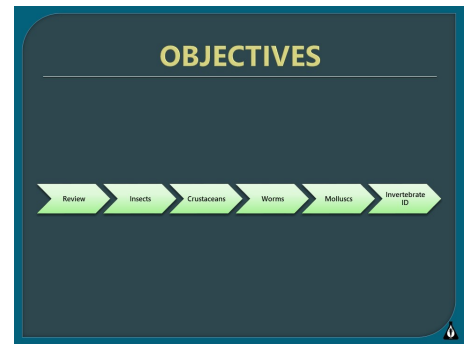


# Aquatic Invertebrate ID



Benthic macroinvertebrates are identified to the taxonomic levels of class, order, or family under Stream Team VWQM protocol. These are the lowest level of identification easily accomplished without magnification. Various keys and identification tools can be used by a monitor until they are familiar with the organisms common in their stream. In this section we will cover:

- Biological sampling review
- Insect identification
- Crustacean identification
- Worm identification
- Mollusc identification
- Invertebrate identification quiz



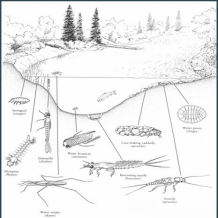
### FACTORS AFFECTING MACROINVERTEBRATES

- ⊙ Dissolved Oxygen
- ⊙ Toxic Chemicals
  - Acute toxicity (major pollution events)
  - Chronic toxicity (long term exposure at lower levels)
- ⊙ Siltation
  - Increase turbidity
  - Increase embeddedness of substrate
- ⊙ Habitat Loss
  - Channelization, dams, urban rip-rap, paving of urban streams

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### STREAM MICROHABITATS

- ⊙ Cobble-rock surface, interstitial spaces
- ⊙ Fine sediment-silt, sand (burrowing species)
- ⊙ Vegetation-aquatic plants, woody debris



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### REMINDERS

- ⊙ Collect samples in an upstream direction
- ⊙ Do not collect from recently disturbed areas
- ⊙ Be consistent

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## Factors Affecting Macroinvertebrates

Many chemical and physical factors associated with stream quality can affect the structure and function of the macroinvertebrate community.

Loss of abundance and diversity are commonly attributed to:

- **Low Dissolved Oxygen**
- **Elevated Toxic Chemicals**
  - \* **Acute toxicity (major pollution events)**
  - \* **Chronic toxicity (long term exposure at lower levels)**
- **Increased Siltation**
- **Habitat loss due to channelization, dams, and urbanization**
- **Increased embeddedness of substrate**
- **Habitat Loss**
- **Channelization, dams, urban rip-rap, paving of urban streams**

## Stream Microhabitats

You are encouraged to sample macroinvertebrates by collecting three net sets from riffle macrohabitat, although rootmat and woody debris macrohabitats can be used if riffles are not present. By collecting each net set from a microhabitat within the riffle you can increase the diversity of your sample. Microhabitats are created by:

- **Interstitial spaces between gravel and cobble**
- **Fine sediment accumulations towards the stream edge**
- **Fast or slow current**
- **Shallow or deeper water**
- **Vegetation**

## Sampling Reminders

Regardless of the macrohabitat that you sample, there are several guidelines that you should apply:

- **Always collect samples in an upstream direction**
- **Do not sample in areas that you have disturbed**
- **Be consistent**

## Specimen Preservation

Solution	Pros	Cons	Comments
30% Isopropyl	Inexpensive and can be found at most general retailers	Harsh on invertebrates-will make them brittle over time	<ul style="list-style-type: none"> <li>•Buffer with 1-2 drops of glycerin</li> <li>•Sold in 70% and 90% concentrations.</li> </ul>
80% Ethyl alcohol (Denatured alcohol)	<p>Best method for long term storage</p> <p>Less harsh on specimens</p>	More expensive and difficult to find	<ul style="list-style-type: none"> <li>•Buffer with Tums</li> <li>•Kleen Strip Green Denatured Alcohol</li> <li>•Often near paint supplies</li> <li>•Make sure product is mostly ethyl alcohol, not methanol</li> </ul>
Hand Sanitizer	Suspends specimens for viewing	Not recommended for large or soft inverts as it's only 60% alcohol	<ul style="list-style-type: none"> <li>•Gel must be replenished over time as it breaks down into a liquid</li> <li>•Specimen must be euthanized before being placed in gel</li> </ul>

### SPECIMEN PRESERVATION

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Review → Insects → Crustaceans → Worms → Molluscs → Invertebrate ID

### NUISANCE SPECIES PREVENTION

Technique	Duration	Concentration	Solution	Comments
Vinegar	20 min.	100%	1 gallon of vinegar, no water	Safety glasses and gloves should be worn. Corrosive to metal and toxic to fish.
Chlorine (6% household bleach)	10 min.	3%	4 oz of bleach and 1 gallon of water	Before re-use rinse with water but don't let the solution runoff directly to the stream.
Air Drying	3-5 days	NA	NA	Equipment must dry completely.
Freezing < 32°F	24 hours	NA	NA	Must be below freezing for duration of contact time.
Salt Bath	24 hours	1%	1/8 cup in 1 gallon of water	Equipment must be completely submerged.


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## Nuisance Species Prevention

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### TAXONOMIC LEVELS WITH EXAMPLE

Kingdom	• Animalia
Phylum	• Arthropoda
Class	• Insecta
Order	• Ephemeroptera
Family	• Heptageniidae
Genus	• Stenonema
Species	• femoratum



MDC photo

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### VWQM TAXA

Class	• Gilled snail, mussel, aquatic worm, leech, other snail
Order	• Caddisfly, mayfly, stonefly, crayfish, scud, sowbug, other beetle larva
Sub-Order	• Dragonfly, damselfly
Family	• Riffle beetle, water penny, crane fly, alderfly, watersnipe fly, midge, pouch snail
Genus	• Hellgrammite, fishfly

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## Taxonomic Levels

Taxonomic levels refer to the organization of macroinvertebrate names that are based on the Linnaeus taxonomic classification system. This naming system is hierarchical, with the broadest grouping starting at “Kingdom” and the narrowest grouping ending at “Species.” The complete system in descending order is: Kingdom, Phylum, Class, Order, Family, Genus, Species. Listed below are the classification groups and common names that the VWQM Program uses for macroinvertebrate identification.

**Class**

- Gilled snail, mussel, aquatic worm, leech, other snail

**Order**

- Caddisfly, mayfly, stonefly, crayfish, scud, sowbug, other beetle larva

**Sub-Order**

- Dragonfly, damselfly

**Family**

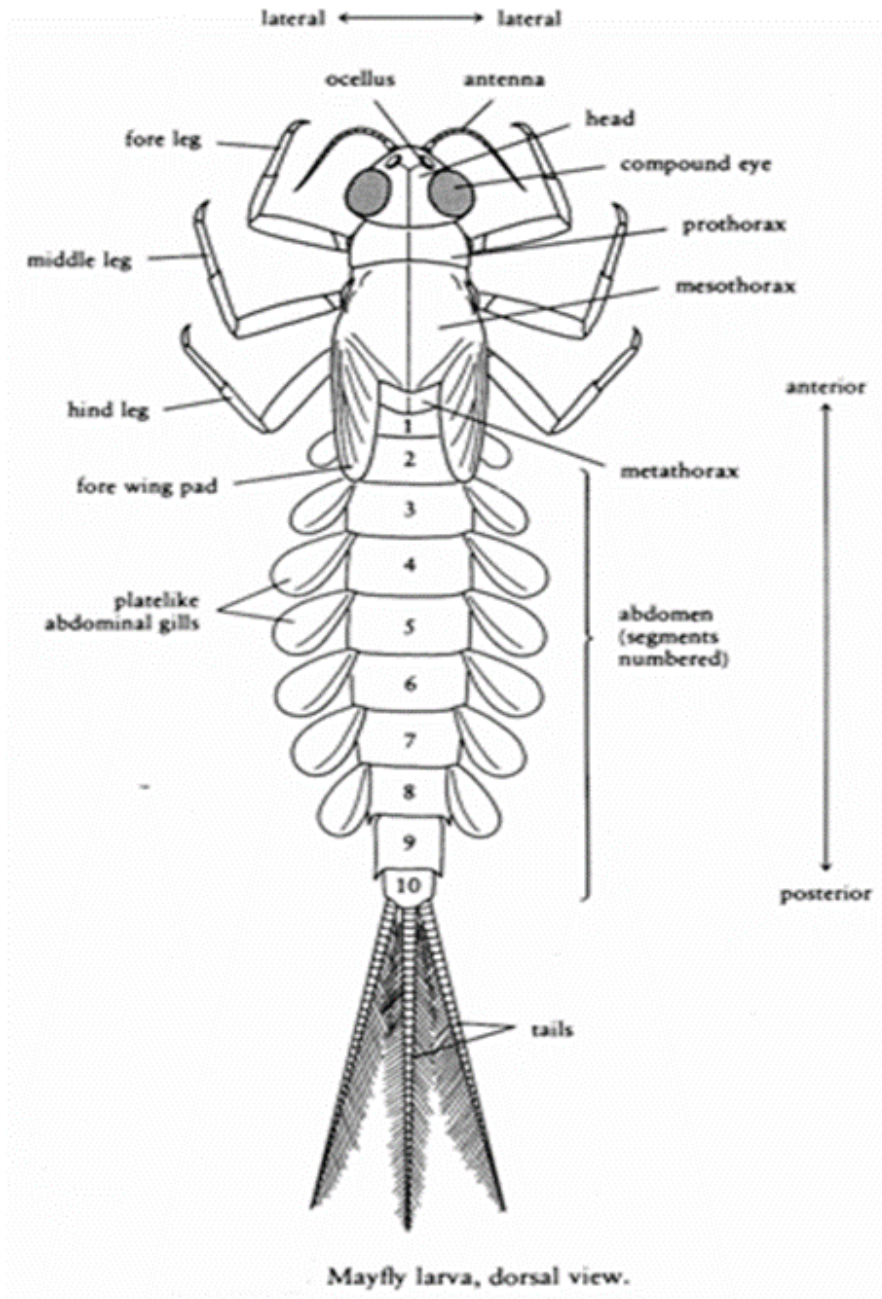
- Riffle beetle, water penny, crane fly, alderfly, watersnipe fly, midge, pouch snail

**Genus**

- Hellgrammite, fishfly



## Generalized Morphology

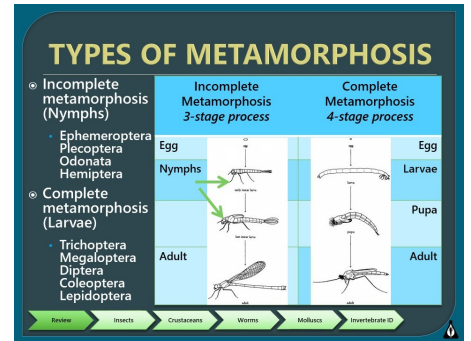
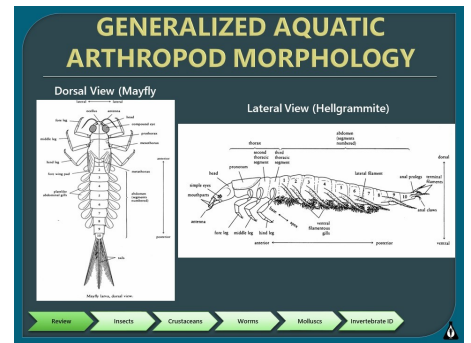


## Types of Metamorphosis

The aquatic insects have two distinct life stages, commonly called the adult stage and the immature stage. Between these stages the insects undergo metamorphosis. There are two types of metamorphosis:


- Incomplete (egg, nymph, and adult);
- Complete (egg, larvae, pupae, and adult)

Complete metamorphosis, with the associated pupal stage, allows insects to make more significant body changes from larvae to adult.



**MAYFLY (EPHEMEROPTERA)**

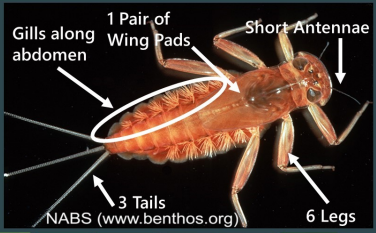
- Three major body regions: head, thorax and abdomen
- Short antennae
- Six legs with one sharp claw on each foot
- One visible pair of wing pads on top of thorax
- Gills on top and sides of abdomen
- Three tails (some have two)
- ¼"-1" in length (not including tail),



MDC photo  
Mayfly adult  
MDC photo

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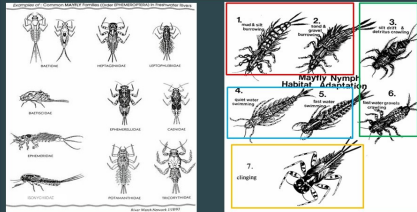
**MAYFLY (EPHEMEROPTERA)**



Gills along abdomen  
1 Pair of Wing Pads  
Short Antennae  
3 Tails  
6 Legs  
NABS (www.benthos.org)

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**MAYFLY (EPHEMEROPTERA)**



1. Head and Thorax  
2. Head and Thorax  
3. Head and Thorax  
4. Head and Thorax  
5. Head and Thorax  
6. Head and Thorax  
7. Girdling

Mayfly Nymph Habitat Adaptation

Review Insects Crustaceans Worms Molluscs Invertebrate ID



MDC photo  
DNR photo  
MDC photo  
MDC photo

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## Insects: Mayfly (Ephemeroptera)

### A checklist of important mayfly characteristics:

- Three recognizable major body regions (head, thorax and abdomen)
- Short antennae
- Thorax has six jointed legs with one sharp claw on each foot
- One visible pair of wing pads on top of thorax
- Gills attach to sides of abdomen
- Three tails at the end of the abdomen (some have two)
- ¼"-1" in length (not including tail)

### Some useful behavioral characteristics:

- Some are good swimmers
- Others are crawlers
- Mayfly gills may be more visible when the mayfly is at rest in water



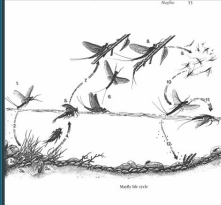
## Insects: Mayfly (Ephemeroptera)

### Life history details:

- Nymphs live in riffles, sand, or mud burrows for months or years eating mostly algae, detritus, etc.
- Nymphs molt to a terrestrial sub-imago stage, which quickly molts again to mature imago stage
- Emergence of adults may be synchronized
- Adults live for hours or days, mate, and lay eggs on water surface
- In healthy ecosystems, adults of some species can create massive swarms during emergence




**MAYFLY  
(EPHEMEROPTERA)**



- Nymphs live in riffles or in sand or mud burrows for months or years eating mostly algae, detritus, etc.
- Molts to terrestrial sub-imago stage, which quickly molts again to mature imago stage
- Emergence of adults may be synchronized
  - Adults live for hours or days, mate, and lays eggs on water surface

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**MAYFLY  
(EPHEMEROPTERA)**



- In healthy ecosystems, adults of some species can create massive swarms during emergence

MDC photo MDC photo 01/07/2014

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### STONEFLY (PLECOPTERA)

- Three major body regions: head, thorax, and abdomen
- Two long bristle-like antennae
- Six legs with two claws on each foot
- Two pairs of large wing pads on thorax
- Might have plume-like gills on thorax between the legs (hairy armpits), abdomen gill-less
- Two bristle-like tails
- 1/8"-1 1/2" long

MDC photo Stonefly adult MDC photo

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### STONEFLY (PLECOPTERA)

2 claws on each foot

2 long tail filaments

No gills on abdomen

2 pairs of wing pads

Long antennae

Plume-like gills on thorax/between legs

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### STONEFLIES (PLECOPTERA)

Examples of Common Stonefly Families (Order Plecoptera) in the Aquatic Biome

- There are multiple families of stonefly
- Various shapes and ecological niches and diets

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MDC Photo MDC Photo MDC photo MDC Photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID

## Insects: Stonefly (Plecoptera)

### A checklist of important stonefly characteristics:

- Three recognizable major body regions (head, thorax, and abdomen)
- Two long bristle-like antennae
- Thorax has six jointed legs with two claws on each foot
- Two pairs of wing pads on thorax
- Might have plume-like gills on thorax between the legs (hairy armpits), abdomen without gills
- Two bristle-like tails
- 1/8" - 1 1/2" long

### Some useful behavioral characteristics:

- All are crawlers





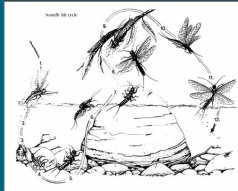
## Insects: Stonefly (Plecoptera)

### Life history details:

- Nymphs can be common in riffles and are herbivorous, omnivorous or carnivorous, depending on species
- After months or years they crawl out of water and molt into adult
- Adults live a few weeks, mate, and lay eggs on the water



**STONEFLY  
(PLECOPTERA)**





- Nymphs usually occupy riffles and are herbivorous, omnivorous or carnivorous, depending on species
- After months or years they crawl out of water and molt into adult
- Adults live a few weeks, mate, and lay eggs on the water

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### CADDISFLY (TRICHOPTERA)

- ⊗ Three major body regions: head, thorax and abdomen; the head and thorax are much darker and harder than abdomen. Hairy body overall
- ⊗ Larvae up to 1"
- ⊗ Three pair of legs
- ⊗ May have filamentous gills on underside of abdomen.
- ⊗ The end of abdomen will have a pair of prolegs with hooks at the end
- ⊗ Larvae have no wing pads and have a very definite grublike or wormlike appearance
- ⊗ Posterior end of abdomen will usually form a slight crook.

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### CADDISFLY (TRICHOPTERA)





NABS (www.benthos.org)


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### CADDISFLY (TRICHOPTERA)


**Caddis Larva Living Modes**


1 FREE LIVING  


2 NET SPINNING  


3 TUBE MAKING  


4 SADDLE CASE  


5 PURSE CASE  


6 PORTABLE CASE  


- ⊗ Free living
- ⊗ Net spinning
- ⊗ Tube making
- ⊗ Saddle case
- ⊗ Purse case
- ⊗ Portable case

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### CADDISFLY (TRICHOPTERA)

**Number of Common CADDISFLY Families (Order Trichoptera) in Each of the Following Biomes**

Biome	Watershed	Temperate Forest	Temperate Grassland	Temperate Deciduous Forest	Temperate Coniferous Forest
Free Living	1	1	1	1	1
Net Spinning	1	1	1	1	1
Tube Making	1	1	1	1	1
Saddle Case	1	1	1	1	1
Purse Case	1	1	1	1	1
Portable Case	1	1	1	1	1

**Number of Common CADDISFLY Families (Order Trichoptera) in Each of the Following Biomes**

Biome	Watershed	Temperate Forest	Temperate Grassland	Temperate Deciduous Forest	Temperate Coniferous Forest
Free Living	1	1	1	1	1
Net Spinning	1	1	1	1	1
Tube Making	1	1	1	1	1
Saddle Case	1	1	1	1	1
Purse Case	1	1	1	1	1
Portable Case	1	1	1	1	1

## Insects: Caddisfly (Trichoptera)

### A checklist of important caddisfly characteristics:

- Three major body regions (head, thorax and abdomen)
- The head and thorax are much darker and harder than abdomen
- The abdomen may be hairy
- Thorax has six jointed legs
- May have filamentous gills on underside of abdomen.
- The end of abdomen will have a pair of prolegs with single hooks at the end
- Larvae have no wing pads and have a very definite grublike or wormlike appearance
- Larvae up to 1"

### Some useful behavioral characteristics:

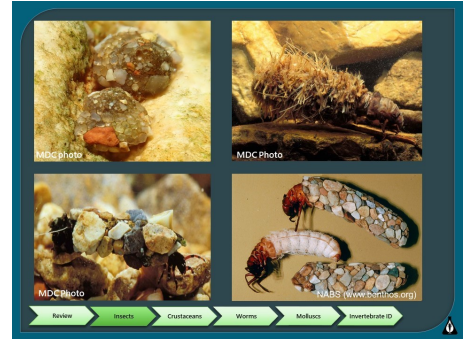
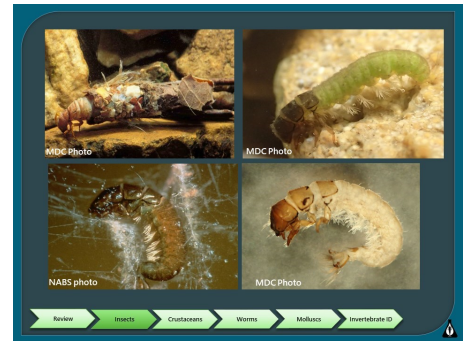
- All are crawlers, but they may try to pull themselves backwards using their abdominal prolegs
- May be free-living, net-spinning, or case makers



## Insects: Caddisfly (Trichoptera)

### Life history details:

- Larvae eat detritus or other organic material, but some are predatory
- Most use silk to form a case or web but some are free-living
- Form pupae and undergo complete metamorphosis, hatch and swim to surface, molt again, and fly away as adults to breed
- Adults are moth-like with hairy wings, are nocturnal, and typically do not eat. They live a few weeks and lay their eggs on water surface or crawl underwater to lay eggs




**CADDISFLY (TRICHOPTERA)**

- Larvae eat detritus or other organic material, but some are predatory
- Most use silk to form a case or web but some are free-living
- Form pupae and undergo complete metamorphosis-hatch and swim to surface, molt again and fly away as adults to breed
- Adults are moth-like w/ hairy wings are nocturnal and typically do not eat. They live a few weeks and lay their eggs on water surface



### DOBSONFLY, FISHFLY, ALDERFLY (MEGALOPTERA)

- ◉ Larvae are elongate and slightly flattened
- ◉ Head possesses large mandibles
- ◉ Head and thorax are harder than abdomen
- ◉ Thorax has six legs
- ◉ Abdominal segments each have a pair of lateral filaments




Hellgrammite  
MDC photo  
Fishfly larvae  
DNR photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID

### DOBSONFLY/HELLGRAMMITE (MEGALOPTERA)


- ◉ Very large mandibles capable of a painful pinch
- ◉ Has conspicuous gill tufts under lateral filaments
- ◉ Very large, up to 4"



MDC photo  
Large gill tufts on abdomen  
MDC photo

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### DOBSONFLY/HELLGRAMMITE (MEGALOPTERA)

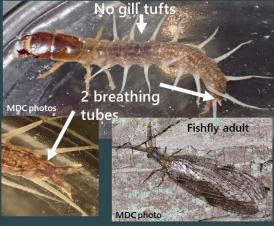


Adult male dobsonfly  
Adult female dobsonfly  
Photo by Bob Firabik  
MDC Photo

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### FISHFLY (MEGALOPTERA)

- ◉ Very similar to hellgrammite
- ◉ Has no gill tufts on abdomen
- ◉ 2 breathing tubes at end of abdomen




No gill tufts  
2 breathing tubes  
MDC photos  
Fishfly adult  
MDC photo

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### ALDERFLY (MEGALOPTERA)

- ◉ Similar to fishfly and dobsonfly but often smaller
- ◉ No gill tufts under filaments
- ◉ Abdomen ends in a single long feathery filament
- ◉ Rarely collected by VWQM methods



1 long tail  
MDC photo  
Alderfly adult  
MDC photo

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## Insects: Dobsonfly, Fishfly, Alderfly (Megaloptera)

Dobsonflies, fishflies, and alderflies belong to the Order Megaloptera. However, each can be easily identified and are separately recorded on the VWQM macroinvertebrate datasheet.

### A checklist of important dobsonfly, fishfly, and alderfly characteristics:

- Larvae are elongate and slightly flattened
- Head possesses large mandibles
- Head and thorax are harder than abdomen
- Thorax has six jointed legs
- Abdominal segments each have a pair of lateral filaments

### A checklist of additional Dobsonfly characteristics:

- Conspicuous gill tufts under lateral filaments
- Prolegs at the end of the abdomen with two claws on the end

### A checklist of additional fishfly characteristics:

- Does not have gill tufts under lateral filaments
- Two breathing tubes near the end of abdomen
- Prolegs at end of the abdomen with two claws on the end

### A checklist of additional alderfly characteristics:

- Does not have gill tufts under lateral filaments
- Abdomen ends in a single long feathery filament

## Insects: Dobsonfly, Fishfly, Alderfly (Megaloptera)

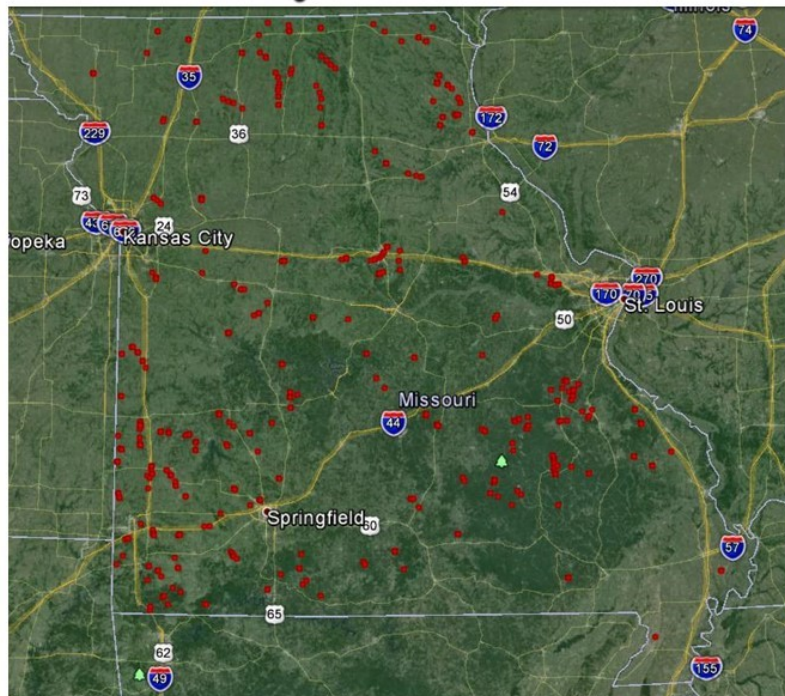
### Some useful behavioral characteristics:

Alderfly are widespread in Missouri (see red dots on graphic below) but are rarely collected by VWQM methods. MoDNR data shows that when they are collected : 80% are found in pools; 25% are found on rootmat; 9% are found in riffles; and 4% are found on woody debris.

### Life history details:

- Larvae are mostly predatory, feeding on other invertebrates or even small fish
- Larvae live in water for as long as 2-3 years
- Hellgrammites are often found in riffles, while fishflies and alderflies can be found in slower water among organic debris or in rootmat
- Larvae crawl out of water to pupate on land
- Adults live days to a week and do not eat. They are often nocturnal and are poor fliers
- Females lay eggs on vegetation overhanging water

## Alderfly Distribution




### DOBSONFLY, FISHFLY, ALDERFLY (MEGALOPTERA)

- Larvae are mostly predatory, feeding on other invertebrates or even small fish
- Larvae live in water for as long as 2-3 years
- Hellgrammites are often found in riffles, while fishflies and alderflies can also be found in slower water among organic debris or silt
  - Larvae crawl out of water to pupate on land
- Adults live days to a week and do not eat.
  - They are often nocturnal and are poor fliers
  - Females lay eggs on vegetation overhanging water

Review Insects Crustaceans Worms Molluscs Invertebrate ID

### FLY (DIPTERA)

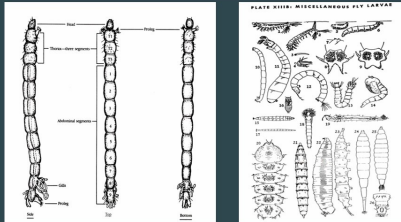
- Very diverse group, many with aquatic larvae
- Adult forms are highly variable, but always have only one pair of wings (other insects have two)
- Larvae are usually elongate and maggot-like
  - Head may or may not be well developed and conspicuous
  - Eyes are poorly developed
  - Wing pads are absent
  - Thorax never possesses three pairs of segmented legs, but prolegs may be present near head or on abdomen



MDC photo

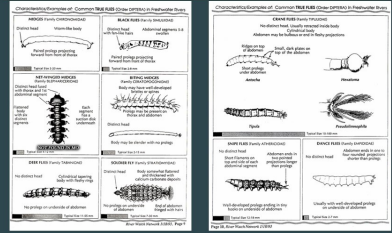
Review Insects Crustaceans Worms Molluscs Invertebrate ID

### FLY (DIPTERA)



Review Insects Crustaceans Worms Molluscs Invertebrate ID

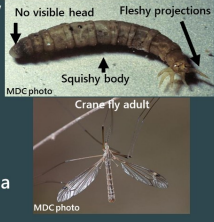
### FLY (DIPTERA)



Review Insects Crustaceans Worms Molluscs Invertebrate ID

### CRANE FLY (DIPTERA)

- Larvae can be up to 4"
- Very soft-bodied
- Abdomen ends in flattened plate, projections, or is bulbous
- Larvae very mobile
- Adults don't eat, or drink nectar and have a short lifespan



MDC photo

MDC photo

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## Insects: Fly (Diptera)

Diptera are a very diverse group; many have aquatic larvae. Fly larvae can be found in almost any aquatic environment, with some, such as midges and mosquitoes, being capable of living in extremely stagnant or polluted water. Most aquatic fly larvae are generalists and feed on detritus or any organic materials, but some are predatory. Adult forms are also highly variable, but always have only one pair of wings (other insects have two)

### A checklist of important fly characteristics:

- Larvae are usually elongate and maggot-like
- Head capsule may or may not be well developed and conspicuous
- Eyes are poorly developed
- Wing pads are absent
- Thorax never possesses jointed legs, but fleshy prolegs may be present near head or on abdomen

### A checklist of additional crane fly characteristics:

- Larvae can be up to 4" long
- Very soft-bodied
- Abdomen ends in flattened plate, projections, or is bulbous
- No distinct head

### A checklist of additional watersnipe fly characteristics:

- Abdomen ends in 2 horn-like projections
- No distinct head

### A checklist of additional midge fly characteristics:

- Prolegs behind head and at end of abdomen
- Most are very small (<1/2")
- Some larvae are red or pinkish (bloodworms); others are green or clear
- Have a hard, distinctive head capsule



## Insects: Fly (Diptera)

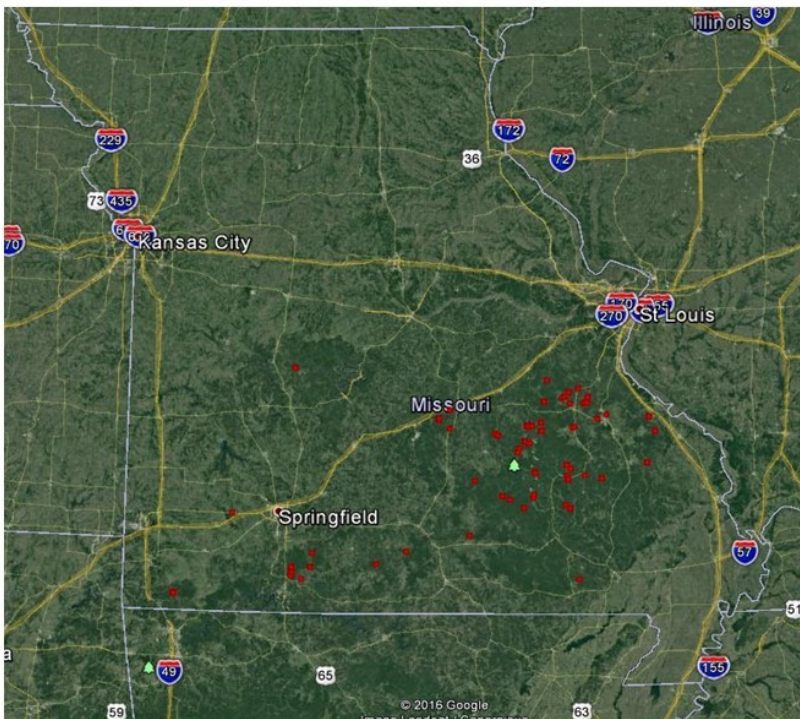
### A checklist of additional black fly characteristics:

- Larvae small (<1/2")
- Have a distinct head capsule
- Have a proleg behind the head capsule
- Have a distinctive "bowling pin" shape

### Some useful behavioral and life history characteristics:

- Although cranefly larvae do not have segmented legs they can be very mobile and "crawl" well
- Watersnipe flies move like a caterpillar with its prolegs
- Watersnipe flies are not widely distributed in Missouri. They are restricted to cool water streams in the Ozarks (see red dots on the distribution map below)
- Midge fly larvae slowly crawl and when suspended in water will generally "flip" and "twitch" in jerky motions
- Black fly larvae stick to surfaces with the end of their abdomen

## Watersnipe Fly Distribution



### WATERSNIPE FLY (DIPTERA)

- Abdomen ends in 2 horn-like projections
- No distinct head
- Moves like a caterpillar with its prolegs
- Rare in Missouri

Feathery horns  
Visible prolegs  
NABS (www.benthos.org)  
Watersnipe fly adult  
Wiki Commons

### HORSE/DEER FLY (DIPTERA)

- Larvae similar to watersnipe fly
  - lacks horns and has prolegs or creeping welts that circle the body
- Larvae very mobile
- Up to 1 1/2" long
- Larvae are predatory or eat detritus.
- Adults feed on nectar/pollen and females also feed on blood to produce eggs

Creeping welts  
MDC photo  
Horsefly adult  
MDC photo

### MIDGE (DIPTERA)

- No jointed legs, only prolegs behind head and at end of abdomen
- Most are very small (<1/2")
- Some larvae are red or pinkish (bloodworms)
- J-shaped when preserved
- Adults often swarm and rarely eat

prolegs  
NABS (www.benthos.org)  
Adult Midge  
MDC photo

### BLACK FLY (DIPTERA)

- Larvae small (<1/2")
- Stick to surfaces with their abdomen
- Filter feed using feathery mouthparts
- Pupae stick to surfaces too and have thread-like tassels
- Adult females feed on blood to produce eggs

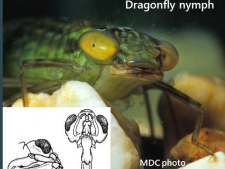
Feathery mouthparts  
Suction disc  
© Steve Marshall  
Black Fly pupae  
Black Fly adult  
MDC photo  
NABS photo

### FLIES (DIPTERA)


- Most aquatic fly larvae are generalists and feed on detritus or any organic material. They are also often very low on the aquatic food chain
- Fly larvae can be found in almost any aquatic environment, with some, such as midges and mosquitoes, being capable of living in extremely stagnant or polluted water
- Pupae highly variable; may be free-living or sedentary and have gills or breathe air
- Adults either don't eat, feed on nectar or other plant juices, drink blood, or are predatory

**DRAGONFLY AND DAMSELFLY (ODONATA)**

- Six long legs
- Two very large compound eyes
- A extendable labium (mouth) that is hinged and designed to grab prey. It is folded under the head and thorax
- No gills, plumes, or hair-like projections on the abdomen or thorax
- Length ranges from 1/4"-2"



Dragonfly nymph




MDC photo

5/11/09

Review Insects Crustaceans Worms Molluscs Invertebrate ID


**DRAGONFLY (ODONATA)**

- No tail or outer surface gills
- Wide, oval to round abdomen
- Nymphs can jet propel by expelling water from their rectum




Wide abdomen

No tail




MDC photo




Dragonfly nymph

MDC photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID



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## Insects: Dragonfly, Damselfly (Odonata)

Dragonfly and damselfly nymphs are aggressive predators, using their labium to catch prey as large as amphibians and even small fish.

### A checklist of important dragonfly and damselfly characteristics:

- Three major body regions (head, thorax and abdomen)
- Thorax has six jointed legs
- Two large compound eyes
- An extendable labium (lower lip) that is hinged and designed to grab prey. It is folded under the head and thorax
- No gills, plumes, or hair-like projections on the abdomen or thorax
- Length ranges from 1/4"-2"

### A checklist of additional dragonfly characteristics:

- No tail or outer surface gills
- Wide, oval to round abdomen

### A checklist of additional damselfly characteristics:

- Three large, paddle-like tails (actually tracheal gills)
- Abdomen long and slender and thorax very short and wider with very tightly folded, high, dorsal wing cases





# Insects: Dragonfly, Damselfly (Odonata)

## Some useful dragonfly and damselfly behavioral characteristics:

- Dragonfly nymphs can jet propel by expelling water from their rectum
- Damselfly nymphs can swim by undulating their bodies

## Life history details for dragonfly and damselfly:

- Nymphs commonly occur in still water or stream edges clinging to aquatic vegetation or rootmat, but some nymphs are bottom-dwelling
- Nymphs can stay in water for 1-2 years, depending on species and environment
- Nymphs crawl out of water for their final molt to become adults
- Adults eat flying insects (midges, mosquitoes, etc.)
- Mating pairs fly in tandem
- Females lay eggs in water

**DAMSELFLY (ODONATA)**

- Three large, paddle-like tails that are actually tracheal gills
- Abdomen long and slender and thorax very short and wider with very tightly folded, high, dorsal wing cases
- Nymphs can swim by undulating their bodies

Long narrow abdomen without projections

3 paddle-like tails

MDC photo

Damselfly adult

MDC photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID

MDC photo

MDC photo

MDC photo

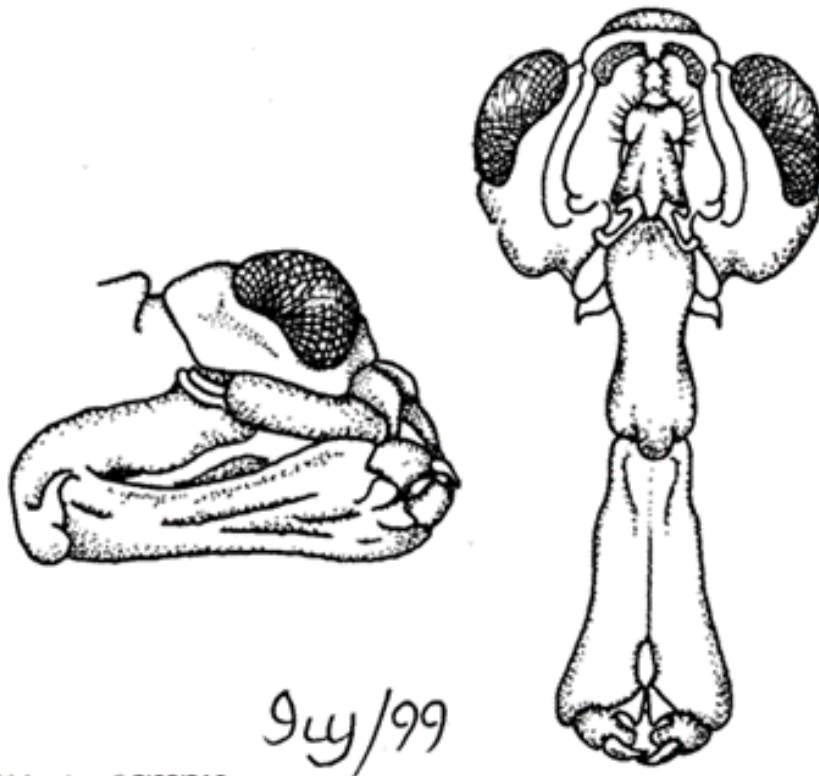
MDC photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID

**DRAGONFLY AND DAMSELFLY (ODONATA)**

- Nymphs are aggressive predators, using their labium to catch prey as large as amphibians & small fish
- Damselfly and many dragonfly nymphs occur in still water or stream edges clinging to aquatic vegetation or root mats, but some dragonfly nymphs are bottom-dwelling
  - Nymphs can stay in water for years depending on species and environment
  - Nymphs crawl out of water for their final molt to become adults
- Adults eat flying insects (midges, mosquitoes, etc.)
  - mating pairs fly in tandem
  - Females lay eggs in water


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9/4/99

### BEETLE (COLEOPTERA)

- ◉ Most diverse group of animals, but most are fully terrestrial
- ◉ Adults are hard-bodied, oval to elongate
  - Head possesses chewing mouthparts, well-developed eyes, and variably shaped antennae
  - Fore wings are modified into hardened covers (elytra) over the abdomen and the hind wings
- ◉ Larvae are variously shaped and measure ¼"-1" at maturity
  - Head is usually distinct in larvae and possesses chewing mouthparts
  - Wing pads are absent on larvae.
  - Thorax has 6 well-developed legs
  - Abdomen may possess lateral and/or terminal filaments, tail-like structures, gills




MDC photo  
Crawling water beetle

Review Insects Crustaceans Worms Molluscs Invertebrate ID

### RIFFLE BEETLE (COLEOPTERA)

- ◉ Very small, 3/8"
- ◉ Larvae are grub-like but covered with hard plates over entire body
- ◉ Adults are dark colored and slow crawling
- ◉ Both larvae and adult are aquatic and feed on algae/detritus




MDC photo Larvae  
Hard plates on every segment  
MDC photo Adult

Review Insects Crustaceans Worms Molluscs Invertebrate ID

### WATER PENNY (COLEOPTERA)

- ◉ Very dorsally flattened and saucer-shaped
- ◉ Segmented body with legs underneath
- ◉ Moves slowly, clinging to rock surfaces in riffles to feed on algae
- ◉ Adults are terrestrial



MDC photo  
MDC photo

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## Insects: Beetle (Coleoptera)

Beetles are the most diverse group of animals, but most are fully terrestrial.

### A checklist of important beetle characteristics:

#### Adults

- Hard-bodied, oval to elongate
- Head possesses chewing mouthparts, well-developed eyes, and variably shaped antennae.
- Fore wings are modified into hardened covers (elytra) over the abdomen and the hind wings

#### Larvae

- Variously shaped and measure ¼"-1" at maturity
- Head is usually distinct in larvae and possesses chewing mouthparts
- Wing pads are absent on larvae.
- Thorax has six jointed legs
- Abdomen may possess lateral and/or terminal filaments, tail-like structures, gills

### A checklist of additional riffle beetle characteristics:

- Very small, ~3/8"
- Larvae are covered with hard plates over entire body
- Adults are dark colored with fairly long legs

### A checklist of additional water penny characteristics:

- Very dorsally flattened and saucer-shaped
- May have gills on the abdomen

### A checklist of additional Other Beetle characteristics:

- Larvae are variously shaped (some have lateral projections)
- Adults are generally oval and convex



## Insects: Beetle (Coleoptera)

### Some useful beetle behavioral characteristics:

- Adult riffle beetles are slow crawlers
- Water penny larvae crawl slowly, clinging to rock surfaces in riffles

### Life history details for beetles:

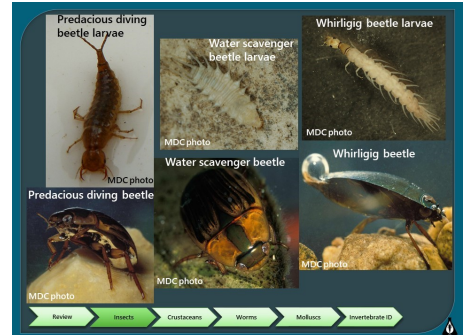
- Both larvae and adult riffle beetles are aquatic and feed on algae/detritus
- Water penny larvae scrape algae off rocks
- Water penny adults are terrestrial
- Species are highly variable but aquatic larvae tend to be benthic
- Diet variable; may feed on algae/detritus (riffle beetles and water penny larvae), or may be aggressive predators of other insects and small fish (predacious diving beetles and whirligig beetles)
- All go through a pupal stage to become adults
- Adults of many aquatic beetle species trap air bubbles to their abdomen via specialized structures on their exoskeleton to breathe under water for short periods
- The adults of aquatic beetles are generally capable of flight and many are powerful swimmers
- Some species prefer riffles but many others prefer still water habitats like pools, ponds, and stream edges



### OTHER BEETLES (COLEOPTERA)

- There are many other aquatic beetles
- Larvae are variously shaped
- Adults are generally oval and convex
- Adults may swim underwater or on the surface, or crawl on the bottom
- Herbivorous, omnivorous, or carnivorous depending upon species and life stage

Review Insects Crustaceans Worms Molluscs Invertebrate ID



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### BEETLE (COLEOPTERA)

- Species are highly variable but aquatic larvae tend to be benthic
- Diet variable; may feed on algae/detritus (riffle beetles and water penny larvae), or may be aggressive predators of other insects and small fish (predacious diving beetles and whirligig beetles)
- All go through a pupal stage to become adults
- Adults of many aquatic beetle species trap air bubbles to their abdomen via specialized structures on their exoskeleton to breathe under water for short periods
- The adults of aquatic beetles are generally capable of flight and many are powerful swimmers too
- Some species prefer riffles but many others prefer still water habitats like pools, ponds, and stream edges

Review Insects Crustaceans Worms Molluscs Invertebrate ID


**TRUE BUG  
(HEMIPTERA)**

- Very diverse, but all have a straw-like beak (proboscis), 6 legs, and large eyes. Many have raptorial forearms and wings as adults
- Nymphs closely resemble adults
- Aquatic species are generally predatory and inject venom and digestive enzymes into their prey and drink its fluids through their beak
- May be at or just below water surface or clinging to aquatic vegetation in still or shallow water
- Usually air-breathing, some breathe out of tubes on their abdomen like a snorkel



Giant Water Bug  
MDC photo

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Giant water bug  
MDC photo

Back swimmer  
MDC photo

Water boatman  
MDC photo

Water scorpion  
MDC photo

Water Strider  
MDC photo

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## Insects: True Bug (Hemiptera)

### A checklist of important true bug characteristics:

- Very diverse, but all have a straw-like beak (proboscis)
- Thorax has six jointed legs
- Have large eyes
- Many have raptorial forearms
- Most adults are winged

### Some useful true bug behavioral characteristics:

- Some are very good swimmers
- Many are slow crawlers

### Life history details for true bugs:

- Nymphs closely resemble adults
- Aquatic species are generally predatory and inject venom and digestive enzymes into their prey and drink its fluids through their beak
- May be at or just below water surface or clinging to aquatic vegetation in still or shallow water
- Usually air-breathing, some breathe out of tubes on their abdomen like a snorkel



## Insects: Aquatic Caterpillar (Lepidoptera)

A few species of moths have aquatic larvae

### A checklist of important aquatic caterpillar characteristics:

- Larvae resemble terrestrial caterpillars
- Long body
- Chewing mandibles
- Thorax has six short jointed legs,
- Have several abdominal prolegs
- May have filamentous gills covering body

### Some useful aquatic caterpillars behavioral characteristics:

- Are found around aquatic vegetation

### Life history details for aquatic caterpillars:

- Adults are terrestrial and resemble a typical moth



### AQUATIC CATERPILLAR (LEPIDOPTERA)


- A few species of moths have aquatic larvae
- Larvae resemble terrestrial caterpillars; long body, chewing mandibles, 6 developed legs, and several abdominal prolegs
- May have filamentous gills covering body
- Are found around aquatic vegetation
- Adults are terrestrial and resemble a typical moth

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### CRAYFISH (DECAPODA)


- Easily recognized (looks like small lobster)
- Can be found in most aquatic environments
  - Some hide under boulders or cobble, or dig burrows in mud, silt, or gravel
- Will eat virtually anything from algae, detritus, and vegetation to live invertebrates, fish, and carrion
- Very diverse in Mo-35 species including 7 endemic species
- The Ozarks have some of the highest densities of crayfish on Earth

Crayfish play a very important role in stream ecosystems, linking benthic food webs to larger animals such as bass, otters, raccoons, herons, hellbenders, etc.




Golden crayfish  
MDC photo


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Northern crayfish  
MDC photo



Painted devil crayfish  
MDC photo



Freckled crayfish  
MDC photo



Belted crayfish  
MDC photo

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## Crustaceans: Crayfish (Decapoda)

### A checklist of important crayfish characteristics:

- Thorax has eight jointed walking legs
- Thorax has two modified legs with claws
- Easily recognized (looks like small lobster)

### Some useful crayfish behavioral characteristics:

- Can be found in most aquatic environments, usually hide under boulders or cobble, or dig burrows in mud, silt, or gravel

### Life history details for crayfish:

- Will eat virtually anything from algae, detritus, and vegetation to live invertebrates, fish, and carrion
- Very diverse in Missouri (35 species including 7 endemic species)
- The Ozarks have some of the highest densities of crayfish on Earth
- Crayfish play a very important role in stream ecosystems, linking benthic food webs to larger animals such as bass, otters, raccoons, herons, hellbenders, etc.





## Crustaceans: Scud (Amphipoda)

### A checklist of important scud characteristics:

- Thorax has seven pairs of jointed legs
- Abdomen has six pairs of appendages
- $\frac{1}{4}$ " –  $\frac{3}{4}$ " in length
- Pale in color
- Shrimp-like and laterally compressed

### Some useful scud behavioral characteristics:

- Very good swimmers

### Life history details for scuds:

- Eat detritus and can be found in many aquatic habitats (streams, ponds, caves, etc.)
- Can be very abundant in some streams



**SCUD  
(AMPHIPODA)**

- 7 pairs of legs and 6 pairs of abdominal appendages
- $\frac{1}{4}$ " –  $\frac{3}{4}$ " in length
- C-shaped and pale in color
- Shrimp-like and laterally compressed
- Swim quickly on their side
- Eats detritus and can be found in many aquatic habitats (streams, ponds, caves etc.)
- Can be very abundant in some streams


MDC photo

MDC photo

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**SOWBUG  
(ISOPODA)**

- Very similar to pill bugs (rollie- pollies)
- 7 pairs of legs
- Dorsally flattened
- ¼" - ¾" in length
- Generally found hiding between rocks and under debris in streams, cave pools, etc.
- Feeds on organic debris such as dead leaves
- Can be very abundant in some streams



MDC photo

Review > Insects > Crustaceans > Worms > Molluscs > Invertebrate ID

## Crustaceans: Sowbug (Isopoda)

### A checklist of important sowbug characteristics:

- Very similar to terrestrial pill bugs (roly poly)
- Seven pairs of jointed legs
- Dorsally flattened
- ¼" - ¾" in length

### Some useful sowbug behavioral characteristics:

- Crawlers

### Life history details for sowbugs:

- Generally found hiding between rocks and under debris in streams, cave pools, etc.
- Feed on organic debris such as dead leaves
- Can be very abundant in some streams



## Worms: Horsehair Worm (Nematomorpha)

### A checklist of important horsehair worm characteristics:

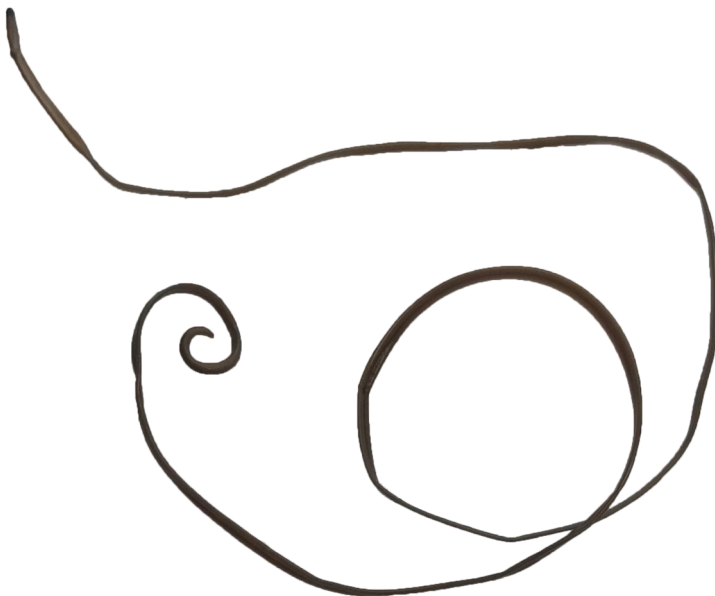
- Very long and thin
- Can grow up to 20-40"
- Unsegmented
- Featureless
- Does not break apart easily

### Some useful horsehair worm behavioral characteristics:

- Often writhes in knots
- If still, can look like a long light-colored root

### Life history details for horsehair worms:


- Larvae are parasites within aquatic and terrestrial arthropods and when mature erupt from their host's rectum upon entering water
- Some larvae chemically alter their host's brain, causing it to seek out water when it is ready to emerge
- Adults are free-living and die after reproducing





### AQUATIC EARTHWORM (ANNELIDA)

- ◉ Resembles a typical segmented earthworm
- ◉ Pale pink in color
- ◉ Found in most aquatic habitats
  - Burrows in substrate or under debris
- ◉ Feeds on any organic material
- ◉ Hermaphroditic




MDC photo

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### LEECH (ANNELIDA)

- ◉ Segmented and flattened
- ◉ Can be several inches long
- ◉ Often black or brown but some are spotted or striped
- ◉ Possess a suction disc on at least one end
- ◉ Very flexible and mobile
- ◉ Can be found in most aquatic habitats
- ◉ Some are predatory, others specialize in sucking blood from specific hosts (mammals, fish, snails, etc)
- ◉ Hermaphroditic



MDC photo

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## Worms: Aquatic Earthworm, Leech (Annelida)

### A checklist of important aquatic earthworm characteristics:

- Resembles a small earthworm
- Pale pink in color
- Segmented
- Breaks apart easily, fragile

### Some useful aquatic earthworm behavioral characteristics:

- Often writhes in knots
- Will readily crawl if left alone

### A checklist of important leech characteristics:

- Segmented and flattened
- Can be several inches long
- Often black or brown but some are spotted or striped
- Possess a suction disc on at least one end
- Tough skin, not fragile

### Some useful leech behavioral characteristics:

- Very flexible and mobile
- Moves by stretching forward with front and then bringing both ends together

### Life history details for aquatic earthworms and leeches:

- Both can be found in most aquatic habitats
- Both are hermaphroditic
- Aquatic earthworms burrow in substrate or under debris and feeds on any organic material
- Some leeches engulf prey, others specialize in sucking blood from specific hosts (mammals, fish, snails, etc.)

## Worms: Planarian (Platyhelminthes)

### A checklist of important planarian characteristics:

- Flat
- ¼" – 1" long
- Arrowhead shaped head with 2 eye spots
- Mostly black or brown

### Some useful planarian behavioral characteristics:

- Will compress into flattened disc when disturbed
- Move by gliding


### Life history details for planarians:

- Can be found in most aquatic habitats
- Feed on detritus or small invertebrates
- Hermaphroditic
- Can regenerate from pieces



**PLANARIAN  
(PLATYHELMINTHES)**

- ⦿ A flat worm
- ⦿ ¼" – 1" long
- ⦿ Tapered head with 2 eye spots
- ⦿ Can be found in most aquatic habitats
- ⦿ Feeds on detritus or small invertebrates
- ⦿ Hermaphroditic
- ⦿ Can regenerate from cut pieces



Review > Insects > Crustaceans > Worms > Molluscs > Invertebrate ID

### CLAM AND MUSSEL (BIVALVIA)

- Easily recognized by their 2-piece shell
- Found in rivers, streams, or ponds depending on species
  - Usually partly buried in substrate
- Filter feeders
- Their young parasitize fish to incubate
- Freshwater mussels are most diverse in the U.S.
  - 69 species found in Mo-about half are of conservation concern due to siltation, pollution, and dams



Review Insects Crustaceans Worms Molluscs Invertebrate ID

## Molluscs: Clam, Mussel (Bivalvia)

### A checklist of important clam and mussel characteristics:

- Clams and Mussels have a 2-piece shell

### Some useful clam and mussel behavioral characteristics:

- Usually partly buried in substrate

### Life history details for clams and mussels:

- Found in rivers, streams, or ponds depending on species
- Filter feeders
- Their young parasitize fish to develop
- Freshwater mussels are most diverse in the U.S.
- 69 species found in Missouri-about half are of conservation concern due to threats from siltation, pollution, and dams



## Molluscs: Snails (Gastropoda)

### A checklist of important snail characteristics:

- Snails have a single shell
- Gilled snails have an operculum and their shell opens on the right side
- Pouch snails do not have an operculum and their shell opens on the left side

### Some useful snail behavioral characteristics:

- Will crawl if undisturbed

### Life history details for snails:


- Gilled snails extract oxygen from the water whereas pouch and rams horn snails possess a lung-like organ and many surface for air
- Gilled snails are usually found in streams, while other aquatic snails can be found in most water bodies
- Eat algae and carrion with their scraping mouthparts
- Pouch and rams horn snails are hermaphroditic, unlike gilled snails




**SNAILS  
(GASTROPODA)**

- Gilled snails have an operculum and their shell opens on the right side, in contrast to pouch snails
- Gilled snails extract oxygen from the water whereas pouch and ramshorn snails possess a lung-like organ and many surface for air
- Gilled snails are usually found in streams, while other aquatic snails can be found in most water bodies
- Eat algae and carrion with their scraping mouthparts
- Pouch and ramshorn snails are hermaphroditic, unlike gilled snails


Pouch snail



Gilled snail



Ramshorn snail





MDC photo

Review
Insects
Crustaceans
Worms

Molluscs
Invertebrate ID


# Invertebrate Identification





**Size:**  
3/4" - 4"

Photo by Andy Turner

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**Size:**  
1/2" - 1"

MDC photo


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# Invertebrate Identification


© Jan Hamrsky  
www.lifeinfreshwater.net




**Size:**  
1/4" - 3/4"

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MDC photo




MDC photo

**Size:**  
1/4" - 1"




MDC photo




MDC photo

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# Invertebrate Identification



MDC photo

**Size:**  
1/16" and up



MDC photo

Review


Insects


Crustaceans

Worms

Molluscs


Invertebrate ID







DNR photo

**Size:**  
1/8" - 1 1/2"







MDC photo

Review


Insects

Crustaceans

Worms

Molluscs


Invertebrate ID






# Invertebrate Identification

**Adult**





**Size:**  
1/16" – 3/8"

Review


Insects


Crustaceans

Worms


Molluscs

Invertebrate ID






MDC photo



MDC photo

**Size:**  
1/3" - 4"



MDC photo

Review


Insects

Crustaceans

Worms

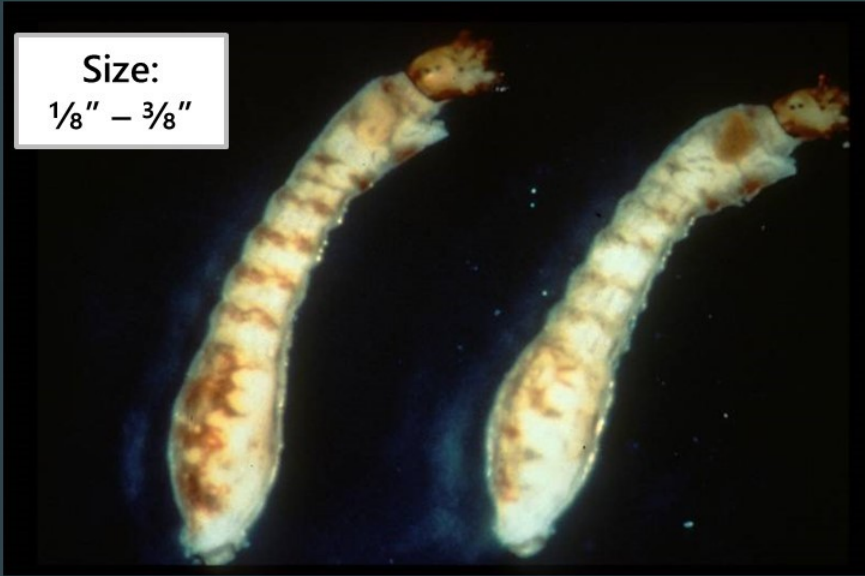
Molluscs

Invertebrate ID




# Invertebrate Identification

**Size:**  
1/8" – 3/8"



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MDC photo MDC photo

**Size:**  
Up to 1"




MDC photo


Review Insects Crustaceans Worms Molluscs Invertebrate ID



# Invertebrate Identification





MDC photo



**Size:**  
1/4" - 1"


Review > Insects > Crustaceans > Worms > Molluscs > Invertebrate ID






MDC photo

**Size:**  
1/4" - 2"




MDC photo




MDC photo

Review > Insects > Crustaceans > Worms > Molluscs > Invertebrate ID







# Invertebrate Identification



MDC photo


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**Size:**  
**3/8" - 1"**

Review   Insects   Crustaceans   Worms   Molluscs   Invertebrate ID






# Invertebrate Identification




MDC photo




MDC photo

**Size:**  
1/16" and up

ReviewInsectsCrustaceansWormsMolluscsInvertebrate ID






MDC photo

**Size:**  
Up to 40"

ReviewInsectsCrustaceansWormsMolluscsInvertebrate ID



# Invertebrate Identification

[Blank white box]




MDC photo

**Size:**  
1/4" - 2"

Review Insects Crustaceans Worms Molluscs Invertebrate ID



[Blank white box]




**Size:**  
1/4" - 1"

NABS (www.benthos.org)

NABS photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID



# Invertebrate Identification



**Size:**  
**1/4"-1"**

MDC photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID





**Size:**  
**Less than 1/4"**


MDC photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID






## Invertebrate Identification




**Size:**  
Up to 1 1/2"

Photo by Tom Murray

Review Insects Crustaceans Worms Molluscs Invertebrate ID






**Size:**  
1/4" - 2"


MDC photo

Review Insects Crustaceans Worms Molluscs Invertebrate ID






# Invertebrate Identification



DNR photo



DNR photo

**Size:**  
1/4"

Review


Insects

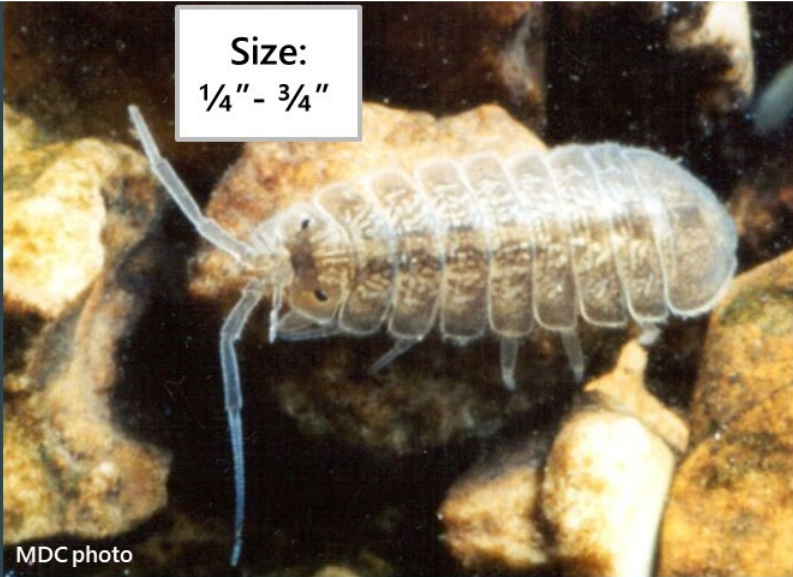
Crustaceans

Worms

Molluscs

Invertebrate ID





MDC photo

**Size:**  
1/4" - 3/4"

Review


Insects

Crustaceans

Worms

Molluscs


Invertebrate ID



## Invertebrate Identification

[Blank white box for notes]

**Size:**  
1/16" and up



Review Insects Crustaceans Worms Molluscs Invertebrate ID

[Blank white box for notes]



**Size:**  
1/3" - 2"

Review Insects Crustaceans Worms Molluscs Invertebrate ID