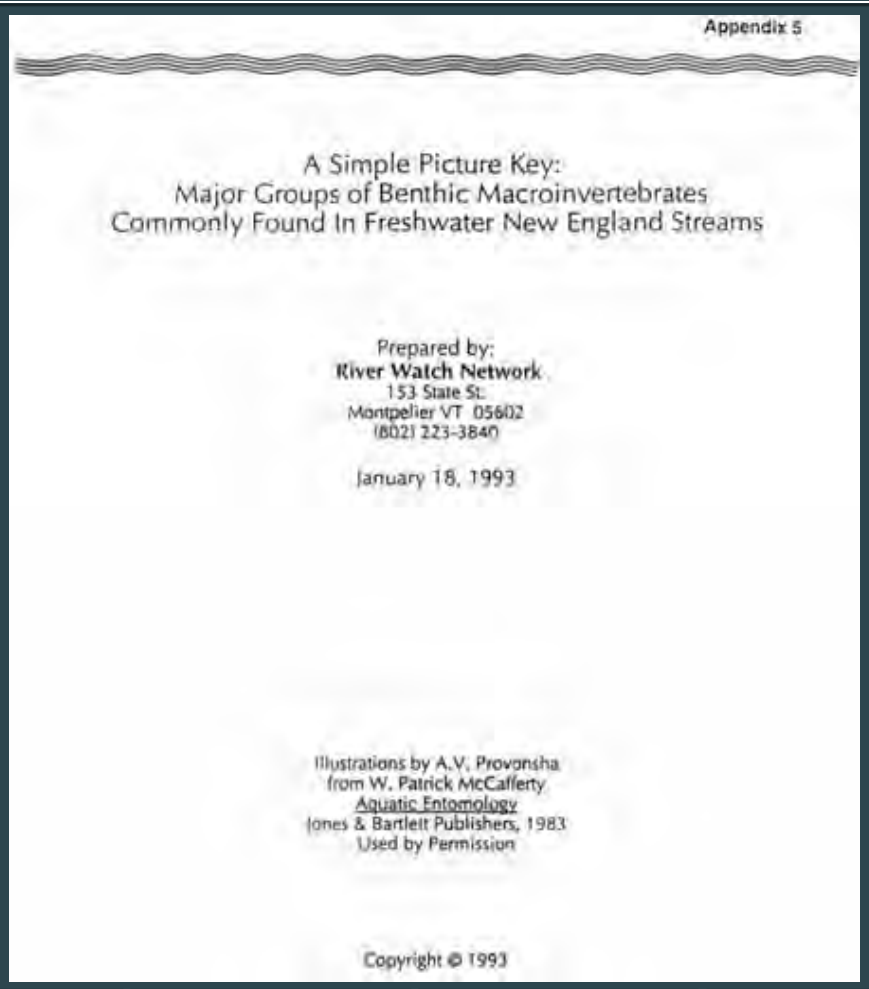


OTHER SNAILS

- Has no spiral point
- Flat/pond snails or limpets
- DO NOT COUNT EMPTY SHELLS

MDC Photos

A SAMPLE PICTURE KEY



Appendix 5

A Simple Picture Key:
Major Groups of Benthic Macroinvertebrates
Commonly Found In Freshwater New England Streams

Prepared by:
River Watch Network
153 State St.
Montpelier VT 05602
(802) 223-3840

January 18, 1993

Illustrations by A.V. Provonsha
from W. Patrick McCafferty
Aquatic Entomology
Jones & Bartlett Publishers, 1983
Used by Permission

Copyright © 1993