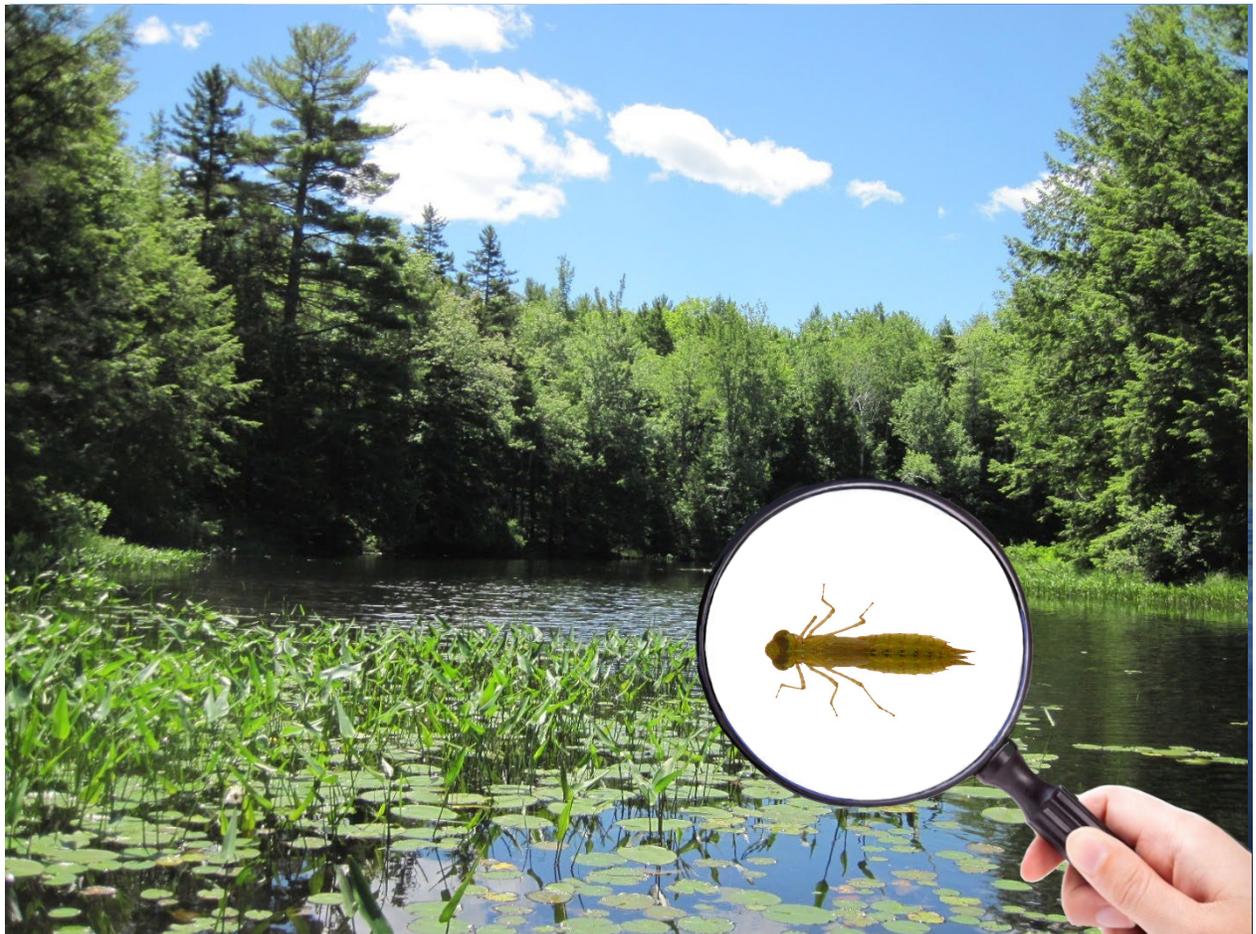


MAINE MARSH EXPLORERS

A treasure hunt to find healthy marshes in Maine



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Introduction to Maine Marsh Explorers

Maine Marsh Explorers is a treasure hunt to find healthy marshes in Maine. Volunteers are trained to collect and identify “sensitive”, “moderately sensitive”, and “tolerant” macroinvertebrates in Maine’s marshes. Macroinvertebrates are animals without backbones that can be seen without magnification. Most macroinvertebrates are insects that have an adult life stage that live out of water and an immature life stage that lives in the water. For example, dragonflies and damselflies that are seen flying around marshes and lakes have young that live in the water. In addition to insects, macroinvertebrates include crayfish, snails, mussels, and many other kinds of animals.

Macroinvertebrates are excellent indicators of water quality because they are exposed to all environmental stressors during their time in the water. They are a direct measure of the biological health of a marsh. Also, there are many kinds of macroinvertebrates with a wide range of tolerance to polluted water. This allows biologists with the Maine Department of Environmental Protection (DEP) to evaluate the health of marshes by collecting macroinvertebrates and evaluating how many and what kinds live in a marsh. Overall, DEP Biologists have collected over a thousand kinds of macroinvertebrates in Maine marshes. Some species require marshes with good habitat and water quality. These are the “sensitive” macroinvertebrates in the Marsh Explorers program. Other species can tolerate slightly more pollution and degraded habitat. These are the “moderately sensitive” macroinvertebrates. Finally, some macroinvertebrates have adaptations that allow them to survive in tough conditions, such as warm or polluted water. These are the “tolerant” macroinvertebrates. *The tolerant macroinvertebrates are not bad, they are just tough.* Tolerant macroinvertebrates can be found in very nice marshes too. Healthy marshes often have 4 or more kinds of “sensitive” macroinvertebrates, and a variety of “moderately sensitive” and “tolerant” macroinvertebrates too. Unfortunately, some marshes in Maine are polluted to the point where “sensitive” macroinvertebrates can no longer live there. The most abundant macroinvertebrates in those streams may be the “tolerant” kinds.

As a volunteer in the Marsh Explorers program, you will gather valuable information about the health of Maine streams. You and your fellow citizen scientists will venture forth to find healthy marshes by looking at macroinvertebrates living in them. In some cases, you may be the first people to collect and identify macroinvertebrates in some streams. In other cases, you may visit marshes that were previously sampled to check up on their condition. You may find marshes that are loaded with “sensitive” macroinvertebrates. In other marshes, you may find none of them. Regardless, your hard work will provide a valuable assessment of marsh health. The program coordinators will compile the results of all the marsh assessments and share them with project partners. Ultimately, your data will be shared with the DEP biologists, who will use the data to help target and prioritize limited funding and staff time for more comprehensive surveys.

Freshwater Marshes

Marshes are a transition zone between aquatic and terrestrial environments. Freshwater marshes are habitats with shallow fresh water and emergent, floating, and submerged plants. Emergent plants have roots in the mud and parts of the plants that stick out above the water surface. Examples of emergent plants include cattails, sedges, rushes, and pickerelweed. The most common plants with floating leaves include water lilies, water shield, and certain pondweeds. Examples of submerged plants include milfoils, bladderworts, and pondweeds. Freshwater marshes may occur by themselves or on the fringe of larger waterbodies, such as lakes, ponds, rivers, and streams (Figure 1).

Figure 1. Examples of freshwater marshes



Training

The main goals of the Marsh Explorers program are environmental education and collecting valuable data. As Rachel Carson once said, everyone has a “sense of wonder” about nature when young. Volunteers will receive training to collect good quality data but also to nurture their sense of wonder about the amazing creatures living in Maine marshes.

Volunteers in the Marsh Explorer program receive annual training for both collecting and identifying macroinvertebrates. Experts in the field will help you learn how to identify the sensitive, moderately sensitive, and tolerant macroinvertebrates. This training will come in the form of this guide, classroom-style workshops, outdoor workshops, and videos and other resources on the Stream Explorer website. In addition, there are interactive on-line resources where you can practice identifying macroinvertebrates.

Sampling Methods

Sampling consists of collecting macroinvertebrates with a net. You will be provided necessary materials in the sampling kits that are available to check out. Typically, sampling is done with two or more people. Plan on being at the marsh for at least an hour and half; time flies when you are having fun. Wear clothing and footwear that are comfortable and you don't mind getting wet. Waders or hip boots can be helpful when wading in marshes. Canoes or small boats are necessary for collecting samples in deeper marshes.

Equipment

The sampling equipment kit that you check out will come with:

- Net
- 3 trays (6"x9" or larger)
- Ice cube trays
- White plastic soup spoons
- Brushes/tweezers
- Pipettes
- Laminated guide and macroinvertebrate keys
- Magnifying lens
- Petri dishes and containers
- Magiscope (only some kits have this)
- Sieve bucket (bucket with fine mesh bottom)

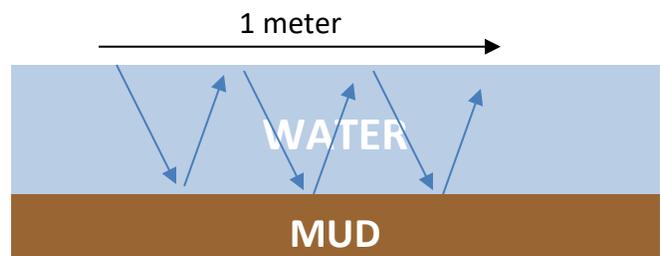


Sampling Overview

You and your partner(s) will collect 3 samples from your marsh. Ideally, pick sample locations that have 4 inches to 2 feet of water and have emergent and/or submerged plants. Sampling is easiest with 2 people. You have the option to either 1) collect samples while standing on the shore or in the marsh or 2) sample the marsh from a canoe or small boat.

Collecting samples while standing on the shore in the marsh

- Try to get samples from 4 inches to 2 feet of water.
- Try to avoid scaring macroinvertebrates away from where you are going to collect the samples.
- Have one person hold the meter/yard stick over target area.
- Have the second person sweep the net through the water for approximately 1 meter. In deeper water, move the net down and up 3 times while sweeping the net through the water.
- Try to get close to the mud while sweeping the net through the water, but avoid getting a lot of mud in the net.
- If you get too much mud in the net, then dump the sample out and try again in a different spot.
- If you do not have a sieve bucket, then sweep the net quickly through the water to get rid of mud and to get the contents of the net toward the bottom of the net. Transfer the sample to a tray with water.
- If you have a sieve bucket, then transfer the sample from the net to the sieve bucket. Gently slap the bottom of the bucket on the surface of the water to help get rid of mud. Transfer the sample to a tray with water.
- If you have a lot in the sample, then split your sample among several trays with water.

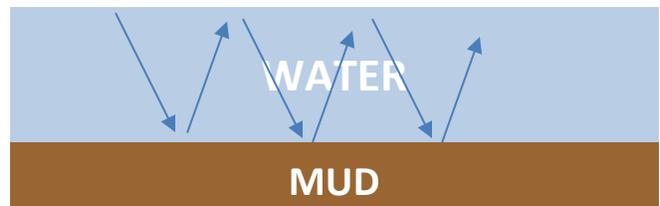


Collecting samples from a canoe or small boat

- Try to get samples from 4 inches to 2 feet of water.
- Try to avoid scaring macroinvertebrates away from where you are going to collect the samples.
- **Be careful to balance the boat so you don't go for a swim.**
- Have one person hold the meter/yard stick over target area.
- Have the second person sweep the net through the water for approximately 1 meter. In deeper water, move the net down and up 3 times while sweeping the net through the water.
- Try to get close to the mud while sweeping the net through the water, but avoid getting a lot of mud in the net.
- If you get too much mud in the net, then dump the sample out and try again in a different spot.
- If you do not have a sieve bucket, then sweep the net quickly through the water to get rid of mud and to get the contents toward the bottom of the net. Transfer the sample to a tray with water.
- If you have a sieve bucket, then transfer the sample from the net to the sieve bucket. Gently slap the bottom of the bucket on the surface of the water to help get rid of mud. Transfer the sample to a tray with water.
- If you have a lot in the sample, then transfer your split your sample among several trays water.



1 meter



Picking macroinvertebrates from the sample

Let the water sit in the white tray for a couple minutes to let the debris settle and allow the animals to become active again. Look carefully at one section of the tray for moving animals. Many macroinvertebrates are small, and many are camouflaged to protect themselves from predators. Be prepared to look for very small creatures. Some will be as small as grains of rice or even poppy seeds. Use the magnifying lenses provided in the kit to look at small creatures. Collect the macroinvertebrates with the spoons or pipettes provided in your kit. It sometimes is helpful to use a brush to get macroinvertebrates into the spoon. After capturing a macroinvertebrate, transfer it to a petri dish or ice cube tray cell filled with water. The following tips may be helpful when looking for macroinvertebrates in the trays:

- Sort the macroinvertebrates while you collect them, putting similar ones together in the same petri dish or ice cube cell. Be careful, some large ones may try to crawl out.
- Gently stirring water in a section of the tray can sometimes reveal macroinvertebrates. Look for anything not moving in the same direction as the swirling debris, whether swimming or sticking in place.
- Pick up and examine rocks, chunks of wood, or large plant parts that are in the tray. Some macroinvertebrates will try to hide on these items. Clean these items and place them back in the marsh or temporarily in a clean container.
- Your eyes will focus first on large and active macroinvertebrates. It is naturally more challenging to find small macroinvertebrates and cryptic kinds that have good camouflage. To balance out what you collect try this challenge... **For every large or active macroinvertebrate that you find, try to search for and collect two or more small, cryptic, or hard to find macroinvertebrates.**

Keep track of how long you spend searching for and sorting macroinvertebrates in the tray. You should spend at least 60 minutes finding, sorting, and identifying macroinvertebrates. You are encouraged to spend more time identifying macroinvertebrates if you are having fun.

Identifying macroinvertebrates

Use the keys and information provided in this guide to identify the macroinvertebrates. Please use magnifying lenses, field scopes, or other means of magnification to help see the creatures. It is very difficult to see some of the diagnostic features without using some form of magnification. After you identify something, try to take a picture of it with a camera or phone. If your camera or phone does not have a macro feature, then get as close as you can without causing the image to become blurry. People with steady hands also could try to hold a magnifying lens between the macroinvertebrate and the lens to magnify the image. One strategy is to take a picture of half of the ice cube tray and another picture of the other half. You will undoubtedly see some macroinvertebrates that are not on the Maine Marsh Explorers field sheet. The keys and write ups in this guide only include common kinds. If you recognize some of the other macroinvertebrates, then please write them down in the comments section of the field sheet. Take pictures of these creatures too.

Filling out the field sheet

Fill out the information about the marsh including its name, town, and description. If possible, please record the coordinates of the sample location with latitude and longitude. If possible, please take pictures of your marsh. It would be helpful to take pictures representing the different habitats that you sampled. Write down the name of the team leader and other people. Record the total time spent at the marsh and amount of that time spent sorting and identifying macroinvertebrates. Write down the number of samples in each of the four habitat types.

After you sort and identify macroinvertebrates, write down the abundance code for each kind that you found underneath the picture of the macroinvertebrate. The abundance codes are Few (F) for 1-5 found, Common (C) for 6-25, and Abundant (A) for more than 25 found. Once that is done, count the number of *different kinds* of “sensitive” macroinvertebrates on the field sheet and write that number in the space provided on the back of the form. Do the same thing for the “moderately sensitive” and “tolerant” macroinvertebrates.

Pictures

Please take pictures of the marsh. Please take representative pictures of each kind of macroinvertebrate you find. Please label pictures with the stream name, date, and description. For example, if you took a picture of a dragonfly at the Northwest River on July 22, 2020, the picture name would be **Northwest_River_07_22_2020_dragonfly.jpg**. E-mail pictures to Mady Eori with Maine Audubon (meori@maineaudubon.org). Although it may be time consuming to label all images, this step is very helpful and allows the project coordinators to double-check identifications, help you improve your identification skills, and improve future training sessions.

Cleaning up

When you are done, please return all samples to the marsh. Wash the net and pick off any debris. Wash the trays, spoons, ice cube trays, and petri dishes with marsh water. Dry them off and pack them up. Please return all items in the sample kit by the time indicated by the program coordinator when you reserved or picked up the sample kit. If something is lost or damaged, then please let the program coordinator know so it can be replaced.

Aquatic Macroinvertebrates

Commonly found in freshwater marshes, aquatic macroinvertebrates have one of three basic life cycles. Becoming familiar with these life cycles will help you recognize different kinds of 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 second life cycle type is called “complete metamorphosis” (Figure 2). Like the monarch butterfly, 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, 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 3). 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 their wings and fly away.

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

Figure 2. Example of Complete Metamorphosis with the Tortoise-shell Caddisfly (*Glossosoma*)

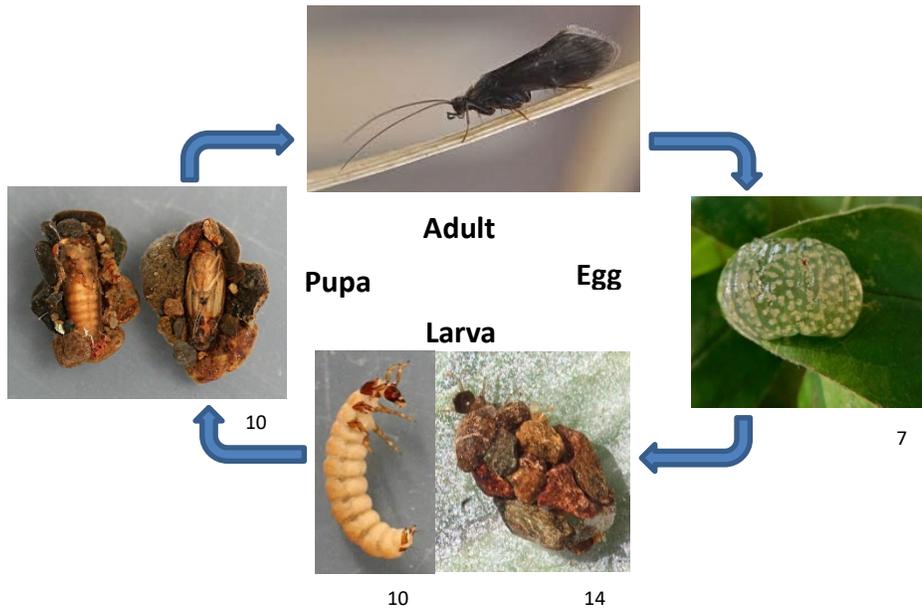
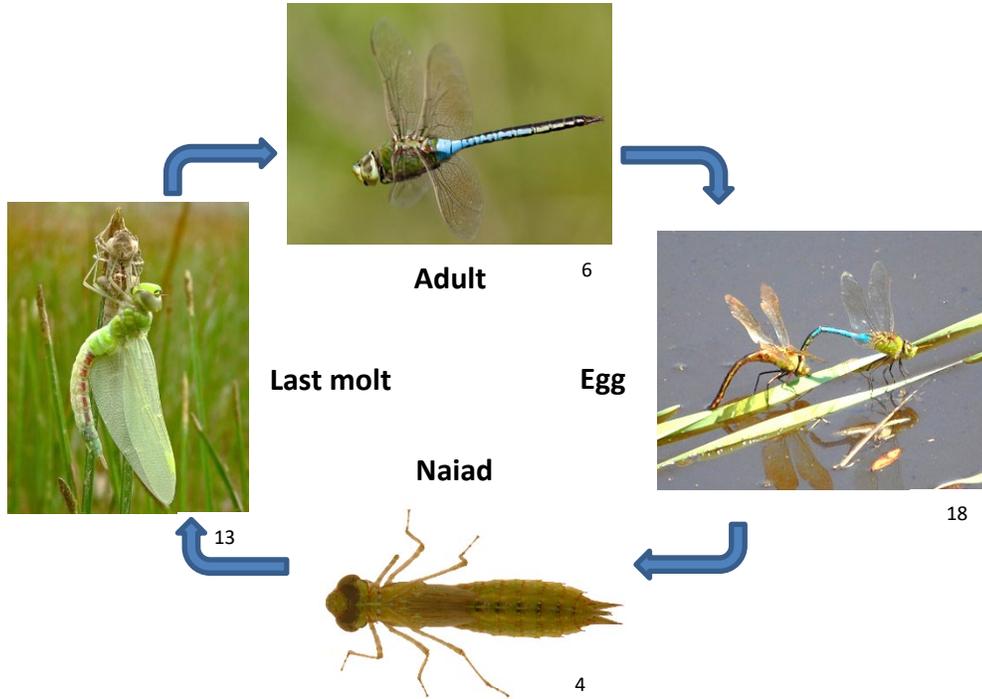


Figure 3. Example of Incomplete Metamorphosis with the Green Darner Dragonfly (*Anax junius*)



Some immature aquatic insects live in marshes for only a few weeks before turning into adults, such as some kinds of non-biting midges. In contrast, some dragonfly naiads may live in marshes for several years before leaving the water. After leaving the water, most adult caddisflies, dragonflies, and other insects have wings and can fly. Some adult insects, such as mayflies, may live for only a few days. Many mayflies, stoneflies, and caddisflies do not eat as adults and others may eat nectar, plants, or other insects. 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 and adult crane flies eat nectar. As an adult, their main purpose is to find a partner, mate, and lay eggs. Some adult insects live in the forest near the marshes. If the forests next to the marshes 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 marshes.

Aquatic macroinvertebrates have varying tolerances of pollution and habitat disturbance. For this guide, we grouped macroinvertebrates as “sensitive”, “moderately sensitive”, or “tolerant” of pollution, habitat degradation, and poor water quality. “Sensitive” macroinvertebrates are most common in healthy marshes. “Moderately sensitive” macroinvertebrates can live in marshes with moderate amounts of pollution or habitat disturbance. “Tolerant” macroinvertebrates can be found in healthy and polluted marshes. *Tolerant macroinvertebrates are not bad.* They can be found in the highest quality marshes along with sensitive and moderately sensitive macroinvertebrates. Tolerant macroinvertebrates are simply tough. They have adaptations that allow them to survive in marshes with poor water quality. For example, some reproduce several times each year and can recolonize marshes 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 for groups of related species to show a range of tolerance of pollution. For example, species of midges range from sensitive to tolerant, but they tend to be tolerant as a group.

Most macroinvertebrates in a healthy Maine marsh will be in the sensitive or moderately sensitive groups. In addition, healthy marshes typically have the highest diversity of sensitive and moderately sensitive macroinvertebrates (Figure 4). Tolerant macroinvertebrates live in the nice marshes too, but they will be less abundant than the sensitive and moderately sensitive kinds. High-quality marshes often have low abundance of macroinvertebrates because surrounding areas are mostly forested, and nutrients in the water are scarce. Marshes with nearby sources of nutrient enrichment often have a lot of macroinvertebrates, but still have many sensitive and moderately sensitive kinds. Marshes 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 marshes may have low overall abundance with no sensitive macroinvertebrates (Figure 5).

Figure 4. Macroinvertebrates from a marsh with good water quality (Image credits: 19)

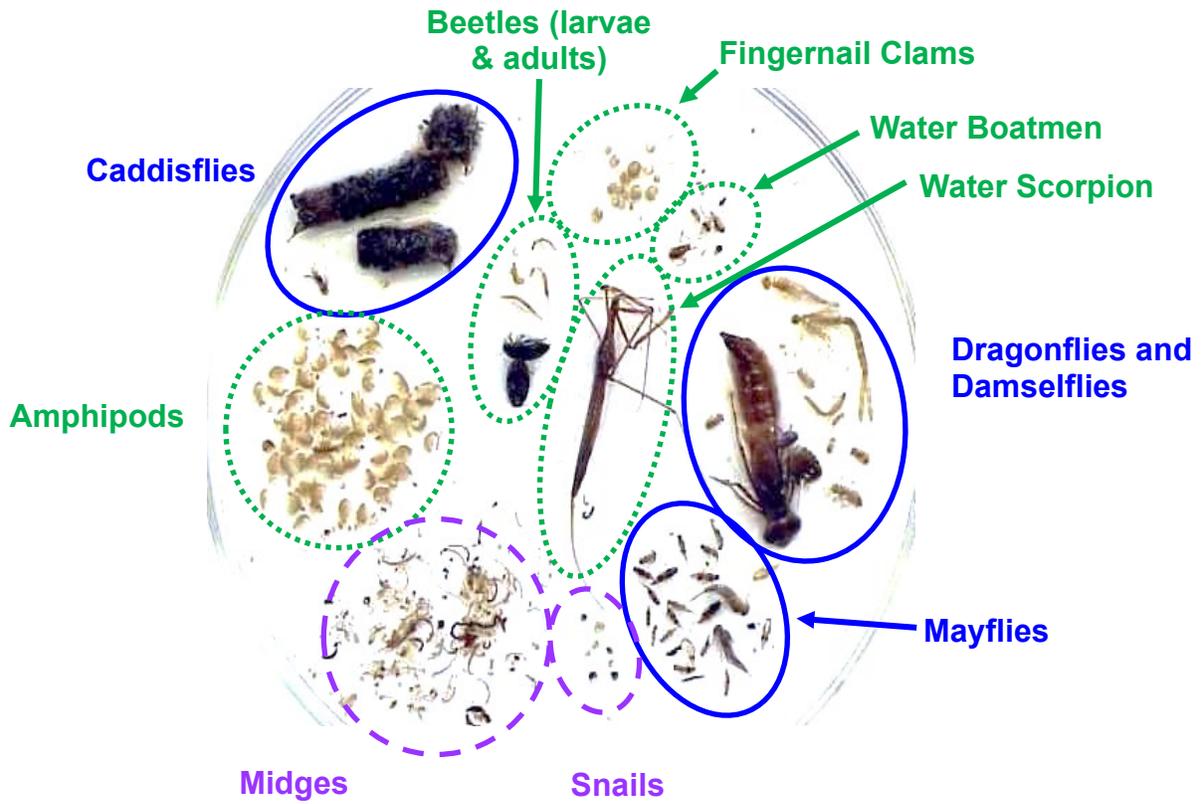


Figure 5. Macroinvertebrates from a severely polluted marsh (Image credits: 19)



Macroinvertebrate Descriptions

This guide focus on the most common macroinvertebrates in marshes. 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 marshes 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 6). 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, on the other hand) have similar body structure but develop one or two pair of wing pads on thoracic segment 2 or segments 2 and 3 (Figure 7).

Figure 6. Body structure of a caddisfly larva (view from the side)

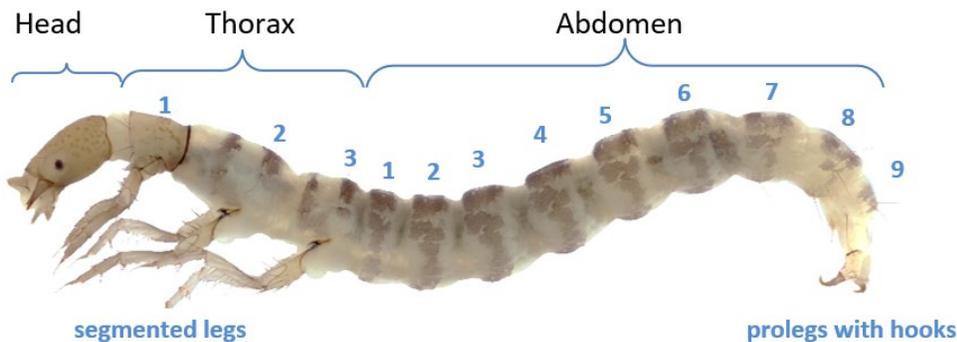


Figure 7. Body structure of a stonefly naiad (view from the top)

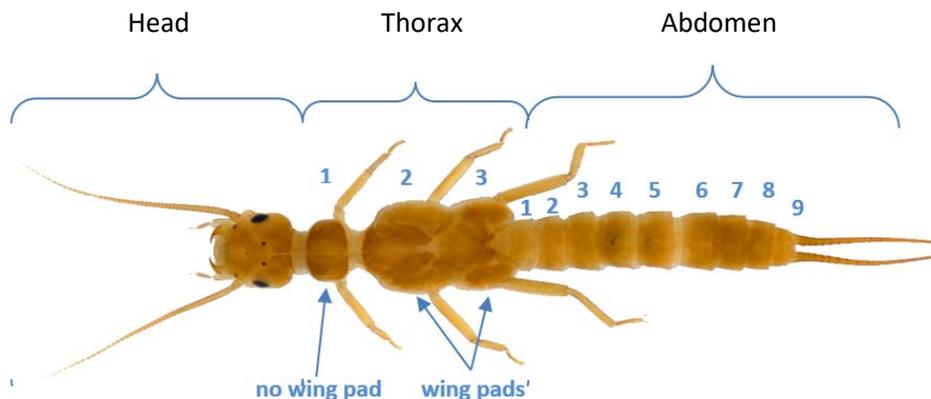


Image credits: 1

What do they look like as adults?

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

Alderfly 3



Aquatic Soldier Fly 3



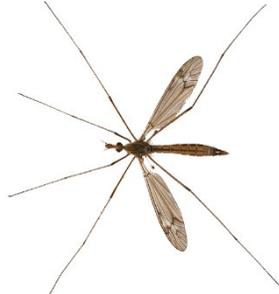
Lily Pad Moth 10



Caddisfly 20



Crane Fly 17



Damselfly 16



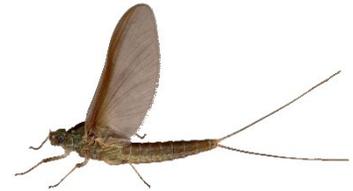
Deer Fly 20



Dragonfly 8



Mayfly 17



Mosquito 17



Non-biting Midge 20



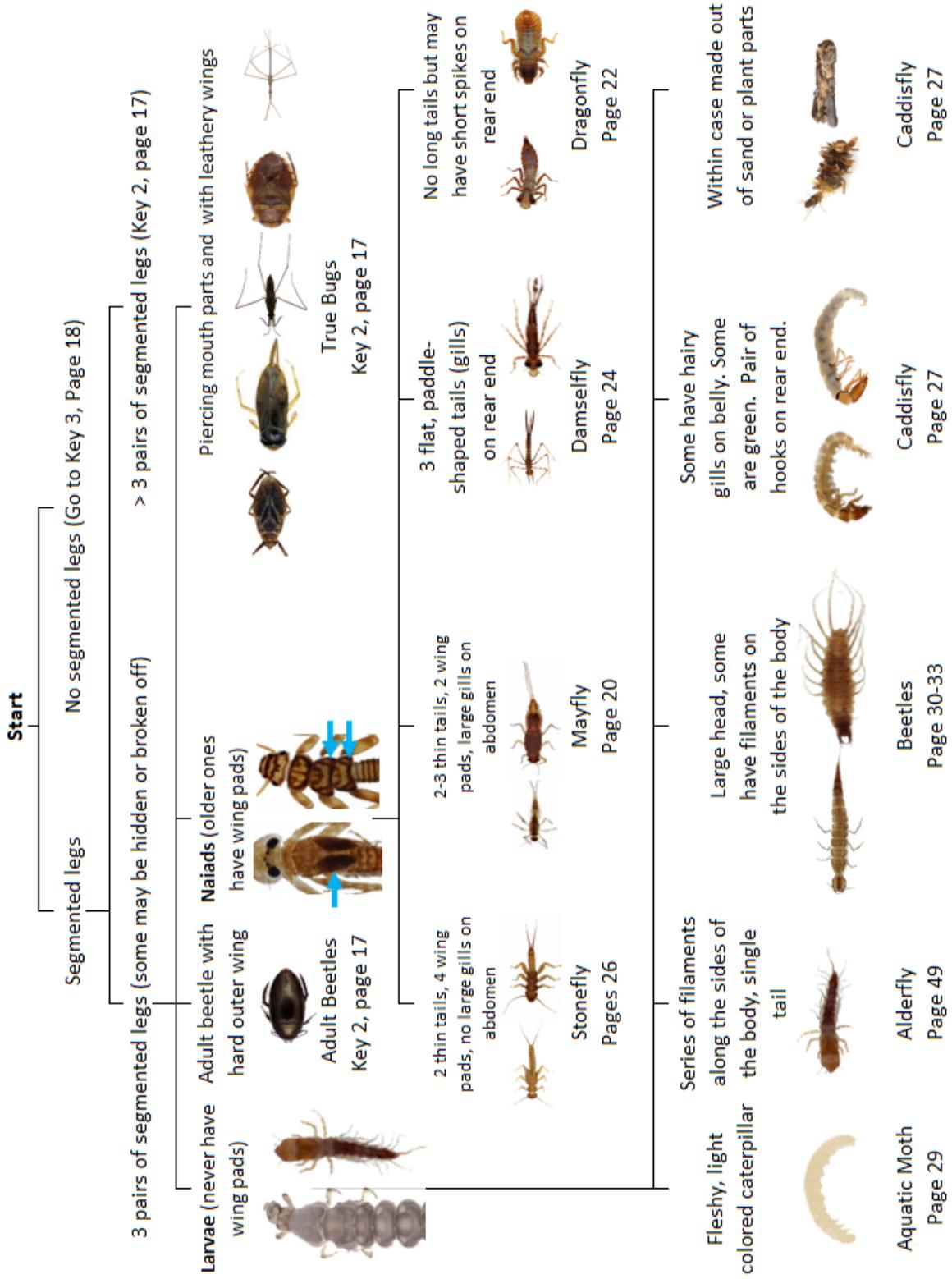
Phantom Midge 20



Taxonomic Key #1 – Start

KEY #1

Key to Macroinvertebrates for Maine Marsh Explorers



Taxonomic Key #2

KEY #2

Key to Macroinvertebrates for Maine Marsh Explorers

More than 3 pairs of segmented legs (From Key 1)

Swims on its side, body is curled



Scud (Amphipod)
Page 50

8 legs, often red, like a small spider



Water Mite
Page 53

10 legs, front 2 are large claws



Crayfish (Decapod)
Page 52

True Bugs (From Key 1)

Triangular mouthpart, dark wings, hind legs are flattened for swimming



Water Boatman
Page 44

Back is often white, belly is dark, swims upside down



Backswimmer
Page 48

Long legs, "skate" on the water surface



Water Strider
Page 45

Body is broadly oval, somewhat flat, eyes are right against the sides of the head



Creeping Water Bug
Page 46

Oval body, front legs for grasping prey, eyes stick out a little from the head



Giant Water Bug
Page 43

Long and thin legs, long tail used for breathing, front legs like a praying mantiss



Water Scorpion
Page 47

Adult Beetles (From Key 1)

Small beetles, small head the sticks out the front, spotted, poor swimmers



Crawling Water Beetle
Page 32

Tiny beetles with long legs for crawling



Riffle Beetle
Page 30

All other beetles



Other Beetles
Page 33

Beetles that swiftly swim in circles on the water surface

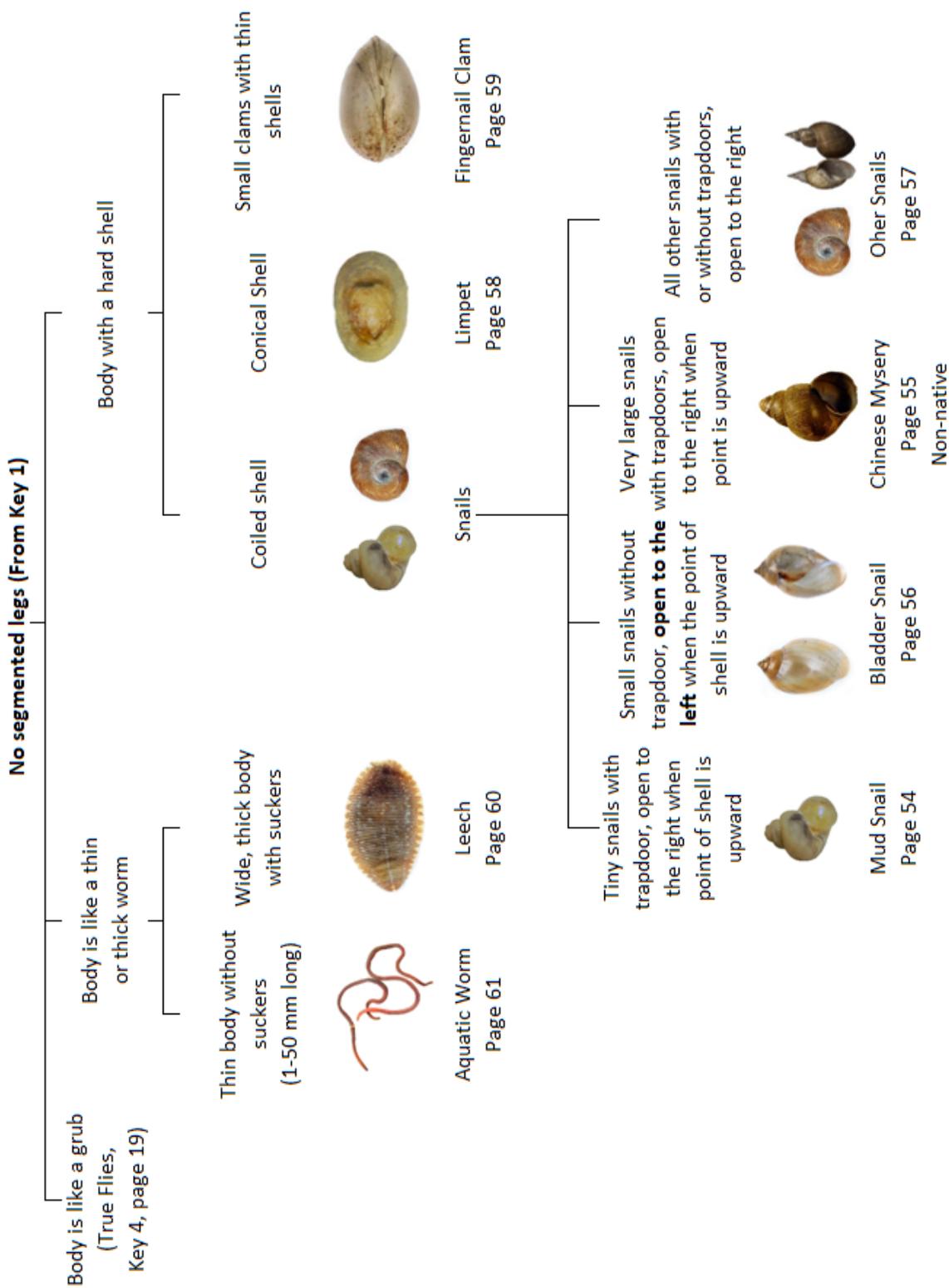


Whirligig Beetle
Page 31

Taxonomic Key #3

KEY #3

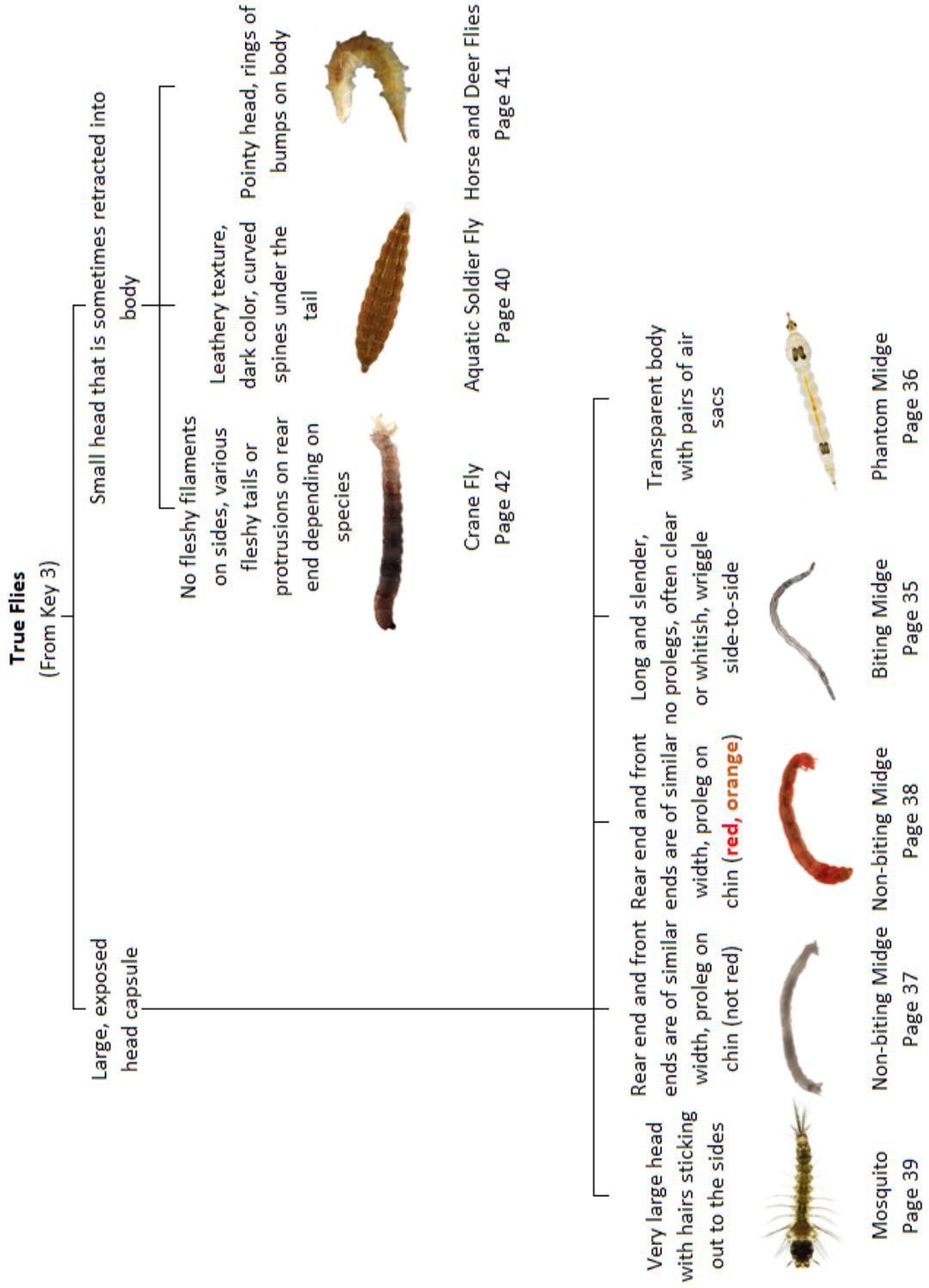
Key to Macroinvertebrates for Maine Marsh Explorers



Taxonomic Key #4

KEY #4

Key to Macroinvertebrates for Maine Marsh Explorers



SENSITIVE
(Most sensitive to pollution) Taxonomy Order: **Ephemeroptera**

Mayfly

View from above



View from the below



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)

Variety of gills...

Shaped like a paddle or a leaf



Covered by a plate



Branched



Behavior

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

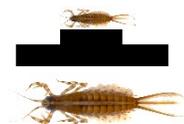
Environmental Sensitivity

- Many species require good water quality and habitat
- Some kinds with gill covers are thought to be better able to live in turbid water
- Some mayflies live in streams and rivers

Adult Mayfly



Image credits: 1, 17 (adult)



Length: 8-20 mm, excluding tails

Variety of Mayflies



Image credits: 1

SENSITIVE (Most sensitive to pollution)	Taxonomy	Order: Odonata Suborder: Anisoptera
---	-----------------	--

Dragonfly

Anax
from above



Libellula
from above



Libellula
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

Environmental Sensitivity

- The larvae of some species spend more than a year in the water



Adult Dragonfly



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

Image credits: 1, 4 (*Anax* larva), 8 (adult)

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 (bottom right, *Anax*)

SENSITIVE (Most sensitive to pollution)	Taxonomy	Order: Odonata Suborder: Zygoptera
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Damselfly

View of *Argia* (Coenagrionidae) from above



View *Argia* (Coenagrionidae) 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

Damselfly adults and larvae eat lots of mosquitoes, black flies and other biting flies and are an important food source for some birds.

Environmental Sensitivity

- Most species require good water quality and habitat
- Some species are tolerant of warmer water
- Commonly found in ponds, lakes, swamps, marshes and ditches on plants, debris, or sediment

Adult Damselfly 



Length: 13-29 mm, excluding gills (“tails”)

Image credits: 1, 16 (adult)

Variety of Damselflies

view from above

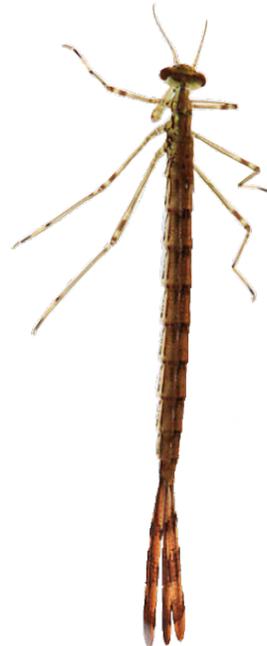


Image credits: 1

SENSITIVE
(Most sensitive to pollution)

Taxonomy Order: Plecoptera

Stonefly

View from above (*Leuctra*)



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

Stoneflies are among the most sensitive macroinvertebrates.

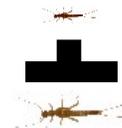
Finding stoneflies in a stream or river is a signal of good water quality.

Behavior

- *Leuctra* love to chew on dead leaves (they eat the stuff growing on the dead leaves)

Environmental Sensitivity

- Stoneflies rarely occur in marshes, but if you find one, it most likely will be *Leuctra*
- They need well-oxygenated water because they get oxygen through their exoskeletons (no gills)
- *Leuctra* are tolerant of acidic water



Length: 3-12 mm excluding tails

Image credits: 1

SENSITIVE
(Most sensitive to pollution)

Taxonomy Order: Trichoptera

Caddisfly

Oecetis (side view and case)



Platycentropus (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 species 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

- Many species require good water quality and habitat
- Prefer marshes plants and woody debris

Adult Caddisfly



Length: 6-12 mm

Image credits: 1, 20 (adult)

Variety of Caddisflies (and their cases)



Image credits: 1, 11

SENSITIVE (Most sensitive to pollution)	Taxonomy	Order: Lepidoptera Family: Crambidae
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Aquatic Moth

View of *Parapoynx* from the side



View of *Parapoynx* from below



Diagnostic characteristics

1. Caterpillar with head, thorax, abdomen
2. Wings and wing pads absent
3. Creamy yellow to white color
4. Short, segmented legs on thorax and abdominal prolegs
5. Short branched gills on body

Behavior

- They move by burrowing, climbing and swimming
- They shred plants such as pondweed, watermilfoil and eelgrass/tape grass to eat them

Environmental Sensitivity

- They live in still-water habitats such as ponds
- Widespread east of the Rocky Mountains

Adult Aquatic Caterpillar 
"Snout Moths"



Larvae of Parapoynx feed on various freshwater plants such as water lily (Nymphaea). They often cut circular pieces from the edge of broadleaf plants to cover themselves while feeding on top of the leaves or drill down from the top of the stem. Pupation occurs in a silk-lined chamber under the leaf piece or in the stem.



Length: 10-25 mm

Image credits: 1, 10 (adult)

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Coleoptera
Family: Elmidae

Riffle 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**
3. **Long legs with pairs of long claws**
4. **Tiny size**
5. **Long or club-shaped antennae**

Diagnostic characteristics (Larvae)

1. Head, thorax with 6 legs, and abdomen
2. **No wing pads on back**
3. **No projections on the side of the body**
4. **Body is slender and leathery**
5. **Has a tuft of hairs and gills and retractable gills on rear end**

Behavior

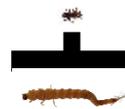
- Predators of other invertebrates
- Prefer fast flowing water and rocky substrates
- Some species are common in sandy and silty streams that have branches and woody debris
- Graze on algae and detritus

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

Image credits: 1

Larvae have retractable gills on their rear ends to get oxygen from water. In contrast, adults have millions of tiny hairs on their bellies that trap a thin layer of air. They breathe the air from this bubble. Oxygen from the water diffuses into the air bubble and replenishes the supply within the bubble. (cool!)



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

SENSITIVE
(Most sensitive to pollution)

Taxonomy

Order: Coleoptera
Family: Gyrinidae

Whirligig Beetle

Dineutus adult from above



Gyrinus adult from above



Gyrinus adult from the side



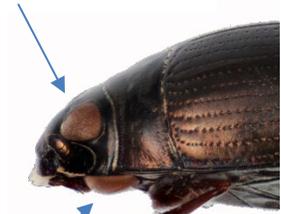
Dineutus larva



Gyrinus larva



Eye above water surface



Eye below water surface

Diagnostic characteristics (Adult)

1. Head, thorax with 6 legs, and abdomen
2. Outer wing is a hard shell
3. Front legs are flattened for swimming
4. Two compound eyes above the water surface
5. Two compound eyes below the water surface

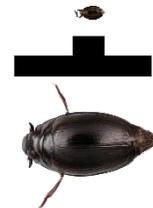
Behavior

- Very good swimmers
- Zoom around in circles on the surface of the water
- Some beetles eat algae and detritus
- Carry an air bubble on their butt so they can breath underwater

Environmental Sensitivity

- Most species require good water quality but some are tolerant of pollution
- Some occur in urban marshes with poor water quality but abundant oxygen and detritus to eat

Image credits: 1



Length: 3-18 mm (adults)
and up to 25 mm (larvae)

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Coleoptera
Family: Haliplidae

Crawling Water Beetle

Views of *Peltodytes* adult from above



View of *Peltodytes* larva from the side



Diagnostic characteristics (Adult)

1. Head, thorax with 6 legs, and abdomen
2. Outer wing is a hard shell
3. Head sticks out in front and is usually a lighter color
4. Long legs for crawling underwater
5. Darker outer wings, often spotted

Behavior

- Feed on small crustaceans, insects, and worms
- Most often live near aquatic plants in shallow, still water

Environmental Sensitivity

- They can tolerate moderate amounts of pollution and nutrient enrichment

They carry an air bubble underwater so they can breath. Oxygen from the water replenishes the oxygen in the air bubble. It is like a scuba tank that automatically refreshes the oxygen.

Image credits: 1



Length: 3-6 mm

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy Order: Coleoptera

Other Beetles

Views of *Agabus* adult



Agabus larva



Diagnostic characteristics (Adult)

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

Copelatus larva



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
- Most often live near aquatic plants in shallow, still water
- Often associated with muddy bottoms or plant debris
- Adults can typically fly in the air

Environmental Sensitivity

- Most species require good water quality but some are tolerant of pollution
- Some occur in urban marshes 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 passively transferring from the water to their air bubbles.



Length: 2-40 mm (adults)
and up to 70 mm (larvae)

Image credits: 1

Variety of Beetles



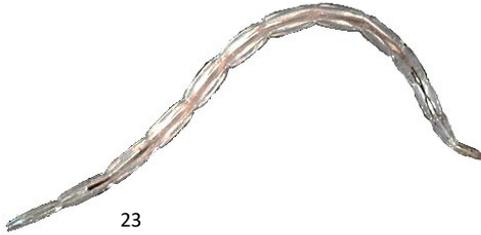
Image credits: 1

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Diptera
Family: Ceratopogonidae

Biting Midge

Bezzia



23

Probezzia



Diagnostic characteristics

1. **Distinct head**
2. Body is long and thin
3. White to semi-transparent coloration
4. **No legs or prolegs**

Behavior

- They move by wriggling their head from side to side
- Often found in sandy and muddy edges of marshes, ponds, and lakes

Environmental Sensitivity

- Different kinds of biting midges range from sensitive to tolerant
- Most biting midge larvae are predators and scavengers
- Some biting midge larvae eat mosquito larvae

Adult biting midges are more commonly known as “no-see-ums”.

Adult biting midges feed on nectar. Adult females also feed on blood to get protein for their developing eggs. The bites can be painful and itchy.



Image credits: 1, 23

Length: 6-10 mm

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** **Diptera**
Family: **Chaoboridae**

Phantom Midge

View from the above (Genus *Chaoborus*)



View from side



Adult Phantom Midge



Diagnostic characteristics

1. Have a **transparent** body without legs or prolegs
2. Cone-shaped head distinct from thorax
3. Have three thorax segments fused together that are wider than the head and abdomen
4. **Usually have pairs of dark air sacs that are visible through the skin located in the thorax and at the end of the abdomen**

Behavior

- The common name comes from their transparency and daily habit to of rising and sinking in the water
- Air sacs are used to regulate buoyancy and store oxygen to extend their time in deep waters that lack dissolved oxygen
- Mostly eat microscopic animals in zooplankton such as water fleas (Cladocera) and small insect larvae like mosquitoes

Environmental Sensitivity

- Often live in deepest parts of ponds and lakes
- Some kinds live in small temporary pools, snowmelt water and cold springs
- Some kinds live in shallow water and breathe air through a siphon like mosquitoes

Phantom midges look like mosquitos but are nearly transparent when living and most lack the brushes of long hairs near the mouth and breathing tube that mosquitoes often have.

Both larvae and pupa are important food for some fish species and birds eat the adults!



Length: 6-12 mm (mature larvae)

Image credits: 3 (larvae), 20 (adult)

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy

Order:

Diptera

Family:

Chironomidae

Non-biting Midge

Orthocladius
(from the side)



Tanytarsus
(from the side)



Adult midge 



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

Environmental Sensitivity

- Species range from sensitive to tolerant
- Red midges (page 26) are tolerant of low dissolved oxygen Concentrations

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



Length: 5-20 mm

Image credits: 1, 20 (adult)

Tolerant
(Least sensitive to pollution)

Taxonomy

Order: Diptera

Family: Chironomidae

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

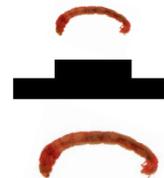
Environmental Sensitivity

- Tolerant of low oxygen concentrations

Adult Non-Biting Midge



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, 20 (adult)

MODERATELY SENSITIVE (Moderately sensitive to pollution)	Taxonomy	Order: Diptera Family: Culicidae
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Mosquito

View of *Anopheles* larva from above



View of pupa from the side



Diagnostic characteristics (larvae)

1. Have a clearly distinguishable head, and thorax and abdomen without prolegs
2. **Three thorax segments are fused together and thorax is wider than the head and abdomen**
3. Have thin antennae and “brushes” of long hairs either side of the mouth at the front of the head
4. Most species have a short breathing tube (“snorkel”) on top of the last segment of the abdomen

Few kinds stick their breathing tube into the underwater parts of live plants to get oxygen.

Behavior

- Larvae mostly eat algae, bacteria, fungi, protozoa and very small debris particles
- Some kinds prey on larvae of other mosquitoes species
- Several generations per year allows it to recolonize after disturbance

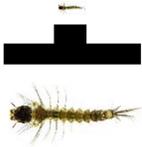
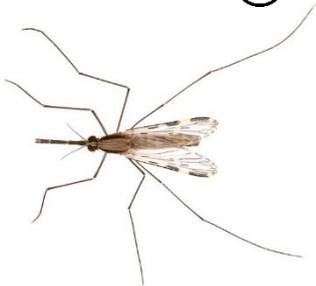
Most adult female mosquitoes require a meal of blood so their eggs can develop.

Environmental Sensitivity

- Larvae can live in almost any still water habitat such as woodland pools, ponds, lakes, swamps, marshes
- Some prefer small, temporary waters that form in tree holes, rock holes or tires

Some mosquitoes transmit serious diseases to humans and animals.

Adult Mosquito 



Length: 4-18 mm

Image credits: 17 (larva and pupa), 20 (adult)

Tolerant (Least sensitive to pollution)	Taxonomy	Order: Diptera Family: Stratiomyidae
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Aquatic Soldier Fly

View from above



View from side



Diagnostic characteristics

1. Does not have segmented legs but sometimes has prolegs
2. Body somewhat flattened from top to bottom
3. Head is often either partially or completely retracted into body and often a lot narrower than thorax
4. Skin has a tough, grainy and leathery texture
5. **Curved spines on underside**



Ventral curved spines pictured above

Behavior

- They eat fine debris and algae
- Common kinds live on organic sludge, decaying vegetation or floating algae mats particularly in shady spots amongst plants emerging from the water (like cattails)

Environmental Sensitivity

- Mostly found at margins of shallow ponds and marshes
- Most live in nutrient-rich habitats
- Some kinds can live in highly saline water, hot springs, or sewage discharges

Adult Aquatic Solider Fly



Length: 5-35 mm but can be up to 50 mm

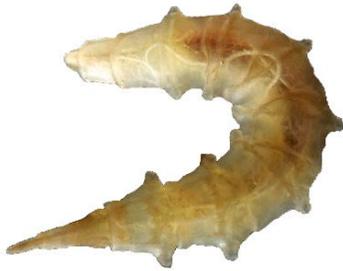
Image credits: 1, 3 (adult)

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** **Diptera**
Family: **Tabanidae**

Horse and Deer Flies

View from the side



Adult Deer Fly



Diagnostic characteristics

1. Head is not distinct
2. Cylindrical/ grub-like, soft, flexible body with cone-shaped ends
3. Have 3-4 pairs of fleshy welts or prolegs on most abdomen segments
4. No projections or prolegs on the end of the abdomen

Horse and deer flies are known for their vicious bite but thankfully don't transmit disease in North America!

Behavior

- Larvae lengthen then shorten their body and use welts to crawl through mud
- They most often eat aquatic worms along with other invertebrates
- Some records of them eating small toads!
- Mature larvae crawl out of water to pupate in the soil
- Adults are strong fliers and will travel great distances from their larval habitat

Environmental Sensitivity

- They mostly live in the sediment of pond, marsh and stream pool bottoms
- Some kinds prefer salt marshes
- A few live on sand and gravel of swift stream bottoms

Length: 11-60 mm

Image credits: 20 (adult), 23 (larva)

MODERATELY SENSITIVE (Moderately sensitive to pollution)	Taxonomy	Order: Diptera Families: Tipulidae, Limoniidae, and Pediciidae
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Crane Fly

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 marshes with good water quality
- Are somewhat tolerant of warmer water
- They prefer marshes with moderate current



Image credits: 1, 17 (adult)

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

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Hemiptera
Family: Belostomatidae

Giant Water Bug

View from above (*Belostoma*)



View from below (*Belostoma*)



Diagnostic characteristics

- Head, thorax with 6 legs, and abdomen
- Brown, oval-shaped body flattened top to bottom
- Front legs wider than middle and hind for grabbing prey
- Narrow, pointed head with **eyes sticking out on the sides**
- Adults have typically leathery and hard forewings and they are translucent and flexible **with veins towards the tip**

Behavior

- Younger larvae and small adults eat mainly other arthropods and macroinvertebrates, but larger species may eat bigger crustaceans, small fish and amphibians!
- Both larvae and adults are piercing predators, and they stalk or ambush their prey to inject “spit” that dissolves soft tissue
- Breathe through a pair of short, flat, retractile strap-like appendages at the end of the abdomen

Environmental Sensitivity

- Both larvae and adults often live in ponds, lake edges, marshes, ditches and stream pools among rooted plants and plant debris

Males of many species look after the eggs laid by the female either on the male's back or on vegetation while the male stands guard nearby.

WARNING: Even small individuals should be handled carefully because they can deliver a very painful bite. Thankfully, the effects wear off quickly with no long-term consequences.

Small individuals could be confused with creeping water bug!

Image credits: 1



Length: 25-65 mm (adults)

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Hemiptera
Family: Corixidae

Water Boatmen

View from above



View from below



Diagnostic characteristics

1. Head, thorax with 6 legs, and abdomen
2. **Has broad, triangular beak that looks like a part of the head**
3. They are usually dark gray or brown with thin, wavy yellow-ish lines on top
4. Front legs end with scoop-like segment with long hairs
5. Adults have typically leathery and hard forewings and they are translucent and flexible

Front tarsi (“feet”) of males usually have tiny pegs that when rubbed across the grooved beak make sound under water!

Behavior

- They are efficient swimmers near the bottom of weedy ponds and slow flowing marshes
- Eat whatever small macroinvertebrates or living material that they stir up from fine sediment
- Some feed on freshwater plant sap
- They lay eggs on solid objects under water
- Adults are strong fliers and can disperse to new habitats

They breathe through an air bubble under the wings that acts like a gill!

Environmental Sensitivity

- They commonly live in shallow water around pond and lake edges on or near aquatic plants
- They are found in harsh environments such as ditches, brackish water, temporary pools and intertidal water



Image credits: 1, 17 (showing mouthpart)



Length: 3-18 mm

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy

Order:

Hemiptera

Family:

Gerridae, Veliidae

Water Strider

View of *Gerris* (above)



View of *Microvelia* (above)



Diagnostic characteristics

1. Head with long antennae, thorax with 6 legs, and abdomen
2. Commonly long and slender body and dark gray to black with brown areas and silvery markings
3. Some kinds are short and broad or light yellow-brown in color
4. Long legs stick out from body giving them a spider-like look
5. Some have claws that stick out of leg before its end
6. Adults have typically leathery and hard forewings and they are translucent and flexible

Behavior

- Both larvae and adults feed on living and dead insects trapped on the water surface
- They locate prey with vibrational sensors and their eyes
- They sometimes hide under leaves on shore when it's raining

Environmental Sensitivity

- They live on the surface of most open waters such as ponds, lakes, marshes, marshes, estuaries, brackish water and ditches
- One genus is only found in marine habitats!

You may have seen these insects skating on top of open, still water before!

They use water-repelling hairs on their tarsi ("feet") to stay on top of the water and claws that penetrate the water's surface to gain leverage on the water-surface tension.



Image credits: 1

Length: 3-11 mm (adults, not including legs)

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Hemiptera
Family: Naucoridae

Creeping Water Bug

View from above



View from below



Diagnostic characteristics

1. Head, thorax with 6 legs, and abdomen
2. Body is broadly oval, somewhat flat top to bottom and color ranges from light to dark brown or gray or greenish
3. Forelegs are broad and used for grasping prey
4. Adults have typically leathery and hard forewings and they are translucent and flexible **without veins**
5. **Eyes are right against the edge of the head**

Behavior

- They are predators and feed on other small insects by stabbing them with their beaks
- They cling to rocks and other surfaces but are also good swimmers
- They crawl around searching for prey especially at bases of live plants or accumulated vegetation debris

Environmental Sensitivity

- Different species live in various standing and flowing water habitats such as ponds, lakes, pools, saline water, marshes and rivers
- A few species live in hot spring with temperatures up to 36°C

WARNING: They should be handled carefully because they can deliver a painful bite with their beak.

Adults breathe through an air bubble under the wings that acts like a gill while larvae obtain dissolved oxygen through their body surface.



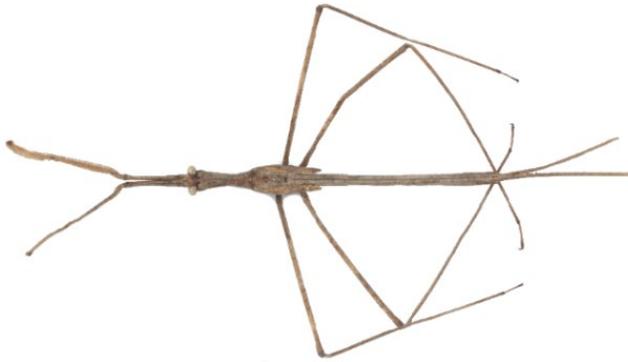
Image credits: 1

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Hemiptera
Family: Nepidae

Water Scorpion

View from above (*Ranatra*)



Algae and protozoans may colonize them because they move so slowly and infrequently, and other aquatic insects like water boatmen, backswimmers and caddisflies sometimes lay eggs on them!

Diagnostic characteristics

1. Head, thorax with 6 legs, and abdomen
2. Most have long, slender and nearly cylindrical bodies and range from dark to light brown or gray with green traces
3. Front legs are wider for grasping prey
4. Adults have typically leathery and hard forewings and they are translucent and flexible
5. Long cylindrical breathing tube on tip of abdomen (2 filaments, not retractable)

Behavior

- They mostly climb on vegetation and debris and are very poor swimmers
- Mostly prey on small crustaceans and insects, sometimes fish and tadpoles
- Most common prey likely water boatmen (Corixidae)
- They are often found with giant water bugs (Belostomatidae)

Environmental Sensitivity

- They live in various types of ponds, swamps and marshes, usually in shallow areas among plants and debris

Length: 15-45 mm (adults, not including breathing tubes)

Image credits: 1



MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Hemiptera
Family: Notonectidae

Backswimmer

View from above



View from below



Diagnostic characteristics

1. Head, thorax with 6 legs, and abdomen
2. Most have colorful patterns of blue-gray with white, orange, red, yellow or black markings
3. Reverse countershading (dark on belly and light on back)
4. Body is wider in the middle looking from above and thick from top to bottom
5. Hind legs longer than others and oar-like with small claws
6. Adults have typically leathery and hard forewings and they are translucent and flexible
7. Nymphs look like small adults but may lack wings

Backswimmers bodies are covered with several hairs that trap air allowing them to breath underwater and swim faster!

Behavior

- They swim upside down
- They feed on the surface or dive down to locate prey
- Piercing predators of a variety of invertebrates and some young (fry) fish and tadpoles

Warning: May bite if mishandled

Somewhat look like water boatmen

Environmental Sensitivity

- They are commonly found in all kinds of still water habitat but especially small ponds and near lake shores with lots of vegetation
- They may also live in sewage lagoons, ditches, thermal springs and brackish water



Length: 5-15 mm (adults)

Image credits: 1, 23 (view from above)

MODERATELY SENSITIVE (Moderately sensitive to pollution)	Taxonomy	Order: Megaloptera Family: Sialidae
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Alderfly

View of *Sialis* from above



View of *Sialis* from below



Diagnostic characteristics

1. Has a head, thorax with six legs, and abdomen
2. Abdomen has a series of well-developed filaments on their sides
3. Head has large mouthparts
4. Abdomen ends with a single, long tail

Behavior

- Active predators of other invertebrates
- Usually larvae are found in mud and silt where there's a lot of organic matter and a few kinds live on sandy substrate
- Females lay eggs on the undersides of leaves and twigs of terrestrial vegetation that hangs over their aquatic habitat

They mostly breathe through their skin.

The filaments on their sides help them absorb oxygen from the water.

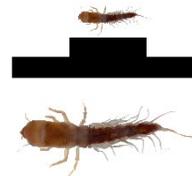
Environmental Sensitivity

- They live in still water habitats such as bogs, marshes, ponds and lakes or pools and back eddies of marshes
- Usually live in clean marshes but are somewhat tolerant of organic enrichment and warmer water
- Some kinds can endure low dissolved oxygen and high concentrations of metals

Adult Alderfly



Image credits: 1, 3 (adult)



Length: 10-25 mm

Tolerant
(Least sensitive to pollution)

Taxonomy **Order: Amphipoda**

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 marshes and streams
- Most common in sandy and mucky marshes with plants or decaying organic matter



Image credit: 2

Length: 3-5 mm

Tolerant
(Least sensitive to pollution)

Taxonomy **Order:** **Isopoda**

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
- Move by crawling along the bottom or on plants

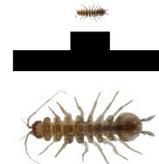
Environmental Sensitivity

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

Asellus



Image credits: 1



Length: 5-20 mm

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy

Order:

Decapoda

Family:

Cambaridae

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 clean water but they can tolerate poor water quality to some degree
- They are somewhat tolerant of warm water

Image credits: 15

Length: Up to 100 m

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy Order: Trombidiformes

Water Mite

Views of *Arrenurus* (above and below)



Views of *Neumania* and *Limnesia* (above)



Mites can be parasitic (see above) – this occurs with young larvae and some kinds of adults and mature larvae.

Water mites look like very small and colorful spiders!

Diagnostic characteristics

1. Round body without visible segments
2. They have 8 segmented legs that point outward
3. Often have bright colors (red, orange, yellow, green, or blue) while others are dull shades of brown and or black
4. They have a pair of finger-like structures (not antennae) on their head
5. Two pairs of simple eyes wide apart may be visible on the front edge

Behavior

- Some are agile swimmers and others are awkward swimmers
- They are only active during the day
- Most species of adult and mature larvae prey on small aquatic insect larvae particularly true flies, and microscopic crustaceans
- A few kinds eat plants and dead plants

Environmental Sensitivity

- Most kinds live in shallow waters of ponds, lakes, swamps, marshes and bogs among aquatic plants but a few kinds live as deep as 100 meters in lakes!
- Most kinds can survive in dissolved oxygen concentrations as low as 1 part per million

Image credits: 21 (parasitic mites), 23

Length: 2-3 mm but up to 7mm (typical adults)



SENSITIVE (Most sensitive to pollution)	Taxonomy	Order: Family:	Littorinida Amnicolidae
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Mud Snail

Amnicola (closed)



Amnicola (open)



can be
challenging to spot
these in collection
pans at first

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

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

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
3. Shell is roughly shaped like a tear drop
4. The tip of the shell is blunt
5. Live snails have a “trap door” called an operculum

Behavior

- Graze on algae and detritus plants, rocks, and mud
- They have gills for obtaining oxygen from water

Environmental Sensitivity

- Mostly occurs in 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

Image credits: 5



Length: 3-5 mm

Tolerant
(Least sensitive to pollution)

Taxonomy **Order:** Viviparida
Family: Viviparidae

Chinese Mystery Snail

Cimpangopaludina



Diagnostic characteristics

1. Very large snails, up to 3"
2. Thick shell that opens to the right when the pointy part of the shell is pointing up
3. Spiraled shell that is widest by the opening (6-8 whorls)
4. Coils form rounded bulges
5. Brown, sometimes has green bands
6. Trapdoor covers shell opening

Behavior

- Graze on algae on mud and plants
- Sometimes scavenge dead plants and animals
- Have gills for obtaining oxygen from water

Environmental Sensitivity

- Tolerant of pollution and organic enrichment
- **Invasive species** originating from people dumping aquariums

Called mystery snails because they give birth to live young snails with fully formed shells. The young snails appear suddenly and "mysteriously".

Chinese mystery snails are edible and can be found in Asian food markets.

They can live for up to 4 years.

Image credits: 5

Length: up to 75 mm

Tolerant
(Least sensitive to pollution)

Taxonomy **Order:** Lymnaeida
Family: Physidae

Bladder Snail

Physa



Diagnostic characteristics

1. Thin shells that are widest by the opening
2. Left-handed (“sinistral”) coil with the opening to the left when the pointy part of the shell is pointing up and the opening is towards you
3. Does not have a trapdoor (operculum)

Behavior

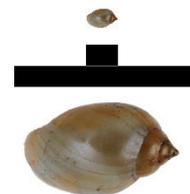
- Graze on algae and scavenge dead plants and animals
- Breathe air and do not have gills
- Can carry a bubble inside their shell so they can breathe underwater

Environmental Sensitivity

- Tolerant of low dissolved oxygen
- Tolerant of a wide range of pH
- They can be common in healthy marshes but can also be abundant in marshes with poor water quality

Bladder snails are hermaphrodites and can self-fertilize their eggs. Bladder snails mature quickly and lay a lot of eggs. They can colonize habitats more quickly than other snails and can disperse to new habitats.

Bladder snails also move faster than many other snails.



Length: 4-24 mm

Image credits: 5

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy Super Order: Hygrophila

Other Snails

Lymnaea



Lymnaea



Helisoma



Valvata



Diagnostic characteristics

1. Thick shells with trapdoors (operculums)
2. Flat coils like a cinnamon roll or pointy spirals
3. Pointy shells open the right when held with the spiral pointing up

Behavior

- Graze on algae and detritus on plants, rocks, and mud
- Most have gills for obtaining oxygen from water

Environmental Sensitivity

- Range from moderately sensitive to tolerant

Image credits: 5



Length: 5-50 mm

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy

Order:

Basommatophora

Family:

Ancylidae

Limpet

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

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.

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 marshes, 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"

Environmental Sensitivity

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



Length 3-7 mm

Image credits: 5

MODERATELY SENSITIVE
(Moderately sensitive to pollution)

Taxonomy **Order:** Veneroida
Family: Sphaeriidae

Fingernail and Pea Clams

View from the side



View from above



Diagnostic characteristics

1. Two mirror-image, thin and fragile shells hinged together
2. Shells often translucent and light gray, tan, cream or whitish
3. Outside of shells are shiny, fairly smooth and often fine growth lines are visible, but they are not strongly ridged or rough

Densities of fingernail clams may be as high as 10,000 individuals per square meter!

Behavior

- During their resting stage, they may burrow up to 25 cm in sediment
- They can be found on any substrate but largest variety on fine silt, sand and clay bottoms

Environmental Sensitivity

- Most are found in standing water and often are the dominant bivalve in ponds, temporary pools and deep parts of lakes
- Some kinds can survive drought for several months by burying themselves
- They are restricted to hard waters (high calcium carbonate levels) like mussels

Image credits: 1



Length: 2-10

Tolerant
(Least sensitive to pollution)

Taxonomy

Order:

Arynchobdellida
Rhynchobdellida

Leech

Diagnostic characteristics

1. **Thick, segmented body**
2. Mouth adapted for sucking
3. Sucker on rear end
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 marshes

Placobdella



Erpobdella



Image credits: 1, 12 (*Erpobdella*)



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

Tolerant
(Least sensitive to pollution)

Taxonomy **Order: Oligochaeta**

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
- There are a few species that are sensitive to pollution
- Some species are reddish because they contain hemoglobin
- Some species are common in urban marshes and streams
- Most common in sandy and mucky marshes



Length: 1-30 mm

References

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The Atlas of Common Freshwater Macroinvertebrates of Eastern North America webpage (macroinvertebrates.org)

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

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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*), adult aquatic soldier fly (*Odontomyia cincta*) and phantom midge larvae (*Chaoborus*)
4. **Don Chandler** (bugguide.net) - *Anax junius* naiad
5. **Fresh Water Gastropods of North America** – *Amnicola*, *Cipangopaludina* 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. **Jason Neuswanger** (troutnut.com) – *Glossosoma* larva and pupae and dragonfly (*Hagenius brevistylus*)
10. **Aaron Hunt (bugguide.net)** – adult *Parapoynx* moth (Crambidae)
11. **Mark Melton**, (bugguide.net) - *Lepidostoma* (inset)
12. **Ondřej Zicha** (www.biolib.cz) – Leech (*Erpobdella octoculata*)
13. **Richard Orr**, Mid-Atlantic Invertebrate Field Studies - *Anax junius* female emerging
14. **Robert Henricks** (bugguide.net) – caddisfly larva (*Glossosoma*) with case in life cycle
15. **Robert Jacobs** (Connecticut DEEP, retired) – crayfish
16. **Stephen Gingold** (bugguide.net) – adult damselfly (*Enallagma divagans*)
17. **Salvador Vitanza** (bugguide.net) – adult mayfly (*Callibaetis*), crane fly (*Tipula*), mosquito larva (*Anopheles*), water boatmen (*Hesperocorixa*), adult mosquito (female *Anopheles*)
18. **Sheryl Pollock** (www.discoverlife.org) - *Anax junius* laying eggs (dragonfly life cycle)
19. **Tom Danielson**
20. **Tom Murray** (bugguide.net) – adult caddisfly (*Hydropsyche*), adult non-biting midge (*Chironomus*), isopod (*Assellus*), dragon hunter naiad (*Hagenius brevistylus*), mosquito pupa, soldier fly larva (*Odontomyia*), deer fly (*Chrysops calvus*), adult phantom midge (*Chaoborus*)
21. **John Carr (bugguide.net)** – midge eyelash mites
22. **Welter Schultes** (www.animalbase.uni-goettingen.de) – *Lymnaea* snails
23. **Stephen Luk** (bugguide.net)– Horse fly larva (Tabanidae), mites (*Arrenurus*, *Neumania*, *Limnesia*), backswimmer (Nototectidae), biting midge (*Bezzia*)



MAINE MARSH EXPLORERS

A treasure hunt to find healthy marshes in Maine

For information on how to volunteer, please contact Mady Eori with Maine Audubon at 207-781-2330, ext. 219 or meori@maineaudubon.org

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