

# MAINE STREAM EXPLORERS

*A treasure hunt to find healthy streams in Maine*

## Volume 2: Basic Macroinvertebrate Guide



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1. **Atlas of Common Freshwater Macroinvertebrates of Eastern North America** (Macroinvertebrates.org)
2. **Biodiversity Institute of Ontario** - Amphipod
3. **Brandon Woo** (bugguide.net) – adult Alderfly (*Sialis*) and water penny (*Psephenus herricki*)
4. **Don Chandler** (bugguide.net) - *Anax junius* naiad
5. **Fresh Water Gastropods of North America** – *Amnicola* and *Ferrissia rivularis*
6. **Gordon Dietzman**, National Park Service - *Anax junius* adult
7. **Ian Alexander** (commons.wikimedia.org) - *Glossosoma* egg mass
8. **Idaho Fish and Game** – green darner (*Anax junius*)
9. **Jan Hamrsky** (lifeinfreshwater.net) – Hydropsychidae in net and *Glossosoma* on rock
10. **Jason Neuswanger** (troutnut.com) – *Glossosoma* larva and pupae and dragonfly (*Hagenius brevistylus*)
11. **Mark Melton**, (bugguide.net) - *Lepidostoma* (inset)
12. **MJ Hatfield** (bugguide.net) – adult aquatic dance fly (*Rhamphomyia*)
13. **Ondřej Zicha** (www.biolib.cz) – Leech (*Erpobdella octoculata*)
14. **Richard Orr**, Mid-Atlantic Invertebrate Field Studies - *Anax junius* female emerging
15. **Robert Henricks** (bugguide.net) – caddisfly larva (*Glossosoma*) with case in life cycle
16. **Robert Jacobs** (Connecticut DEEP, retired) – crayfish
17. **Sage Ross** (commons.wikimedia.org) – adult damselfly (*Calopteryx*)
18. **Salvador Vitanza** (bugguide.net) – adult mayfly (*Callibaetis*), crane fly (*Tipula*), dobsonfly (*Corydalus*), blackfly (*Simulium*), and stonefly
19. **Sheryl Pollock** (www.discoverlife.org) - *Anax junius* laying eggs (dragonfly life cycle)
20. **Tom Danielson**
21. **Tom Murray** (bugguide.net) – adult caddisfly (*Hydropsyche*), adult non-biting midge (*Chironomus*), isopod (*Assellus*), dragon hunter naiad (*Hagenius brevistylus*)
22. **Thomas Palmer** (bugguide.net) – riffle beetle larva (*Macronychus*)
23. **Welter Schultes** (www.animalbase.uni-goettingen.de) – *Lymnaea* snails

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## Aquatic Macroinvertebrates

Aquatic macroinvertebrates have one of three basic life cycles. Becoming familiar with these life cycles will help you recognize macroinvertebrates. First, some animals hatch from an egg and are tiny versions of their adult form. For example, baby crayfish and snails look like tiny versions of the adults and are called “immature”. Immature crayfish and other crustaceans molt their exoskeletons periodically as they grow. Like lobsters, they have a “soft shell” phase after molting, which allows them to increase in size before hardening again. In contrast, snails increase the size of their shells as they grow.

*The terms “larvae”, “nymphs”, and “naiads” are sometimes used interchangeably in books and other resources, which can cause confusion.*

The second life cycle type is called “complete metamorphosis” (Figure 1). Like the monarch caterpillar, these animals have four life stages: egg, larva, pupa, and adult. Most aquatic macroinvertebrates with complete metamorphosis have larvae that live in the water. Animals in this group include beetles, caddisflies, blackflies, and a wide diversity of flies. All the larvae look different than the adults. The larvae undergo metamorphosis in the pupal stage. In the pupa, the cells rearrange and transform the larva into the adult form.

The third life cycle type is called “incomplete metamorphosis” (Figure 2). These animals have three life stages: egg, nymph/naiad, and adult. Young insects in the group are called nymphs or naiads based on how they obtain oxygen. Naiads have gills to get oxygen from water while nymphs breathe air. Young dragonflies and damselflies primarily get oxygen from the water and are called naiads. In contrast, young water striders and water boatmen breathe air and are called nymphs. The nymphs and naiads look somewhat like the adults but do not have wings. For example, dragonfly naiads and adults have a head, a thorax with three sets of legs, and an abdomen. The basic body structure is similar, but the naiad does not have wings and it is adapted to breathe water instead of air. Dragonfly naiads start off tiny and molt their exoskeletons as they grow. Depending on the species, they may molt 8 or more times. After molting several times, they start to grow wing pads on their backs. The wings develop inside the wing pads. When they naiads are ready to turn into adults, they crawl out of the water and molt one last time. After molting, they pump up the wings and fly away.

Figure 1. Example of Complete Metamorphosis with the Tortoise-shell Caddisfly (*Glossosoma*)

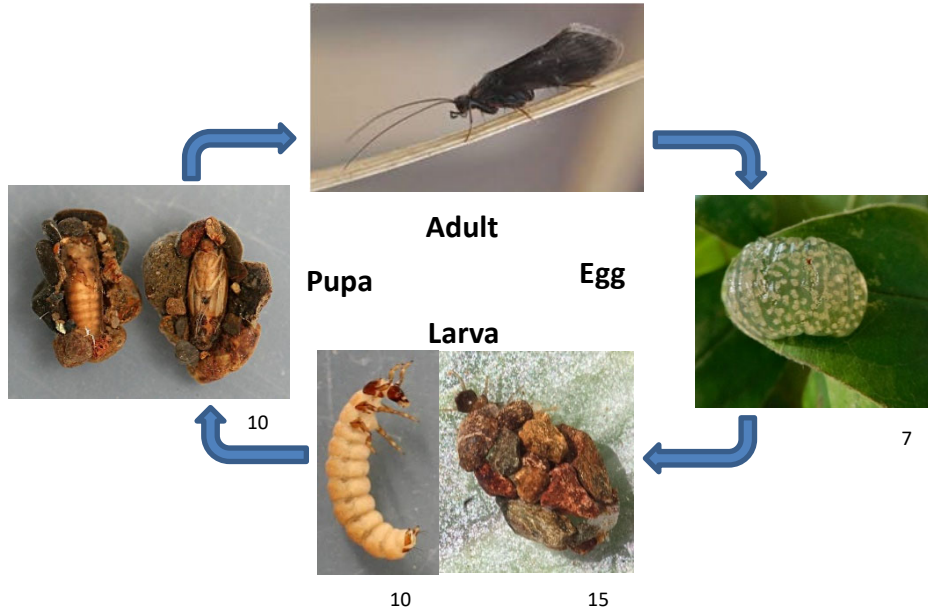
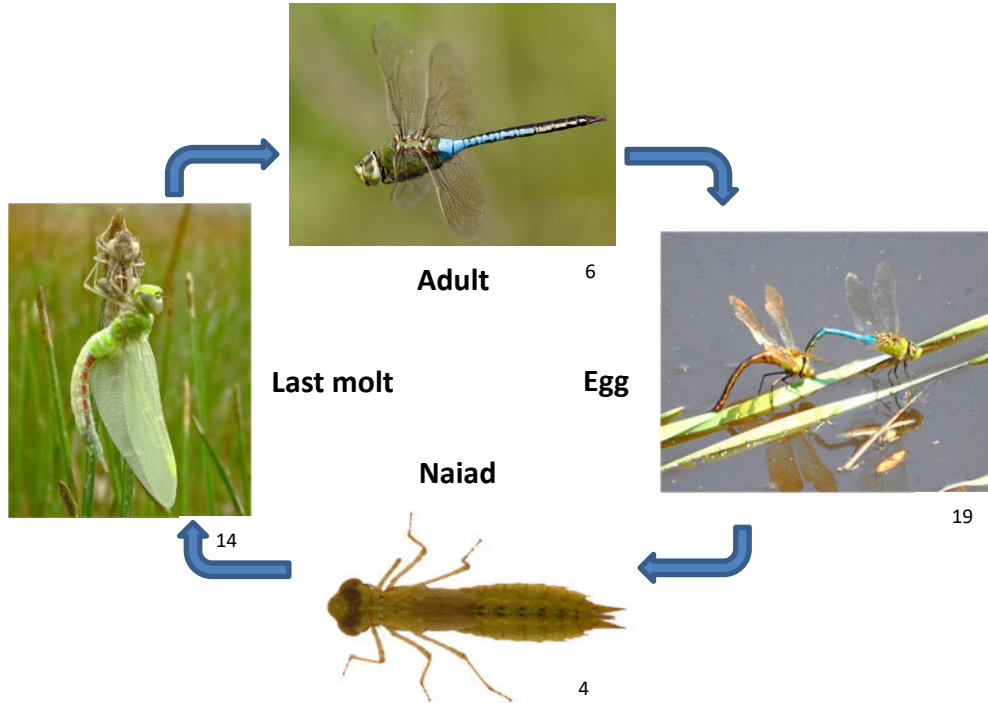


Figure 2. Example of Incomplete Metamorphosis with the Green Darner Dragonfly (*Anax junius*)




Some immature aquatic insects live in streams for only a few weeks before turning into adults, such as some kinds of non-biting midges. In contrast, some dragonfly naiads and dobsonfly larvae may live in streams for several years before leaving the water. After leaving the water, most adult caddisflies, dragonflies, and other insects have wings and can fly. Some may live for only a few days and do not eat as adults. For example, some mayfly adults live for a few days. Many mayflies, stoneflies, and caddisflies do not eat as adults. Some eat nectar or plants. Some adult insects may live for several weeks and eat a variety of foods. For example, adult dragonflies eat flying insects and some may live for several months. In comparison, adult crane flies eat nectar. As an adult, their main purpose is to find a partner, mate, and lay eggs. Many live in the forest and marshes that border the streams. If the forests next to the streams are cut down or otherwise damaged, then some adult insects will not have a place to live and may not be able to reproduce. Therefore, it is important to keep healthy forests and native plants next to our streams.

Maine is fortunate to have many streams with excellent water quality. Maine has water quality standards to keep our streams healthy, which include four classes: Class AA, Class A, Class B, and Class C. Class AA and A share the same environmental expectations, but Class AA have more restrictions on human activities. For example, dams and discharges of pollution are not allowed in Class AA streams. Since Class AA and A share the same environmental expectations, they will be grouped together as Class A for the remainder of this document. Each stream in the state has been assigned to one of these four classes by the State Legislature. DEP biologists collect and analyze samples of macroinvertebrates and algae from streams to determine if a stream attains biological criteria of its designated class (A, B, or C). DEP has collected more than 2,200 samples since the 1980s and has identified more than 1,400 different kinds of macroinvertebrates. Obviously, that is way too many kinds for volunteers to identify, so we had to narrow the list.

For the Stream Explorers project, we took the DEP sample results and grouped all species observations to the genus level. For example, if a sample had more than one species of it in the genus *Baetis*, then those species counts were added together in that sample. For each genus, we counted how many samples had that genus. Our next step was to remove uncommon genera from the list. We only included commonly seen macroinvertebrates in the Stream Explorers project. Finally, we grouped macroinvertebrates that have similar appearance and would be difficult to identify in the field. The resulting list of macroinvertebrates included some genera, some families, some groups of families, and some orders. For example, there is a kind of flatheaded mayfly, called *Epeorus*, that has a distinctive appearance by having only 2 tails compared to the other kinds of flatheaded mayflies that have 3 tails. It was worthwhile to keep *Epeorus* separate from the other flat-headed mayflies because it tends to occur in clean, cold streams and some of the other flat-headed mayflies are somewhat more tolerant of pollution.

**Taxonomy of the *Baetis* mayfly**

Kingdom – Anamalia, animals  
 Phylum – Arthropoda, arthropods  
 Class – Insecta, insects  
 Order – Ephemeroptera, mayflies  
 Family – Baetidae, small minnow mayflies  
 Genus – *Baetis*  
 Species – *B. bicaudatus*  
 (examples) *B. pluto*  
                   *B. tricaudatus*





In contrast, all isopods collected in Maine streams were grouped to the Order level, Isopoda, because they have similar appearance and tolerance to pollutants.

After selecting the macroinvertebrates for this project, DEP biologists grouped them as being “sensitive”, “moderately sensitive”, or “tolerant” of pollution, habitat degradation, and poor water quality. Macroinvertebrates that were most common in streams that attain Class A water quality standards were put in the “sensitive” group. Macroinvertebrates that were most common in streams that attain Class A or B water quality standards were put in the “moderately sensitive” group. Finally, macroinvertebrates that were most common in streams that did not attain Class A or B water quality standards were put in the “tolerant” group. *Tolerant macroinvertebrates are not bad.* They can be found in the highest quality streams along with sensitive and moderately sensitive macroinvertebrates. Tolerant macroinvertebrates are simply tough. They have adaptations that allow them to survive in streams with poor water quality. For example, some of them reproduce several times each year and can recolonize streams after disturbances. Some of them have adaptations that allow them to live in warm water that contains little oxygen. For example, some midges (Chironomidae) have hemoglobin that helps them extract oxygen from the water, like the hemoglobin that helps our red blood cells carry oxygen. Other macroinvertebrates are tolerant of water that has been contaminated by road salt.

The way that we assigned macroinvertebrates to the “sensitive”, “moderately sensitive”, and “tolerant” groups is not perfect. It is common to have related species show a range of tolerance to pollution. For example, there are several kinds of net-spinning caddisflies. Many of the net-spinning caddisflies are moderately sensitive but some are tolerant of pollution and nutrient enrichment, such as *Cheumatopsyche*. A great abundance of *Cheumatopsyche* caddisflies can be an indicator of pollution. However, it is difficult to distinguish different kinds of net-spinning caddisflies in the field and we ended up keeping them all together in the “moderately sensitive” group.

Most macroinvertebrates in a healthy Maine stream will be sensitive or moderately sensitive. In addition, there will be several kinds of sensitive macroinvertebrates (Figure 3). Tolerant macroinvertebrates live in the nice streams too, but they will be less abundant than the sensitive and moderately sensitive kinds. High-quality streams often have low abundance of macroinvertebrates because upstream areas are mostly forested and nutrients in the water are scarce. Streams with upstream sources of nutrient enrichment often have a lot of macroinvertebrates, but still have many sensitive and moderately sensitive kinds (Figure 4). Streams that are overly enriched with nutrients will have an extreme abundance of macroinvertebrates, often with a great abundance of moderately sensitive or tolerant midges and caddisflies that obtain food by filtering water with nets that they construct. In contrast, severely polluted streams may have low overall abundance with no sensitive macroinvertebrates (Figure 5).

Figure 3. Macroinvertebrates from a stream with good water quality (Image credits: 20)

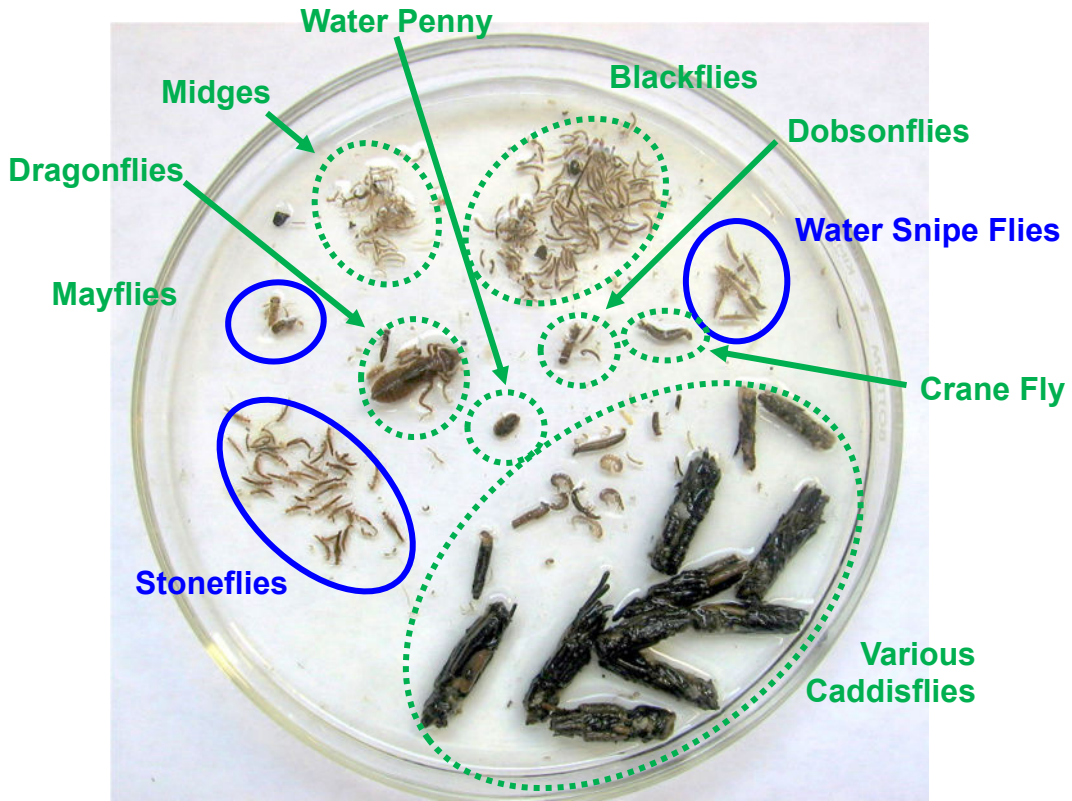


Figure 4. Macroinvertebrates from a stream that is moderately enriched with nutrients

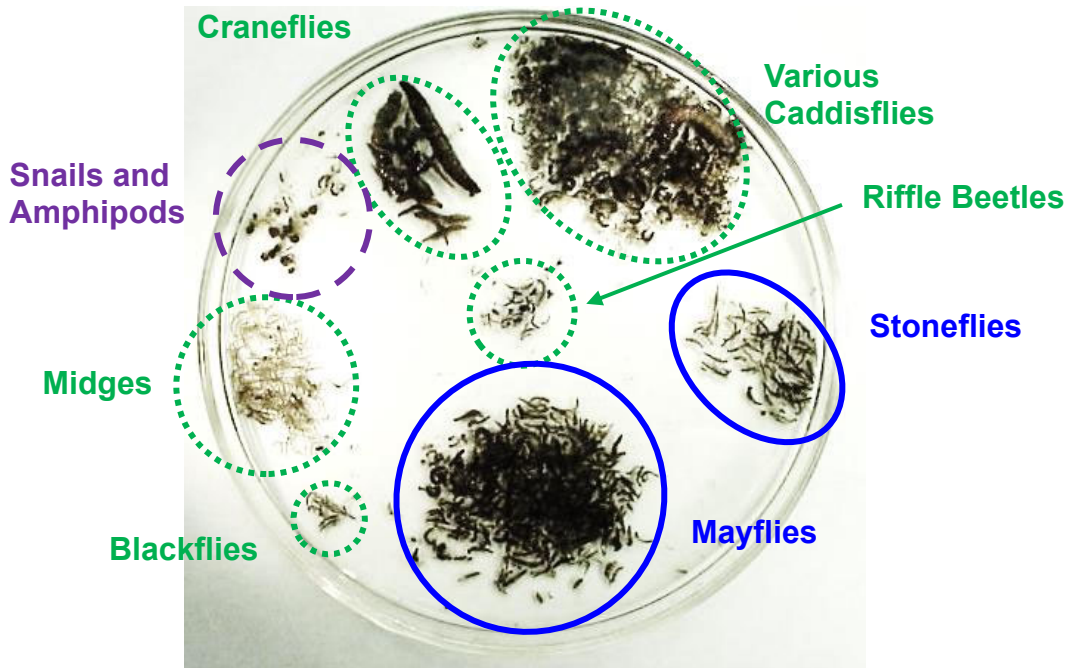
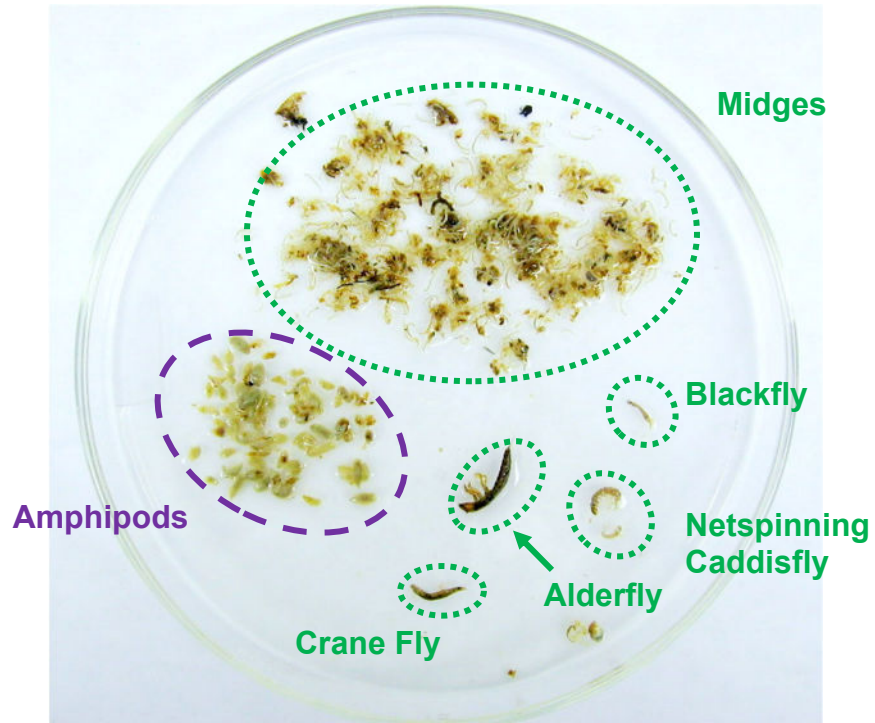


Figure 4. Macroinvertebrates from a severely polluted stream



## Macroinvertebrate Descriptions

The taxonomic keys are restricted to the macroinvertebrates in this guide. There are many other macroinvertebrates not included in the keys or guide. The keys are designed for volunteers and are not as complex as those used by professionals. The pictures of macroinvertebrates in this guide are representative examples. Macroinvertebrates in the same group can come in many shapes, sizes, and color variations. Also, some of the specimens shown in this guide were preserved and may have different color than live organisms. The scale bars shown on the macroinvertebrate descriptions later in this guide show the range in the size of mature specimens. Young specimens are tiny and are smaller than the scale bars.

Most aquatic insects in Maine streams are naiads or larvae. It is helpful to become familiar with the basic body structures to use this guide. A larva has 1) a head, 2) a thorax comprised of three segments, and 3) an abdomen with 8-11 segments, depending on the species (Figure 5). Some larvae have a pair of segmented legs on all three thoracic segments. Some larvae have various bumps, prolegs (false legs), gills, and filamentous projections on the abdomen. Caddisfly larvae have hardened shields on the back of some or all thoracic segments. Some larvae have hooks on their rear end. Naiads have similar body structure but develop one or two pair of wing pads on thoracic segment 2 or segments 2 and 3 (Figure 6).

Figure 5. Body structure of a caddisfly larva (view from the side)

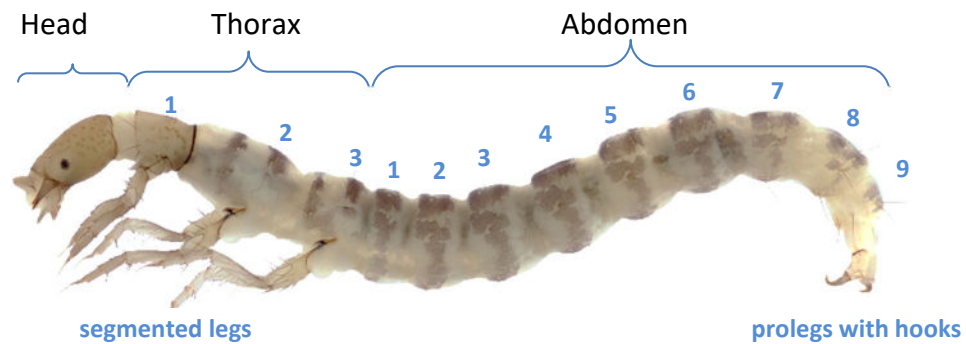


Figure 6. Body structure of a stonefly naiad (view from the top)

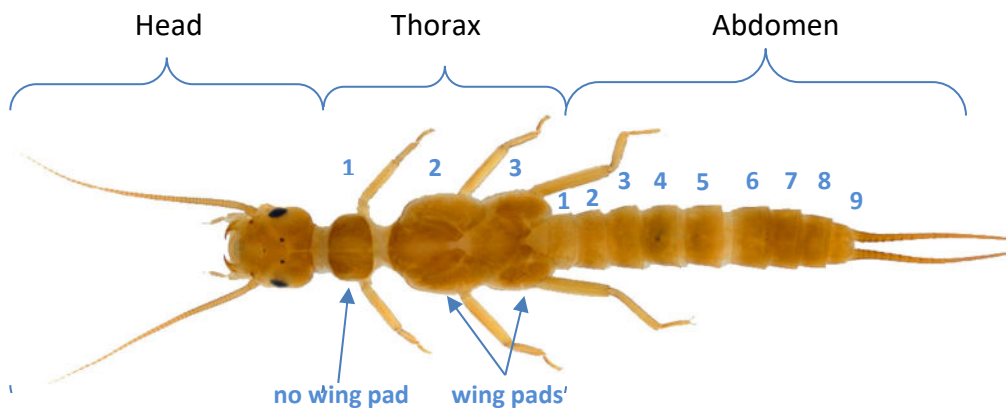


Image credits: 1

## What do they look like as adults?

Here are some examples of adult forms of insects that live in streams as larvae or naiads. Each group may have a wide variety of shapes, sizes, and colors.

Alderfly 3



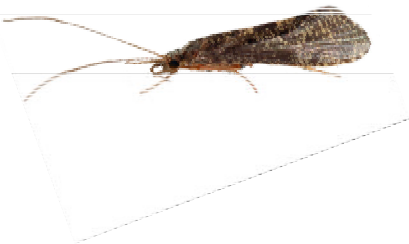
Aquatic Dance Fly 12



Blackfly 18



Caddisfly 21



Crane Fly 18



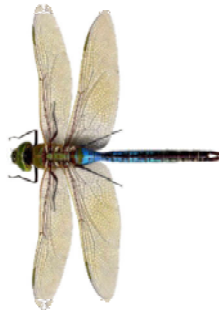
Damselfly 17



Dobsonfly 18



Dragonfly 8



Mayfly 18



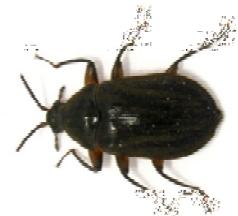
Non-biting Midge 21



Stonefly 18



Water Penny 3

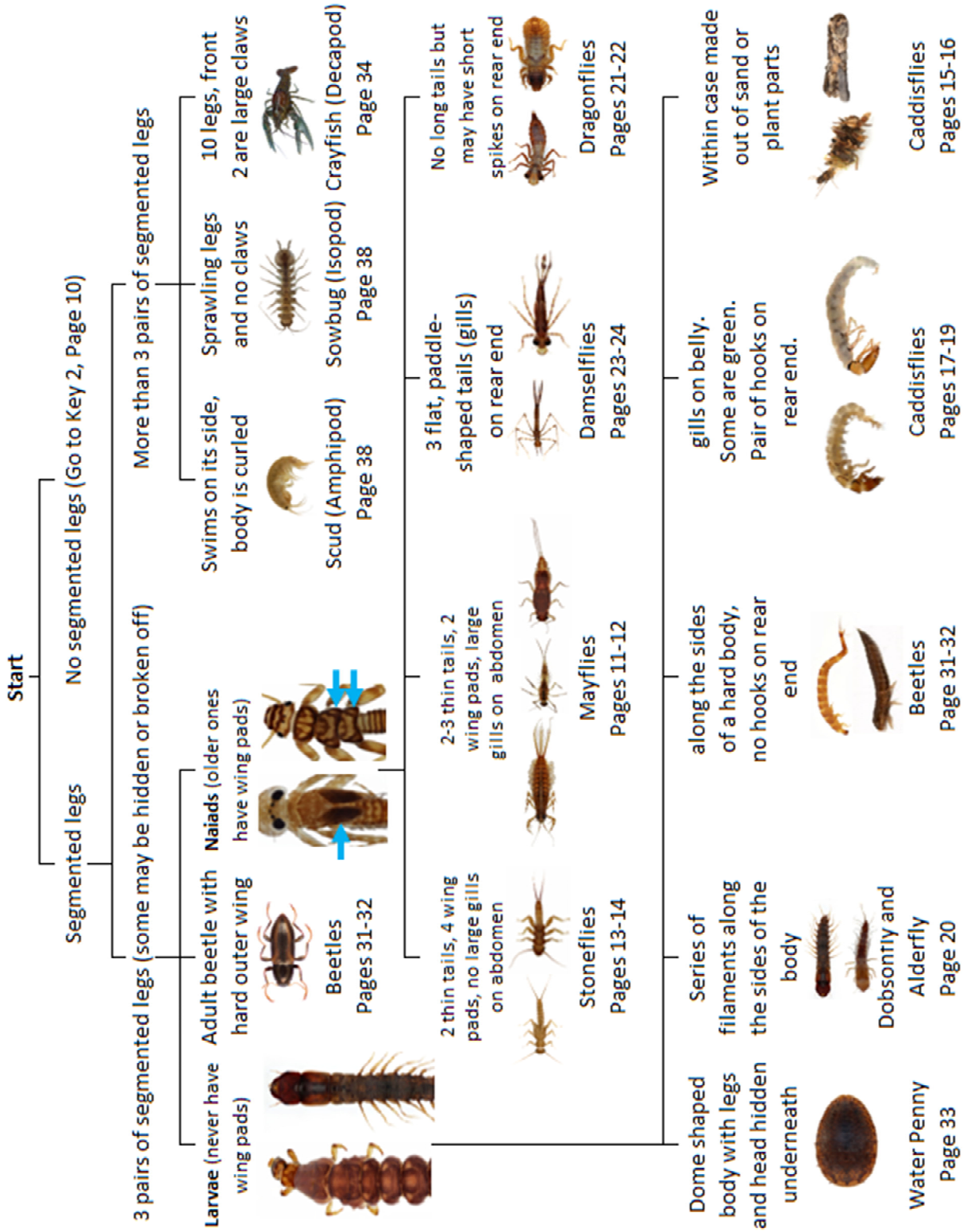


# Taxonomic Keys

## Taxonomic Key #1 – Start

### KEY #1

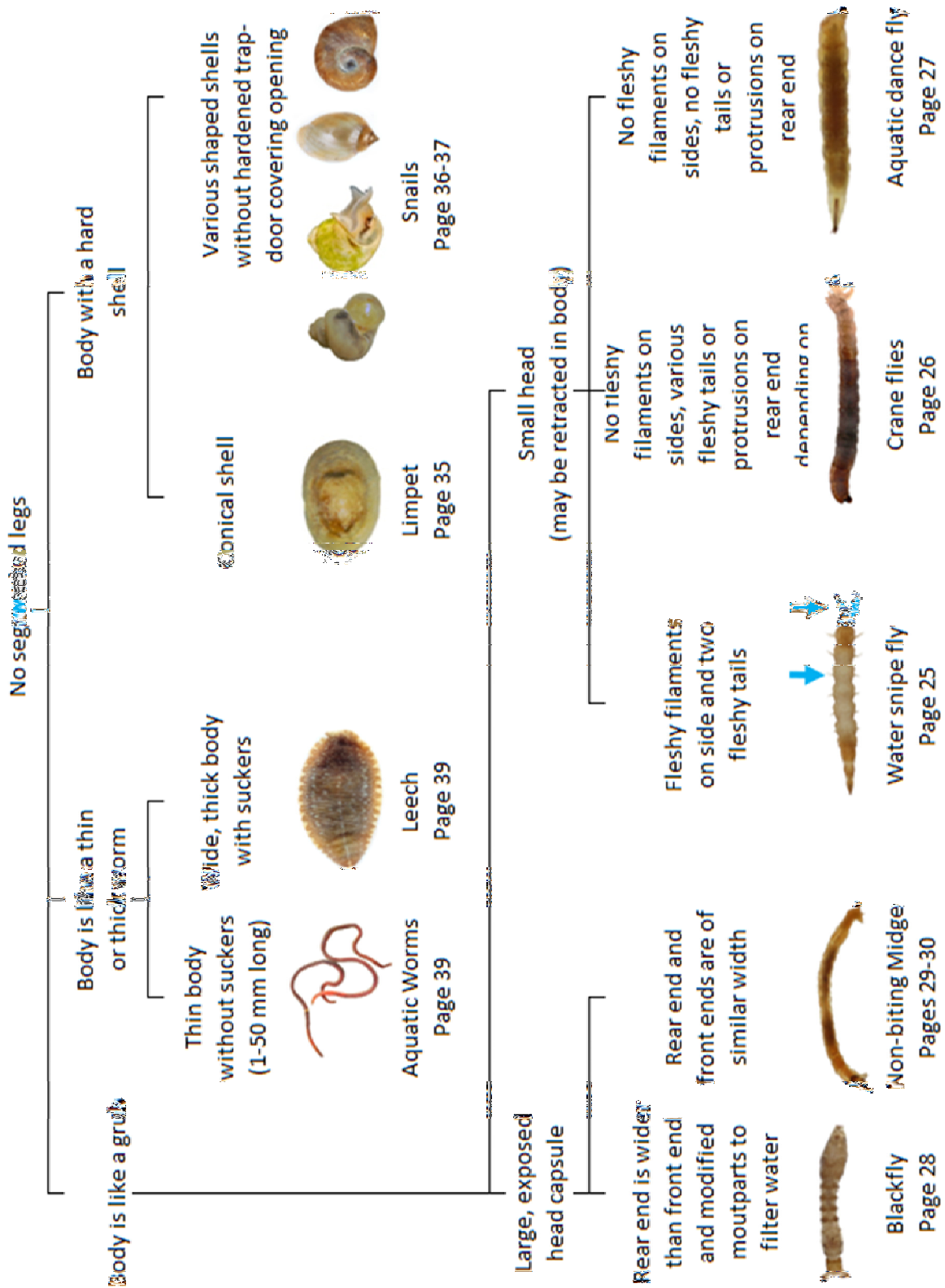
### Key for Maine Stream Explorers Basic Macroinvertebrate Guide (3rd Edition)



## Taxonomic Key #2 – No Segmented Legs

### KEY #2

### Key to Macroinvertebrates for Maine Stream Explorers



**SENSITIVE**  
(Most sensitive to pollution)

Taxonomy: Order Ephemeroptera

## Mayfly

View from above



View from the side



### Diagnostic characteristics

1. Has clearly distinguishable head, thorax with 6 legs, and abdomen
2. One pair of wing pads on the back of older larvae
3. Each leg ends with a single claw
4. Gills on the abdomen (some are shaped like leaves, some are covered by protective plates, and some are branched)
5. 3 thin tails (a few species have only 2 tails)

### Behavior

- Different species eat algae, detritus, and/or invertebrates
- Some are good swimmers with an up-down motion, like a dolphin

### Environmental Sensitivity

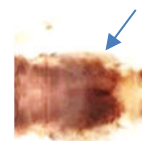
- Mostly occurs in clean, cold streams with good habitat
- Prefers streams with rocks
- Prefers moderate to swift flowing water
- Some kinds with gill covers are thought to be better able to live in turbid water

Variety of gills...

Shaped like a paddle or a leaf



Covered by a plate



Branched



Image credits: 1

Length: 8-20 mm, excluding tails



## Variety of Mayflies



1

Image credits: 1

**SENSITIVE**  
(Most sensitive to pollution)

Taxonomy: Order Plecoptera

## Stonefly

View from above



View from below



### Diagnostic characteristics

1. Has clearly distinguishable head, thorax with 6 legs, and abdomen
2. 2 pairs of wing pads on back
3. Each leg ends with two claws
4. 2 tails
5. No gills on abdomen
6. Some have hairy gills in "armpits"

*Stoneflies are among the most sensitive macroinvertebrates.*

*Finding stoneflies in a stream or river is a signal of good water quality.*

### Behavior

- Some kinds love to chew on dead leaves
- Some are predators

### Environmental Sensitivity

- Mostly occurs in clean, cold streams with good habitat
- Some kinds are mostly found in small streams while others are most common in larger streams and rivers



**Length:** 3-50 mm excluding tails

Image credits: 1

## Variety of Stoneflies



Image credits: 1

Taxonomy: Order Plecoptera

**SENSITIVE**  
(Most sensitive to pollution)  
*Casemaking Caddisfly*

*Brachycentrus* (top view and case)*Micrasema* (side view and case)**Diagnostic characteristics**

1. Has a head, thorax with six legs, and abdomen
2. Abdomen is soft and usually thick
3. Most have a pair of hooks on their rear end
4. Some have sparsely scattered filamentous gills on abdomen

**Behavior**

- They spin silk and use the silk to create cases made of rocks, sand, sticks, or plants
- They eat detritus, algae, and/or small invertebrates

**Environmental Sensitivity**

- Mostly occurs in clean, cold streams with good habitat
- Prefer moderately or swiftly flowing water
- Prefer streams with rocks, sticks, or plants

Image credits: 1



Length: 6-12 mm

### Variety of Casemaking Caddisflies



9

Image credits: 1, 9

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order

Trichoptera

## *Net-spinning Caddisfly*

View of *Neureclipsis* (Polycentropodidae) from the side



### Diagnostic characteristics

1. Has a head, thorax with six legs, and abdomen
2. Last abdominal segment has a pair of hooks on fleshy bumps
3. **The pair of bumps (prolegs) with the hooks are well developed**
4. **Areas between abdominal segment not deeply constricted**
5. **Usually pale cream to yellow bodies**
6. **No armor on the back of thoracic segments 2 and 3**
7. **No armor on the underside of last abdominal segment**

### Environmental Sensitivity

- Occur in streams with good water quality but are often more abundant in nutrient-enriched streams
- Prefer rocky substrates
- Prefer streams with moderately or swiftly flowing water

### Behavior

- **Spin nets with silk on the tops and sides of rocks (fine mesh)**
- Catch animal and plant matter in nets
- Will abandon nets when stressed

*Neureclipsis* makes a large silken net that is shaped like a cornucopia. Nets can be several inches long.

*Net-spinning caddisflies* range in color from cream, to grey, brown, and lime green (they do not taste like limes, however).

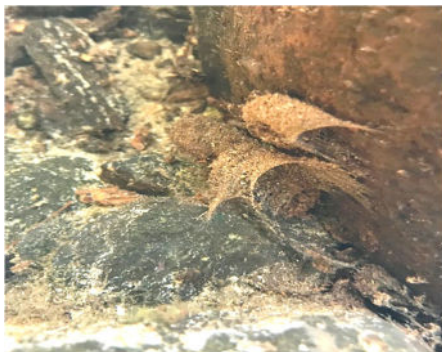
They sometimes fight to take over nets or defend nets from interlopers (they make scraping vibrations to



Length: 10-25 mm

Image credits: 1, 20 (net)

**Variety of Netspinning Caddisflies (Some are green)**



9

Image credits: 1, 9 (larva in net)

**SENSITIVE**  
(Most sensitive to pollution)

Taxonomy: Order Trichoptera

***Freeliving Caddisfly***

View from above (These are often green)



View from the side



**Diagnostic characteristics**

1. Looks like a caterpillar
2. Has a head, thorax with six legs, and abdomen
3. Last abdominal segment has a pair of hooks on fleshy bumps
4. **The pair of bumps with the hooks are well developed (prolegs)**
5. **Deep constrictions between abdominal segments**
6. **No armor on the back of where the 2nd and hind legs join the body (thoracic segments 2 and 3)**
7. **Armor on the back of the first thoracic segment**
8. **No gills underneath abdomen**

*Mature people may compare them to the "Michelin Man" and younger folks have no idea what they are talking about.*

*They are sometimes a pretty blueish-green color.*

**Behavior**

- **Do not spin webs or make cases**
- Active predators of other invertebrates
- Are more mobile than most caddisflies

**Environmental Sensitivity**

- Mostly occurs in clean, cold streams with good habitat
- Prefer clear water



**Length:** 11-18 mm (sometimes longer)

Image credits: 1



**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order Megaloptera  
Family Corydalidae  
Sialidae

## Dobsonfly and Alderfly

### *Nigronia* (Dobsonfly)

above



below



### *Sialis* (Alderfly)

above



below



### Diagnostic characteristics

- Has a head, thorax with six legs, and abdomen
- Abdomen has a series of well-developed filaments on their sides
- Head has large mouthparts
- **(Dobsonfly) abdomen ends with pair of prolegs, each with a pair of hooks**
- **(Alderfly) abdomen ends with a single, long tail**

### Behavior

- Active predators of other invertebrates
- Dobsonflies are most common in rocky streams with moderately or swiftly flowing water
- Fishflies are most common in sandy and silty streams with deposits of wood and detritus

### Environmental Sensitivity

- Usually live in clean streams but are somewhat tolerant of organic enrichment and warmer water
- Dobsonfly larvae take three years or more to mature before pupating and turning into an adult. (It is a good sign to see a dobsonfly in a stream!)

*If you were as small as a blackfly, the sight of a dobsonfly approaching would be truly frightening.*

*They mostly breathe through their skin but they also can breathe air (a little). The filaments on their sides help them absorb oxygen from the water.*

*They rarely bite fingers but only when handled roughly.*



Length: 25-90 mm (dobsonfly)  
10-25 mm (alderfly)

Image credits: 1

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order Odonata

## Dragonfly

### *Boyeria*

from above

from below



### Diagnostic characteristics

1. Has a head, thorax with six legs, and abdomen
2. 2 pairs of wing pads on back of older naiads
3. No visible gills (they are on the inside)
4. Their mouthparts are hinged and can extend forward
5. Lower lip of mouth (labium) is large and flat

### Behavior

- These predators extend their hinged mouthparts to grab their prey (lightening quick!)
- Naiads will eat insects, small fish and amphibians
- Adult *Hagenius* dragonflies are known as dragon hunters because of their habit of eating other dragonflies (wow!)

### Environmental Sensitivity

- Different species prefer rocky substrates or sandy substrates
- The larvae of some species spend more than a year in the water



Image credits: 1, 4 (*Anax*)

**Length:** 15-50 mm (up to 65 mm)

## Variety of Dragonflies



*Dragonfly mouthparts are hinged and extend to grab prey. The picture to the left shows the extended mouthpart.*



*Dragonflies can suck in water through their mouth and shoot it out of their rear end to jet forward (fart propulsion!)*

Image credits: 1, 4

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order Odonata  
Family Calopterygidae  
Broad-winged Damselfly  
Genus *Calopteryx*

**Damselfly**

**View from Above**



**View from Below**



**Diagnostic characteristics**

1. Has a head, thorax with 6 legs, and abdomen
2. Has 2 pairs of wing pads on back
3. Their mouthparts are hinged and can extend forward
4. Long, slender bodies
5. 3 leaf-shaped gills that may look like tails

**Behavior**

- These predators extend their hinged mouthparts to grab their prey (lightening quick!)
- They eat other macroinvertebrates
- Poor swimmers, move with side-to-side motion
- They crawl on plants, tree roots, and between rocks in search of food
- Adults lay their eggs on aquatic plants, sometimes even going underwater to lay the eggs

**Environmental Sensitivity**

- Mostly occurs in streams with good water quality
- Are somewhat tolerant of warmer water

*Adults jewelwings have shiny, metallic green, blue, and gold bodies depending on the species and the angle of the sun. There are three species in Maine. The most common is the ebony jewelwing which has a greenish/blue body and black wings.*



Image credits: 1

**Length:** 20-29 mm, excluding gills (tails)

## Variety of Damselflies

view from above



view from below



21

Image credits: 1, 21

**SENSITIVE**  
(Most sensitive to pollution)

Taxonomy: Order Diptera  
 Family Athericidae  
 Watersnipe Fly  
 Genus **Atherix**

**Watersnipe Fly**

**View from Above**



**View from the side**



**Diagnostic characteristics**

1. Does not have segmented legs
2. Small head that can be partially retracted into body
3. Abdomen has pairs of prolegs (not true legs) which help them hold on to rocks in fast current
4. **Abdomen has a series of pointy, fleshy filaments on the sides and two larger ones with hairs on the rear end**

*Adults lay eggs on plants that hang over the stream. When the eggs hatch, the larvae fall into the water.*

**Behavior**

- These predators eat other macroinvertebrates
- They crawl between rocks in search of prey

*Aquatic dance flies look similar but do not have the filaments on the side or rear end.*

**Environmental Sensitivity**

- They inhabit cold, clean streams with good habitat
- Are intolerant of warmer water
- They prefer streams with moderate current

Image credits: 1



**Length: 10-18 mm**

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order Diptera  
Families Limoniidae  
Pediciidae  
Tipulidae

**Crane Flies**

**Antocha (Limoniidae)**



**Dicranota (Pediciidae)**



**Tipula (Tipulidae)**



**Diagnostic characteristics**

1. Does not have segmented legs
2. Head is often retracted into body
3. Grub-like body
4. **Various projections and breathing parts on their rear ends**
5. **Do not have filaments on the side of the body**
6. **Some have prolegs, some have bumps, some have neither**

*Adult craneflies look like giant mosquitoes with extra long legs.*

*The adults are peaceful vegetarians and do not bite, thankfully.*

**Behavior**

- Most species are omnivores that eat detritus, algae, and small invertebrates
- *Dicranota* is a predator
- Most species are somewhat secretive because fish would find them quite tasty
- Some specialize on chewing on dead leaves and can be found in leaf packs
- Tipulidae are the largest crane flies (both larvae and adults)

**Environmental Sensitivity**

- Mostly occurs in streams with good water quality
- Are somewhat tolerant of warmer water
- They prefer streams with moderate current



Image credits: 1

**Length:** 10-25 mm but some Tipulidae can be more than 50 mm long

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

**Aquatic Dance Fly**

Taxonomy: Order     Diptera  
 Family     Empididae  
             Aquatic Dance Fly  
 Genus     ***Hemerodromia***

**View from the side**



**View from below**



**Diagnostic characteristics**

1. Does not have segmented legs
2. **Grub-like body with thin neck and small head**
3. **Several short projections on their rear ends**
4. **Do not have projections on the side of the body**
5. **Series of short prolegs on underside of body**

*In comparison, crane flies do not have prolegs on the underside of their bodies.*

**Behavior**

- Predators of other invertebrates
- Prefer rocky streams with swift current
- Adults have an erratic flight pattern of twisting and turning above the water (“dancing”)
- Some larvae will form pupa in blackfly cocoons after eating the blackfly (some house guest!)

*Watersnipe flies have filaments on the side of their bodies and two longer projections on their rear ends.*

**Environmental Sensitivity**

- Mostly occurs in streams with good water quality



**Length:** 2-20 mm

Image credits: 1



**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order Diptera  
Family Simuliidae  
Blackfly

## *Blackfly*

**View from above**



**View from side**



**View from below**



### Diagnostic characteristics

1. Grub-like body with head and no legs
2. Has a small proleg below the head
3. Large, fan-like mouthparts
4. Swollen rear end
5. Rear end has a ring of tiny hooks that helps them attach to rocks and plants

### Behavior

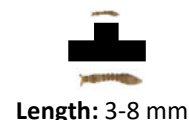
- They anchor themselves to rocks and plants
- They filter water and catch food with their fan-like mouthparts (algae, detritus, tiny invertebrates)
- They can move around with an inchworm movement

### Environmental Sensitivity

- Mostly occurs in streams with good water quality
- Are somewhat tolerant of warmer water
- They prefer streams with moderate current

*They spin silken threads and can anchor safety lines to where they are located. If a dobsonfly, common stonefly, or other predator comes too close, they can let go of the rock and float downstream. The safety lines prevent them from floating away until they can find something to grab on to.*

Image credits: 1



Length: 3-8 mm

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order Diptera  
Family Chironomidae  
Non-biting midge  
Chironomid (midge)

**Non-biting Midge**

***Orthocladius***  
(from the side)



***Tanytarsus***  
(from the side)



**Diagnostic characteristics**

1. Grub-like body with head and no legs
2. **Both ends of body have similar width**
3. **Pair of prolegs beneath head**
4. **Pair of prolegs on rear end (sometimes hairs too)**

**Behavior**

- They sometimes wriggle on the bottom of collection pans
- Some make tube-shaped retreats out of silken threads can be found on rocks or in sediment
- Most eat algae, plants, and detritus but a few are predators
- Some make nets out of silk to catch food in flowing water
- They range in color from white to yellow

*Close to 400 kinds of midges have been collected from Maine streams, rivers, ponds, and wetlands. Almost all streams in Maine have some kind of midge living in them.*

**Environmental Sensitivity**

- Species range from sensitive to tolerant
- Red midges (page 63) are tolerant of low dissolved oxygen concentrations



**Length: 5-20 mm**

Image credits: 1

**TOLERANT**  
(Tolerant to pollution)

Taxonomy: Order

Coleoptera

## *Red Non-biting Midge*

*Chironomus*  
(from the side)



### Diagnostic characteristics

1. Grub-like body with head and no legs
2. **Both ends of body have similar width**
3. **Pair of prolegs beneath head**
4. **Pair of prolegs on rear end**
5. **Red or orange body color**

### Behavior

- They sometimes wriggle on the bottom of collection pans
- They burrow and make silken tubes in sand and mud
- Most eat algae, plants, and detritus
- They range in color from orange to bright red

### Environmental Sensitivity

- Tolerant of low oxygen concentrations

*Red and orange midges have a substance like the hemoglobin in our blood, which makes our blood red. It helps them extract oxygen from the water, allowing these midges to survive in habitats where oxygen is scarce.*



**Length: 10-20 mm**

Image credits: 1

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order Coleoptera

**Beetle**

**Views of a *Dubiraphia* adult**



***Dubiraphia* larva**



***Macronychus* larva**



**Diagnostic characteristics (Adult)**

1. Head, thorax with 6 legs, and abdomen
2. Outer wing is a hard shell

**Diagnostic characteristics (Larvae)**

1. Head, thorax with 6 legs, and abdomen
2. No wing pads on back
3. Some have projections on the side of the body

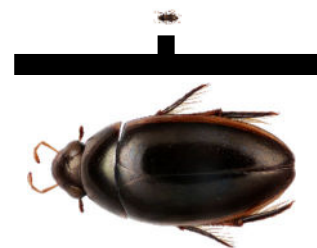
**Behavior**

- Most beetles are predators
- Some beetles eat algae and detritus
- Some kinds prefer fast flowing water and rocky substrates
- Some kinds prefer slow flowing water or ponds

**Environmental Sensitivity**

- Mostly occurs in streams with good water quality
- Some occur in urban streams with poor water quality but abundant oxygen and detritus to eat

*Many adults have millions of tiny hairs on their bodies that trap a thin layer of air. They breathe the air from this bubble. Some adults swim to the surface to get fresh air. Some rely on oxygen transferring from the cold water to their air bubbles.*



**Length:** 2-8 mm (adults) and up to 16 mm (larvae)

Image credits: 1

## Variety of Beetles



Image credits: 1

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

**Water Penny**

Taxonomy: Order Coleoptera  
 Family Psephenidae  
 Water Penny  
 Genus *Psephenus*

View from above



View from below



**Diagnostic characteristics**

1. Distinctive flat, elliptical shape
2. Head, thorax with six legs, and abdomen with gills (as seen from below)

**Behavior**

- Prefer rocky streams with moderately or swiftly flowing water
- Move around on top of rocks grazing on algae
- The streamlined body shape helps them stick to the top of rocks in fast currents and makes it harder for fish to eat them
- Adult beetles live on land near streams

**Environmental Sensitivity**

- Mostly occurs in streams with good water quality
- Somewhat tolerant to nutrient enrichment

*It can be challenging to spot these in collection pans at first. Pick up any rocks or plants that are in the collection pan to see if the water pennies climbed on to them*

*Swirl water in the pan and look for the contrast of the swirling material and these beetles stuck to the bottom of the pan*



**Length:** 3-10 mm

Image credits: 1

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

Taxonomy: Order  
Family

Decapoda  
Cambaridae  
Crayfish, Crawdads

## Crayfish

### Spiny cheek crayfish (*Faxonius limosus*)

- Patch of spines on cheek, which are easy to feel and see
- Brown body and claws
- Some have reddish brown spots along center of their tail and silvery eyes



### Northern Crayfish (*Faxonius virile*)

- Light-colored bumps on cheek and single spines on neck but not a patch of spiky spines on the cheek
- Blueish-green claws with orange tips and yellowish bumps
- Brown body
- Has a few spines on head



### Rusty Crayfish (*Faxonius rusticus*)

- Non-native and invasive
- Prominent dark, rust colored spots on either side of the carapace
- Greenish-reddish claws with black bands at the tips



### Behavior

- These species occur in a variety of stream habitats, from rocky to muddy
- They are opportunistic feeders that will eat almost anything, even live fish if they can catch them
- They can survive out of water for short periods of time if their gills remain wet
- They make burrows under rocks and in the mud
- Rusty crayfish are aggressive

*Crayfish will flick their tails to swim backwards. They sometimes flick their tails when being held, which can startle people.*

*The best way to hold them is to pinch behind their claws on their carapace.*

### Environmental Sensitivity

- They mostly occur in streams with clean water but they can tolerate poor water quality to some degree
- They are somewhat tolerant of warm water

Image credits: 16

**Length:** Up to 100 m

**MODERATELY SENSITIVE**  
(Moderately sensitive to pollution)

## Limpet

Taxonomy: Order Basommatophora  
Family Ancyliidae  
Limpet  
Genus *Ferrissia*

View from the side



View from above



### Diagnostic characteristics

1. This snail's unique shell is flattened with a wide opening that points down and a spire that points up and to the rear
2. Its tentacles, eyes and mouth are located under the shell

### Behavior

- Grazes algae from rocks, logs, and plants
- The streamlined body shape helps them stick to the top of rocks in fast currents and makes it harder for fish to eat them
- Although easily overlooked because of their small size, limpets are widespread in Maine streams, lakes, and ponds
- Limpets have 1-2 generations per year
- Air is stored in a cavity inside the shell near the pointy end and functions as a "lung"

*These non-descript snails have both an air bubble in the shell that functions like a primitive lung and gill-like structure to obtain oxygen from the water.*

### Environmental Sensitivity

- Mostly occurs in streams with good water quality but is somewhat tolerant of warm water and nutrient enrichment
- Can be found on rocks, logs, and mud

Image credits: 5



Length: 3-7 mm



**TOLERANT**  
(Least sensitive to pollution)

Taxonomy: Order Neotaenioglossa  
Family Hydrobiidae  
Mud Snail

**Snail**

***Amnicola* (closed)**



***Amnicola* (open)**



**Diagnostic characteristics**

1. The shell opens to the right when held with the pointy end up and the opening facing toward you
2. Spiraled shell that is widest by the opening

*It can be challenging to spot these in collection pans at first*

**Behavior**

- Graze on algae and detritus plants, rocks, and mud
- Some have gills for obtaining oxygen from water
- Some breath air and carry an air bubble within their shells

*Pick up any rocks or plants that are in the collection pan to see if they climbed on to them*

**Environmental Sensitivity**

- Some streams with good water quality but is somewhat tolerant of warm water and nutrient enrichment
- They can be abundant in streams with a little nutrient enrichment
- Can be found on rocks, logs, and mud

*Swirl water in the pan and look for the contrast of the swirling material and these snails stuck to the bottom of the pan*

Length: 3-5 mm

Image credits: 5

## Variety of Snails



Image credits: 1, 23

**TOLERANT**  
(Least sensitive to pollution)

Taxonomy: Order Amphipoda  
Side-swimmer,  
Scud

### Amphipod

#### Diagnostic characteristics

1. More than 10 legs
2. Some resemblance to shrimp
3. Legs are designed for swimming
4. It swims on its side



#### Behavior

- Eats algae, plants, and detritus
- Several generations per year allows it to recolonize after disturbance

#### Environmental Sensitivity

- Some species are tolerant of warm water
- Some species are common in urban streams
- Most common in sandy and mucky streams with plants or decaying organic matter



Image credit: 2

Length: 3-5 mm

**TOLERANT**  
(Least sensitive to pollution)

Taxonomy: Order Isopoda  
Isopod, Sowbug

### Isopod

#### Diagnostic characteristics

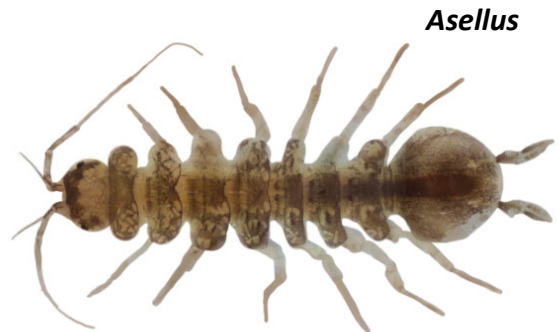
1. More than 10 legs
2. Legs are designed for crawling
3. Pair of appendages on rear end

#### Behavior

- Eats algae, plants, and detritus
- Several generations per year allows it to recolonize after disturbance

#### Environmental Sensitivity

- Some species are tolerant of warm water
- Some species are common in urban streams
- Most common in sandy and mucky streams with plants or decaying organic matter



*Asellus*

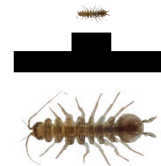


Image credits: 1

Length: 5-20 mm

**TOLERANT**  
(Least sensitive to pollution)

Taxonomy: Order Tubificida  
Aquatic oligochaete worm

### Aquatic Worm

#### Diagnostic characteristics

1. Long, thin, delicate segmented body
2. Some have hairs on them
3. Grey to pink coloration

#### Behavior

- Eats detritus
- Several generations per year allows it to recolonize after disturbance

#### Environmental Sensitivity

- Some species are tolerant of warm water
- Some species are reddish because they contain hemoglobin
- Some species are common in urban streams
- Most common in sandy and mucky streams



Length: 1-30 mm

**TOLERANT**  
(Least sensitive to pollution)

Taxonomy: Order Hirudinida  
Leech

### Leech

#### Diagnostic characteristics

1. Thick, segmented body (A)
2. Mouth adapted for sucking (B)
3. Sucker on rear end (B, C)
4. Range in color from cream to dark grey and brown
5. Bodies can stretch and contract like an accordion

#### Behavior

- Most are predators and scavengers
- Some suck blood from animals
- Several generations per year allows it to recolonize after disturbance

#### Environmental Sensitivity

- Some species are tolerant of warm water
- Some species are common in urban streams

*Placobdella*



*Erpobdella*



Length: 5-20 mm in Maine streams  
(some pond leeches are larger)

Image credits: 1, 13 (*Erpobdella*)

## References

*A Guide to Freshwater Invertebrates of North America* by J. Reese Voshell, Jr., 2002

*An Introduction to the Aquatic Insects of North America* edited by R.W. Merritt, K.W. Cummins, and M.B. Berg, 2019, 5<sup>th</sup> Edition

*Aquatic Entomology: The Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives* by W. Patrick McCafferty, 1981

BugGuide webpage by Iowa State University, Department of Entomology ([bugguide.net](http://bugguide.net))

Digital Key to Aquatic Insects of North Dakota webpage by Valley City State University, Macro-Invertebrate Lab ([waterbugkey.vcsu.edu](http://waterbugkey.vcsu.edu))

Life in Fresh Water webpage by Jan Hamrsky ([lifeinfreshwater.net](http://lifeinfreshwater.net))

Riffle Bioassessment by Volunteers (RBV), Citizen-Science Based Stream Water Quality Monitoring by Connecticut Department of Energy and Environmental Protection (<https://portal.ct.gov/DEEP/Water/Inland-Water-Monitoring/Riffle-Bioassessment-by-Volunteers-RBV>)

*The Atlas of Common Freshwater Macroinvertebrates of Eastern North America* webpage ([macroinvertebrates.org](http://macroinvertebrates.org))

The Audubon Naturalist Society Water Quality Monitoring Program (<https://anshome.org/water-quality-monitoring>)





# MAINE STREAM EXPLORERS

*A treasure hunt to find healthy streams in Maine.*

For information on how to volunteer, please contact Hannah Young with Maine Audubon at 207-781-2330, ext. 219 or [conserve@maineaudubon.org](mailto:conserve@maineaudubon.org)

For help identifying macroinvertebrates, please contact Tom Danielson with the Maine Department of Environmental Protection at [thomas.j.danielson@maine.gov](mailto:thomas.j.danielson@maine.gov)