Georgia Adopt-A-Stream

MACROINVERTEBRATE MONITORING WORKSHOP

Georgia Adopt-A-Stream
Volunteer Water Quality Monitoring

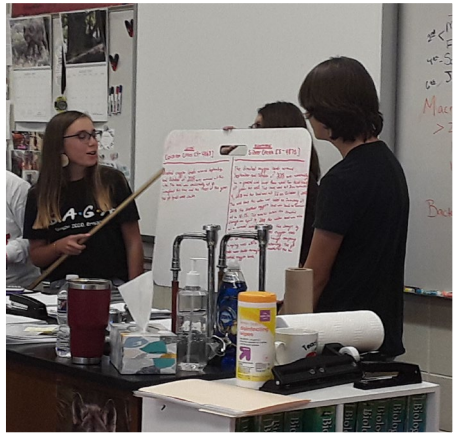
GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Georgia Adopt-A-Stream

A citizen science water quality monitoring program encouraging all Georgians to get familiar with their watersheds, monitor impacts, improve streams, rivers, wetlands, lakes, and estuaries, and inform others about their effect on water quality.

Georgia Adopt-A-Stream
Volunteer Water Quality Monitoring

A
Awareness



Increase public **awareness** of nonpoint source pollution & water quality issues

D
Data

Collect baseline water quality **data** according to QA/QC protocols

O
Observations

Take **observations** of sites to note any potential sources of pollution

P
Partnerships

Seek **partnerships** with local gov'ts, nonprofits, & other organizations to share results & resources

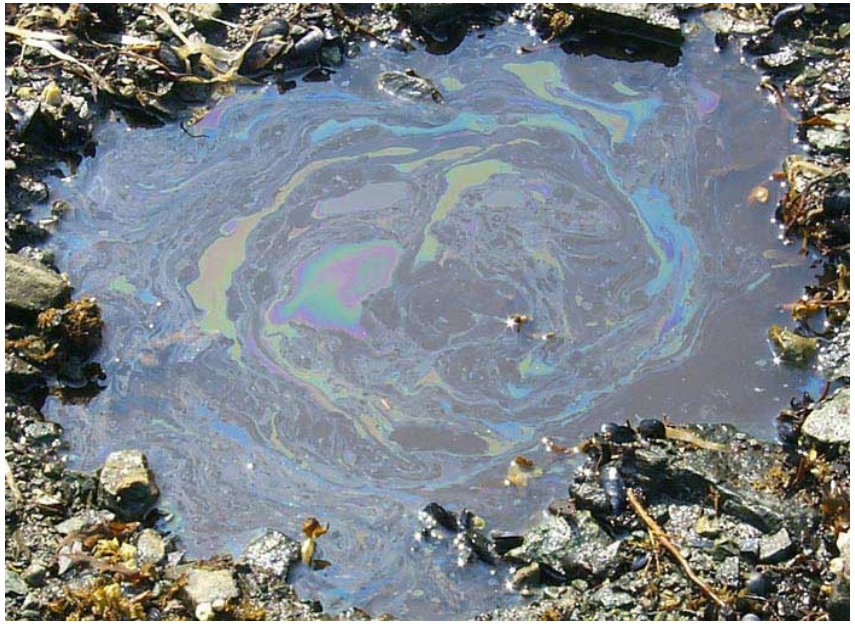
T
Tools & Training

Utilize **tools & training** provided by staff & local coordinators

TYPES OF POLLUTION

POINT SOURCE POLLUTION

- Easily identifiable pollutant source
- Regulated by GA EPD through NPDES permitting process



NONPOINT SOURCE POLLUTION

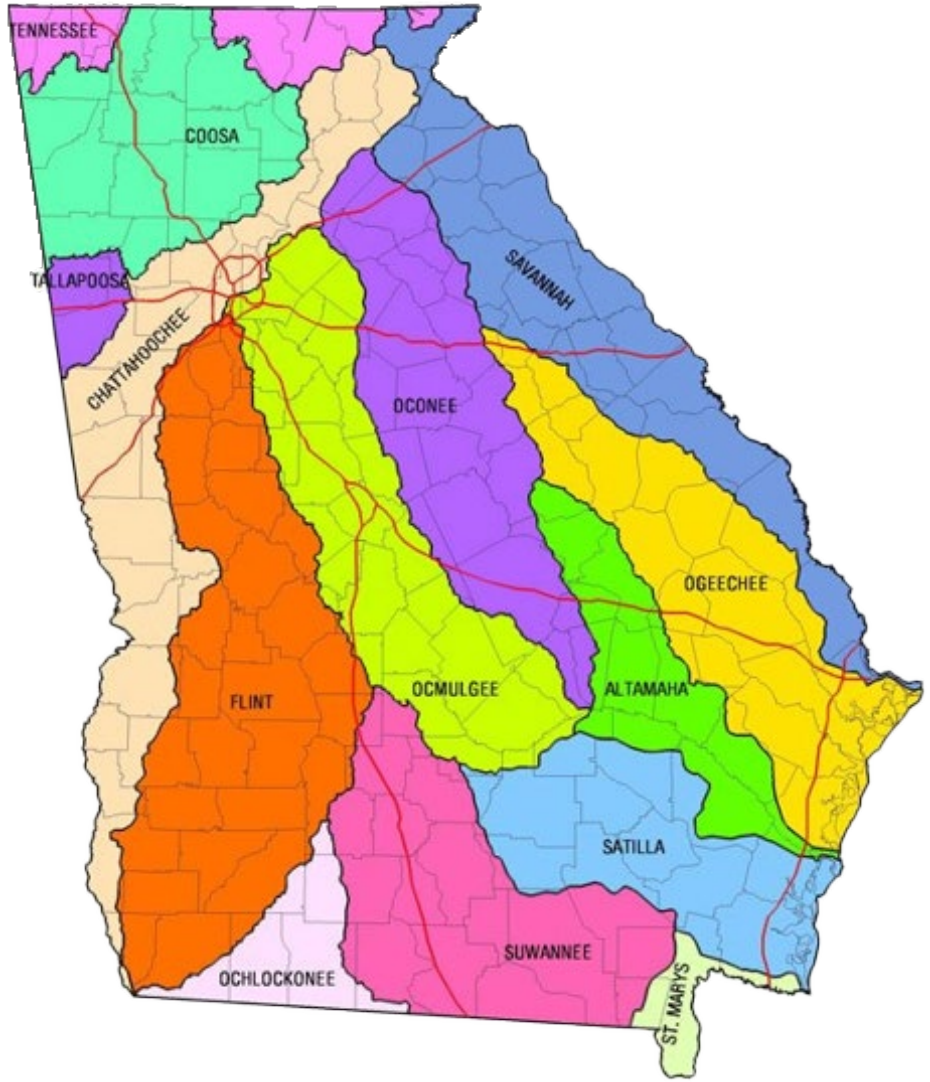
- Sources not easily distinguished/identified
- Everyone contributes
- Main cause of water quality problems in GA

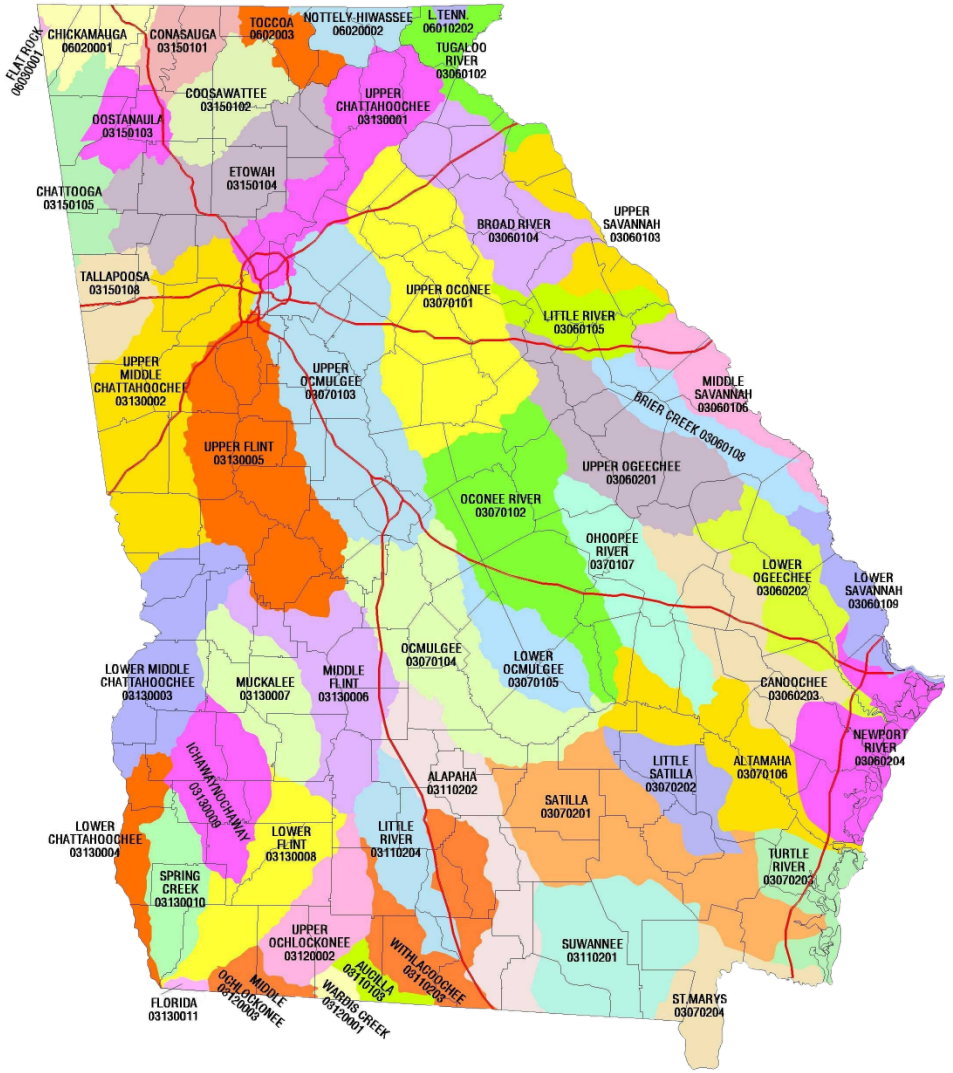
WHAT IS A WATERSHED?

- **A land area from which water, sediment, and dissolved materials drain to a common point along a stream, wetland, lake, or river.**
- Its boundaries are defined by the highest points of land around the waterbody.

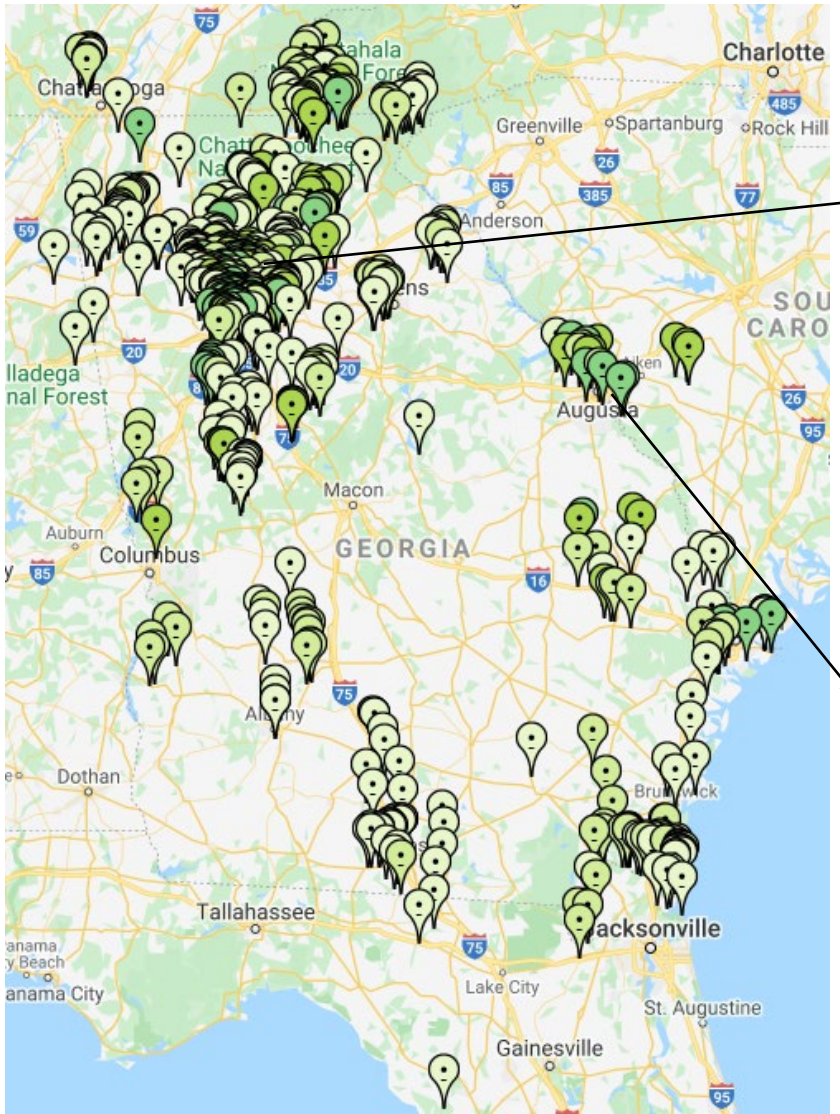
There is an unbreakable link between human health and wellbeing and ecosystems. -Walter Reid

WHERE IS YOUR WATERSHED?





VOLUNTEER NETWORK AND SUPPORT



VOLUNTEER NETWORK AND SUPPORT

AAS VOLUNTEERS USE STANDARDIZED PROTOCOLS

- EPA Approved Quality Assurance Project Plan (QAPP)
- Quality Assurance/Quality Control (QA/QC)
  - Required to attend workshop(s) and pass certification test(s) to become certified
  - Only individuals are certified
  - Set monitoring protocol ensures all volunteers are collecting baseline data using standard methods
  - Only certified volunteers can enter data, but anyone can access the 20+ years of data in the online AAS database

EARNING YOUR QA/QC MACROINVERTEBRATE CERTIFICATION

FIELD:

Volunteers must demonstrate the ability to collect macroinvertebrate samples properly

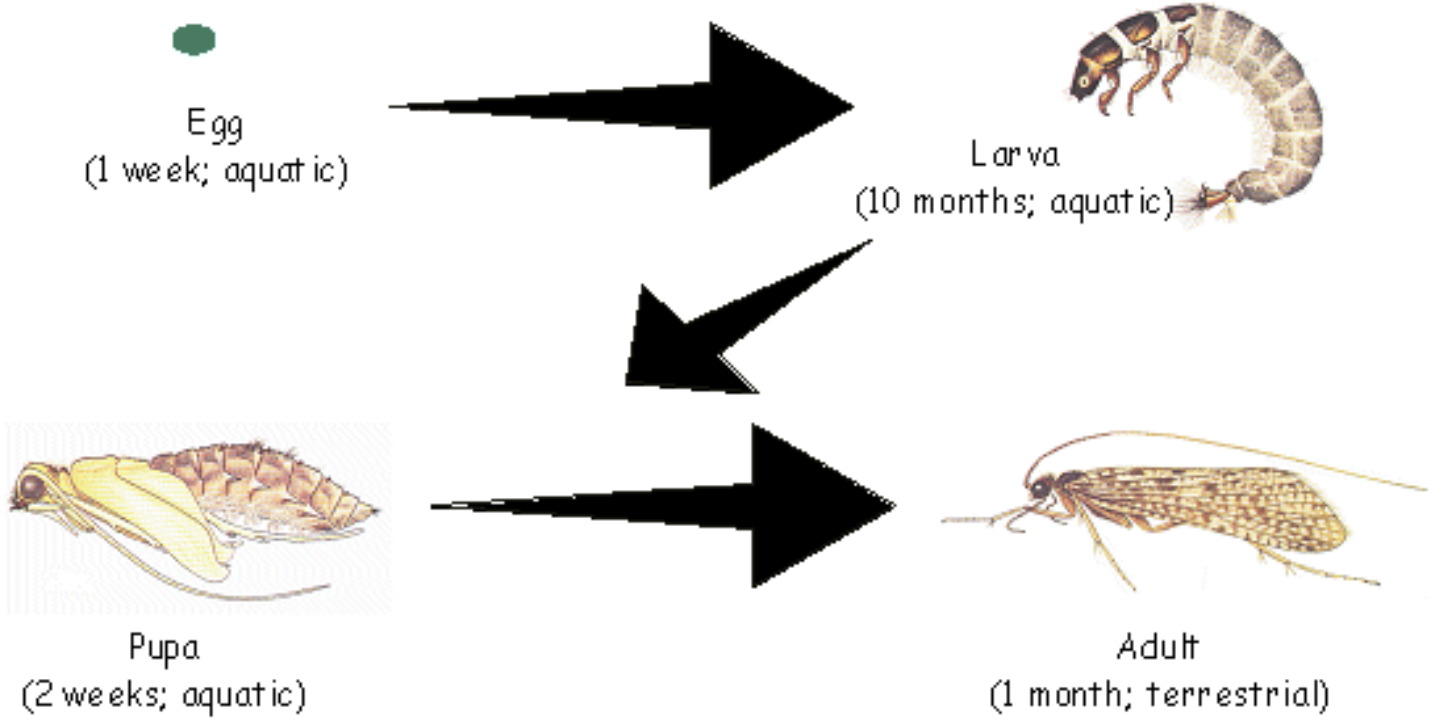
WRITTEN TEST AND MACRO ID:

Volunteers must pass a written evaluation with a score of at least 80% and identify 20 macroinvertebrates with at least 90% accuracy

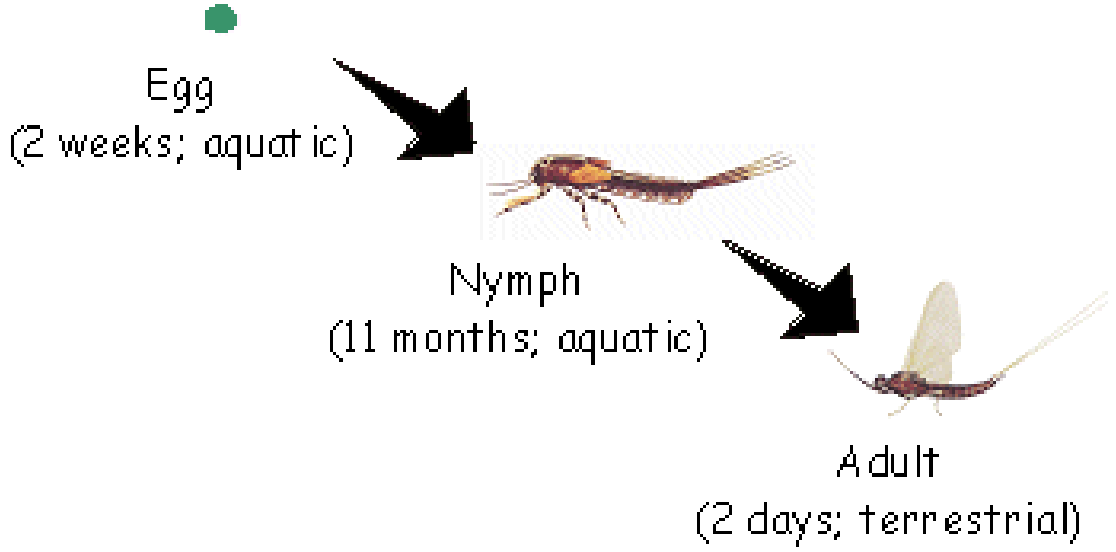
WHAT ARE MACROINVERTEBRATES?

- Organisms that lack a backbone and can be seen with the naked eye
  - Many insects found are in the nymph or larval stage of their life cycle
- Benthic macroinvertebrates – macros that live in the substrate, or bottom, of a water body
- Macros live in various stream habitats and **derive their oxygen from the water**

WHAT ARE MACROINVERTEBRATES?



WHAT ARE MACROINVERTEBRATES?



WHY MONITOR MACROINVERTEBRATES?

- **Macroinvertebrates are bioindicators**
  - **Taxa have known tolerance values**
- **Not very mobile**
- **Relatively easy to catch, view and identify**

WHY MONITOR MACROINVERTEBRATES?

- **Present during ALL stream events**
  - **Recent heavy rains can affect results**
- **Affected by physical, chemical and biological conditions of the stream**
- **Taxa, diversity, and abundance will differ throughout Georgia**

PURPOSE OF MACROINVERTEBRATES MONITORING

- Quickly assess both **water quality and habitat quality**
  - Involves collecting, identifying, and counting macroinvertebrates
- Characterizes stream health by abundant and diverse macroinvertebrate populations
  - **AAS places importance on diverse populations**

WHERE, WHEN, AND HOW OFTEN?

- Where to monitor:
  - Be sure to target macro habitats
  - Same site location*
- When to monitor:
  - Normal flow conditions
  - Same time of day
    - 1 ½ - 2 hours
- How often to monitor:
  - **Quarterly/Seasonally**

*within stream reach

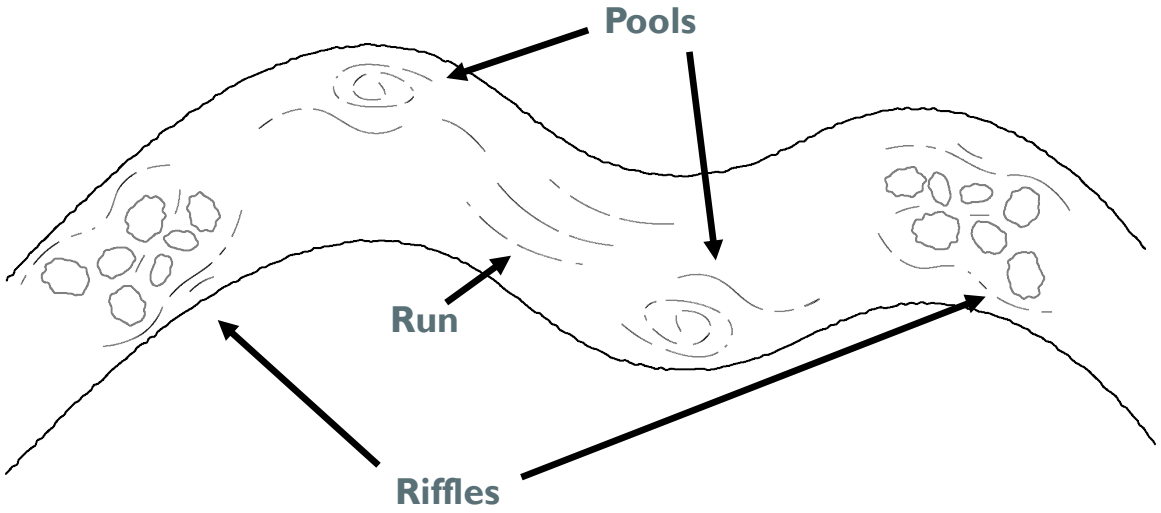
STREAM HABITATS

- Vegetative Margins
- Substrate
  - Sand/rock/gravel streambed
  - Riffles
- Organic Matter **(submerged & decomposing)**
  - **Leaf packs**
  - **Woody debris**

STREAM HABITATS

STREAM AND SAMPLING TYPES: ROCKY BOTTOM STREAMS

- Generally found in North GA and Piedmont Region
- Characterized by fast moving water flowing over large rocks and boulders
- Pool/riffle system



ROCKY BOTTOM SAMPLING METHOD

TWO habitat types sampled

- **Substrate**
  - **3 samples**
  - Sample **2x2 foot area with kick seine** net in riffle areas
- **Organic Matter**
  - **4 samples**
  - Using both hands, take handfuls (**1 square foot**) of **decayed**, **submerged** leaf packs

Total Area Sampled: 16ft^2

STREAM AND SAMPLING TYPES: MUDDY BOTTOM STREAMS

- Found mostly in South GA and urban environments
- Slow moving water with little or no turbulence
- Substrate is generally composed of fine silt, sand, or coarse gravel

If your stream shows traits of both categories,
do your best to CHOOSE ONE and proceed with that method!

MUDDY BOTTOM SAMPLING METHOD

THREE habitat types sampled

- **Substrate**
  - **3 samples**
  - Scoop (**1 square foot**) of the coarsest area of streambed **with a D-frame net**
- **Organic Matter**
  - **4 samples**
  - Scoop (**1 square foot**) in woody debris
- **Vegetative Margins**
  - **7 samples**
  - Scoop (**1 square foot**) along underside of stream bank

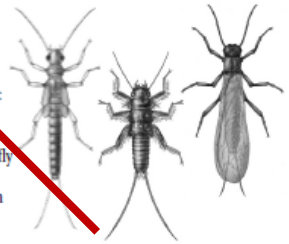
Total Area Sampled: 14ft^2

SORTING AND COUNTING

AAS FIELD GUIDE

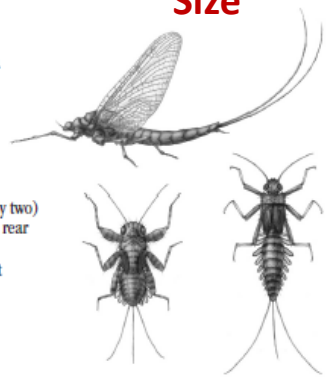
INSECTS

Stoneflies
Order: Plecoptera
Size: ½" to 1½"
Tolerance: Sensiti
Distinguishing Characteristics:
- Two hair-like tails
- No gills on rear half of body
- Structurally similar to mayfly nymphs, but have two tails instead of the usual three in mayflies
- 2 claws on each foot



Size

Mayflies
Order: Ephemeroptera
Size: ¼" to 1"
Tolerance: Sensitive
Distinguishing Characteristics:
- Usually three long, hair-like tails (but sometimes only two)
- Gills present on the rear half of body
- 1 hook on each foot



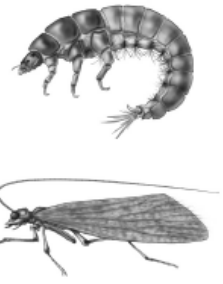
Water Pennies
Order: Coleoptera
Size: up to ½"
Tolerance: Very sensitive
Distinguishing Characteristics:
- Looks like a flat, oval disc
- Plates extend from all sides
- Cannot survive on rocks covered with excessive algae or inorganic sediment

Riffle Beetles
Order: Coleoptera
Size: 1/16" to 1/8"
Tolerance: Sensitive
Distinguishing Characteristics:
- Very small
- Dark colored
- Adult riffle beetles will be found walking on the bottom of the stream

Aquatic Snipe Flies
Order: Diptera
Size: ¼" to 1"
Tolerance: Sensitive
Distinguishing Characteristics:
- Body is pale brown to green color
- Mostly cylindrical, with the front tapering to a cone-shaped point
- Larva have a number of mostly paired caterpillar-like prolegs
- Two stout, pointed tails with feathery hairs at back end

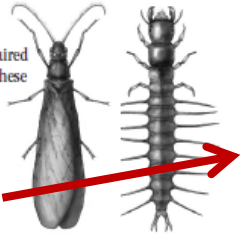
Caddisflies
Order: Trichoptera
Size: ½" to 1 ½"
Tolerance: Sensitive
Distinguishing Characteristics:
- Larva is caterpillar-like with three pairs of legs and tends to curl up slightly
- Two claws at posterior (rear) end
- May be found in a stick, rock, or leaf case with its head sticking out

Common Net Spinning Caddisflies
Order: Trichoptera
Family: Hydropsychidae
Size: up to 1"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Body is caterpillar-like with three pairs of legs and is strongly curved
- Dorsal plates (sclerites) on all three thoracic segments
- Branched gills on the ventral surface of the last two thoracic segments and most of the abdominal segments
- Usually have a bristle-like, setal tuft at the end of each anal proleg
- Color varies from bright green to dark brown



Dobsonflies/Hellgrammites and Fishflies
Order: Megaloptera
Size: ¾" to 4"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Stout body with large pinching jaws
- Eight pairs of pointed lateral appendages
- On the rear end of the body a pair of stubby, unjointed legs (prolegs), each with a pair of claws
- Dobsonflies/Hellgrammites have paired cotton-like gill tufts, fishflies lack these
- Fishflies have two short tube-like structures on the tail end

Dobsonfly Larva



Fishfly Adult

Fishfly Larva

Distinguishing Characteristics

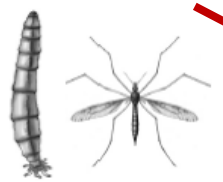
Damselflies and Dragonflies
Order: Odonata
Size: ½" to 2"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Both have large eyes, six legs, and a large lower lip that covers much of the bottom of the head
- Damselflies are slender and have three oar shaped tails (gills)
- Dragonflies have a stocky body without tails

Dragonfly Adult

Dragonfly Larva

Damselfly

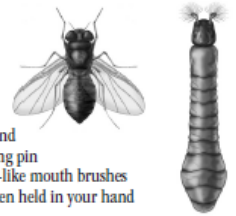
Crane Flies
Order: Diptera
Size: ⅕" to 2 ½"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Worm-like plump body
- Can be found in a variety of colors (clear, white, brown, and green)
- Segmented body with finger-like projections (gills) at the back end
- Head is usually pulled back into the front of the body



Midge Flies
Order: Diptera
Size: up to ¼"
Tolerance: Tolerant
- They can indicate poor stream health caused by pollution if found in large numbers

Distinguishing Characteristics:
- Often whitish to clear, but occasionally bright red
- Segmented body
- Has distinct head with two small prolegs in the front of the body
- Display a spastic squirming action in the water

Black Flies
Order: Diptera
Size: up to ¼"
Tolerance: Tolerant
Distinguishing Characteristics:
- The body is larger at the rear end similar to the shape of a bowling pin
- The distinct head contains fan-like mouth brushes
- Often curl into a "u" shape when held in your hand



Length Reference

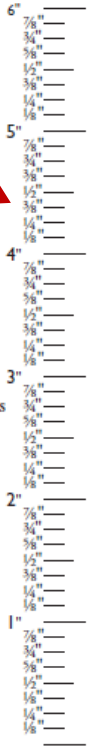
CRUSTACEANS

Crayfish
Order: Decapoda
Size: up to 5"
Tolerance: Somewhat sensitive
- Can withstand large ranges of pH and temperatures and is sensitive to toxic substances

Distinguishing Characteristics:
- Resembles a lobster
- Has 10 legs and the two front legs have large claws or pinchers

Aquatic Sow Bugs
Order: Isopoda
Size: ¼"- ¾"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Flat, segmented body
- Has an "armored" appearance
- Seven pairs of legs
- Can be confused with scuds, however they are flattened top to bottom

Scuds
Order: Amphipoda
Size: ⅛" to ¼"
Tolerance: Somewhat sensitive
Distinguishing Characteristics:
- Resemble a small shrimp
- Translucent body with silvery-gray or tan coloration
- Seven pairs of legs
- Unlike sow bugs, scuds are flattened side to side



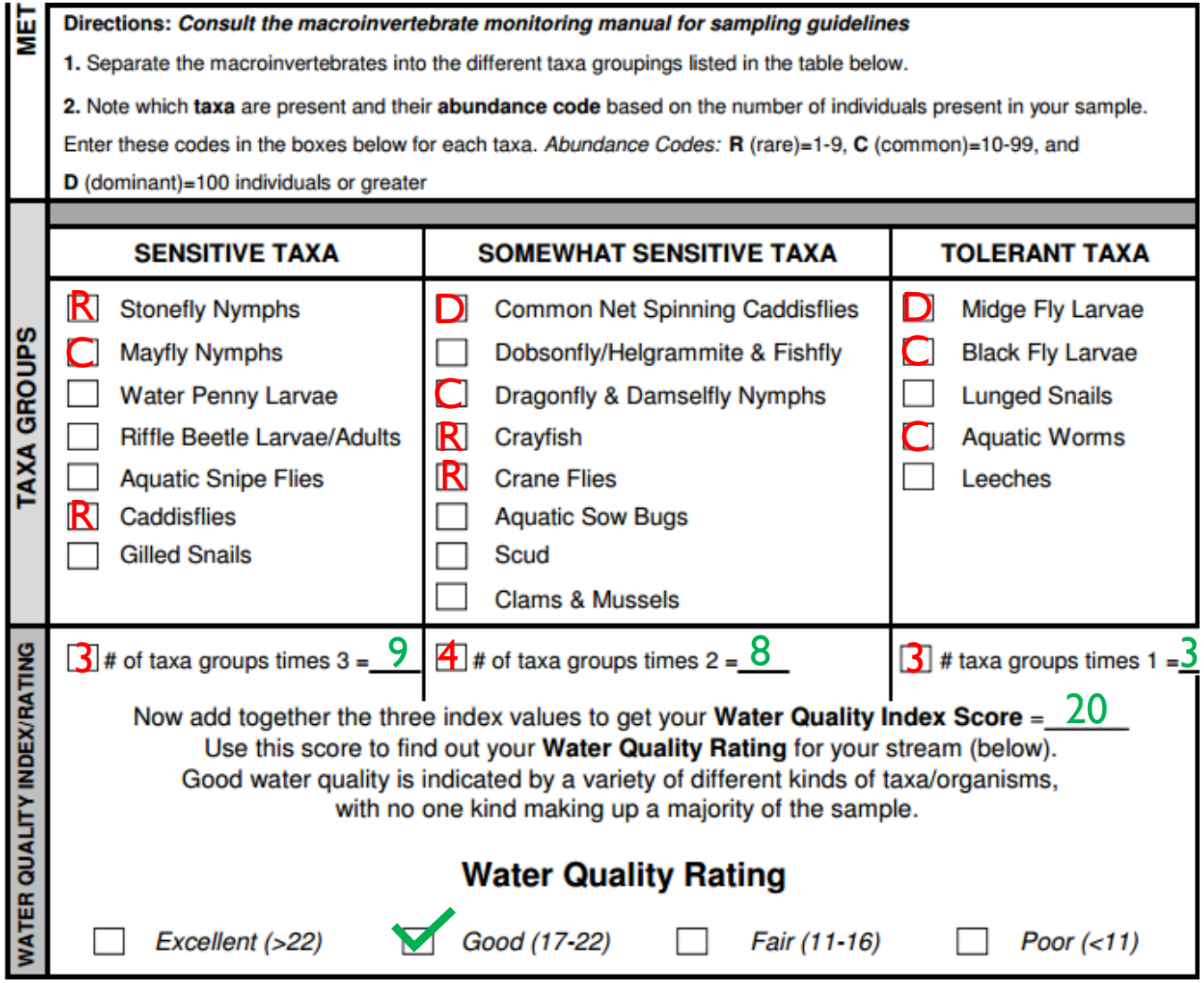
WORMS

Aquatic Worms
Class: Oligochaeta
Size: Usually 1" but up to 4"
Tolerance: Tolerant
Distinguishing Characteristics:
- Can be very tiny and slender or look similar to earthworms
- No legs, distinct head or any mouthparts
- Segmented body
- Aquatic worms can indicate organic pollution when they dominate the majority of the sample collection

Leeches
Class: Hirudinea
Size: ¼" to 2"
Tolerance: Tolerant
Distinguishing Characteristics:
- Somewhat slimy, soft, segmented body
- Two suckers on the underside of the body, one in the front and one in the rear
- Can be confused with a flatworm, however flatworms have no suckers and leeches have fine lines (annuli) across the body

COMPLETING THE DATA FORM

Remember: Diversity is more important than Abundance!



MET

Directions: ***Consult the macroinvertebrate monitoring manual for sampling guidelines***

1. Separate the macroinvertebrates into the different taxa groupings listed in the table below.

2. Note which **taxa** are present and their **abundance code** based on the number of individuals present in your sample. Enter these codes in the boxes below for each taxa. *Abundance Codes:* **R** (rare)=1-9, **C** (common)=10-99, and **D** (dominant)=100 individuals or greater

TAXA GROUPS

SENSITIVE TAXA	SOMEWHAT SENSITIVE TAXA	TOLERANT TAXA
R Stonefly Nymphs	D Common Net Spinning Caddisflies	D Midge Fly Larvae
C Mayfly Nymphs	Dobsonfly/Helgrammite & Fishfly	C Black Fly Larvae
Water Penny Larvae	C Dragonfly & Damselfly Nymphs	Lunged Snails
Riffle Beetle Larvae/Adults	R Crayfish	C Aquatic Worms
Aquatic Snipe Flies	R Crane Flies	Leeches
R Caddisflies	Aquatic Sow Bugs	
Gilled Snails	Scud	
	Clams & Mussels	

WATER QUALITY INDEX/RATING

3 # of taxa groups times 3 = 9 | 4 # of taxa groups times 2 = 8 | 3 # taxa groups times 1 = 3

Now add together the three index values to get your **Water Quality Index Score** = 20

Use this score to find out your **Water Quality Rating** for your stream (below).

Good water quality is indicated by a variety of different kinds of taxa/organisms, with no one kind making up a majority of the sample.

Water Quality Rating

☐ *Excellent (>22)* ☑ *Good (17-22)* ☐ *Fair (11-16)* ☐ *Poor (<11)*

HANDLING OF MACROINVERTEBRATES

- Keep the macros in a container with stream water and out of direct sunlight
- Transfer and handle macros gently
- Rinse and check the nets
- Avoid/minimize handling salamanders if any insect repellant, sunscreen, moisturizer, etc. is on your skin
- Promptly release organisms back into the water once identified
- Supervise and educate others on best handling techniques

SAFETY

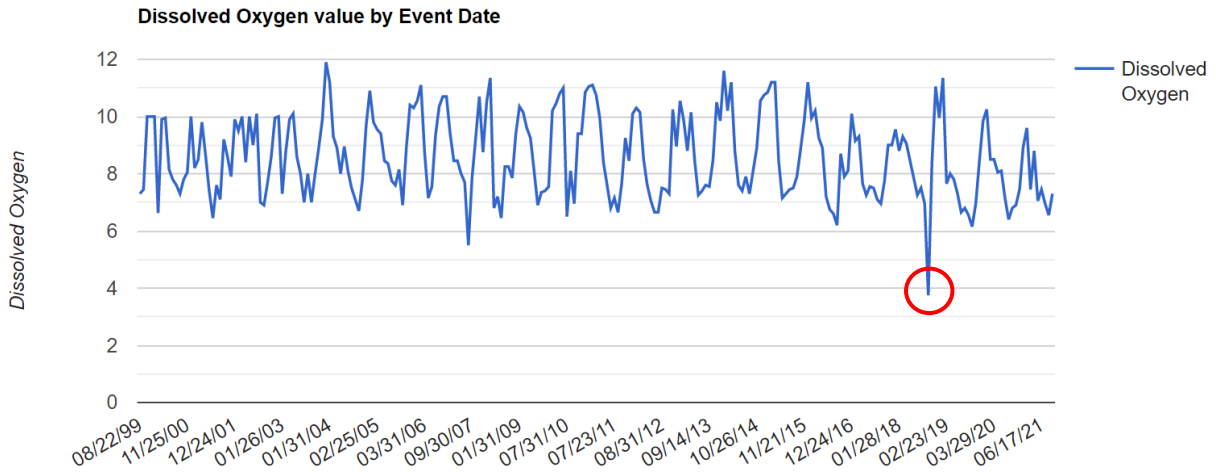
- Try not to sample alone- take a monitoring buddy!
- Do not sample during high flows or after a heavy rain event
- Obtain permission if sampling on private property

ONCE YOU'RE CERTIFIED

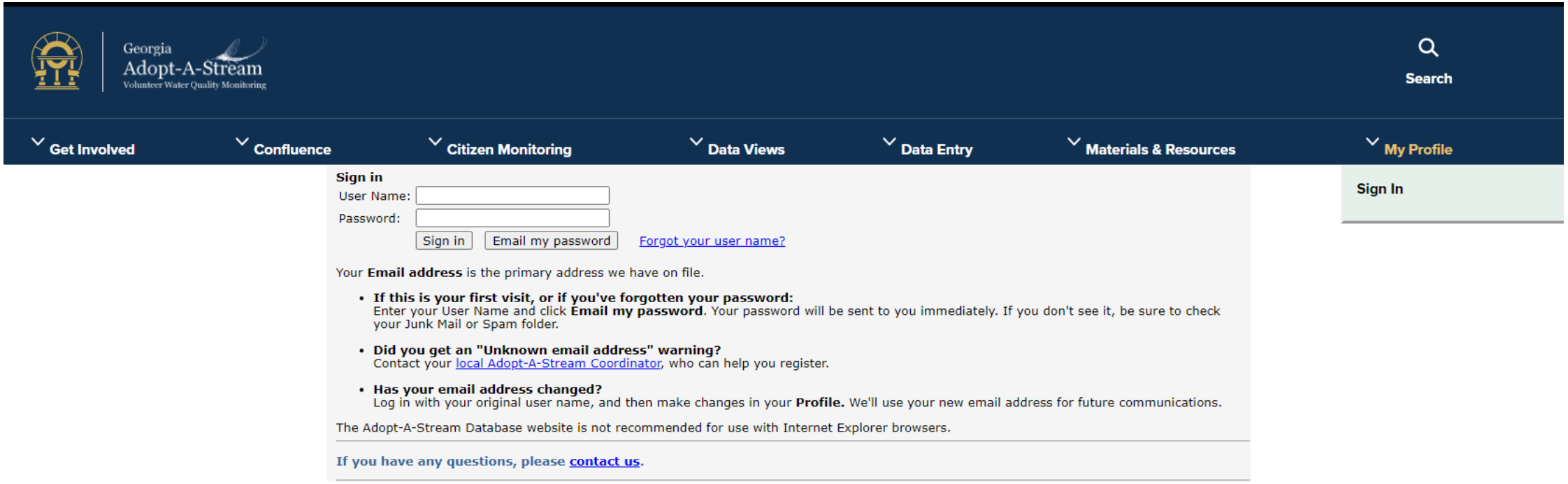
- You get an account to our online database!
- Only certified volunteers can submit data
- Certification is valid for one year
- Volunteers must attend an annual recertification workshop

HOW ARE YOUR DATA USED?

- Establish baseline conditions for waterbodies across the state
- Discover and report water quality issues
- Educate your community
- Help inform status of streams for 303d/305b list

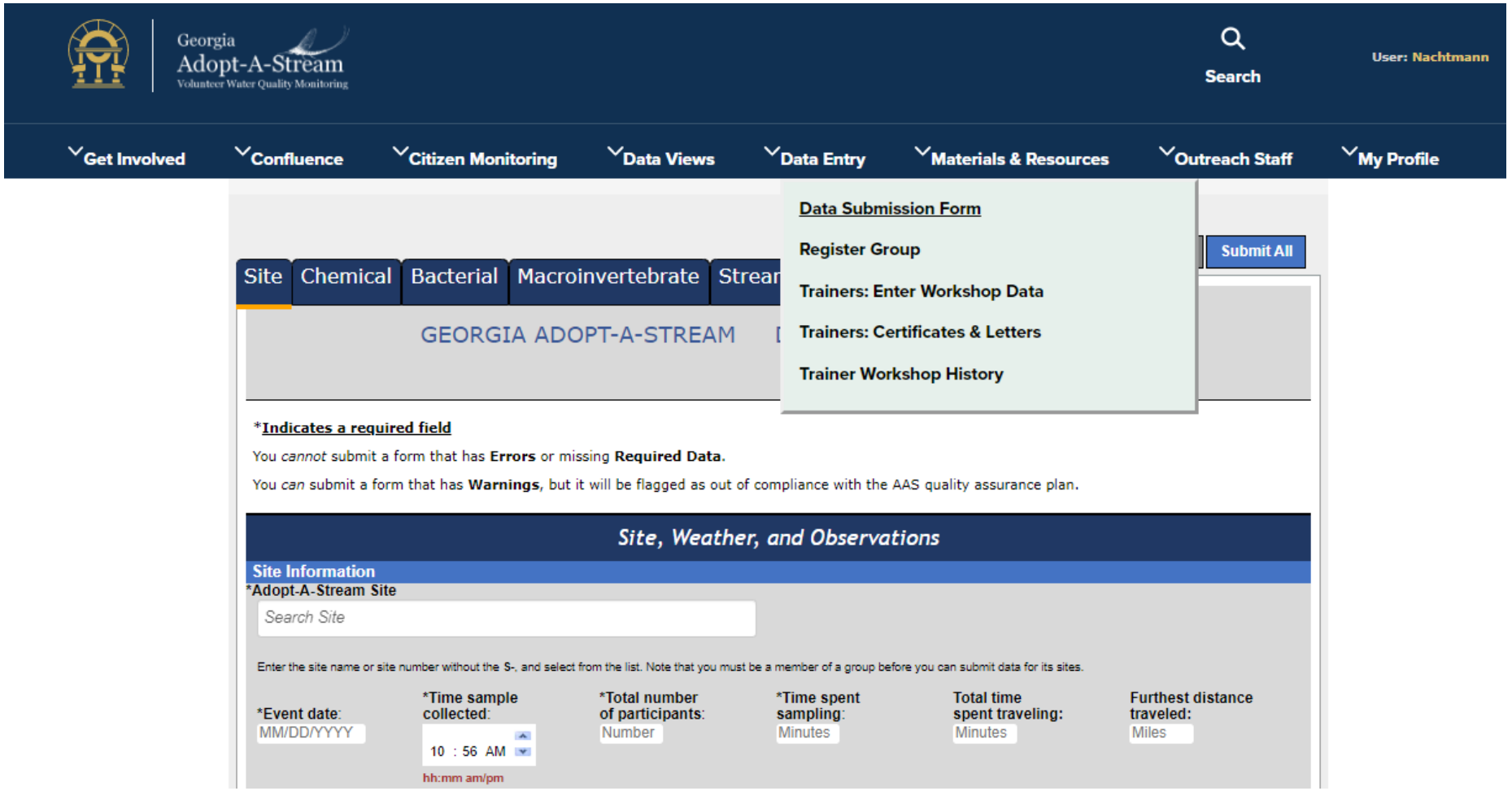


DATABASE LOGIN



From the AAS website's homepage, hover over the My Profile tab and click Sign In

DATA SUBMISSION FORM



From the AAS website's homepage, hover over the Data Entry tab and click Data Submission Form

SITE, WEATHER, AND OBSERVATIONS

GEORGIA ADOPT-A-STREAM: Macroinvertebrate Form (page 1)

To be conducted quarterly

SITE INFORMATION

Group Name:_____

Group ID: G-_____ Site ID: S-_____

Stream Name:_____

Monitor(s):_____

Number of Participants:_____

Event Date: _____ (MMDDYYYY)

Time Sample Collected:_____ (HHMM am/pm)

Time Spent Sampling: _____ (Min)

Total Time Spent Traveling *(optional)* : _____ (Min)

Furthest Distance Traveled *(optional)* : _____(Miles)

WEATHER

Present conditions (check all that apply)

☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

☐ Overcast ☐ Partly Cloudy ☐ Clear/Sunny

Amount of rain, if known?

Amount in Inches:_____

In Last Hours/Days:_____

*Refer to *wunderground.com* for rainfall data

OBSERVATIONS

Flow/Water Level: *(check all that apply)* ☐ Dry ☐ Stagnant/Still ☐ Low ☐ Normal ☐ High ☐ Flood (over banks)

Water Clarity: ☐ Clear/Transparent ☐ Cloudy/Somewhat Turbid ☐ Opaque/Turbid ☐ Other:_____

Water Color: ☐ No Color ☐ Brown/Muddy ☐ Green ☐ Milky/White ☐ Tannic ☐ Other:_____

Water Surface: ☐ Clear ☐ Oily sheen: Does it break when disturbed? Yes/No (circle one) ☐ Algae

☐ Foam ◯ Greater than 3" high ◯ It is pure white ☐ Other:_____

Water Odor: ☐ Natural/None ☐ Gasoline ☐ Sewage ☐ Rotten Egg

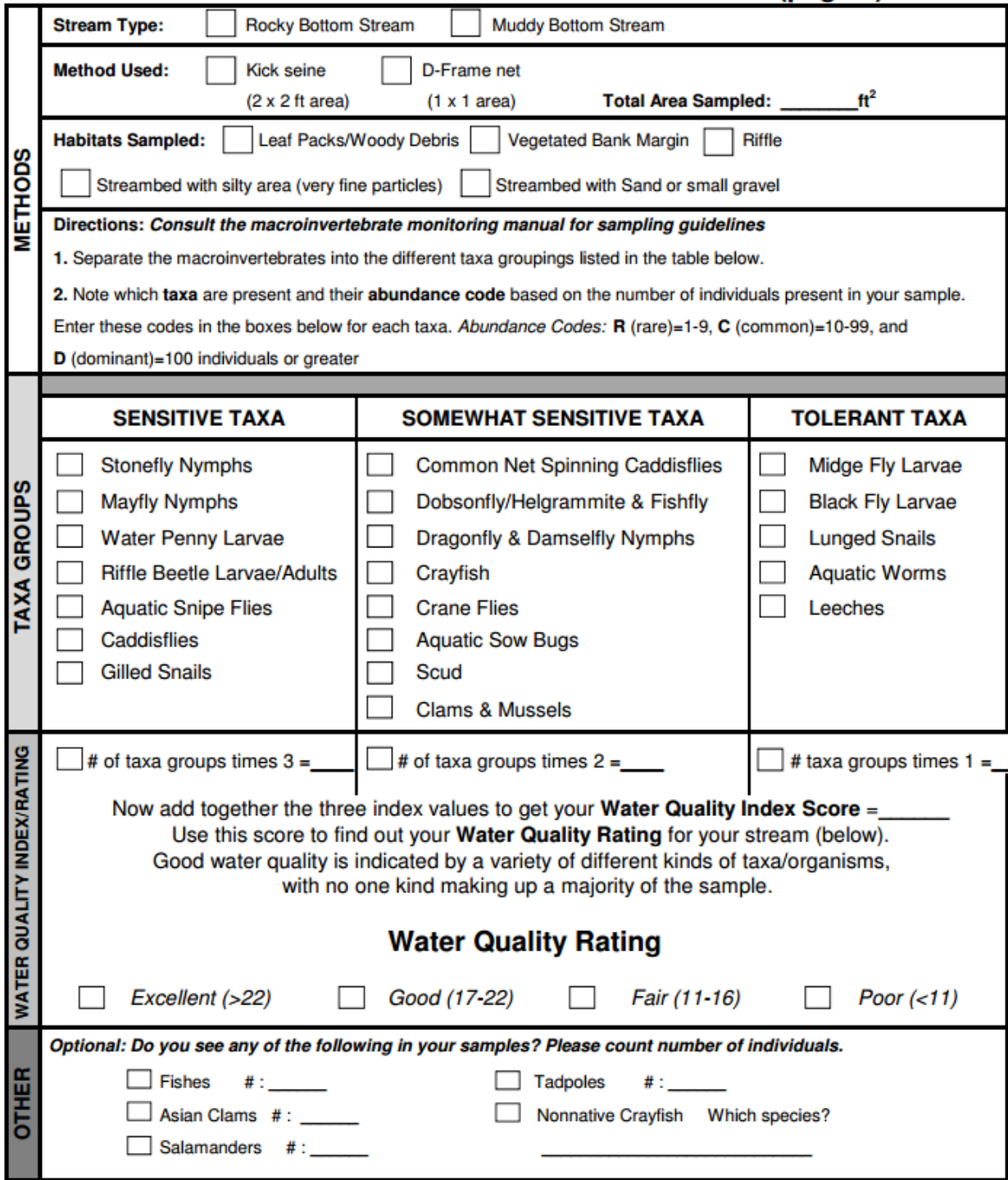
☐ Fishy ☐ Chlorine ☐ Other:_____

Trash: ☐ None ☐ Yes, I did a cleanup ☐ This site needs an organized cleanup

MACROINVERTEBRATE DATA

Submit data ASAP to online database

Access database via
AdoptAStream.Georgia.gov



METHODS

Stream Type: ☐ Rocky Bottom Stream ☐ Muddy Bottom Stream

Method Used: ☐ Kick seine (2 x 2 ft area) ☐ D-Frame net (1 x 1 area) **Total Area Sampled:** _____ ft^2

Habitats Sampled: ☐ Leaf Packs/Woody Debris ☐ Vegetated Bank Margin ☐ Riffle ☐ Streambed with silty area (very fine particles) ☐ Streambed with Sand or small gravel

Directions: ***Consult the macroinvertebrate monitoring manual for sampling guidelines***

1. Separate the macroinvertebrates into the different taxa groupings listed in the table below.

2. Note which **taxa** are present and their **abundance code** based on the number of individuals present in your sample. Enter these codes in the boxes below for each taxa. *Abundance Codes:* **R** (rare)=1-9, **C** (common)=10-99, and **D** (dominant)=100 individuals or greater

TAXA GROUPS

SENSITIVE TAXA	SOMEWHAT SENSITIVE TAXA	TOLERANT TAXA
☐ Stonefly Nymphs	☐ Common Net Spinning Caddisflies	☐ Midge Fly Larvae
☐ Mayfly Nymphs	☐ Dobsonfly/Helgrammite & Fishfly	☐ Black Fly Larvae
☐ Water Penny Larvae	☐ Dragonfly & Damselfly Nymphs	☐ Lunged Snails
☐ Riffle Beetle Larvae/Adults	☐ Crayfish	☐ Aquatic Worms
☐ Aquatic Snipe Flies	☐ Crane Flies	☐ Leeches
☐ Caddisflies	☐ Aquatic Sow Bugs	
☐ Gilled Snails	☐ Scud	
	☐ Clams & Mussels	

WATER QUALITY INDEX/RATING

☐ # of taxa groups times 3 =____ ☐ # of taxa groups times 2 =____ ☐ # taxa groups times 1 =____

Now add together the three index values to get your **Water Quality Index Score** =_____
Use this score to find out your **Water Quality Rating** for your stream (below).
Good water quality is indicated by a variety of different kinds of taxa/organisms, with no one kind making up a majority of the sample.

Water Quality Rating

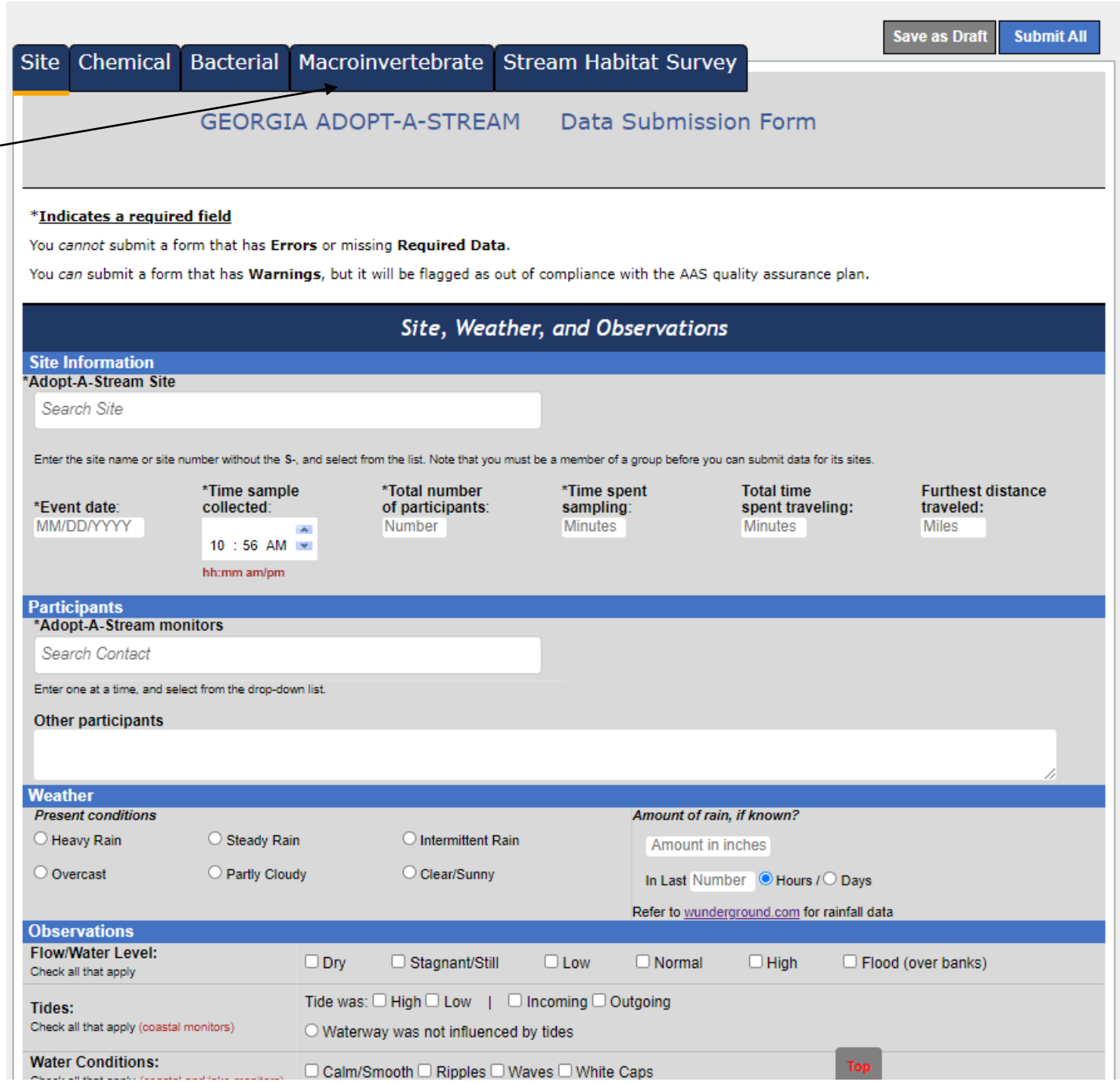
☐ *Excellent (>22)* ☐ *Good (17-22)* ☐ *Fair (11-16)* ☐ *Poor (<11)*

OTHER

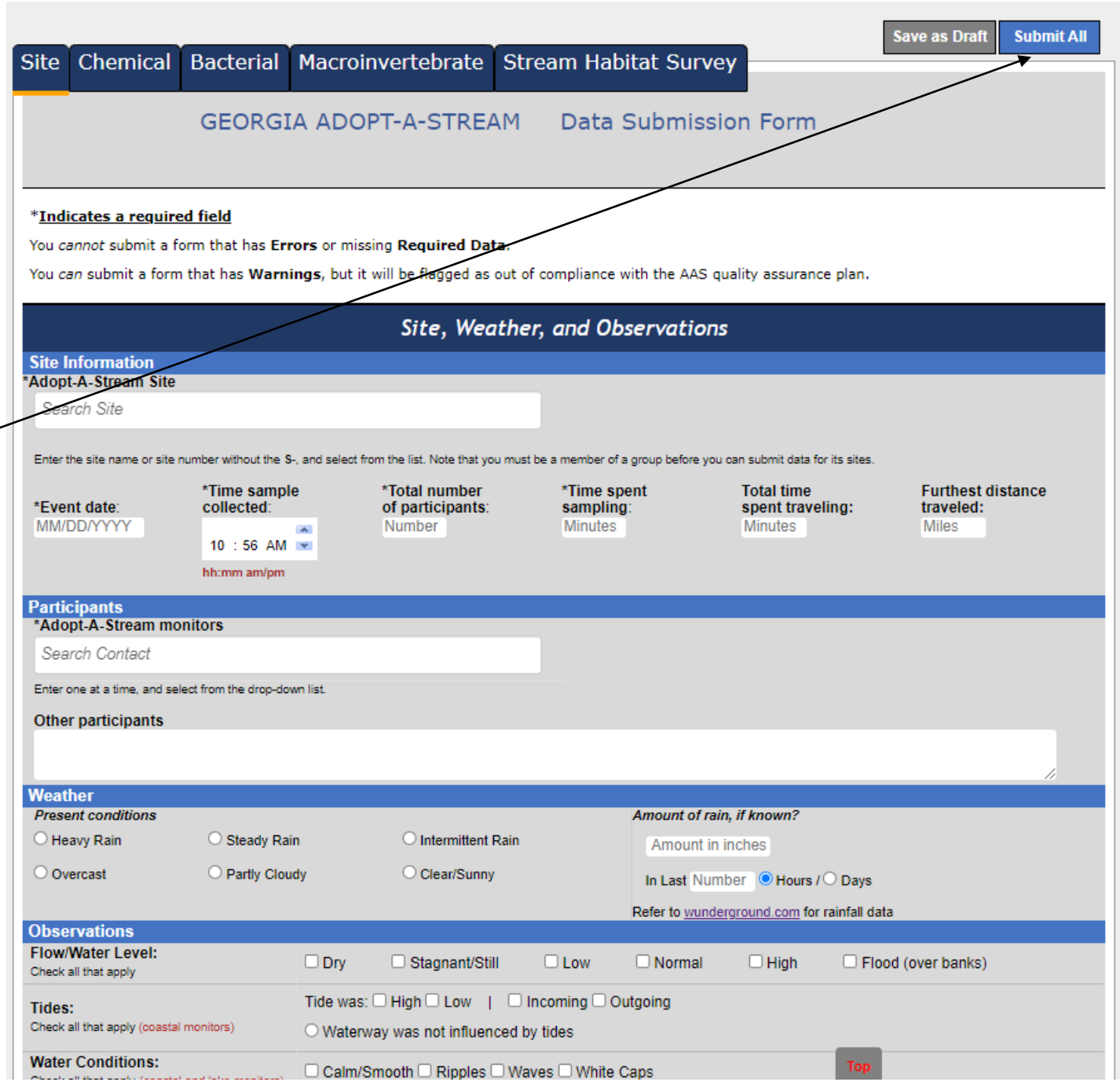
Optional: Do you see any of the following in your samples? Please count number of individuals.

☐ Fishes # : _____ ☐ Tadpoles # : _____
☐ Asian Clams # : _____ ☐ Nonnative Crayfish Which species?
☐ Salamanders # : _____ _____

Fill out site data first, then navigate to the macroinvertebrate tab to continue entering data

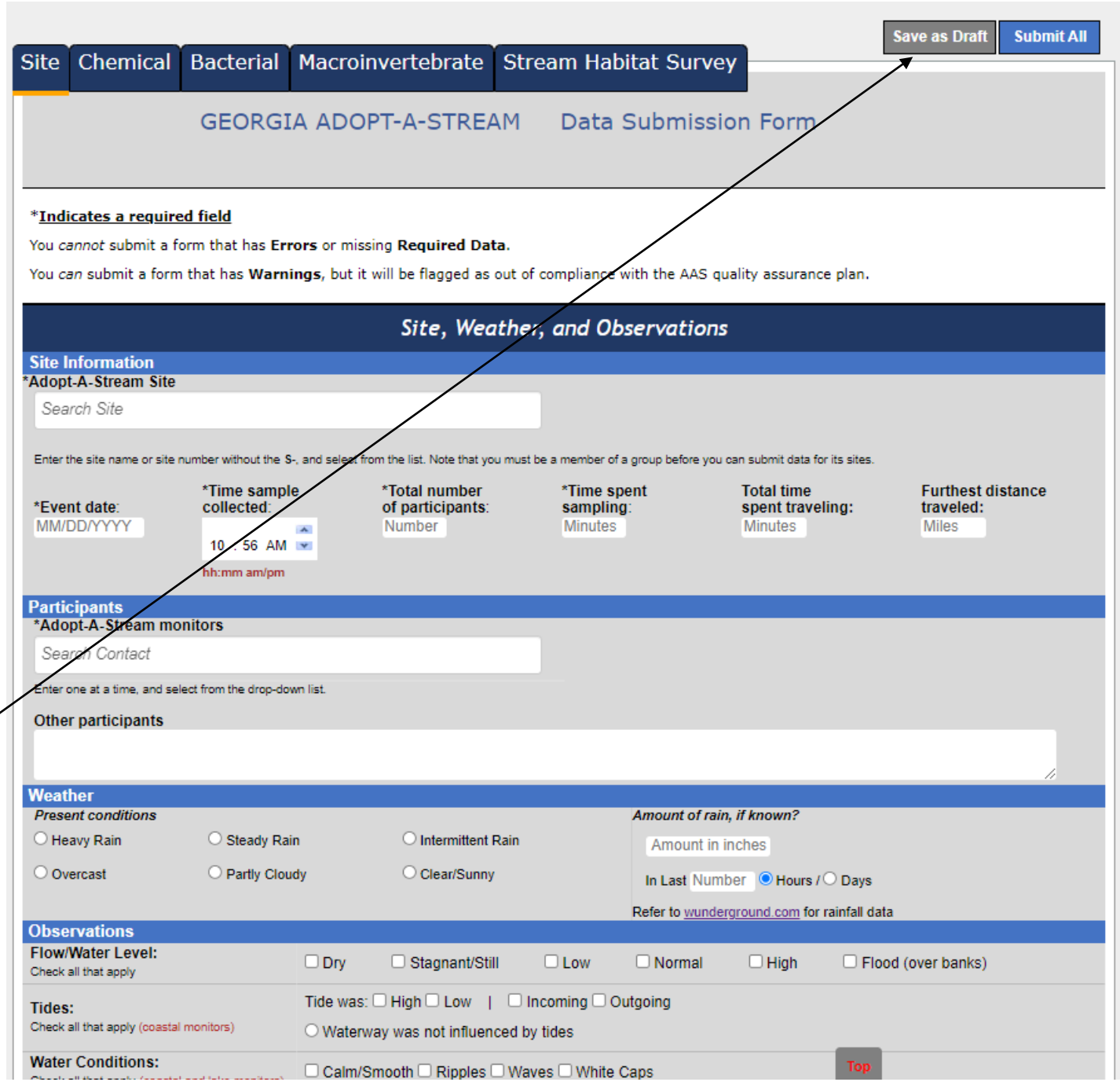


After entering all of your data, click "Submit All" to submit your data to the database



Use “Save as Draft” to finish submitting data at a later time.

Data must be submitted within 7 days of saving as a draft.



FOLLOW AAS AND STAY CONNECTED

AAS@dnr.ga.gov

AdoptAStream.Georgia.gov

facebook.com/georgiaadoptastream

@georgiaadoptastream

2 Martin Luther King Jr. Drive
Suite 1452, East Tower
Atlanta, Georgia 30334

470-524-5791

TEST REVIEW

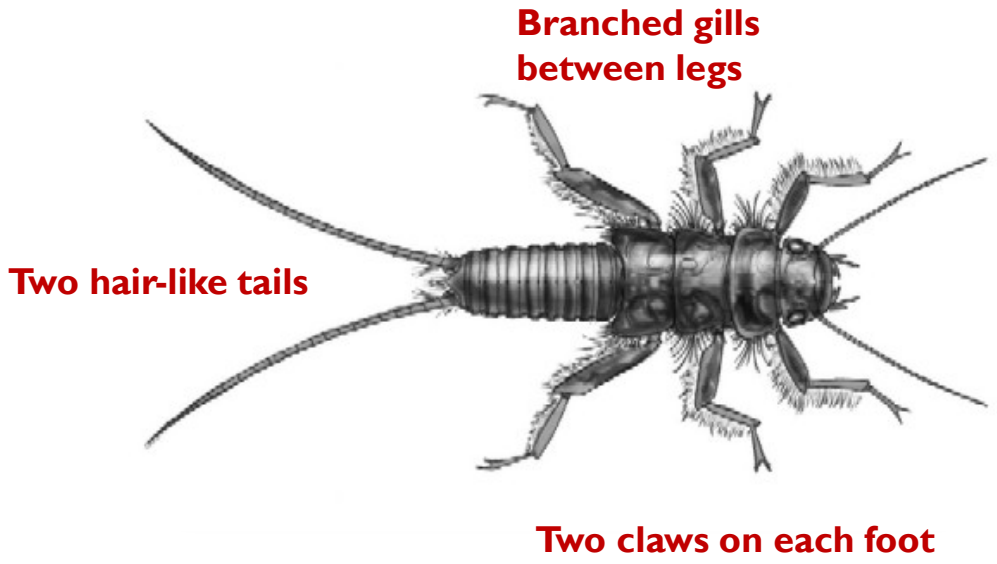
Macro ID

POLLUTION SENSITIVE ORGANISMS

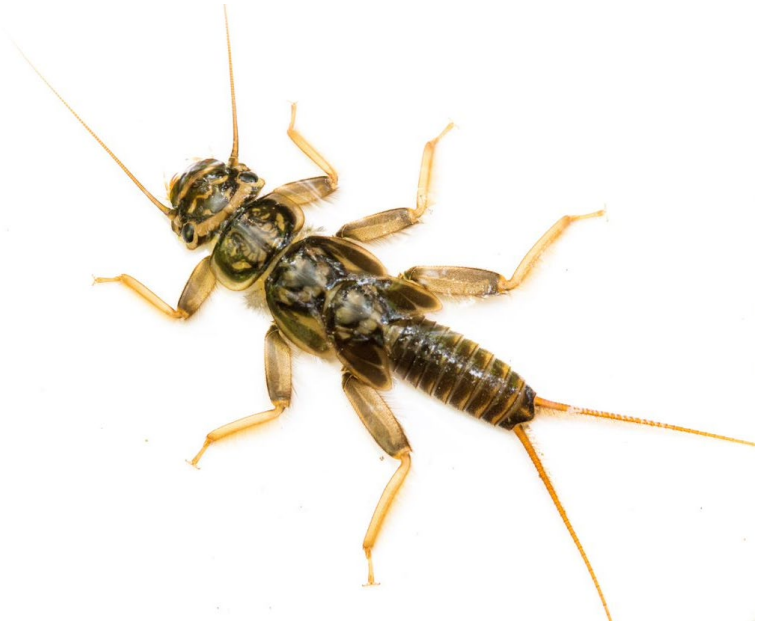
Require High Levels of Dissolved Oxygen
Found In Good Quality Water

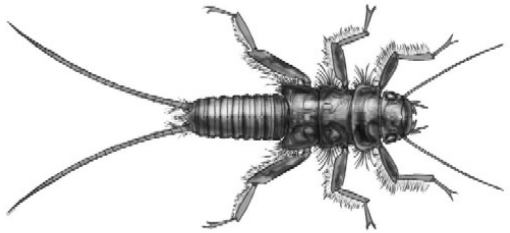
STONEFLY NYMPH

- 2 sets of wing pads
- **Branched gills between legs** on underside of body (distinguishing from mayfly)
- Yellow to brown in color
- **Two tails**
- Prominent antennae
- **Two claws** at the end of each leg

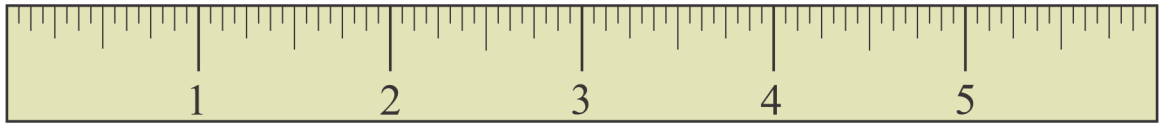


STONEFLY NYMPH



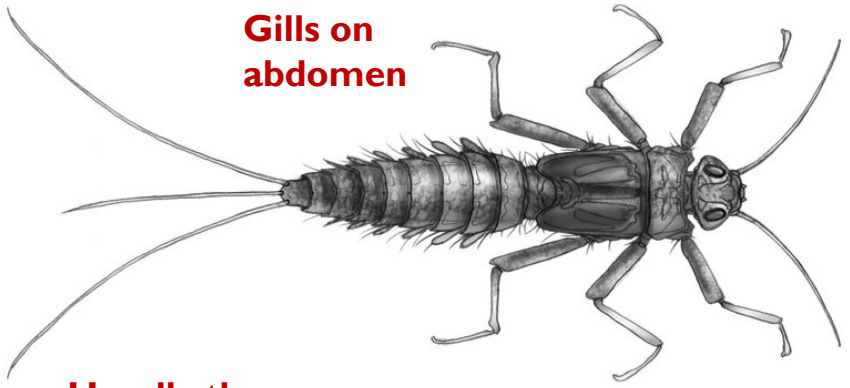


Measures ½ – 1 ½ **inches** in length (not including tails)



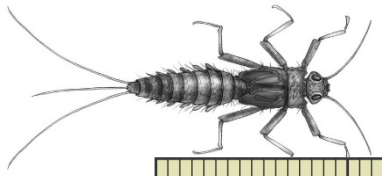
MAYFLY NYMPH

- **Noticeable gills on abdomen** (distinguishing from stonefly)
- **Three tails** (usually!)
- Two rows of long hairs present on inside of front legs
- **One claw on each foot**
- Slender antennae
- May be minnow like with a vertically oriented head and three tails (as pictured) or may be more flattened with a horizontally oriented head and two tails

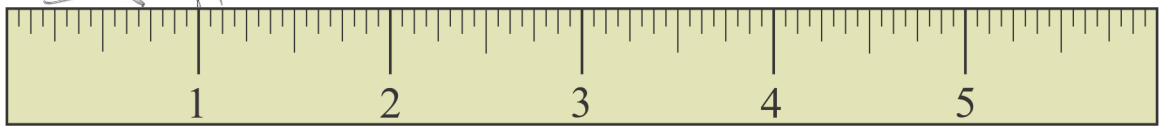


MAYFLY NYMPH

Two tails, but gills present on the abdomen!

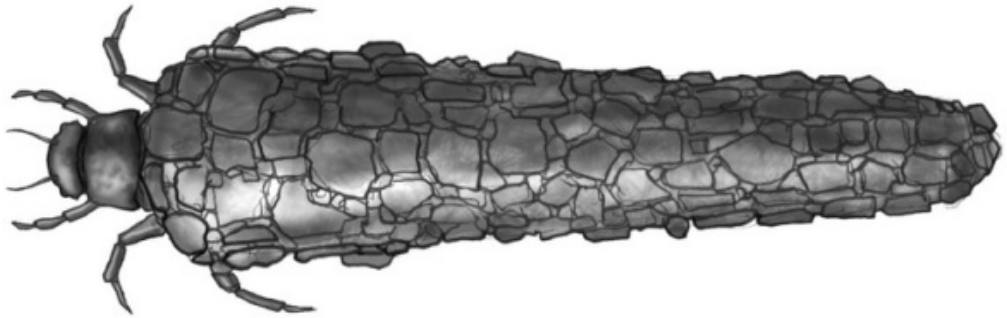


Measures **up to 1 inch** in length (excluding tails)



CASE-MAKING CADDISFLY NYMPH

- Antennae reduced and inconspicuous
- Curls up slightly (not as tightly as the common net-spinning caddisfly)
- **Builds distinctive cases** made of sticks, rocks, sand, plant material and/or other debris

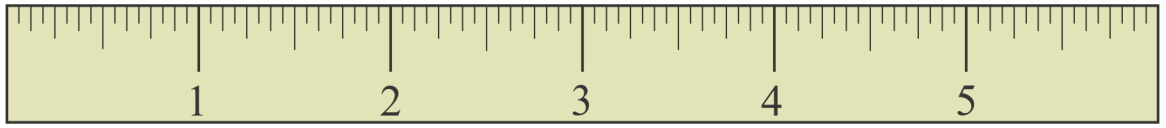


CASE-MAKING CADDISFLY NYMPH

Photo credit: Macroinvertebrates.org and the National Science Foundation

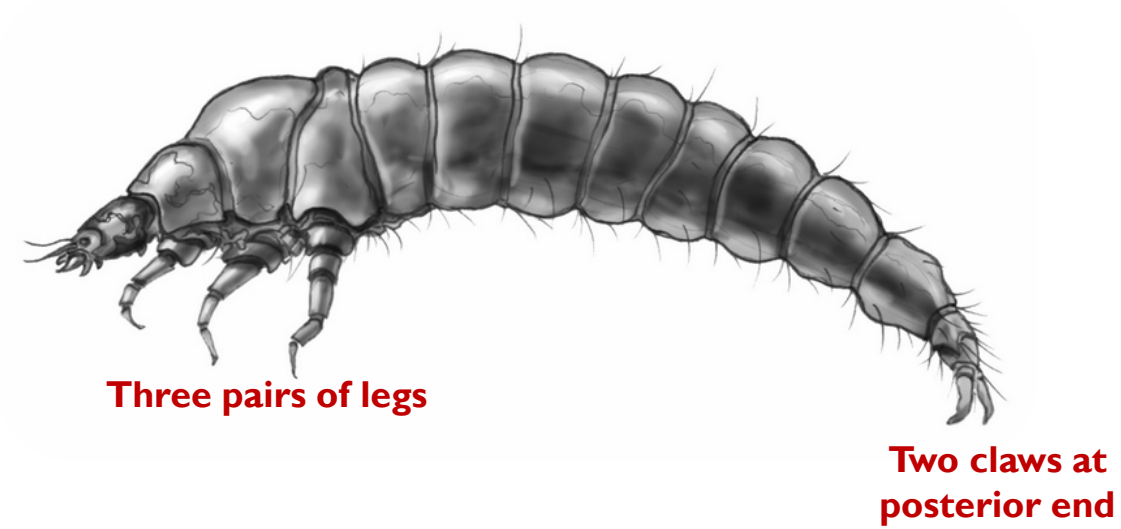
Caddisfly cases

Measures **up to 1½ inch** in length



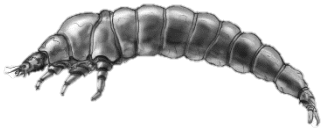
FREE-LIVING CADDISFLY NYMPH

- Antennae reduced and inconspicuous
- Curls up slightly (not as tightly as the common net-spinning caddisfly)
- Well defined segments
- Do not build a case and instead moves throughout their environment
- **Three pairs of legs**
- **Two claws at posterior end**

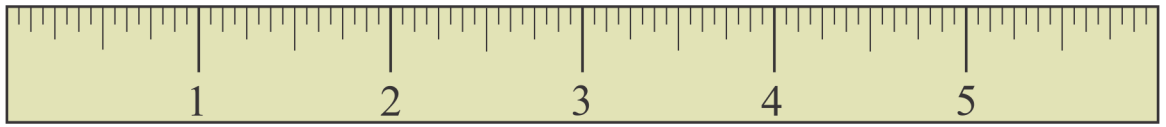


FREE-LIVING CADDISFLY NYMPH

Photo credit: Macroinvertebrates.org and the National Science Foundation

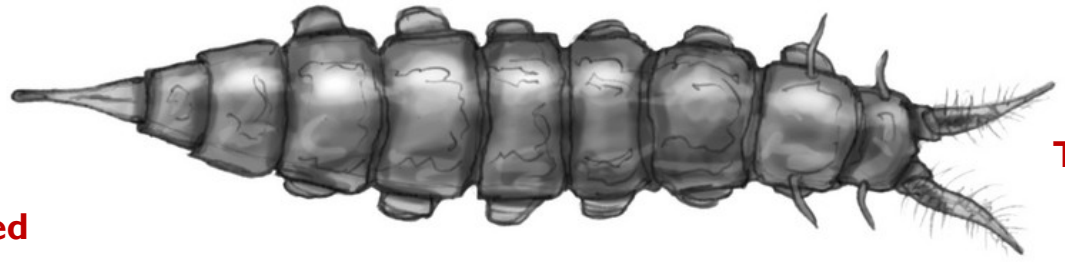


Measures **up to 1½ inch** in length



AQUATIC SNIPE FLY LARVA

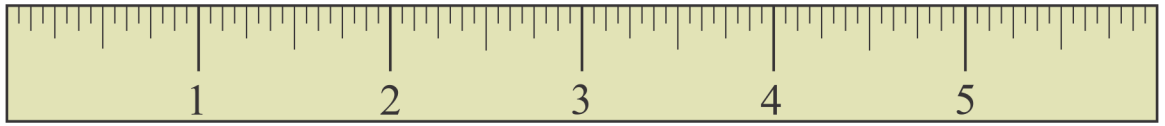
- Mostly cylindrical, with the **front tapering to a cone-shaped point**
- Body is pale brown to green color
- Larva have several paired caterpillar-like prolegs
- **Two stout, pointed tails** with feathery hairs at back end



AQUATIC SNIPE FLY LARVA

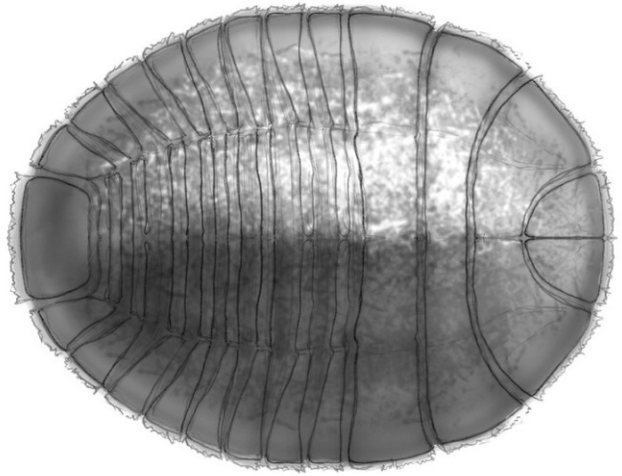
Photo credit: Macroinvertebrates.org and the National Science Foundation

Measures ¼ - **1** inch in length



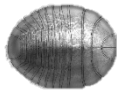
WATER PENNY

- **Flat disk-like body**
- Head and legs concealed from above
- **6 legs and branched gills on underside**
- Usually found attached onto smooth rocks where they graze on algae

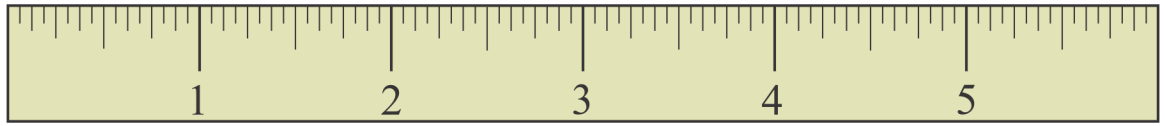


WATER PENNY

Photo credit: Macroinvertebrates.org and the National Science Foundation

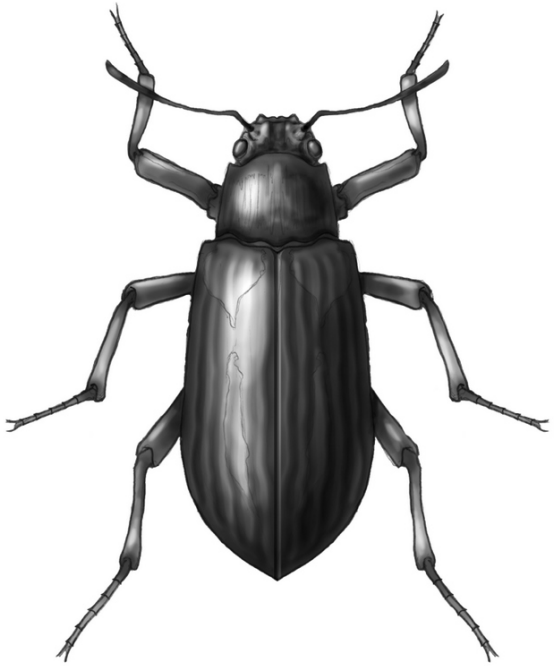


Measures ½ **inch** in length

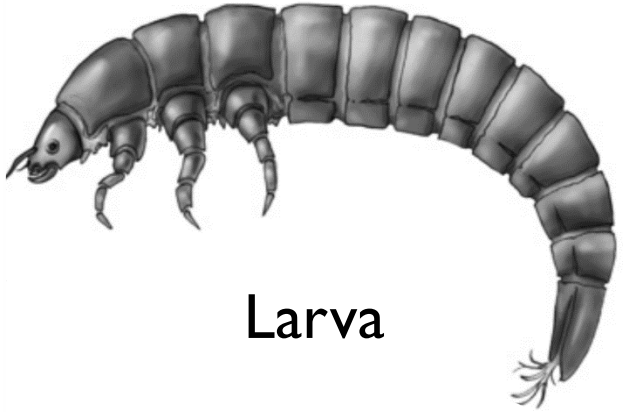


RIFFLE BEETLE

- **Body small, usually oval**
- Legs are long
- Antennae are usually slender
- Walk slowly underwater
  - They do not swim on the surface!
- **Larva look similar to caddisflies, but are much smaller**



Adult



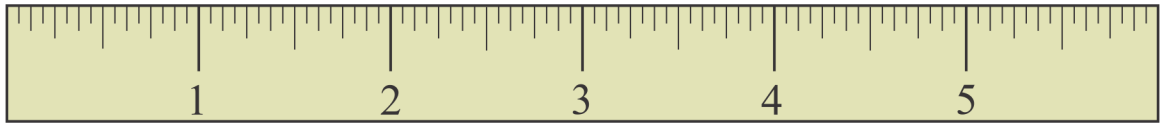
Larva

RIFFLE BEETLE

Photo credit: Macroinvertebrates.org and the National Science Foundation

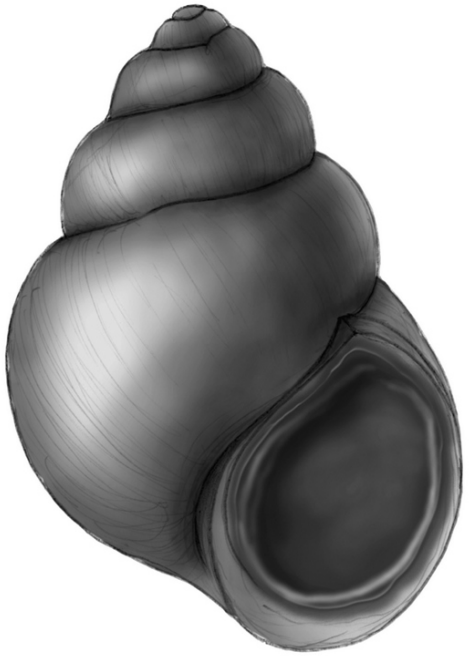
Photo credit: Macroinvertebrates.org and the National Science Foundation

Measures approximately **1/16 to 1/8 inch** in length



GILLED SNAIL

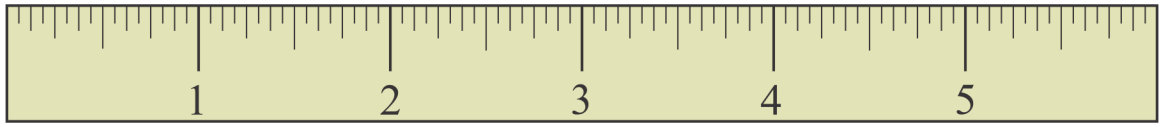
- Shell **opens on right**
- Shell opening covered by a thin plate (operculum)
- When monitoring, do not count empty shells!



GILLED SNAIL

Photo credit: Macroinvertebrates.org and the National Science Foundation

Measures ¼ **to 1 inch**

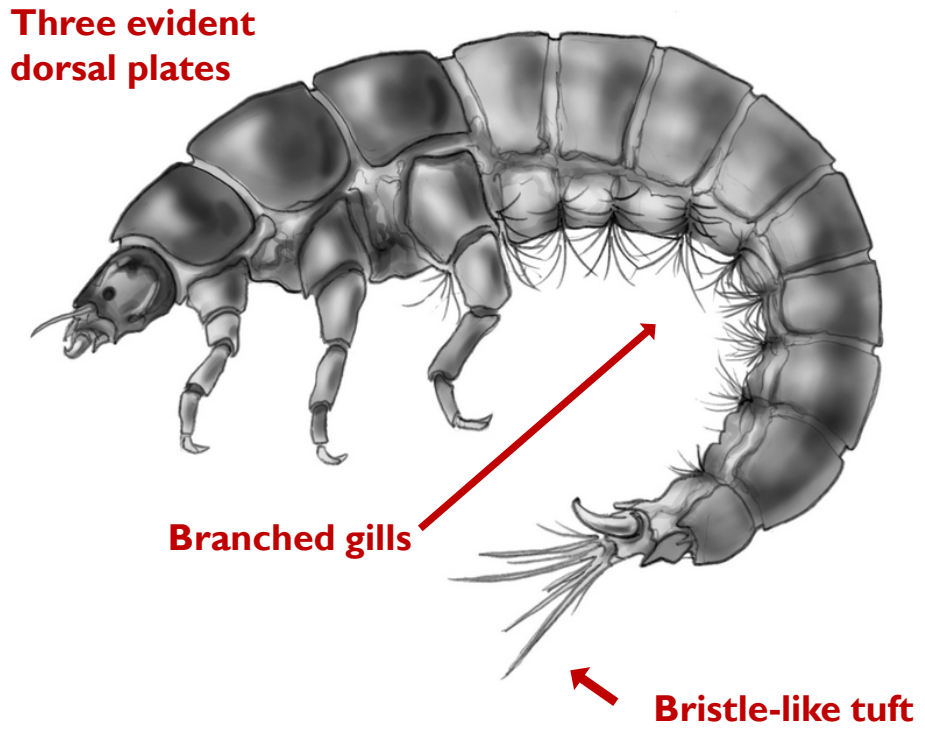


SOMEWHAT POLLUTANT TOLERANT ORGANISMS

Require Moderate Levels of Dissolved Oxygen
Found In Good or Fair Quality Water

COMMON NET-SPINNING CADDISFLY

- Body is caterpillar-like and strongly curved with three pairs of legs
- **Dorsal plates (sclerites) on all three thoracic segments**
- **Branched gills along the underside of the body**
- **Bristle-like tuft at the end of the abdomen**



COMMON NET-SPINNING CADDISFLY

Measures up to **1 inch**

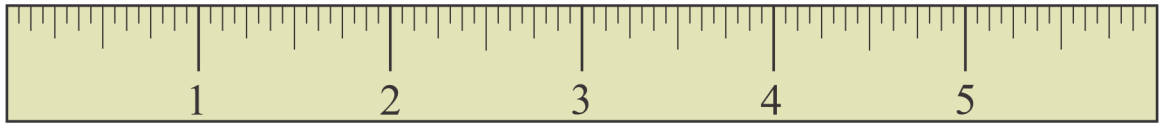
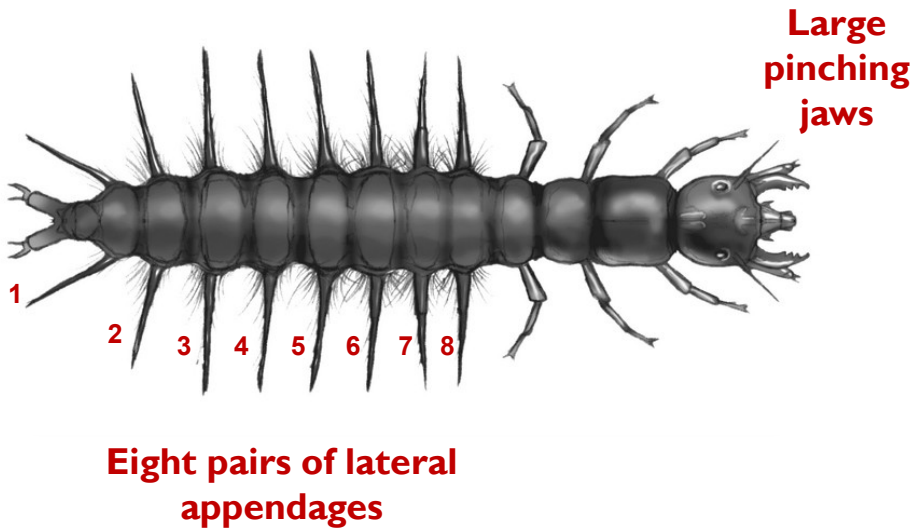


Photo credit: Macroinvertebrates.org and the National Science Foundation

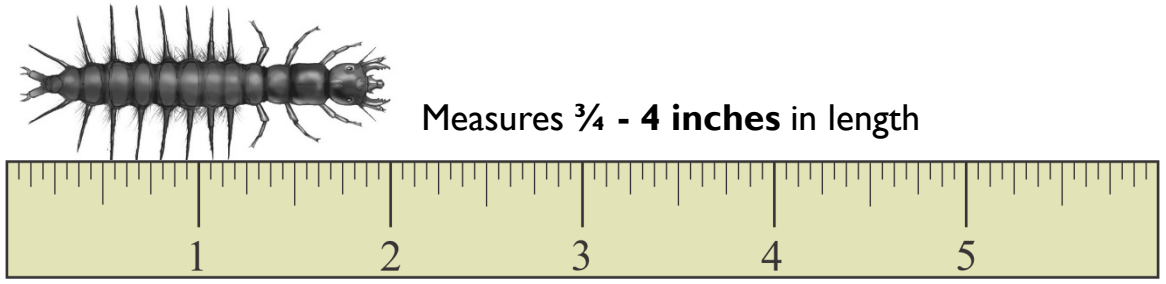
DOBSONFLY AND FISHFLY LARVA

- Body is elongate and somewhat flattened
- **Large, pinching jaws**
- **Eight pairs of lateral appendages**
- Short inconspicuous antennae
- Abdomen terminates in two small prolegs, each bearing two claws
- Usually found on the underside of large rocks in cool, slow-moving streams
- Handle carefully- larger individuals may deliver a painful pinch!



DOBSONFLY AND FISHFLY LARVA

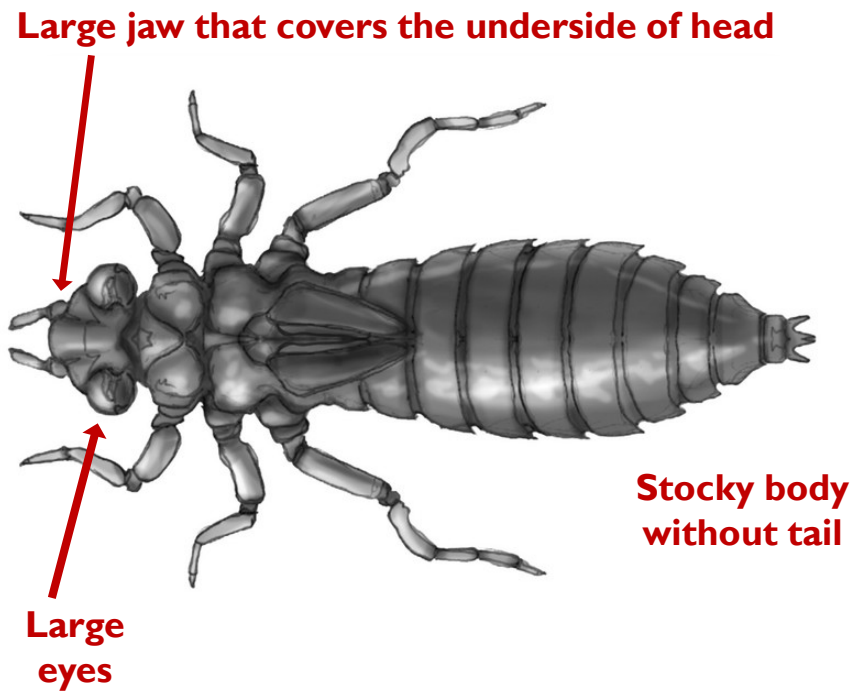
Photo credit: Macroinvertebrates.org and the National Science Foundation



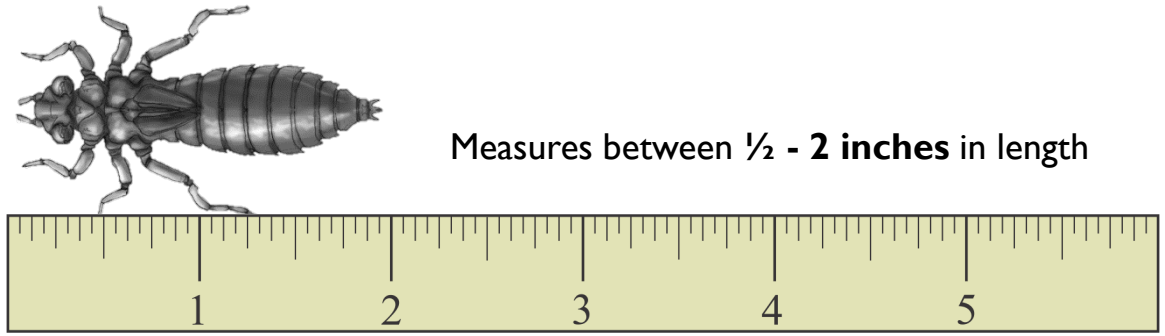
Measures ¾ - **4 inches** in length

DRAGONFLY NYMPH

- Two pairs of wing pads
- **Large eyes and jaw**
- **Large round or oval abdomen without a tail**
- Abdomen terminates in three small pointed structures
- Often found among vegetation and leaf packs or burrowed in sediment



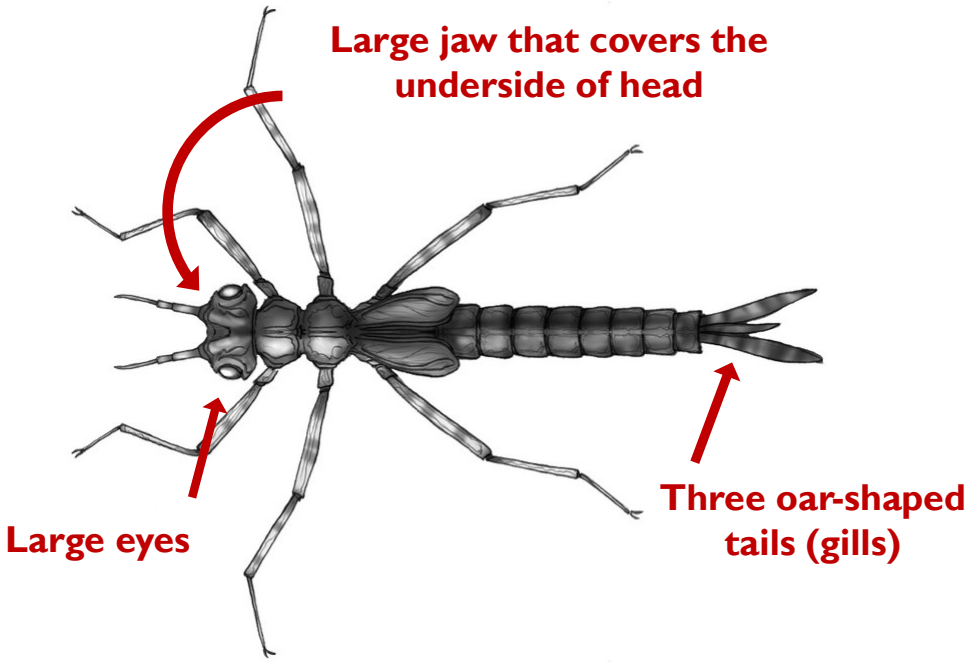
DRAGONFLY NYMPH



Measures between ½ - **2 inches** in length

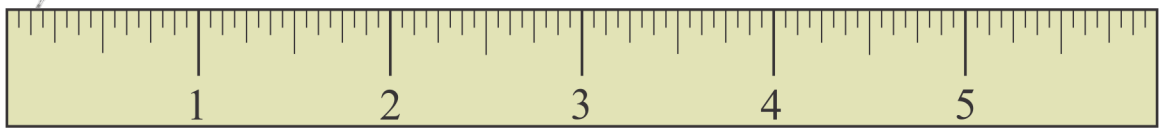
DAMSELFLY NYMPH

- **Large eyes and jaws**
- Six legs
- Abdomen usually much narrower and slenderer than that of dragonflies
- **Three oar-shaped tails**, which are actually their gills



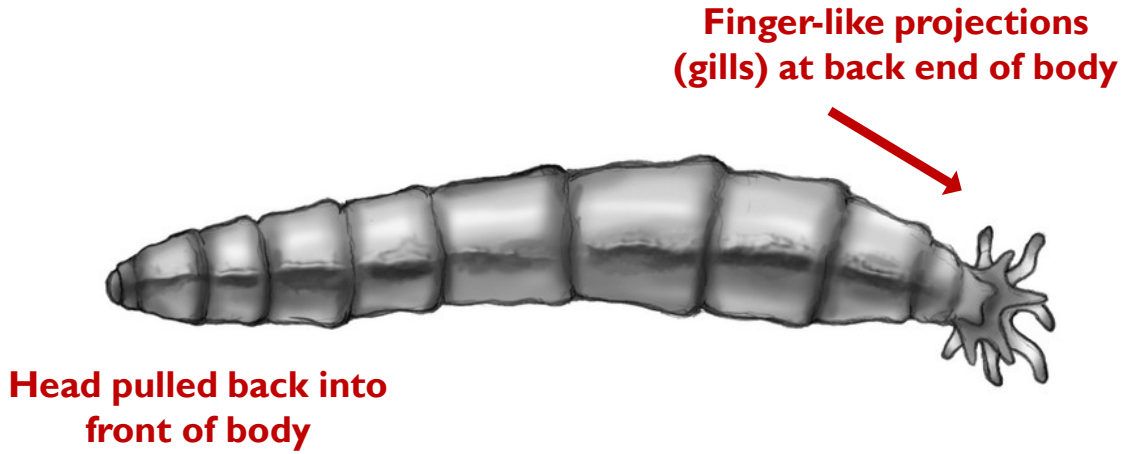
DAMSELFLY NYMPH

Measures ½ - **1 inch** in length

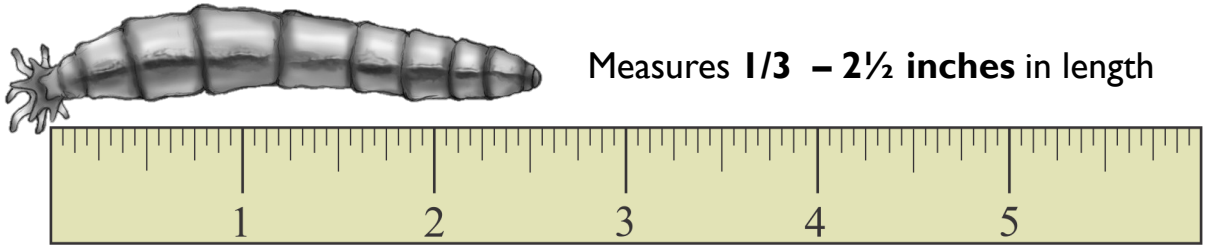


CRANE FLY LARVA

- Plump caterpillar-like segmented body
- Milky green to brown color
- Segmented body
- **Head is usually pulled back into the front of the body**
- **Finger-like projections (gills) at back end of body**



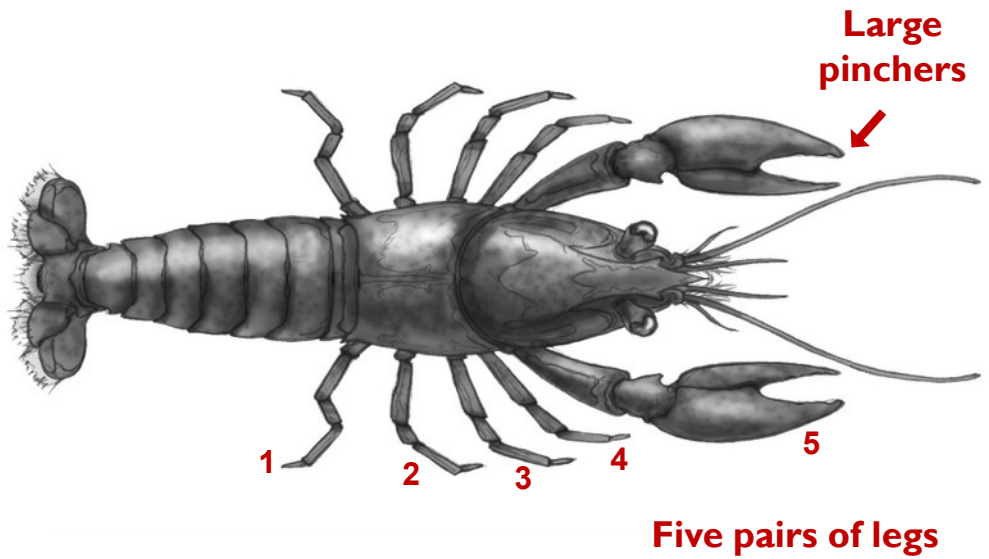
CRANE FLY LARVA



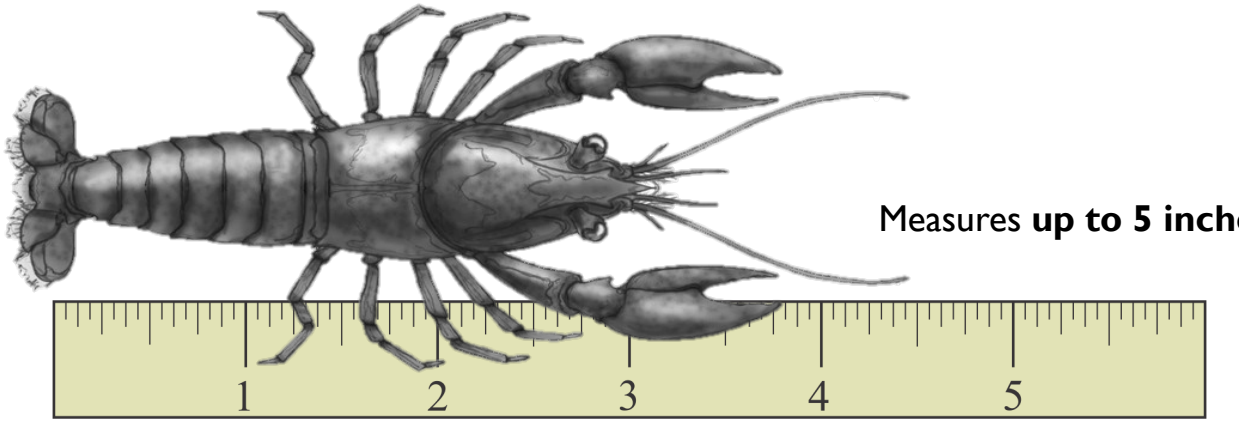
Measures **1/3 – 2½ inches** in length

CRAYFISH

- Resembles a small lobster
- **10 legs and 2 front legs with large claws or pinchers**
- During the day they are often found hiding in burrows or under rocks



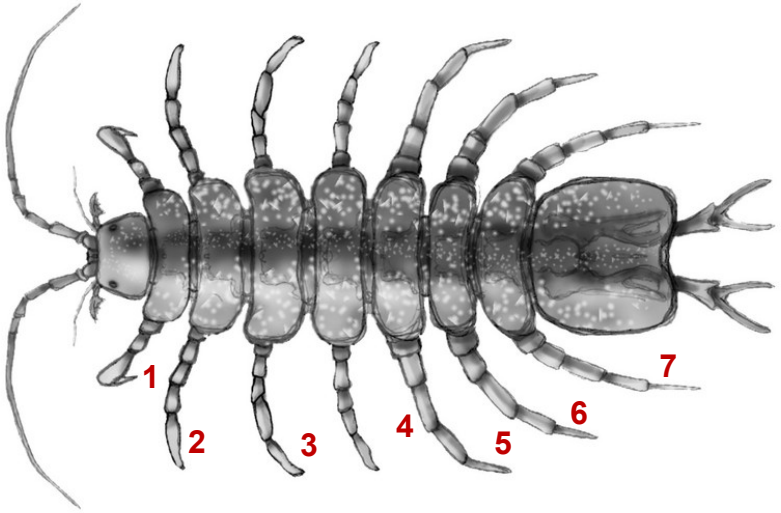
CRAYFISH



Measures **up to 5 inches** in length

AQUATIC SOWBUG

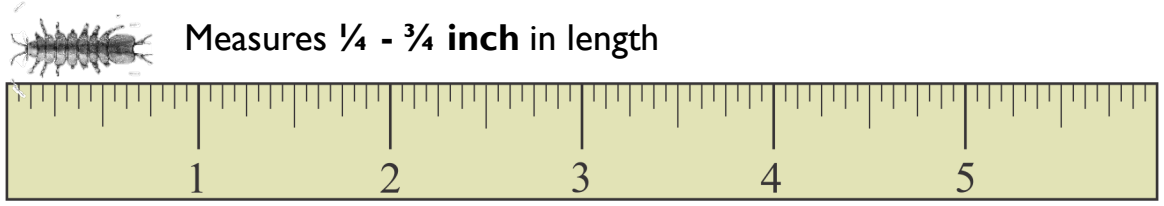
- Clear whitish to pink in color
- **Dorsoventrally flattened** (top to bottom)
- **Seven pairs of legs**, the first two are modified for grasping



Seven pairs of legs

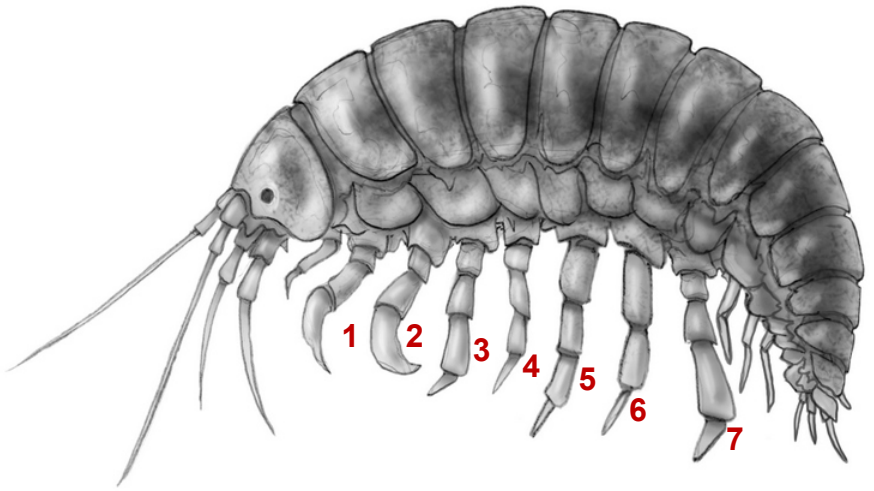
AQUATIC SOWBUG

Photo credit: Macroinvertebrates.org and the National Science Foundation



SCUD

- Translucent body, whitish to pink in color
- Resemble a small shrimp
- **Laterally flattened** (side to side)
- **Seven pairs of legs**



Seven pairs of legs

SCUD

Measures **1/8 – 1/4 inch** in length

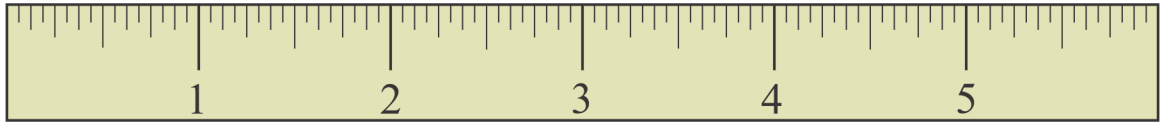
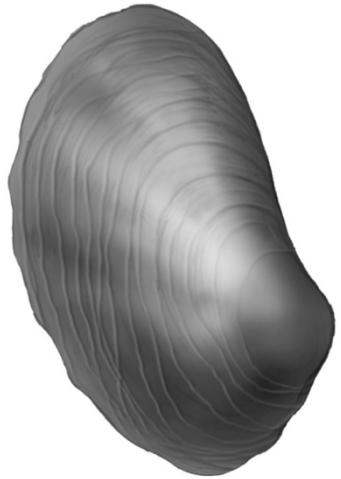


Photo credit: Macroinvertebrates.org and the National Science Foundation

CLAMS & MUSSELS

- Fleshy body enclosed between **two clamped shells**
- If alive, shells cannot be pried apart
- When monitoring, do not count empty shells!

Clam



Mussel

CLAMS & MUSSELS

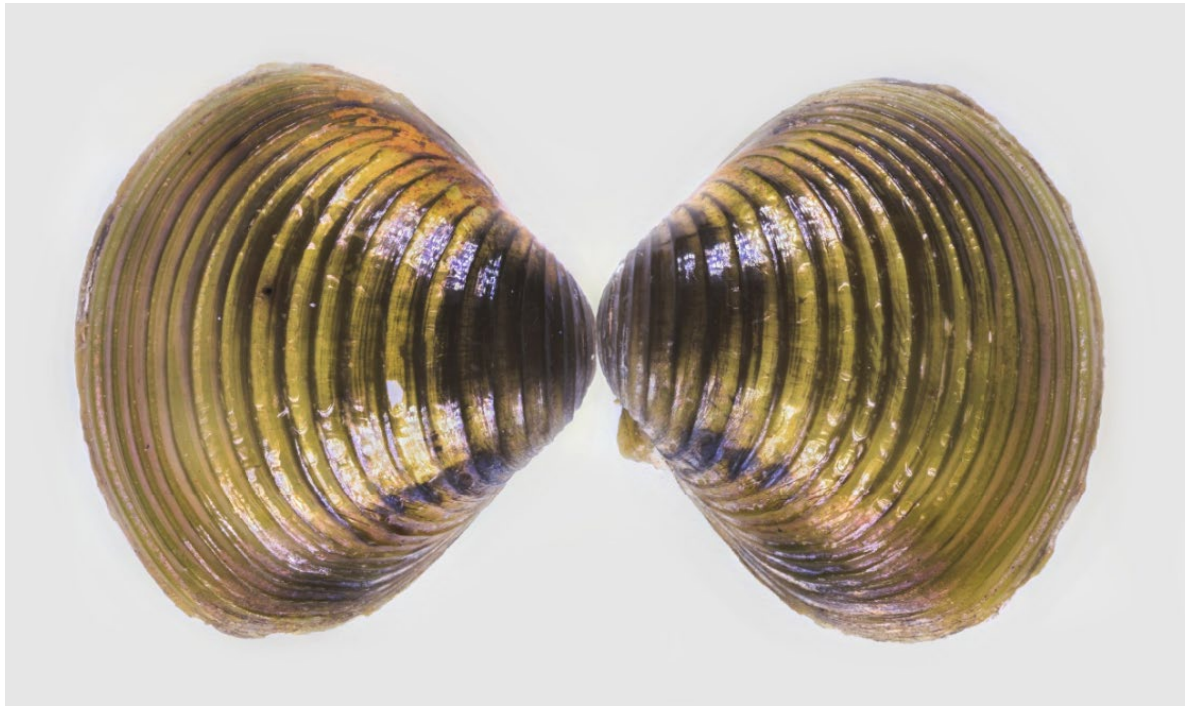


Photo credit: Macroinvertebrates.org and the National Science Foundation

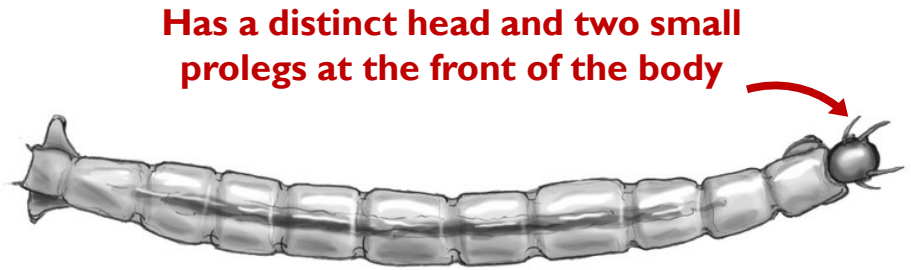
Photo credit: Macroinvertebrates.org and the National Science Foundation

POLLUTANT TOLERANT ORGANISMS

Can Survive in Low Levels of Dissolved Oxygen
Found In Any Quality Water

MIDGE FLY LARVA

- Body small, cylindrical, and slightly curved
- Occasionally deep red in color, otherwise variously colored
- **Two small prolegs** just posterior to head
- Display a **spastic squirming action** in the water



MIDGE FLY LARVA

Measures up to ¼ **inch** in length

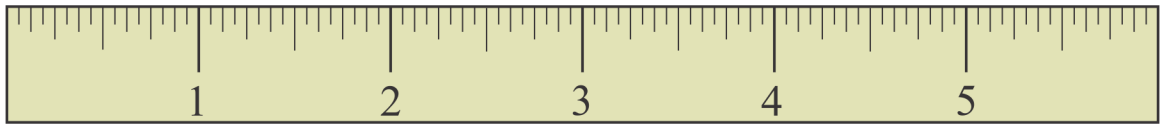
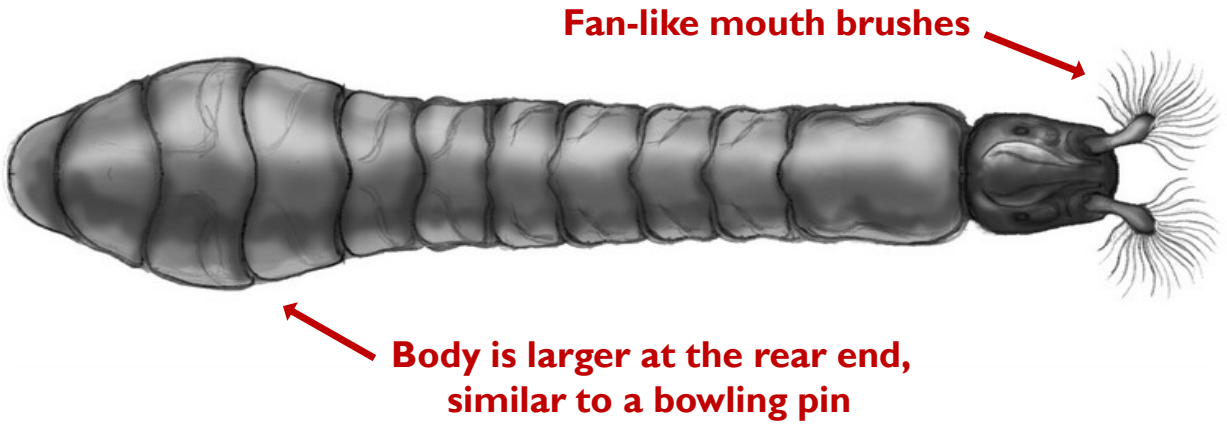


Photo credit: Macroinvertebrates.org and the National Science Foundation

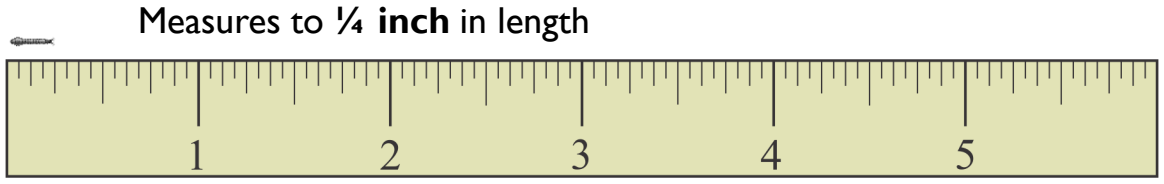
BLACKFLY LARVA

- Abdomen terminates in an attachment disc which is larger than the rest of the body, giving it a **shape similar to a bowling pin**
- The distinct head contains **two fan-like mouth brushes**
- Usually found attached by their abdomens to rocks, woody debris, or vegetation



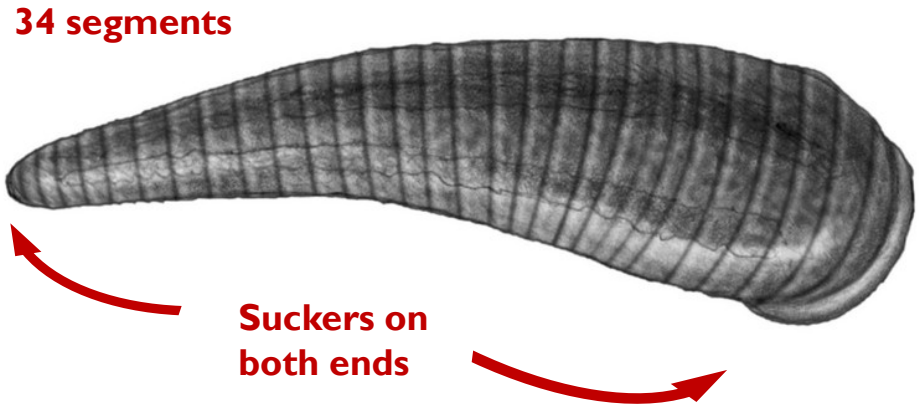
BLACKFLY LARVA

Photo credit: Macroinvertebrates.org and the National Science Foundation



LEECH

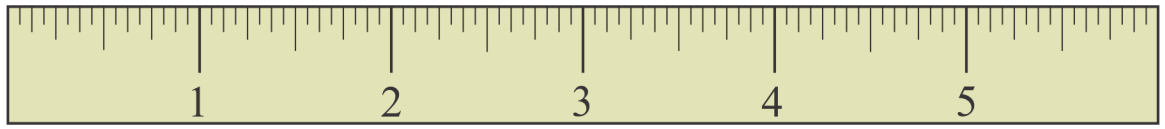
- Typically dorsoventrally flattened
- Somewhat slimy, soft, **segmented body**
- **Two suckers** on the underside of the body, one in the front and one in the rear



LEECH

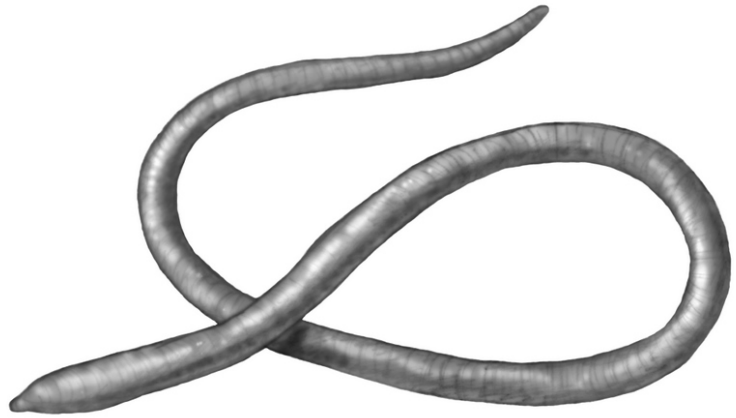
Photo credit: Macroinvertebrates.org and the National Science Foundation

Measures ¼ - **2 inches** in length

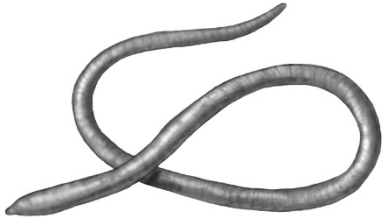


AQUATIC WORM

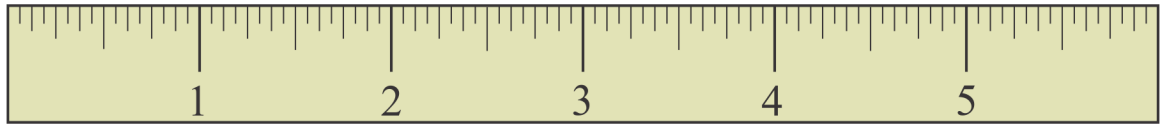
- Can be very tiny and slender, or look similar to earthworms
- **No legs, distinct head or any mouthparts**
- **Segmented body**
- Clear whitish to pink in color
- Body consists of 7 to 500 segments
- Segments often have bristles or hairs
- Found in silty substrates and among debris or detritus in ponds, lakes, streams and rivers



AQUATIC WORM

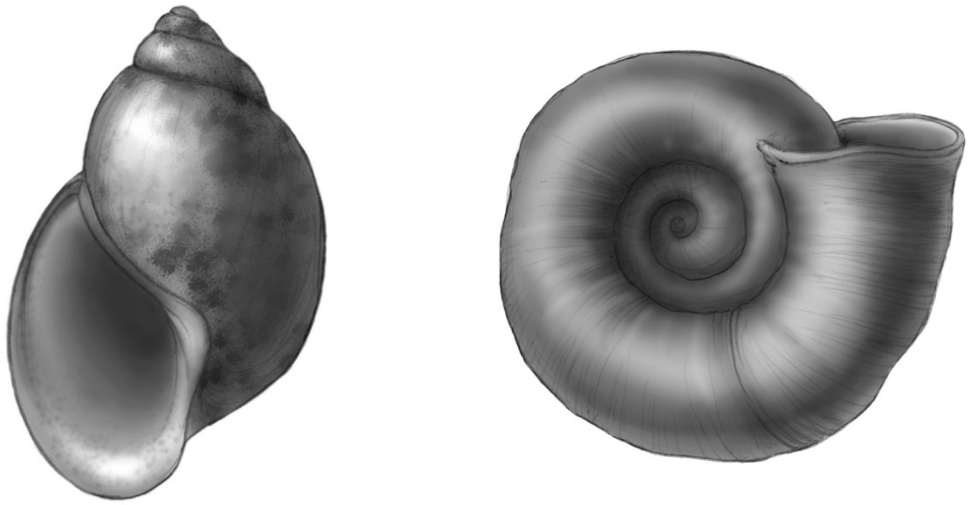


Usually measure **about 1 inch** in length, but **up to 4 inches**

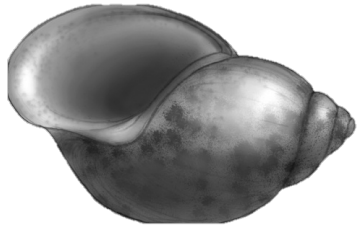


LUNGED SNAIL

- Shell **usually opens to the left** when pointed end is up
- Breathes air
- No operculum
- When monitoring, do not count empty shells!



LUNGED SNAIL



Measures **up to 2 inches**

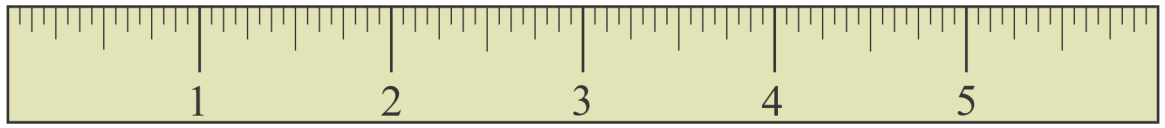


Photo credit: Macroinvertebrates.org and the National Science Foundation